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Science and Technology Foresight Survey

Delphi Analysis

May 2005

Science and Technology Foresight Center
National Institute of Science and Technology Policy
Ministry of Education,Culture,Sports, Science and Technology Japan

On publication of the Delphi analysis

The design of this Delphi analysis differs significantly from that used in the past. The newly-introduced structure of "field, area, and topic," presents a comprehensive view of the development of science and technology.

The 130 areas and the 858 topics that represent them were selected through repeated discussions among more than 170 experts in the subcommittees on the 13 fields. Furthermore, a questionnaire with the participation of 2,300 Japanese researchers, engineers, and other experts surveyed scientific and technological, economic, and social impacts in each area, as well as the level of research and development in Japan. Regarding topics, we surveyed in detail the forecast times of technological realization and social application, as well as the necessity of government support and effective policies for each stage of development.

In this sense, this analysis is unprecedented anywhere in the world in the way it collects the opinion distribution of a diverse and large-scale group of experts regarding the future of science and technology.

The Science and Technology Foresight Survey that includes this analysis is intended to contribute the development of science and technology policy, especially the next Science and Technology Basic Plan. However, as stated above, this analysis is predicated on collecting the opinion distribution of science and technology experts. When utilizing the results in the policy making process, the following should be taken into consideration.

(1) The areas and topics designated in this analysis look ahead 30 years into the future and are extracted based on recognition of their great potential and high expectations. The analysis is not necessarily intended to examine technologies at various stages of development in each field in a systematic or comprehensive manner.

(2) The results obtained through the large-scale questionnaire represent the distribution of opinion among frontline Japanese researchers and engineers, and, of course, these results do not necessarily represent "the truth."

We hope that departments and agencies related to science and technology policy will utilize the results of this analysis with the above point in view, while adding to it their own policy and specialist perspectives.

May 2005

IKOMA Toshiaki
Committee Chair
On behalf of the Steering Committee

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I. Introduction

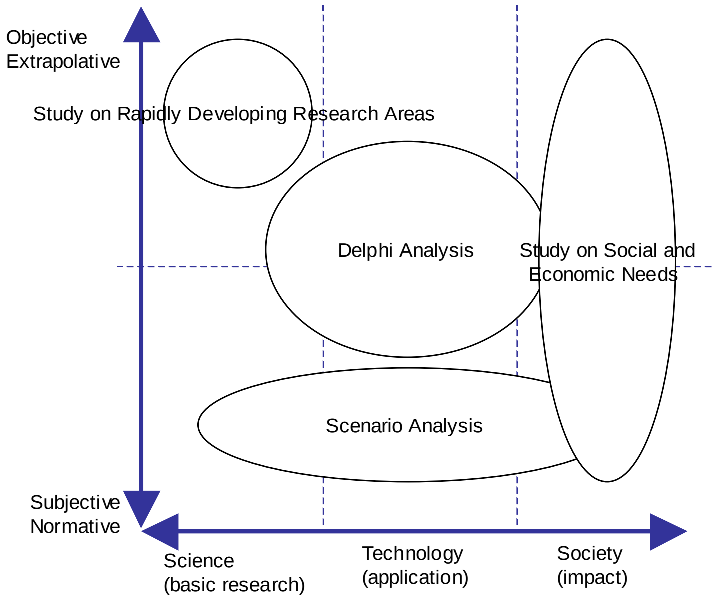
1.1. Positioning and goals

(1) The aims of the Foresight Survey

In Japan, the Council for Science and Technology Policy has implemented the strategic prioritization of research and development funds as promotion strategies on prioritized areas and ranked projects under the Second Science and Technology Basic Plan. The more the need for prioritized and efficient allocation of budgets increases, the more rational bases for prioritization are required.

The "Science and Technology Foresight Survey" is intended to provide information useful in examining priorities for the next Science and Technology Basic Plan (expected to be the plan for 2006–2010, looking ahead to 2015). The Foresight Survey comprises four components. To the Delphi analysis performed in the past, this Survey added the Study on Social and Economic Needs (to think about the future society and its needs), the Study on Rapidly Developing Research Areas (to search for emerging areas through analysis of citation database), and the Scenario Analysis (to create progressive scenarios based on the views of experts with deep insight). The Survey is thus able to give a comprehensive view of the future of science and technology, from basic research to social impact, and from subjective and normative points of view to objective and extrapolative perspectives.

Figure 1-1: The positioning of each survey



The horizontal axis represents the subject of the survey (science, technology, society), while the vertical axis represents the characteristics of the methodology (objective and extrapolative, subjective and normative).

(2) Purpose and role of the Delphi analysis

The Delphi analysis centers on technology (application), while also including some aspects of science (basic research) and society (impact) in its subject matter. The subjective views of many experts are statistically processed in order to collect the distribution of expert opinion on such predictions. The period of prediction for the analysis (the future period looked at) is the 30 years from 2006 through 2035.

1.2. Implementation system

For the implementation of the analysis, thirteen field subcommittees* were established under the Steering Committee, which has overall charge of the survey. The subcommittee members were frontline researchers and engineers. The subcommittees identified key areas and technologies in the relevant fields, set questionnaire items, selected candidates to receive the questionnaires, and analyzed results.

*In addition, a Needs Analysis subcommittee was established for the Study on Economic and Social Needs and a Scenario Analysis subcommittee was established for the Scenario Analysis.

1.3. Survey methods

(1) Survey fields

The thirteen fields below were surveyed. In light of the requirement to build comprehensive systems that enable technologies to meet social missions, the field of social technology was newly added. In addition, the industrial infrastructure field, covering industrial technology other than manufacturing, was added to expand the previous fields of management and distribution, and the marine and earth field and the space field were combined in the new frontier field. The services field was divided among the fields of information/communications, health/medical care/welfare, and social technology.

Survey fields: Information/communications; Electronics; Life science; Health/medical care/welfare; Agriculture/forestry/fisheries/foods; Frontier (space, marine and earth sciences); Energy/resources; Environment; Nanotechnology/ materials; Manufacturing; Industrial infrastructure; Social infrastructure; Social technology

(2) Survey areas and topics

1) Areas

The analysis was predicated on a hierarchical structure comprising fields, areas, and topics. Areas are new as subjects for analysis.

Areas are positioned between fields and topics (individual technologies), and comprise multiple technologies and research. Each field was examined from the perspective of expectations of social and economic contributions, potential to generate new directions in science and technology, the possibility of Japanese leadership, and so on with about 5 to 10 areas comprising a total of 130 areas.

Figure 1-2: Relationships among fields, areas, and topics

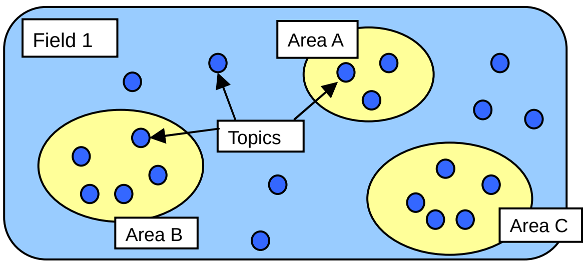


Table 1-1: The designated areas

Fields	No. of areas	No. of topics	Areas
Information/ Communications	9	75	Very large scale information processing; High-productivity computing; Human support (intellectual support); Ultra-transparent communications (space sharing)/ human interface (muscular strength support); Information security; Information technology for developing social systems; New principles for information and telecommunications; Ubiquitous networking; Software technology for large-scale networks
Electronics	15	69	Integrated systems; Silicon electronics; Optical and photonic devices; Wireless electronics; Bioelectronics; Molecular and organic electronics; Storage; Displays; Energy conversion/storage devices; Digital home appliances; Ubiquitous electronics; Robot electronics; Car electronics; Network electronics; Security electronics

Fields	No. of areas	No. of topics	Areas
Life science	11	65	Basic research in drug development; Basic research for new medical technologies; Brain generation and growth; Higher-order brain functions; Understanding and treating brain conditions; Regenerative medicine; Monitoring and sensor technology for biological substances; Control of higher-order biological functions; Information biology; Environmental and ecological biology; Nanobiology
Health/Medical care/Welfare	8	80	Personalized medicine; Elucidation of biological defense mechanisms and therapeutic application; Recovery of biological functions focusing on QOL and support for it; Application of IT to medicine; Human-centered medicine and construction of healthcare support systems; Preventive medicine; Measures against emerging and reemerging infectious diseases; Medicine and welfare for an aging society
Agriculture/ Forestry/Fisheries/ Foods	5	46	Elucidation of the complex interaction between biodiversity and ecosystems; Biological solutions to environmental problems and achievement of a sustainable society; Development of production technology that harmonizes with ecosystems and improves the environment; Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life; Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology
Frontier	11	76	Planetary exploration technology; Earthlike life and extrasolar planetary exploration technology; Space and particle research; Basic technology for space transportation and manned space activity; Space utilization technology —basic satellite technology—; Technology for high precise observation of Earth environments and for prediction of change; Technology to explore, capture, and cultivate life under extreme environment; Deep Earth observation technology; Ocean and deep ocean floor observation research technology; Space, ocean, and Earth technology for a safe and secure society; Space, ocean, and Earth technology that drives science and technology innovation
Energy/Resources	10	51	Innovative nuclear power systems; Nuclear fusion energy; Hydrogen energy systems; Fuel cells; Decentralized energy systems; Renewable energy; Clean-coal technology; Efficient energy conversion and use; Resource assessment; Recycling system (including biomass and waste)
Environment	7	55	Global environment (focus on global warming); Urban environment; Focus on identification and mitigation of ecological effects (including soil and water); Environmental economic index; Lifestyle based on environment; Environmental disasters; Water resources
Nanotechnology/ Materials	10	70	Nanomaterials modeling simulation; Nano measurement and analysis technology; Nano processing, molding, and manufacturing technology; Matter and materials origination, synthesis technology and process technology; New materials from nanolevel structure control; Nano devices and sensors; NEMS technology; Environment and energy materials; Nanobiology; Nanoscience for a safe and secure society
Manufacturing	9	59	Manufacturing technology utilizing advanced information technology; Manufacturing technology using virtual design; Manufacturing technology for high-value added products; Nano-machining/ micromachining technology; Recycling-oriented manufacturing technology with a low environmental load; Human and robot participation in manufacturing; Manufacturing technology in special environments; Advanced manufacturing technology for social infrastructure; Surface modification and interface control technology
Industrial infrastructure	10	59	Optimization of industrial infrastructure through regional dispersion and concentration; Knowledge management; Corporate decision-making, governance, and management; Public-sector governance and management; Risk management and finance; Human resources management (relationship among education, competition, and cooperation); Competition and cooperation in business; Higher productivity in service industries and the services sector; Environmental management; Art, culture, and entertainment that drive industry
Social infrastructure	14	97	Social infrastructure technology for non-densely populated areas; Improvement of structure performance; Revitalization, maintenance, and management of social infrastructure; Social infrastructure technology responsive to an aging society; Environmental technology in social infrastructure; Comprehensive water management technology; Environmental measures appropriate to architectural scale; Security technology as social infrastructure; Disaster prevention technology; Total management of social infrastructure that includes public involvement; New transport system technology; Traffic safety technology; Environmental management in the transport sector; Efficient and environmentally-conscious logistics systems technology
Social technology	11	56	Safety, security, and stability of day to day life; Urban safety, security, and stability Universal availability of services; Support for the elderly and the disabled; Social application of brain research; Technology for solving international problems; Technology that supports education and learning; Handing down and preserving culture and technology; Knowledge production system; Entertainment technology; Technology assessment

2) Topics

Topics are key technologies and research topics typical of individual areas. Some of them refer to social systems and lifestyles, which are not technologies but are likely to influence technological development or to be influenced by technology. Topics not included in areas are designated as non-area topics. Study resulted in a total of 858 topics, with several in each area. The following conditions were used to decide the topics. In the event that identical or similar areas or topics were designated in different fields, no adjustments were made, because it is likely that perspectives will vary accordingly.

- In principle, topics subject to analysis should have the potential to be realized by 2035, but when necessary, topics that may be realized in 2036 or later are included.
- Unless otherwise noted, the place of realization for each topic is the country or area where that is projected to occur first.
- Along with changes in questions regarding time of realization (two development stages, technological realization and social application, for each topic), in principle, descriptions of topics do not refer to technological development stages (e.g., elucidation, development, practical application, dissemination).

e.g., Effective technology to prevent cancer metastasis (a topic in the current survey)
Practical application of effective measures to prevent cancer metastasis (a topic in the previous survey)

(3) Survey items

Regarding the areas and topics, questions such as the following were established. In addition, two general questions regarding the science and technology field as a whole and social change were also designated.

1) Questions regarding areas

○ Impact

Evaluate the increased intellectual assets, the economic impacts, and the social impacts that will be brought about by the area over the next 10 years or so (the survey says "current") as will be examined by the next Science and Technology Basic Plan and over the 10 years beginning in 2016 (the survey says "the medium term"). For each impact, two detailed questions were established, with answers to be on a five-point scale of "Large," "Somewhat large," "Moderate," "Small," and "None."

<Increased intellectual assets>

Contribution of the relevant area itself to increased intellectual assets:
Possibility and potential that the relevant area itself will form a base for the generation of new knowledge, or that in the future it will generate new technology

Contribution to the development of other fields:
Potential to bring about propagation effects (creation of new fields, accelerated development of other fields, etc.) in other fields

<Economic impacts>

Contribution to the development of existing Japanese industry:
Potential to cause additional growth in existing Japanese industry, or to increase its competitiveness

Contribution to the creation of new industries or businesses:
Potential to generate new businesses and services that had not existed before, and to develop them into new industries

<Social impacts>

Contribution to safety and security:

Potential to maintain or increase safety and security for individuals or society as a whole

Contribution to improved social vitality and quality of life:

Potential to add vitality to society and bring about better lives

○ Japan's research and development level

Evaluate Japan's research and development level relative to USA, EU, and Asia (for the EU and Asia, the most advanced countries in those areas) today and five years ago. The evaluation scale is (Japan is) Leading, Somewhat leading, Even, Somewhat behind, Behind.

2) Questions regarding topics

○ Degree of importance to Japan

Use four-point scale of High: very important, Moderate: important, Low: somewhat important, None: not important (including unnecessary, should not be implemented).

○ Questions regarding technological realization (completion of a technological environment enabling the desired function)

Time of technological realization

(Choose one from 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036 or later, Will not be realized, Do not know.)

Countries at the leading edge

(Choose one from Japan, USA, EU, and Asia.)

Necessity of government involvement towards technological realization

(Choose one from High: strong involvement needed, Moderate: some involvement needed, Low: slight involvement needed, None: no involvement needed.)

Effective measures that should be taken by government towards technological realization

(Choose from the following measures (multiple choices permitted). However, do not answer if you selected "None" for "Necessity of government involvement towards realization.")

Human resources development: Training and retention of researchers, engineers, and research support personnel

Strengthened industry-academic-government and interdisciplinary collaboration: Greater fluidity of human resources, human exchange among industry, academia, and government, along with promotion of interdisciplinary cooperation including the humanities; promotion of joint projects, etc.

Development of R&D infrastructure: Development of large-scale joint facilities and equipment, database development, provision of standardized materials and genetic resources, etc.

Expansion of R&D funding: Expansion of R&D funding borne by government (including R&D subsidies to the private sector)

Internationalization of R&D activities: International joint research, international research exchanges, sending people to and sponsoring international research conferences

Relaxation or elimination of relevant regulations: Relaxation of relevant regulations, relaxation or elimination of approval and licensing systems

Tightened or new regulations: Strengthened protection for intellectual property rights, promotion of the dissemination of electric cars, etc., through environment taxes

Other

○ Questions regarding social application (technology becomes possible to utilize in products, services, etc.)

Time of social application

(Choose one from 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036 or later, Will not be applied, Do not know.)

Necessity of government involvement towards social application

(Choose one from High: strong involvement needed, Moderate: some involvement needed, Low: slight involvement needed, None: no involvement needed.)

Effective measures that should be taken by government towards social application

(Choose from the following measures (multiple choices permitted). However, do not answer if you selected "None" for "Necessity of government involvement towards realization.")

Human resources development: Training and retention of researchers, engineers, and research support personnel

Strengthened industry-academic-government and interdisciplinary collaboration: Greater fluidity of human resources; human exchange among industry, academia, and government, along with promotion of interdisciplinary cooperation including the humanities; promotion of joint projects, etc.

Improvement of environment for business startups: Financial, tax, and other measures to support ventures and new businesses

Support through taxation, subsidies, and procurement: Support through tax benefits and subsidies, government procurement of products, etc.

Relaxation or elimination of relevant regulations: Relaxation of relevant regulations, relaxation or elimination of approval and licensing systems

Tightened or new regulations: Strengthened protection for intellectual property rights, promotion of the dissemination of electric cars, etc., through environment taxes

Other

3) General questions

○ Regarding the development of Japanese science and technology fields (questions for all fields)

Looking ahead to the next 5 to 10 years, what field(s) should integrate and collaborate with the field regarding which you are responding (the respondent's field of expertise)? Looking at the 10 years after that (2016–2025), what field(s) has/have a high need for integration and collaboration?

Selections: information/communications; electronics; life science; health/medical care/welfare; agriculture/forestry/fisheries/foods; frontier; energy/resources; environment; nanotechnology/materials; manufacturing; industrial infrastructure; social infrastructure; social technology (Choose up to three.)

○ Predict what society will be like 30 years from now

(Two or three themes relevant to the development of the field in question.)

(4) Methodology

1) Technique

As in the previous survey, we use the Delphi method. The method applies the same questionnaire to experts twice in order to create a convergence in their answers.

Note: Delphi method

The Delphi method repeats the same questionnaire with multiple people in order for opinions of respondents to converge. It differs significantly from conventional questionnaires in that the second and subsequent questionnaires feed back previous responses to the respondents, enabling them to see the overall direction of opinions and to individually reevaluate question topics. Because some respondents may assent to the majority opinion, opinions converge. The name "Delphi" is taken from the location of the Temple of Apollo in ancient Greece, where the gods were said to visit the Oracle in order to have their futures told. The Rand Corporation of USA developed the method.

2) Premises of respondents and responses

Experts with deep knowledge of relevant fields are listed based on recommendations from subcommittee members. Conditions for recommendation are that the candidate be "a person with expert knowledge in the relevant field and engaged in or supervising research and development, or the equivalent." In addition, the following points are considered.

- Care is taken that the percentages of respondents in industry, academia, and government match those of each field.
- Care is taken to increase the number of relatively young respondents (those in their 30s and 40s) and the number of women.

Candidates selected through this process are then surveyed for willingness to participate, and the round 1 questionnaire is sent to those who agree. The round 2 questionnaire is sent to those who respond to the round 1 questionnaire.

Responses are predicated on there being no worldwide wars or catastrophes that destroy economic society during the next 30 years.

3) The questionnaires

In the Delphi analysis, the respondent group is decided by field, so results obtained from different populations can be aligned in order to make cross-field comparisons. In addition, there is a clear general trend for experts to evaluate their own fields highly. When analyzing the results, therefore, we must compare the responses of experts and non-experts and examine them for bias towards specialties.

This analysis therefore prepared two types of questionnaires, one to obtain responses from experts in a given field (Questionnaire A), and one to obtain responses from experts in other fields (Questionnaire B). Respondents answer Questionnaire A regarding areas and topics in their specialty fields, and Questionnaire B regarding areas in which they have some knowledge but that are outside their specialty fields. This enables comparisons between responses regarding areas from experts and non-experts in the field in question. Because the survey utilizing Questionnaire B is intended to identify the influence of specialization, the Delphi method is not used and it is taken only once. Questionnaire A is given twice, using the Delphi method, with the results of the second round analyzed as the final results. The following table shows the characteristics of the questionnaires and their respondents.

Table 1- 2: Types of questionnaires

Questionnaire	Questionnaire types	Respondents	Questions	Survey method
Questionnaire A	13 types (1 per field)	Specialists in the relevant field	Questions on areas in their specialty field and on topics	Delphi method (2 rounds)
Questionnaire B	1 type	All respondents	Questions on areas outside their specialty fields	1 round

4) Questionnaire execution

The questionnaire's execution can be summarized as follows.

○ Round 1 questionnaire

Date: September-October 2004

Delivery: 4,219 sent, 2,659 returned (63 percent collection rate)

○ Round 2 questionnaire

Date: December 2004-January 2005

Delivery: 2,659 sent, 2,239 returned (84 percent collection rate)

Final respondents totaled 2,239, a 53 percent collection rate. Respondent affiliations were private sector corporation, 27 percent; university, 45 percent; independent administrative agency, 19 percent; group or other, 8 percent. Their age composition was 40 percent, the highest percentage, in their 50s; followed by 33 percent in their 40s. Five percent of respondents were female. (See Table 1-3.)

(5) Procedure of analysis

In the analysis, the following methods were used for indexing.

○ Questions regarding areas

Responses were indexed on a 10-point scale for both impacts and R&D level.

Impacts — Calculated as (No. of "Large" responses x 10 + No. of "Somewhat large" responses x 7.5 + No. of "Moderate" responses x 5 + No. of "Small" responses x 2.5 + No. of "None" responses x 0) ÷ total responses on impacts (non-responses not included)

*Regarding increased intellectual assets, economic impacts, and social impacts, when subdivided into two indexes, the larger was taken as the relevant impact.

Overall impact — Calculated as Overall impact index = $\sqrt{\{(\text{index of increased intellectual assets})^2 + (\text{index of economic impacts})^2 + (\text{index of social impacts})^2\}}$

R&D level — Calculated as (No. of "Leading" responses x 10 + No. of "Somewhat leading" responses x 7.5 + No. of "Even" responses x 5 + No. of "Somewhat behind" responses x 2.5 + No. of "Behind" responses x 0) ÷ total responses on level (non-responses not included)

○ Questions regarding topics

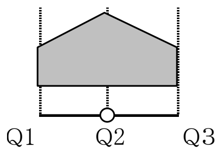
Regarding the degree of importance to Japan, responses were scored in the way used in the previous survey (100-point maximum) to enable comparison. The necessity of government involvement towards technological realization and the necessity of government involvement towards social application were indexed on 10-point scales, like the questions regarding areas.

Degree of importance: Calculated as (No. of "High" x 100 + no. of "Moderate" x 50 + no. of "Low" x 25 + no. of "None" x 0) ÷ no. of responses on importance (non-responses not included)

Necessity of government involvement: Calculated as (No. of "High" responses x 10 + No. of "Moderate" responses x 6.7 (10 x 2 ÷ 3) + No. of "Low" responses x 3.3 (10 ÷ 3) + No. of "None" responses x 0) ÷ total responses on necessity (non-responses not included)

Regarding countries currently at the leading edge, a ratio (%) is calculated with total responses (non-responses not included) as the population. For effective measures that should be taken by government towards technological realization and social application responses of either "High," Moderate," or "Low" to the "Necessity of government involvement" question above are taken as valid, and a percentage (%) is calculated with valid responses as the population.

Regarding times of technological realization and social application, the earliest and latest quarters of the answers were discarded and the half in between was used to obtain a value. The center half (Q1–Q3) is used as the range of answers and the median (Q2) is used as the representative value for achievement.



With responses on forecast time of realization/application arranged from earliest to latest,
Q1: quarter point of forecast time of realization/application
Q2: halfway point of forecast time of realization/application
Q3: three-quarter point of forecast time of realization/application

For questionnaire results regarding forecast time of realization/application, all decimals are discarded to round to whole numbers (years). For degree of importance and selection percentage, decimals were rounded to the nearest whole number. Indexes other than degree of importance were rounded to the first decimal.

The following abbreviations were used for survey item names. Numbers in front of field, area, and topic names signify field, area, and topic numbers. Field and areas names are abbreviated as necessary in charts. Longer topics are abbreviated by deleting those parts in parentheses, etc.

Survey items, etc.	Abbreviations
Increased intellectual assets	Intellectual assets (or, "Intellectual")
Contribution of the relevant area itself to increased intellectual assets	Relevant area
Contribution to the development of other fields	Development of other fields
Economic impacts	Economic
Contribution to the development of existing Japanese industry	Development of existing industry
Contribution to the creation of new industries or businesses	Creation of new industries
Social impacts	Social
Contribution to safety and security	Safety and security
Contribution to improved social vitality and quality of life	Social vitality
Degree of importance to Japan	Degree of importance
Effective measures that should be taken by government	Effective Measures
Human resources development	Human resources (or, “HR”)
Strengthened industry-academia-government and interdisciplinary collaboration	Strengthened collaboration (or, "Collaboration")
Development of R&D infrastructure	Developed Infrastructure (or, "Infrastructure")
Expansion of R&D funding	Expanded funding (or, "Funding")
Internationalization of R&D activities	Internationalization
Relaxation or elimination of relevant regulations	Relaxed regulation (or, "Relaxed reg.")
Tightened or new regulations	Tightened regulations (or, "Tightened reg.")
Improvement of environment for business startups	Business startup environment (or, "Business startups")
Support through taxation, subsidies, and procurement	Taxation/subsidies/procurement (or, "Procurement")
Other	(Same as on the left)
Round 1 questionnaire	R1
Round 2 questionnaire	R2

Table 1-3: Questionnaire collection status and characteristics of respondents

Field	No. of topics	Collection status						Characteristics (Round 2 questionnaire, unit: %)																		
								Gender			Age							Affiliation						Type of work		
		R1 sent	R1 collected	Collection rate	R2 sent	R2 collected	Collection rate	Male	Female	No response	20s	30s	40s	50s	60s	70 and older	No response	Company	University	Independent administrative	Other Organization	Other	No response	Engaged in R&D	Other	No response
01 Information/ communications	75	265	168	63%	168	144	86%	96%	2%	2%	0%	8%	36%	40%	10%	5%	0%	47%	40%	8%	1%	5%	0%	81%	19%	0%
02 Electronics	69	292	187	64%	187	159	85%	97%	1%	1%	0%	6%	37%	46%	9%	3%	0%	56%	33%	8%	2%	1%	0%	86%	14%	0%
03 Life science	65	431	278	65%	278	226	81%	90%	8%	1%	0%	15%	41%	33%	8%	2%	0%	15%	60%	20%	2%	3%	0%	89%	10%	1%
04 Health/medical care/welfare	80	306	152	50%	152	119	78%	81%	15%	4%	0%	2%	24%	55%	18%	0%	1%	1%	85%	4%	3%	7%	1%	44%	55%	1%
05 Agriculture/forestry/ fisheries/foods	46	391	294	75%	294	253	86%	89%	9%	2%	0%	12%	39%	34%	12%	2%	0%	8%	32%	49%	4%	6%	0%	81%	18%	1%
06 Frontier	76	415	296	71%	296	250	84%	95%	5%	0%	0%	13%	31%	40%	12%	4%	0%	12%	42%	37%	3%	5%	1%	85%	15%	0%
07 Energy/resources	51	313	229	73%	229	202	88%	98%	0%	1%	0%	9%	32%	44%	13%	2%	0%	43%	30%	13%	9%	4%	0%	76%	24%	0%
08 Environment	55	361	213	59%	213	184	86%	93%	6%	1%	1%	9%	26%	45%	16%	4%	0%	23%	44%	20%	8%	5%	1%	76%	24%	0%
09 Nanotechnology/materials	70	366	214	58%	214	179	84%	95%	1%	4%	0%	11%	39%	35%	15%	1%	0%	32%	51%	15%	1%	2%	0%	89%	11%	0%
10 Manufacturing	59	255	186	73%	186	163	88%	99%	1%	1%	0%	6%	30%	48%	16%	0%	0%	53%	39%	4%	2%	2%	0%	74%	26%	0%
11 Industrial infrastructure	59	210	108	51%	108	88	81%	93%	6%	1%	0%	17%	35%	26%	16%	6%	0%	35%	53%	0%	2%	8%	1%	57%	42%	1%
12 Social infrastructure	97	331	188	57%	188	155	82%	94%	5%	1%	1%	12%	29%	41%	15%	3%	0%	23%	54%	14%	4%	4%	1%	81%	19%	0%
13 Social technology	56	283	146	52%	146	117	80%	94%	4%	2%	0%	17%	32%	39%	9%	3%	0%	21%	50%	16%	6%	5%	1%	72%	28%	0%
Total	858	4219	2659	63%	2659	2239	84%	94%	5%	2%	0%	11%	33%	40%	13%	3%	0%	27%	45%	19%	4%	4%	0%	78%	21%	0%
Total from previous (7th) survey	1065	4448	3813	86%	3809	3106	82%	97%	3%	1%	1%	9%	31%	44%	14%	2%	0%	31%	42%	14%	10%	3%	0%	79%	21%	0%

II. General Findings

2.1. Major results regarding topics

2.1.1. Forecast times of realization

(1) Distribution of forecast time of realization

Figure 2-1 shows the distribution of the forecast time of realization for all topics. Sixty percent of the times of technological realization are concentrated from 2011 through 2015, but most times of social application are spread widely from 2011 through 2030. Even among topics predicted to become technologically possible at the same time, there is a broad range of expected times of social application.

Figure2-1: Distribution of time of technological realization and time of social application

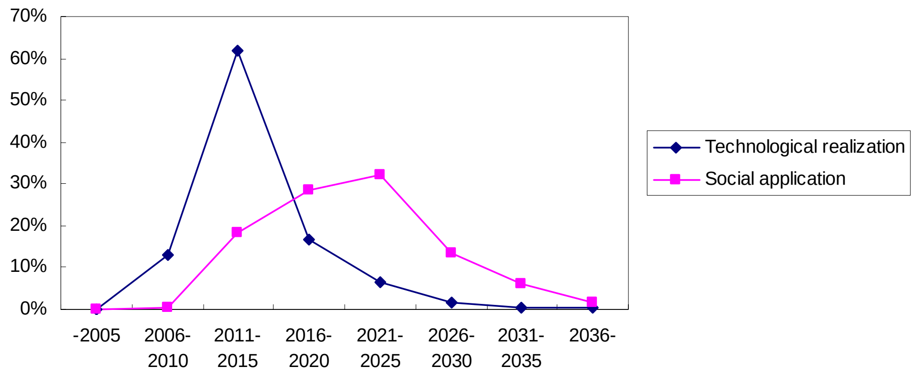
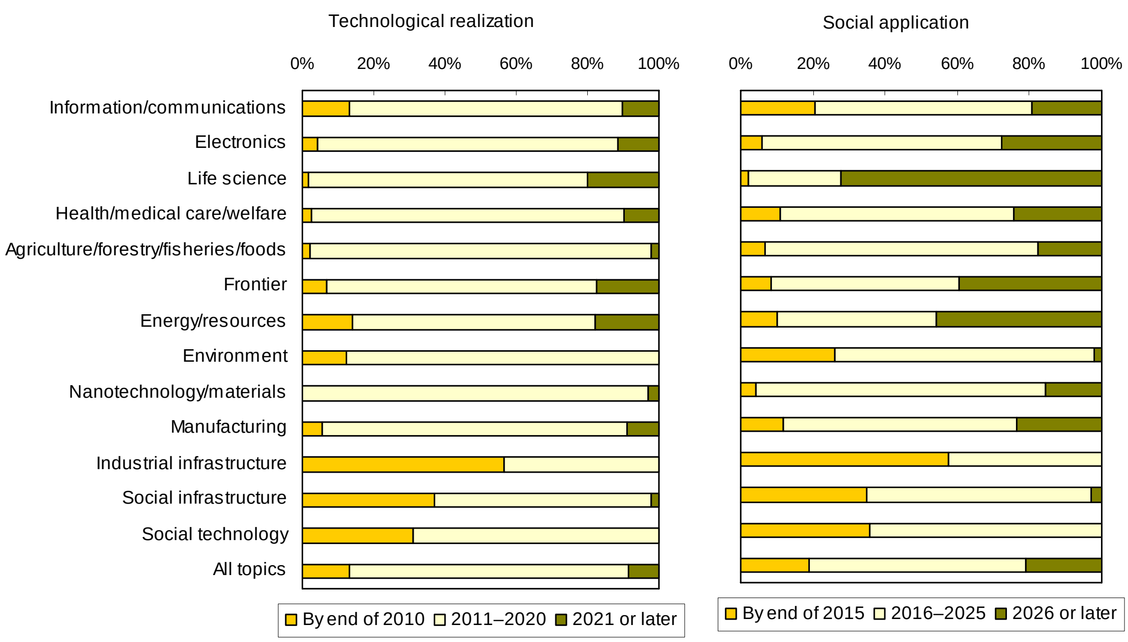


Figure 2-2: Percentages of topics with early/late predicted time of realization/application



Fields with many topics with early times of technological realization and social application are industrial infrastructure field, social infrastructure field, and social technology field. Fields with relatively late topics are life science field, energy and resources field, and frontier field. In terms of technological realization, topics in the industrial infrastructure field are very early, with 60 percent of them predicted for realization within five years. Many topics with early times of social application are found in the fields of industrial infrastructure, social infrastructure, and social technology. The life science field stands out for the late realization of its topics, with 70 percent predicted for 2026 or later.

Table 2-1 shows topics with early and late times of technological realization. Topics predicted for early realization are those with real-world applications, such as disaster management and information technology. Topics predicted for late realization include brain research, new energy, and new information and communication principles.

Table 2-1: Topics with early/late times of technological realization

A. Topics predicted for early realization

Place	Year of realization	Topic	Area	Delphi field
1	2005	18: Governmental services through which applications and other formal documents may be submitted to government offices over the Internet.	122: Universal availability of services	Social Technology
1	2006	52: Technology for economically and practically desalinating seawater and purifying polluted water using reverse osmosis membrane or other methods.	76: Water resources	Environment
1	2006	35: An electronic book that makes full use of multimedia technology for reversing the growing trend of aliteracy or people not reading books.	126: Technology that supports education and learning	Social Technology
4	2007	47: An intelligent transport system (ITS) that makes a motor trip more enjoyable and comfortable by, for example, providing voice guidance on nearby tourist attractions and events for those who make a stop at a roadside station or an expressway toll booth.	129: Entertainment technology	Social Technology
4	2007	60: System technology for promptly providing provisional housing after disasters.	114: Disaster prevention technology	Social Infrastructure
4	2007	13: Base-isolation and vibration-control devices that dramatically improve buildings' safety and property protection.	107: Improvement of structure performance	Social Infrastructure
4	2007	39: Room environment control technology for addressing indoor air contamination problems (sick-house syndrome) and ensuring safety, comfort, and health.	112: Environmental measures appropriate to architectural scale	Social Infrastructure
4	2007	45: Intelligent tags designed for product identification, quality control, and product tracking become widely available.	102: Competition and cooperation in business	Industrial Infrastructure
9	2008	50: Recovery of rare metals from electronic circuit boards.	69: Recycling system	Energy/ Resources
9	2008	47: A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.	114: Disaster prevention technology	Social Infrastructure

B. Topics predicted for late realization

Place	Year	Topic	Area	Delphi field
1	2036-	6: Nuclear fusion electric power generation furnaces.	61: Nuclear fusion energy	Energy/ Resources
1	2036-	21: Solar electric power generation systems in space.	65: Renewable energy	Energy/ Resources
3	2032	3: Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.	60: Innovative nuclear power systems	Energy/ Resources
4	2031	57: Discovery of a mechanism for the human brain to directly receive a greater amount of information faster by means of systems other than the visual (text) and auditory (sound) systems.	7: New principles for information and telecommunications	Information/ Communications
5	2030	29: Mind-machine interfaces based on brain waves, etc. (certain thoughts conveyed to the computer).	4: Ultra-transparent communications; human interface	Information/ Communications
5	2030	26: Artificial photosynthesis technology with a solar energy conversion efficiency of 3 percent or more (vs. about 1 percent in plant photosynthesis).	65: Renewable energy	Energy/ Resources
5	2030	58: General-purpose quantum computing applicable to diverse algorithms.	7: New principles for information and telecommunications	Information/ Communications

Place	Year	Topic	Area	Delphi field
5	2030	18: Permanent manned moon surface bases (scientific observation from the moon, lunar science, development of technology to utilize resources, etc.).	52: Basic technology for space transportation and manned space activity	Frontier
9	2028	16: Nearly complete elucidation of the molecular mechanisms for neural network formation.	27: Brain generation and growth	Life Science
9	2028	19: Elucidation of neural mechanisms of dreaming.	28: Higher-order brain functions	Life Science

(2) Periods between technological realization and social application

Figure 2-3 shows the distribution of periods between technological realization and social application. The social technology field has many topics where the period until social application is less than five years, while the life science, frontier, and energy/resources fields have many topics that require ten or more years until social application. There are no topics requiring less than five years in the life science field, and 70 percent of those topics require ten or more years. In the information/communications field, almost 20 percent of the topics require less than five years until social application, while about 10 percent require ten or more years.

Table 2-2 shows the 10 topics with the shortest periods to social application and the 10 topics with the longest. Many of the 10 short-period topics are in the information/communications field, while many of the 10 long-period topics are in the life science and energy/resources fields.

Figure 2-3: Percentages of topics with short/long periods between technological realization and social application

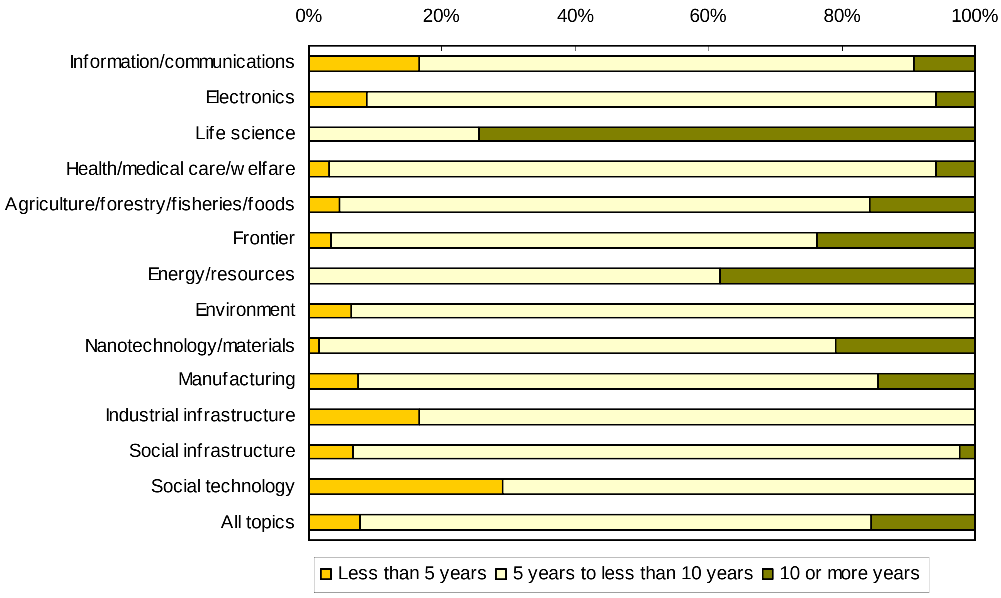


Table2-2: Topics with short or long periods until social application

A. The 10 topics with the shortest periods

	Period	Year*	Topic	Area	Delphi field
1	3.5	2015	1: A search system that satisfies advanced access needs, such as one whereby a person who is watching a video and wants to search for relevant video information, can output the most appropriate results by collecting through sensors information on the searcher such as the interest, skills, and search context.	1: Very large scale information processing	Information/ Communications

	Period	Year*	Topic	Area	Delphi field
2	4.0	2016	55: Advances in research on comfort/discomfort, likes/ dislikes, and other sensibilities that people feel as a result of consuming goods and services lead to the establishment of methods by which consumer sensibilities are directly analyzed, measured, and assessed, so that the results are used for R&D, sales, and marketing of goods and services.	105: Art, culture, and entertainment that drive industry	Industrial Infrastructure
3	4.0	2013	41: A spam-free e-mail system.	5: Information security	Information/ Communications
4	4.0	2013	39: Technology to detect intrusions and viruses on the Internet backbone.	5: Information security	Information/ Communications
5	4.1	2015	49: Technology for expanding leisure time, such as a system in which people can easily find a substitute who performs their office work or household chores, for encouraging the proposal of new ways of spending leisure time.	129: Entertainment technology	Social Technology
6	4.2	2015	80: Automatic Systems for programming fitness for the elderly.	43: Medicine and welfare for an aging society	Health/Medical care/Welfare
7	4.3	2016	10: Widespread use of electronic secretary terminals that offer functions such as voice recognition and fuzzy search, in addition to the information agent functions for schedule management and access to databases.	3: Human support (intellectual support)	Information/ Communications
8	4.4	2013	40: Capability of tracing back the source address of suspect packet in the Internet to detect intrusions.	5: Information security	Information/ Communications
9	4.4	2014	16: Technology that allows to utilize networked, but heterogeneous, global information sources (the Web, etc.) like an encyclopedia (including a summarization function of important items and a question-and-answer mechanism).	3: Human support (intellectual support)	Information/ Communications
10	4.4	2015	43: A system capable of identifying the online content harmful to young people and automatically checking it.	6: Information technology for developing social systems	Information/ Communications

B. The 10 topics with the longest periods

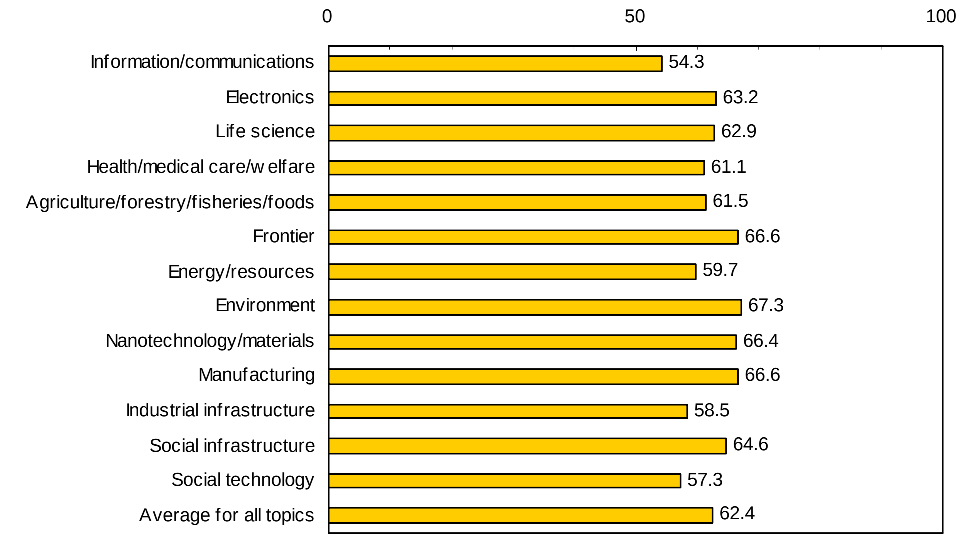
	Period	Year*	Topic	Area	Delphi field
1	16.0	2030	23: Ocean-thermal conversion electric power generation.	65: Renewable energy	Energy/ Resources
2	13.6	2029	28: Reprogramming technology to create stem cells from differentiated somatic cells.	30: Regenerative medicine	Life Science
3	13.4	2029	29: Technology to manipulate stem cell differentiation and growth for induction of functional cells to use for therapy.	30: Regenerative medicine	Life Science
4	13.3	2029	42: Technology to extract methane hydrate from continental permafrost areas.	68: Resource assessment	Energy/ Resources
5	12.5	2032	4: Geologic disposal technology for high-level radioactive waste.	60: Innovative nuclear power systems	Energy/ Resources
6	12.5	2031	2: Medium and small cogeneration nuclear reactors.	60: Innovative nuclear power systems	Energy/ Resources
7	12.1	2027	54: Technology to create practical plants resistant to cold and drought through elucidation of the molecular mechanisms of signal transductions in plants, from perception of low temperatures and other outside data to phenotypic expression.	34: Environmental and ecological biology	Life Science
8	12.1	2032	43: Technology to extract methane hydrate from sediments under the deepsea floor.	68: Resource assessment	Energy/ Resources
9	12.1	2031	45: Growth regulation of crop/tree based on the knowledge of the mechanism about biosynthesis, transport, and receptor-mediated signaling by regulators in plants.	48: Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology	Agriculture/ Forestry/ Fisheries/Foods
10	12.0	2027	55: Genetically-engineered plants and microorganisms that can remove NOx and other pollutants.	34: Environmental and ecological biology	Life Science

2.1.2. Degree of importance to Japan

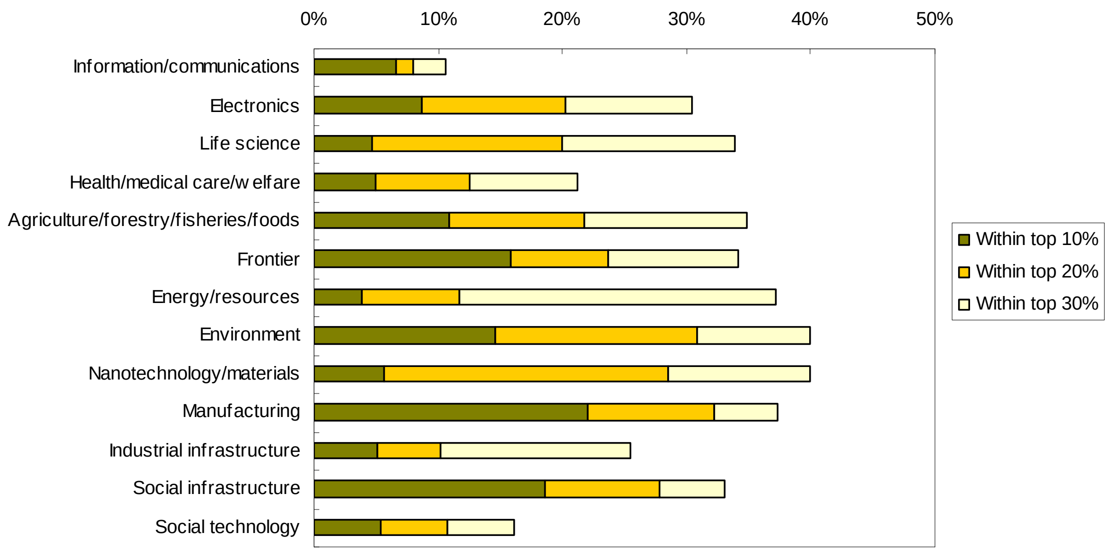
Figure 2-4 shows the degree of importance index for each field, along with the ratios of topics with a high degree of importance in each field. Fields with high degrees of importance are the environment, manufacturing, frontier, and nanotechnology/materials fields.

Figure 2-4: Degree of importance index by field and distribution by field of topics with high degrees of importance

Degree of importance index by field



Distribution by field of topics with high degrees of importance



The field with the highest percentage of topics in the top 10 percent of all topics (86 topics) is manufacturing, with 13 of its 59 topics, or 22 percent, in the top 10 percent. Next come the social infrastructure field (19 percent), the frontier field (16 percent), and the environment field (15 percent). The average for the information/communications field is low, but it still makes a strong showing with 7 percent of its topics in the top 10 percent in degree of importance.

Dividing the top 100 topics in terms of degree of importance into the categories of life-related, information-related, environment-related, disaster-related, energy-related, and other, disaster-related accounts for one-fourth (23 topics) of the top 100. Compared with the previous survey, disaster-related topics have increased significantly, while life-related, information-related, and environment-related topics declined substantially. The following are the characteristics of each category.

[Life-related] Cancer-related topics (4 topics) are the most common, with cognitive disorder (Alzheimer's disease) and other topics connected to illnesses accompanying an aging society also apparent. In addition, drug resistance in infectious diseases, allergic disease, and other topics that have recently become major issues, as well as safety-related topics such as the impact of hazardous chemicals are seen.

[Information-related] Topics related to microfabrication technology for the realization of high-performance LSIs and wearable devices, and to security, such as preventing unauthorized access to networks and detecting viruses, are considered important.

[Environment-related] Several topics related to exhaust gases such as CO_2 and NO_X (7 topics) and to a recycling-oriented society (5 topics) appear.

[Disaster-related] Half of these topics are earthquake-related. They cover a broad range, from detection and simulation to measures to mitigate human damage.

[Energy-related] These topics include manufacturing processes that utilize non-fossil energy, transportation facilities utilizing fuel cells, and solar batteries.

The increase in the number of topics that can be classified as "other" is also notable. Further breaking down the category, 7 topics are related to human resources, including education, mobility of human resources, transmission of skills and expertise, and participation of women in society. In addition, there are 4 topics related to nanotechnology, including manufacturing with atomic or molecular manipulation and control. Including those that are classified as life-related or information-related, there are 9 nanotechnology-related topics, about 10 percent of the top 100. In addition, there are a number of topics related to ensuring safety, including evaluation of structures for soundness and detection of explosives and pathogenic microorganisms in public places. Combined with topics in the existing category of disaster-related, many topics can be described with the word "safety."

The top 100 topics in terms of degree of importance are shown in Table 2-4.

Table2-3: Changes in the makeup of the top 100 topics in terms of degree of importance

Category	Current survey	7th survey (2001)	6th survey (1997)	5th survey (1992)
Life-related	17	26	17	37
Information-related	13	21	24	10
Environment-related	19	26	25	28
Disaster-related	23	8	11	9
Energy-related	8	10	11	6
Other	21	9	12	10

*One topic appears in both the life-related and the disaster-related categories.

Table 2-4: Top 100 topics in terms of degree of importance

Place	Index*	Topic	Year**	Field***	Category
1	98	52: A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand situations after disasters occur, and respond swiftly (send the necessary information where it is needed).	2014	Frontier	Disaster
2	98	58: Technology to forecast the timing and scale of volcanic eruptions by observing and assessing in real time magma conditions inside volcanoes that are likely to erupt.	2022	Frontier	Disaster
3	98	57: Technology to precisely forecast the imminence (place and time period) of earthquakes (plate boundary earthquakes and inland earthquakes) of magnitude 7 or greater that are likely to cause damage, helping mitigate human disasters.	2030	Frontier	Disaster

Place	Index*	Topic	Year**	Field***	Category
4	96	60: Technology to evenly and densely place comprehensive earthquake/ crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.	2016	Frontier	Disaster
5	96	59: Formation of a worldwide consensus, including developing countries, on international regulations on the output of carbon dioxide and other greenhouse gases.	2014	Frontier	Environment
6	95	61: Elucidation of the mechanisms of rainfall, snow accumulation, torrential rain, and so on.	2020	Frontier	Disaster
7	95	15: Technology for safely and efficiently demolishing and removing commercial nuclear power plants after decommissioning.	2020	Social Infrastructure	Energy
8	95	45: Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones.	2026	Frontier	Disaster
9	95	51: High-accuracy rainfall prediction technology capable of providing reliable forecast information on floods and landslides.	2019	Social Infrastructure	Disaster
10	95	27: Widespread use of production processes using low CO2 emitting energy sources such as non-fossil energy (wind, geothermal, photovoltaic, solar heat, waste heat, etc.), cogeneration systems, stationary fuel-cell systems etc..	2023	Manufacturing	Energy
11	95	59: Implementation of a new elementary and secondary education scheme that emphasizes science and mathematics to make Japan a world leader in science and technology.	2013	Manufacturing	Other
12	94	47: A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.	2013	Social Infrastructure	Disaster
13	94	23: Forecasting technology for year-to-year variation of climate system.	2022	Frontier	Environment
14	94	45: Technology for forecasting abnormal weather disasters resulting from climate change.	2023	Environment	Disaster
15	94	56: A technical education program that ensures the handing down of expertise and craftsmanship by establishing technology for converting implicit knowledge on manufacturing and manufacturing technique (e.g. basic techniques and skills, know-how, experience) into explicit knowledge.	2019	Manufacturing	Other
16	93	55: Technology to assess the safety of geologic disposal of high-level radioactive waste.	2021	Frontier	Energy
17	93	53: An integrated national land management and use system (using Earth observation satellite data, GPS, communications satellites, GIS, and so on to digitize land use, ocean data, maps, etc.) that covers all of Japan, including the sea.	2014	Frontier	Other
18	93	48: Technology for medium-term (5-10 years) prediction of major earthquakes (magnitude 8 or greater) by the analysis of crustal strain distribution and the records of past earthquakes.	2021	Social Infrastructure	Disaster
19	93	19: Technology for recycling, rather than demolishing, deteriorated infrastructure and technology for maintaining and managing infrastructure to extend its life.	2019	Social Infrastructure	Other
20	93	59: Technology for formulating an effective response strategy in the event of a major disaster, using systems for efficiently assessing the damage and predicting its spread.	2015	Social Infrastructure	Disaster
21	93	58: Promotion of human resources mobility that is promoted across industry, academia, and government, leading to a greater number of joint or collaboration projects, and consequently bringing about innovations in manufacturing technology.	2013	Manufacturing	Other
22	93	68: A crustal movement sensor that enables prediction of an earthquake a few minutes before it occurs.	2023	Electronics	Disaster
23	93	34: Technology for predicting and assessing global depletion of the resources that are used in Japan.	2018	Environment	Other
24	93	36: A highly reliable network system capable of protecting the privacy and secrecy of individuals and groups from intrusion by malicious hackers.	2016	ICT	Information
25	93	33: Risk management technology for harmful chemicals (endocrine disruptors, heavy metals, etc.) based on elucidation of their long-term impacts on human beings, crops, livestock, and ecosystems.	2024	Agriculture	Life
26	93	50: Technology for accurately simulating the behavior of structures and the ground motion in response to a strong earthquake.	2014	Social Infrastructure	Disaster
27	92	12: Technology for earthquake-resistance assessment and anti-seismic reinforcement to protect high-rise buildings and tanks from ocean-trench earthquakes that generate long-period seismic waves.	2014	Social Infrastructure	Disaster

Place	Index*	Topic	Year**	Field***	Category
28	92	3: Elucidation of the pathogenesis of atherosclerosis.	(2015)	Health	Life
29	92	54: A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management (transport, storage, treatment) and in systems for warning, evacuation, and regulation.	2017	Social Infrastructure	Disaster
30	92	40: Energy consumption per capita in Japan reduces by half.	2031	Environment	Energy
31	92	35: Generalized technology, extended from total building management systems and home security systems, which is coupled with seismic detection systems so that the safety of human life can be ensured before seismic waves arrive, in an earthquake whose epicenter is distant.	2020	ICT	Disaster
32	91	28: Manufacturers' responsibility for collecting and disposing of discarded products is defined by law, and recycling systems in which more than 90% of used material is thermal- or material-recycled become widespread. Design for recycle/disassemble technology, easy assemble & disassemble production technology, selective collection system technology etc. enable it to achieve.	2021	Manufacturing	Environment
33	91	55: Technology for supporting the restoration of the functions of an urban city that has been severely and extensively paralyzed by a large-scale power failure or a long-duration break in the water supply.	2018	Social Infrastructure	Disaster
34	91	17: Super high precision process technology (for processing, analyzing, testing, and in-situ monitoring) at the angstrom level achieved through advances in beam technology (ion, electron, laser, etc.), machine control technology, and sensor technology.	2018	Manufacturing	Other
35	91	63: A system that allows people to recognize and understand the disaster risk potential associated with natural phenomena (e.g. earthquakes, volcanic eruption, flood) and man-made accidents, so that they can construct disaster mitigation measures in cooperation with the government.	2014	Social Infrastructure	Disaster
36	90	25: An "inverse" manufacturing system that combines "arterial" (production) and "venous" (disposal) activities in which the production system (design→produce→use→scrap) and the resources recycling system (collect→disassemble/sort→reuse→produce) are integrated.	2021	Manufacturing	Environment
37	90	24: Earth environment change forecasting technology with a scale of several decades by Earth system models that handle the composition of the atmosphere and oceans, ecosystems, and the material cycles within them.	2027	Frontier	Environment
38	90	44: Technology for minimizing the impacts of and restoring damage from large-scale industrial accidents.	2017	Environment	Disaster
39	90	36: A social environment that encourages women to balance work and marriage, childbearing, and childrearing (e.g. 30% of listed companies set up day care centers) becomes a reality in Japan to promote the utilization of female human resources.	2014	Industrial Infrastructure	Other
40	90	39: In Japan, for easier job changes, corporate pensions become "portable" so that the pension funds deposited under the pension program of the previous employer can be transferred to the new employer's pension program when a worker changes jobs.	2013	Industrial Infrastructure	Other
41	90	14: Production processing technology capable of controlling dimensions and shapes with single nanometer precision.	2019	Nano	Other
42	90	4: Geologic disposal technology for high-level radioactive waste.	2032	Energy and Resources	Energy
43	90	42: Introduction of an automobile tax based on CO2 emissions.	2013	Environment	Environment
44	90	34: Formation of positive understanding and consensus on genetically engineered plants and foods.	2015	Agriculture	Life
45	90	13: Base-isolation and vibration-control devices that dramatically improve buildings' safety and property protection.	2013	Social Infrastructure	Disaster
46	90	14: Clean fuel (other than hydrogen) that does not emit particulates, NOx, etc.	2021	Environment	Environment
47	89	2: Therapeutic application of the achievements on the pathophysiology of cancerization	2028	Health	Life
48	89	58: Construction of effective information and social systems that help improve the capacity of community-based activities for disaster prevention and welfare.	2014	Social Infrastructure	Other
49	89	12: Effective technology to prevent cancer metastasis.	2030	Life Science	Life
50	89	18: Packaging technology at the few micron level for achieving super-small wearable equipment for use anywhere, anytime by a combination of optoelectronics, microelectronics, and micromachinery.	2021	Manufacturing	Information
51	89	84: Automobile recycling technology that can almost completely solve car scrapping problems.	2017	Social Infrastructure	Environment

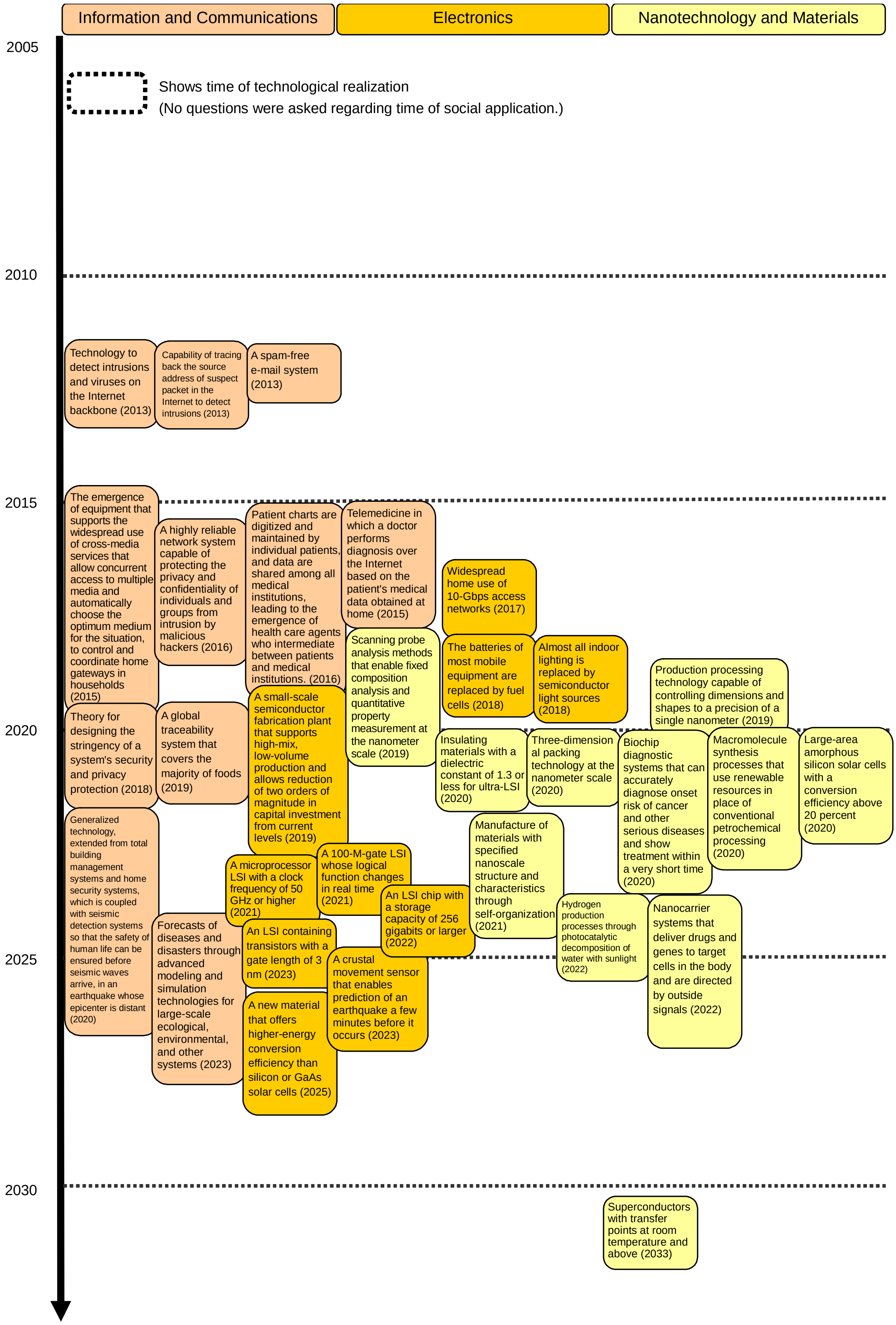
Place	Index*	Topic	Year**	Field***	Category
52	89	32: Prevention, diagnosis, and treatment technology through the complete elucidation of BSE onset.	2020	Agriculture	Life
53	89	87: Emissions treatment technology that allows all land and marine transport systems to satisfy the current automobile emissions limits (current limits for gasoline passenger vehicles in g/km: 1.27(0.67) for carbon monoxide; 0.17(0.08) for hydrocarbon; 0.17(0.08) for nitrogen oxides; in 10/15 mode tests, max. values per car, average of emissions per type of vehicle in parentheses).	2021	Social Infrastructure	Environment
54	88	10: Technology for immediate, complete control of allergies based on elucidation of the immunoregulatory mechanisms and environmental factors that lead to hay fever, atopic dermatitis, and other allergies.	2027	Life Science	Life
55	88	71: Methane hydrate mining utilization technology.	2025	Frontier	Energy
56	88	38: Large-area amorphous silicon solar cells with a conversion efficiency above 20 percent.	2020	Nano	Energy
57	88	15: Achievement of low costs agriculture and forestry and rural communities oriented towards zero emissions by using local agricultural and forestry resources, organic waste, and other sources of biomass energy.	2022	Agriculture	Environment
58	88	22: Treatment for preventing the progression of Alzheimer's disease.	2030	Life Science	Life
59	88	86: Fuel cell-powered transport systems (automobiles, ships, etc.)	2021	Social Infrastructure	Energy
60	88	39: Technology to detect intrusions and viruses on the Internet backbone.	2013	ICT	Information
61	88	9: A wide-area disaster monitoring system that monitors, when a major disaster occurs, the impacts of the disaster widely across the affected area, by using satellite images and the analysis by laser radar equipment, to help provide prompt and safe evacuation guidance.	2018	Social Technology	Disaster
62	88	13: A small-scale semiconductor fabrication plant that supports high-mix, low-volume production and allows a two orders of magnitude reduction in capital investment from the current levels.	2019	Electronics	Information
63	88	55: Hydrogen production processes through photocatalytic decomposition of water with sunlight	2022	Nano	Environment
64	87	9: Discovery of the seeds of new practical technologies for the safe disposal of CO2 with long-term stability.	(2017)	Environment	Environment
65	87	1: Elucidation of the emission, absorption and fixation mechanism of greenhouse gases in a natural system as a result of climate change.	(2014)	Environment	Environment
66	87	65: Biochip diagnostic systems that can accurately diagnose onset risk for cancer and other serious diseases and supply information for setting treatment within a very short time.	2020	Nano	Life
67	87	7: An advanced virtual manufacturing system and its operation system to support optimization, efficiency improvement, license application, and other processes of production activities such as design, development, manufacture, operation, maintenance, and disposal.	2018	Manufacturing	Other
68	87	2: A support system that explicitly shows experts' decision-making process, skills, and know-how for reuse and leaning by non-experts.	2018	Manufacturing	Other
69	87	2: Technology to estimate long-term changes in resource amounts in order to appropriately manage true sardines and other important fisheries resources.	2022	Agriculture	Other
70	87	22: Manufacturing technology for achieving innovative functions and properties through nanoscale manipulation and control of atoms and molecules or through control of materials structure or arrangement.	2028	Manufacturing	Other
71	86	17: Almost all indoor lighting is replaced by semiconductor light sources.	2018	Electronics	Information
72	86	47: Recycle systems for the production, distribution, and consumption of recovered materials and products based on new economic criteria/standards.	2016	Energy and Resources	Environment
73	86	40: Capability of tracing back the source address of suspect packet in the Internet to detect intrusions.	2013	ICT	Information
74	86	10: A system for quickly and accurately detecting trace amounts of explosives, drugs, radioactive substances, and pathogenic microorganisms in public and other crowd-attracting facilities and public transportation such as airports, seaports, and railroads.	2020	Social Technology	Other
75	86	6: A 100M-gate LSI whose logical function changes in real time.	2021	Electronics	Information
76	86	1: Elucidation of the pathophysiology of cancer metastasis.	(2018)	Health	Life
77	86	51: Over half of Japan's listed companies adopt management schemes that emphasize corporate social responsibility as the fundamental business policy.	2011	Industrial Infrastructure	Other

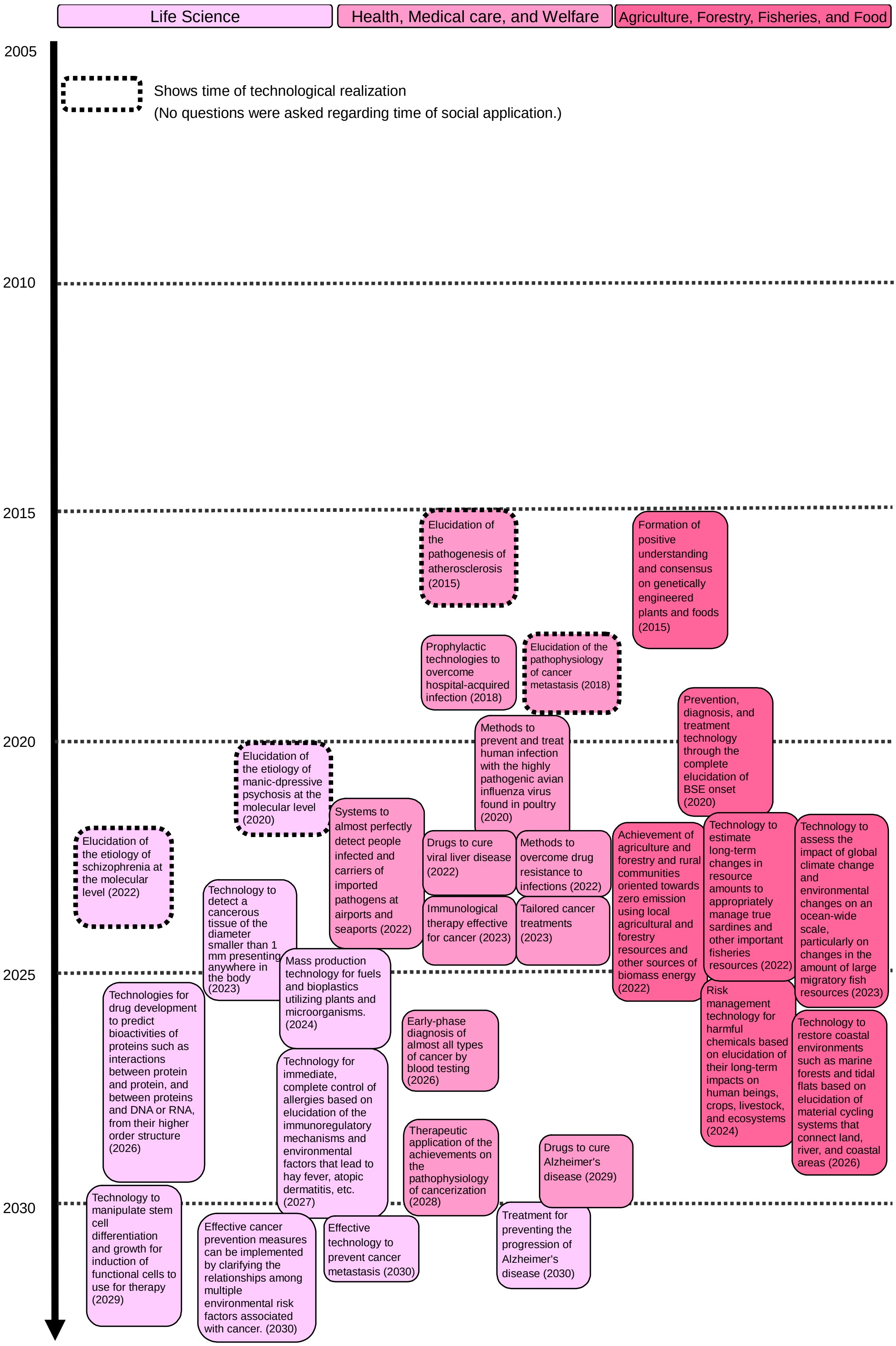
Place	Index*	Topic	Year**	Field***	Category
78	86	7: Forecasts of diseases and disasters through advanced modeling and simulation technologies for large-scale ecological, environmental, or other systems.	2023	ICT	Information
79	85	17: Technology for efficiently reinforcing existing structures by assessing their structural soundness through nondestructive inspection.	2014	Social Infra-structure	Other
80	85	51: Systems for early warning and prediction by experts (e.g. early detection of human/livestock infection and prediction of its impacts, early warning of the environmental effects of an accident or disaster) are established, enabling early detection and impact assessment of the problems that should be solved by science and technology.	2021	Social Technology	Life, Disaster
81	85	57: Widespread adoption of earthquake risk management as a result of the establishment of the technique for long-term estimation of the probability of earthquake occurrence.	2018	Social Infrastructure	Disaster-related
82	85	15: Widespread home use of 10-Gbps access networks.	2017	Electronics	Information
83	85	14: A reconfigurable manufacturing system in which production volume can be quickly and flexibly adjusted to each of many different products.	2019	Manufacturing	Other
84	85	6: Japan's original manufacturing software for supporting autonomous adaptability, large variety small volume production, and short delivery time.	2015	Manufacturing	Information
85	85	5: A microprocessor LSI with a clock frequency of 50 GHz or higher.	2021	Electronics	Information
86	85	30: Prophylactic technologies to overcome hospital-acquired infection.	2018	Health	Life
87	85	50: Meso-scale (about 10-km mesh) precipitation simulation.	2018	Environment	Environment
88	85	28: High-precision Earth environment models with about 100–500 m resolution for a short-range forecasting that can distinguish buildings and predict air pollution, and urban flooding.	2022	Frontier	Environment
89	84	8: Digital mock-up technology with which, for the aim of shortening the design and R&D periods and reinforcing product competitiveness, all product evaluation parameters including strength, performance, reliability, environment-friendliness, and productivity can be assessed.	2018	Manufacturing	Information
90	84	54: Integrated usage and conservation technology for entire bays such as Tokyo Bay and Osaka Bay that are densely used.	2015	Frontier	Environment
91	84	13: Three-dimensional packing technology at the nanometer scale.	2020	Nano	Other
92	84	23: Elucidation of the etiology of manic-dpressive psychosis at the molecular level.	(2020)	Life Science	Life
93	84	33: Technology to detect a cancerous tissue of the diameter smaller than 1 mm presenting anywhere in the body.	2023	Life Science	Life
94	84	24: Elucidation of the etiology of schizophrenia at the molecular level.	(2022)	Life Science	Life
95	84	19: A system that supports women's social participation by ensuring mothers the future availability of child-rearing support such as nursery schools, at the time of pregnancy or childbirth.	2012	Social Technology	Other
96	84	7: An LSI containing transistors with a gate length of 3 nm.	2023	Electronics	Information
97	83	7: Development of a global monitoring system for marine pollution.	2022	Environment	Environment
98	83	25: Technology to precisely observe carbon dioxide gas emission and absorption within country, using space technology.	2022	Frontier	Environment
99	83	71: Methods to overcome drug resistance in infections.	2022	Health	Life
100	83	62: Nanocarrier systems that deliver drugs and genes to target cells in the body and are directed by outside signals.	2022	Nano	Life

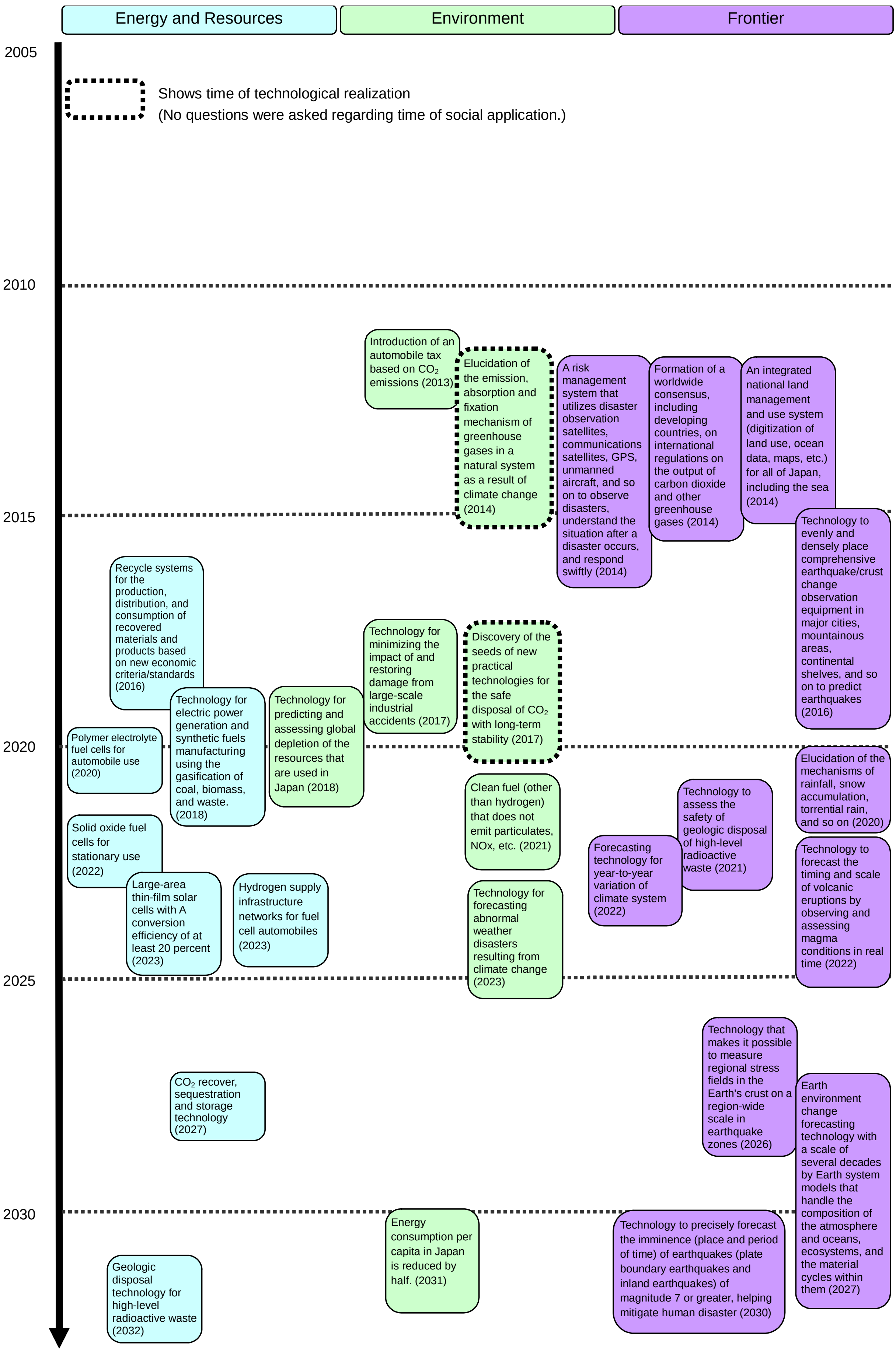
*Index: Degree of importance to Japan
**Year = time of social application. Where no question regarding time of social application was asked, time of technological realization is written in parentheses.
***Field abbreviations: ICT (information/communications), Health (health/medical care/welfare), Agriculture (agriculture/forestry/fisheries/foods), Nano (nanotechnology/materials)

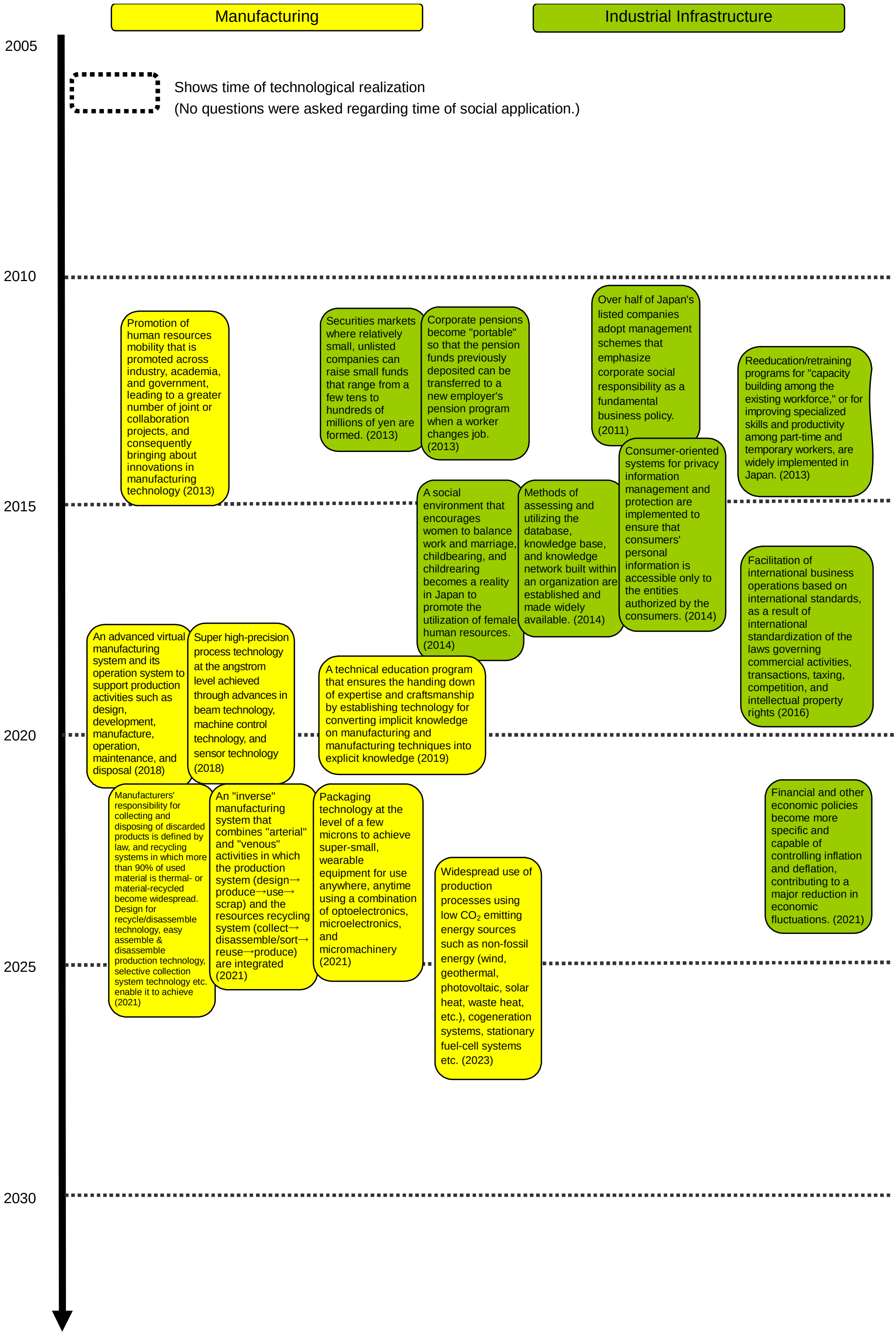
Figure 2-5 shows important topics (top 15 percent in terms of degree of importance) by field. In principle, topics are arranged by time of social application.

Figure 2-5: Time line of top topics in terms of degree of importance, by field

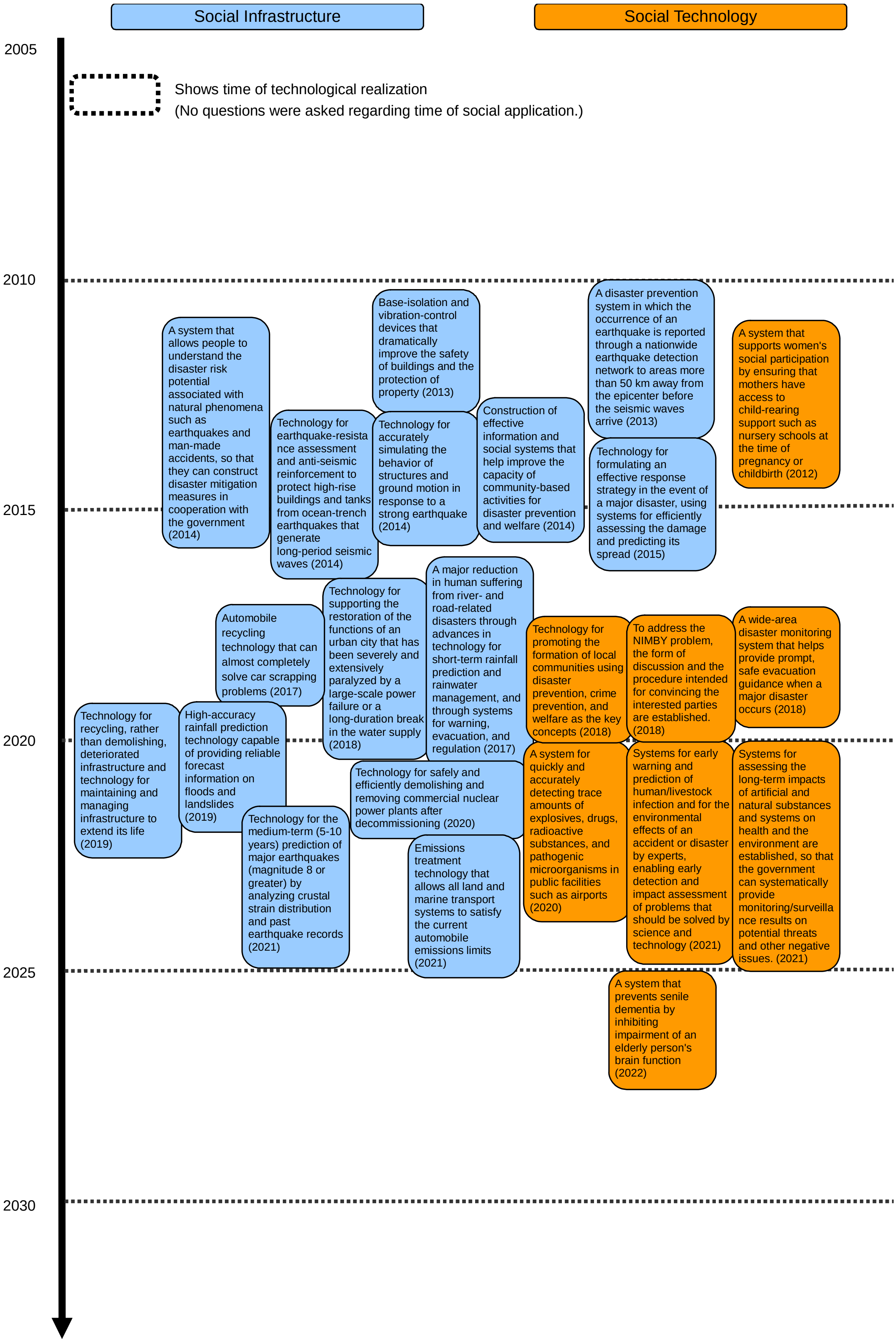



Life Science
Health, Medical care, and Welfare
Agriculture, Forestry, Fisheries, and Food
2005
2010
2015
2020
2025
2030
Shows time of technological realization
(No questions were asked regarding time of social application.)
Elucidation of the pathogenesis of atherosclerosis (2015)
Formation of positive understanding and consensus on genetically engineered plants and foods (2015)
Prophylactic technologies to overcome hospital-acquired infection (2018)
Elucidation of the pathophysiology of cancer metastasis (2018)
Prevention, diagnosis, and treatment technology through the complete elucidation of BSE onset (2020)
Methods to prevent and treat human infection with the highly pathogenic avian influenza virus found in poultry (2020)
Elucidation of the etiology of manic-dpressive psychosis at the molecular level (2020)
Systems to almost perfectly detect people infected and carriers of imported pathogens at airports and seaports (2022)
Elucidation of the etiology of schizophrenia at the molecular level (2022)
Drugs to cure viral liver disease (2022)
Methods to overcome drug resistance to infections (2022)
Achievement of agriculture and forestry and rural communities oriented towards zero emission using local agricultural and forestry resources and other sources of biomass energy (2022)
Technology to estimate long-term changes in resource amounts to appropriately manage true sardines and other important fisheries resources (2022)
Technology to assess the impact of global climate change and environmental changes on an ocean-wide scale, particularly on changes in the amount of large migratory fish resources (2023)
Technology to detect a cancerous tissue of the diameter smaller than 1 mm presenting anywhere in the body (2023)
Immunological therapy effective for cancer (2023)
Tailored cancer treatments (2023)
Mass production technology for fuels and bioplastics utilizing plants and microorganisms. (2024)
Risk management technology for harmful chemicals based on elucidation of their long-term impacts on human beings, crops, livestock, and ecosystems (2024)
Technologies for drug development to predict bioactivities of proteins such as interactions between protein and protein, and between proteins and DNA or RNA, from their higher order structure (2026)
Early-phase diagnosis of almost all types of cancer by blood testing (2026)
Technology to restore coastal environments such as marine forests and tidal flats based on elucidation of material cycling systems that connect land, river, and coastal areas (2026)
Technology for immediate, complete control of allergies based on elucidation of the immunoregulatory mechanisms and environmental factors that lead to hay fever, atopic dermatitis, etc. (2027)
Therapeutic application of the achievements on the pathophysiology of cancerization (2028)
Drugs to cure Alzheimer's disease (2029)
Technology to manipulate stem cell differentiation and growth for induction of functional cells to use for therapy (2029)
Effective cancer prevention measures can be implemented by clarifying the relationships among multiple environmental risk factors associated with cancer. (2030)
Effective technology to prevent cancer metastasis (2030)
Treatment for preventing the progression of Alzheimer's disease (2030)


Energy and Resources
Environment
Frontier
2005
2010
2015
2020
2025
2030
Shows time of technological realization
(No questions were asked regarding time of social application.)
Introduction of an automobile tax based on CO_2 emissions (2013)
Elucidation of the emission, absorption and fixation mechanism of greenhouse gases in a natural system as a result of climate change (2014)
A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand the situation after a disaster occurs, and respond swiftly (2014)
Formation of a worldwide consensus, including developing countries, on international regulations on the output of carbon dioxide and other greenhouse gases (2014)
An integrated national land management and use system (digitization of land use, ocean data, maps, etc.) for all of Japan, including the sea (2014)
Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on to predict earthquakes (2016)
Recycle systems for the production, distribution, and consumption of recovered materials and products based on new economic criteria/standards (2016)
Technology for minimizing the impact of and restoring damage from large-scale industrial accidents (2017)
Discovery of the seeds of new practical technologies for the safe disposal of CO_2 with long-term stability (2017)
Technology for electric power generation and synthetic fuels manufacturing using the gasification of coal, biomass, and waste. (2018)
Technology for predicting and assessing global depletion of the resources that are used in Japan (2018)
Polymer electrolyte fuel cells for automobile use (2020)
Elucidation of the mechanisms of rainfall, snow accumulation, torrential rain, and so on (2020)
Clean fuel (other than hydrogen) that does not emit particulates, NOx, etc. (2021)
Technology to assess the safety of geologic disposal of high-level radioactive waste (2021)
Solid oxide fuel cells for stationary use (2022)
Forecasting technology for year-to-year variation of climate system (2022)
Technology to forecast the timing and scale of volcanic eruptions by observing and assessing magma conditions in real time (2022)
Large-area thin-film solar cells with A conversion efficiency of at least 20 percent (2023)
Hydrogen supply infrastructure networks for fuel cell automobiles (2023)
Technology for forecasting abnormal weather disasters resulting from climate change (2023)
Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones (2026)
CO_2 recover, sequestration and storage technology (2027)
Earth environment change forecasting technology with a scale of several decades by Earth system models that handle the composition of the atmosphere and oceans, ecosystems, and the material cycles within them (2027)
Energy consumption per capita in Japan is reduced by half. (2031)
Technology to precisely forecast the imminence (place and period of time) of earthquakes (plate boundary earthquakes and inland earthquakes) of magnitude 7 or greater, helping mitigate human disaster (2030)
Geologic disposal technology for high-level radioactive waste (2032)



Manufacturing
Industrial Infrastructure
2005
Shows time of technological realization
(No questions were asked regarding time of social application.)
2010
2015
2020
2025
2030
Promotion of human resources mobility that is promoted across industry, academia, and government, leading to a greater number of joint or collaboration projects, and consequently bringing about innovations in manufacturing technology (2013)
Securities markets where relatively small, unlisted companies can raise small funds that range from a few tens to hundreds of millions of yen are formed. (2013)
Corporate pensions become "portable" so that the pension funds previously deposited can be transferred to a new employer's pension program when a worker changes job. (2013)
Over half of Japan's listed companies adopt management schemes that emphasize corporate social responsibility as a fundamental business policy. (2011)
Reeducation/retraining programs for "capacity building among the existing workforce," or for improving specialized skills and productivity among part-time and temporary workers, are widely implemented in Japan. (2013)
Consumer-oriented systems for privacy information management and protection are implemented to ensure that consumers' personal information is accessible only to the entities authorized by the consumers. (2014)
A social environment that encourages women to balance work and marriage, childbearing, and childrearing becomes a reality in Japan to promote the utilization of female human resources. (2014)
Methods of assessing and utilizing the database, knowledge base, and knowledge network built within an organization are established and made widely available. (2014)
Facilitation of international business operations based on international standards, as a result of international standardization of the laws governing commercial activities, transactions, taxing, competition, and intellectual property rights (2016)
An advanced virtual manufacturing system and its operation system to support production activities such as design, development, manufacture, operation, maintenance, and disposal (2018)
Super high-precision process technology at the angstrom level achieved through advances in beam technology, machine control technology, and sensor technology (2018)
A technical education program that ensures the handing down of expertise and craftsmanship by establishing technology for converting implicit knowledge on manufacturing and manufacturing techniques into explicit knowledge (2019)
Manufacturers' responsibility for collecting and disposing of discarded products is defined by law, and recycling systems in which more than 90% of used material is thermal- or material-recycled become widespread. Design for recycle/disassemble technology, easy assemble & disassemble production technology, selective collection system technology etc. enable it to achieve (2021)
An "inverse" manufacturing system that combines "arterial" and "venous" activities in which the production system (design→produce→use→scrap) and the resources recycling system (collect→disassemble/sort→reuse→produce) are integrated (2021)
Packaging technology at the level of a few microns to achieve super-small, wearable equipment for use anywhere, anytime using a combination of optoelectronics, microelectronics, and micromachinery (2021)
Financial and other economic policies become more specific and capable of controlling inflation and deflation, contributing to a major reduction in economic fluctuations. (2021)
Widespread use of production processes using low CO_2 emitting energy sources such as non-fossil energy (wind, geothermal, photovoltaic, solar heat, waste heat, etc.), cogeneration systems, stationary fuel-cell systems etc. (2023)


Social Infrastructure
Social Technology
2005
2010
2015
2020
2025
2030
Shows time of technological realization
(No questions were asked regarding time of social application.)
A system that allows people to understand the disaster risk potential associated with natural phenomena such as earthquakes and man-made accidents, so that they can construct disaster mitigation measures in cooperation with the government (2014)
Base-isolation and vibration-control devices that dramatically improve the safety of buildings and the protection of property (2013)
Technology for earthquake-resistance assessment and anti-seismic reinforcement to protect high-rise buildings and tanks from ocean-trench earthquakes that generate long-period seismic waves (2014)
Technology for accurately simulating the behavior of structures and ground motion in response to a strong earthquake (2014)
Construction of effective information and social systems that help improve the capacity of community-based activities for disaster prevention and welfare (2014)
A disaster prevention system in which the occurrence of an earthquake is reported through a nationwide earthquake detection network to areas more than 50 km away from the epicenter before the seismic waves arrive (2013)
Technology for formulating an effective response strategy in the event of a major disaster, using systems for efficiently assessing the damage and predicting its spread (2015)
A system that supports women's social participation by ensuring that mothers have access to child-rearing support such as nursery schools at the time of pregnancy or childbirth (2012)
Automobile recycling technology that can almost completely solve car scrapping problems (2017)
Technology for supporting the restoration of the functions of an urban city that has been severely and extensively paralyzed by a large-scale power failure or a long-duration break in the water supply (2018)
A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management, and through systems for warning, evacuation, and regulation (2017)
Technology for promoting the formation of local communities using disaster prevention, crime prevention, and welfare as the key concepts (2018)
To address the NIMBY problem, the form of discussion and the procedure intended for convincing the interested parties are established. (2018)
A wide-area disaster monitoring system that helps provide prompt, safe evacuation guidance when a major disaster occurs (2018)
Technology for recycling, rather than demolishing, deteriorated infrastructure and technology for maintaining and managing infrastructure to extend its life (2019)
High-accuracy rainfall prediction technology capable of providing reliable forecast information on floods and landslides (2019)
Technology for safely and efficiently demolishing and removing commercial nuclear power plants after decommissioning (2020)
A system for quickly and accurately detecting trace amounts of explosives, drugs, radioactive substances, and pathogenic microorganisms in public facilities such as airports (2020)
Systems for early warning and prediction of human/livestock infection and for the environmental effects of an accident or disaster by experts, enabling early detection and impact assessment of problems that should be solved by science and technology (2021)
Systems for assessing the long-term impacts of artificial and natural substances and systems on health and the environment are established, so that the government can systematically provide monitoring/surveillance results on potential threats and other negative issues. (2021)
Technology for the medium-term (5-10 years) prediction of major earthquakes (magnitude 8 or greater) by analyzing crustal strain distribution and past earthquake records (2021)
Emissions treatment technology that allows all land and marine transport systems to satisfy the current automobile emissions limits (2021)
A system that prevents senile dementia by inhibiting impairment of an elderly person's brain function (2022)

2.1.3. Countries at the leading edge

Figure 2-6 shows the percentage naming Japan as the country at the leading edge for each field. The highest percentage for Japan of any field is manufacturing field, followed by social infrastructure field and electronics field. On the other hand, Japan's percentage is low in the fields of health/medical care/welfare and life science. Japan alone holds the highest percentage in the field of social infrastructure, while it is roughly equal with USA in the fields of electronics, agriculture/forestry/fisheries/foods, energy/resources, and manufacturing.

Japan's percentage is above 90 percent for 65 topics, with many of them found in fields where Japan has a high average, such as social infrastructure, electronics, and manufacturing fields. On the other hand, Japan is weak (0 percent) in 64 topics. These include 19 life-related topics (life science, health/medical care/welfare, and agriculture/forestry/fisheries/foods fields), 11 frontier-field topics, and 9 information-related topics (information/communications and electronics fields). Of the 773 topics for which the question of the leading country was asked, Japan received less than 10 percent in 361, nearly half of the total.

Figure 2-6: Ratio of leading countries

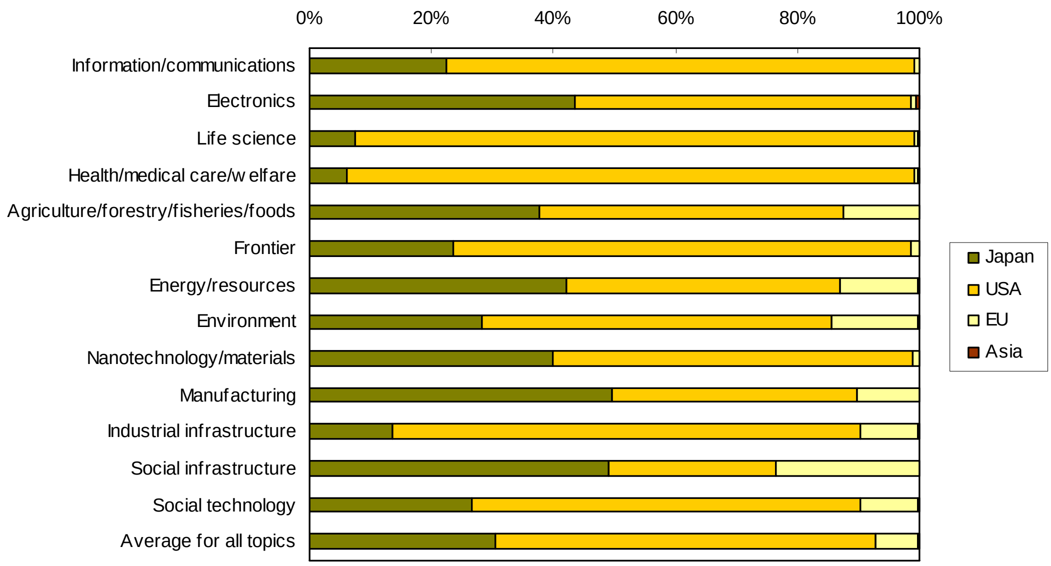


Table2-5: Topics with a high percentage naming Japan as leader

Topic	Japan %	2nd place country %	Area	Delphi field
38: Large-area amorphous silicon solar cells with a conversion efficiency above 20 percent.	100	—	81: New materials from nanolevel structure control	Nanotechnology /Materials
60: Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.	99	USA:0.7	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
17: Almost all indoor lighting is replaced by semiconductor light sources.	99	USA:0.8	12: Optical and photonic devices	Electronics
19: Production system technology artificially seed eels in mass quantities, raise them, and ship them.	99	EU:0.9	46: Development of production technology that harmonizes with ecosystems and improves the environment	Agriculture/ Forestry/ Fisheries/Foods
47: A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.	99	USA:1.0	114: Disaster prevention technology	Social Infrastructure

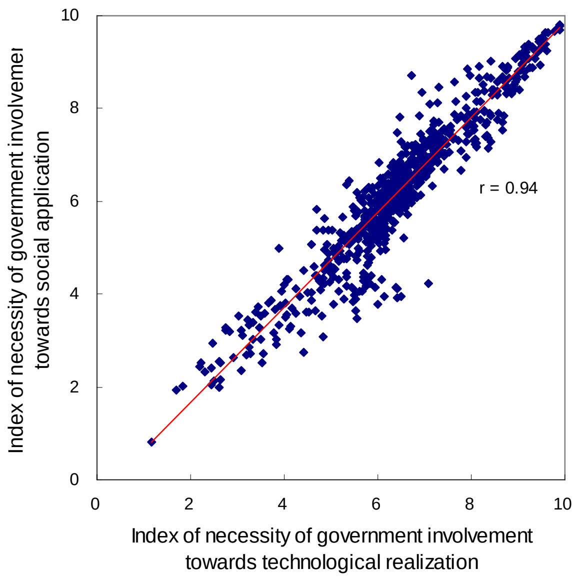
Topic	Japan %	2^{nd} place country %	Area	Delphi field
41: A flat-panel display larger than A3 size and with a resolution equivalent to high quality print images (600 dpi or higher).	98	EU, Asia: 0.9	17: Displays	Electronics
13: Base-isolation and vibration-control devices that dramatically improve buildings' safety and property protection.	98	USA:1.0	107: Improvement of structure performance	Social Infrastructure
48: Technology for medium-term (5-10 years) prediction of major earthquakes (magnitude 8 or greater) by the analysis of crustal strain distribution and the records of past earthquakes.	98	USA:1.1	114: Disaster prevention technology	Social Infrastructure
68: A crustal movement sensor that enables prediction of an earthquake a few minutes before it occurs.	98	USA:2.3	24: Security electronics	Electronics
54: A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management (transport, storage, treatment) and in systems for warning, evacuation, and regulation.	98	USA:1.3	114: Disaster prevention technology	Social Infrastructure

2.1.4. The necessity of government involvement and effective measures that should be taken by government

(1) Overview

Looking at the necessity of government involvement towards technological realization and towards social application for the 721 topics regarding which both questions were asked, a positive correlation (r = 0.94) is apparent. Topics that require government involvement towards technological realization also require government involvement towards social application. Among effective measures that should be taken by government, looking at those measures applicable to both technological realization and social application (human resources development, strengthened industry-academia-government and interdisciplinary collaboration, relaxation or elimination of relevant regulations, and tightened or new regulations), there is a correlation for the two in human resources development, relaxation or elimination of relevant regulations, and tightened or new regulations (r = 0.87–0.94).

Figure 2-7: The necessity of government involvement towards technological realization and towards social application



(2) Topics with a high necessity of government involvement and effective measures

Looking at the whole, topics in the frontier and environment fields have a high necessity of government involvement for both technological realization and social application, while those in the industrial infrastructure field and information and communications fields have a low necessity.

Regarding effective measures that should be taken by government towards technological realization, the ratio for expansion of R&D funding is high in almost every field, followed by strengthened industry-academia-government and interdisciplinary collaboration and human resources development. The ratio for expansion of R&D funding is high in 12 fields, all but industrial infrastructure. The ratio of strengthened industry-academia-government and interdisciplinary collaboration is high in the fields of electronics, agriculture/forestry/fisheries/foods, nanotechnology/materials, manufacturing, and social infrastructure. Fields in which the ratio of human resources development is high are life science, health/medical care/welfare, frontier, and industrial infrastructure fields.

Of the above-mentioned three major effective measures, the ratio of strengthened industry-academia-government and interdisciplinary collaboration is low in the frontier field, with development of R&D infrastructure replacing it in third place. In the energy/resources, manufacturing, and social infrastructure fields, the ratio of human resources development is low, with development of R&D infrastructure in third place. In the industrial infrastructure field, the ratio of expansion of R&D funding is low, with relaxation or elimination of relevant regulations replacing it in third place.

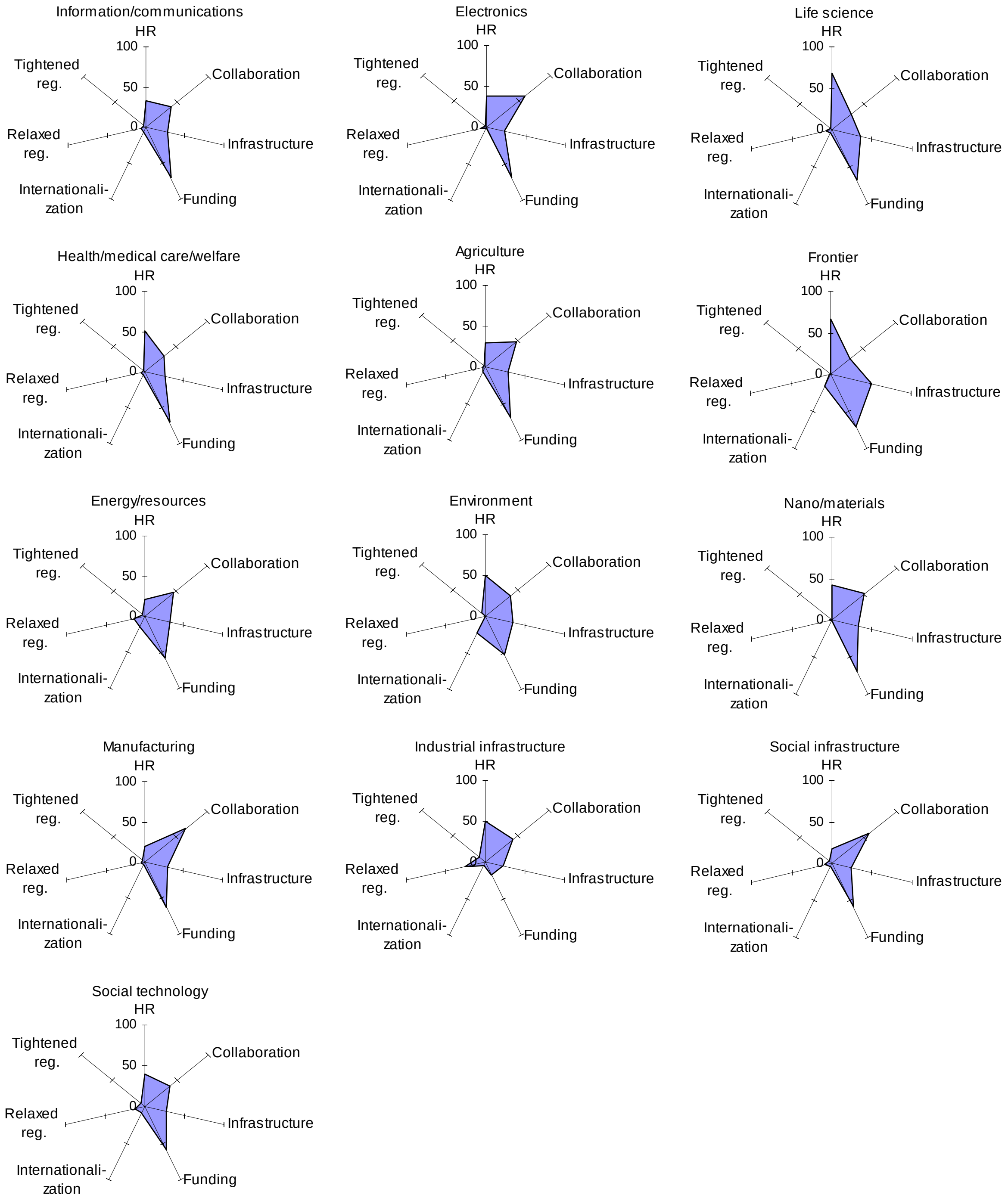
If we categorize the fields according to which measures are considered especially effective, there is a field in which human resources development, development of R&D infrastructure, and expansion of R&D funding are effective (frontier); fields in which strengthened industry-academia-government and interdisciplinary collaboration and expansion of R&D funding are effective (electronics; agriculture/forestry/fisheries/foods; nanotechnology/materials; manufacturing; and social infrastructure); fields in which human resources development and expansion of R&D funding are effective (life science and health/medical care/welfare); and fields in which expansion of R&D funding is effective (information/communications, energy/resources, environment, and social technology).

Looking at effective measures that should be taken by government towards social application, human resources development; strengthened industry-academia-government and interdisciplinary collaboration; and support through taxation/subsidies/procurement are the three major measures in almost all fields. The ratio for human resources development is high in the fields of life science; health/medical care/welfare; and frontier. The ratio for strengthened industry-academia-government and interdisciplinary collaboration is high in the electronics; life science; agriculture/forestry/fisheries/foods; frontier; nanotechnology/materials; and manufacturing fields. The ratio of support through taxation/subsidies/procurement is high in the fields of information/ communications; electronics; health/medical care/welfare; energy/resources; manufacturing; social infrastructure; and social technology.

Of the three major effective measures mentioned above, the ratio for human resources development is low in the energy/resources field, where relaxation or elimination of relevant regulations replaces it in third place. The ratio for support through taxation/subsidies/procurement is low in the environment field, where tightened or new regulations takes its place in third. The ratio for support through taxation/subsidies/procurement is also low in the industrial infrastructure field, where relaxation or elimination of relevant regulations is in second place.

Figure 2-8: Effective measures that should be taken by government

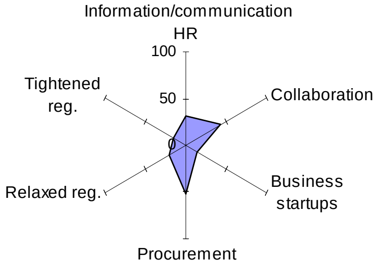
For technological realization

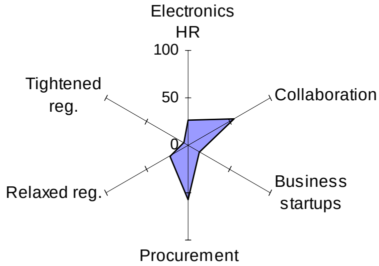


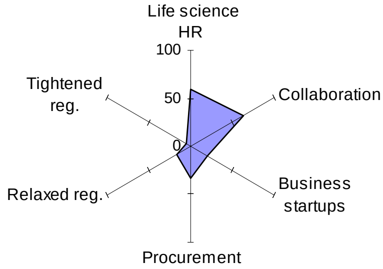
Abbreviations for measures: HR (Human resources development), Collaboration (Strengthened industry-academia-government and interdisciplinary collaboration), Infrastructure (Development of R&D infrastructure), Funding (Expansion of R&D funding), Internationalization (Internationalization of R&D activities), Relaxed reg. (Relaxation or elimination of relevant regulations), Tightened reg. (Tightened or new regulations)

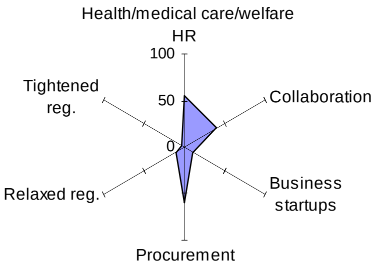
Abbreviations for fields: Agriculture (agriculture/forestry/fisheries/foods), Nano/materials (nanotechnology/materials)

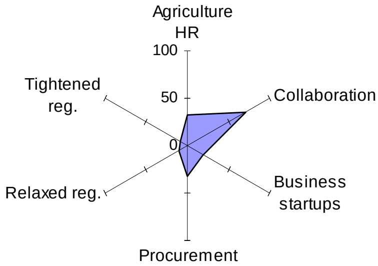
For social application

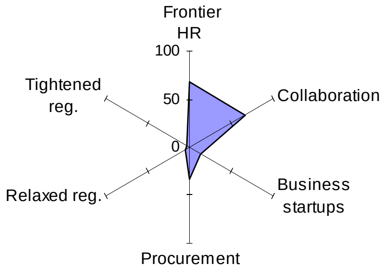


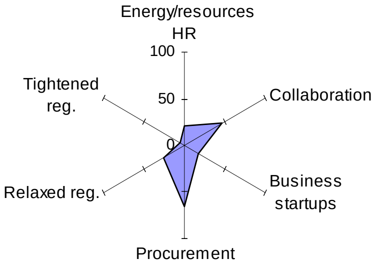


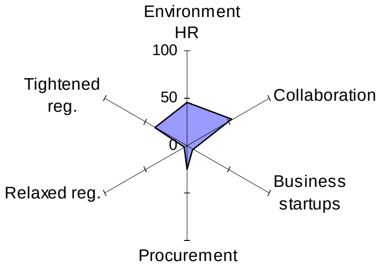


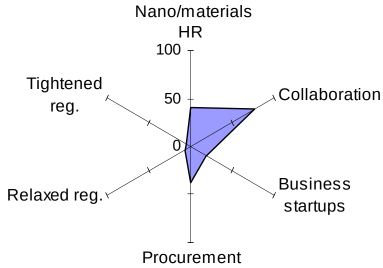


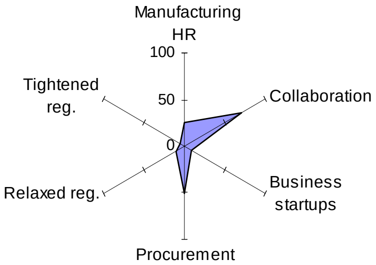


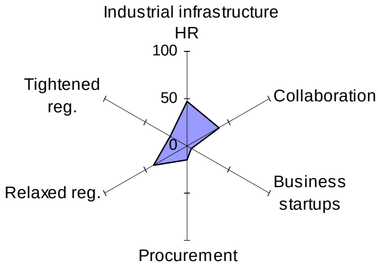


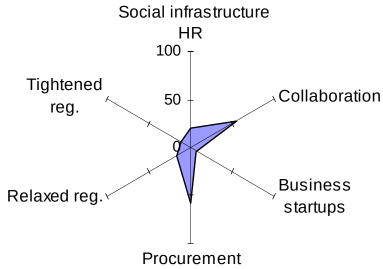


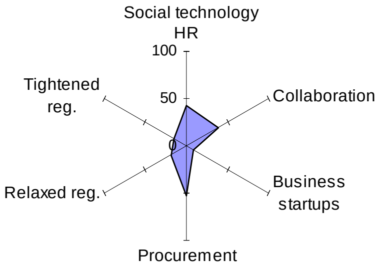












Abbreviations: HR (Human resources development), Collaboration (Strengthened industry-academia-government and interdisciplinary collaboration), Business startups (Improvement of environment for business startups), Procurement (Support through taxation, subsidies, and procurement), Relaxed reg. (Relaxation or elimination of relevant regulations), Tightened reg. (Tightened or new regulations)

Table 2-6: Topics with a high necessity of government involvement

For technological realization

Topic	Score	Measures*	Area	Delphi field
58: Technology to forecast the timing and scale of volcanic eruptions by observing and assessing in real time magma conditions inside volcanoes that are likely to erupt.	9.9	HR Infrastructure Funding	58: Space, ocean, and Earth technology for a safe and secure society	Frontier

Topic	Score	Measures*	Area	Delphi field
52: A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand situations after disasters occur, and respond swiftly (send the necessary information where it is needed).	9.9	HR Collaboration Infrastructure Funding	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
60: Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.	9.9	HR Infrastructure Funding	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
57: Technology to precisely forecast the imminence (place and time period) of earthquakes (plate boundary earthquakes and inland earthquakes) of magnitude 7 or greater that are likely to cause damage, helping mitigate human disasters.	9.8	HR Infrastructure Funding	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
55: Technology to assess the safety of geologic disposal of high-level radioactive waste.	9.8	HR Infrastructure Funding	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
45: Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones.	9.6	HR Infrastructure Funding	56: Deep Earth observation technology	Frontier
53: An integrated national land management and use system (using Earth observation satellite data, GPS, communications satellites, GIS, and so on to digitize land use, ocean data, maps, etc.) that covers all of Japan, including the sea.	9.6	HR Collaboration Infrastructure Funding	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
4: Geologic disposal technology for high-level radioactive waste.	9.6	Funding	60: Innovative nuclear power systems	Energy/ Resources
15: Technology for safely and efficiently demolishing and removing commercial nuclear power plants after decommissioning.	9.6	Collaboration	108: Revitalization, maintenance, and management of social infrastructure	Social Infrastructure
61: Elucidation of the mechanisms of rainfall, snow accumulation, torrential rain, and so on.	9.6	HR Infrastructure Funding	58: Space, ocean, and Earth technology for a safe and secure society	Frontier

For social application

Topic	Score	Measures*	Area	Delphi field
59: Formation of a worldwide consensus, including developing countries, on international regulations on the output of carbon dioxide and other greenhouse gases.	9.8	HR Collaboration	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
58: Technology to forecast the timing and scale of volcanic eruptions by observing and assessing in real time magma conditions inside volcanoes that are likely to erupt.	9.8	HR Collaboration	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
60: Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.	9.8	HR Collaboration	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
52: A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand situations after disasters occur, and respond swiftly (send the necessary information where it is needed).	9.7	Collaboration HR Procurement	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
42: Introduction of an automobile tax based on CO_2 emissions.	9.7	Tightened reg.	74: Lifestyle based on environment	Environment
57: Technology to precisely forecast the imminence (place and time period) of earthquakes (plate boundary earthquakes and inland earthquakes) of magnitude 7 or greater that are likely to cause damage, helping mitigate human disasters.	9.7	HR Collaboration	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
55: Technology to assess the safety of geologic disposal of high-level radioactive waste.	9.7	HR Collaboration	58: Space, ocean, and Earth technology for a safe and secure society	Frontier
59: Implementation of a new elementary and secondary education scheme that emphasizes science and mathematics to make Japan a world leader in science and technology.	9.7	HR	-	Manufacturing
15: Technology for safely and efficiently demolishing and removing commercial nuclear power plants after decommissioning.	9.6	Collaboration	108: Revitalization, maintenance, and management of social infrastructure	Social Infrastructure
15: Full implementation of traffic demand management (TDM) for the optimization and minimization of traffic volume in large cities.	9.6	Tightened reg. Collaboration	71: Urban environment	Environment

*Effective measures: categories with over 50 percent of responses on effective measures that should be taken by government.

If we categorize the fields according to which measures are considered especially effective, there are fields in which support through taxation/subsidies/procurement are effective (information/communications, health/medical care/welfare, energy/resources, and social technology), fields in which strengthened collaboration is effective (agriculture/forestry/fisheries/foods, environment, nanotechnology/ materials, and manufacturing), fields in which strengthened industry-academia-government and interdisciplinary collaboration and support through taxation/subsidies/procurement are effective (electronics and social infrastructure), fields in which strengthened industry-academia-government and interdisciplinary collaboration and human resources development are effective (life science and frontier), a field in which support through taxation/subsidies/procurement and human resources development are effective (health/ medical care/welfare), and a field in which human resources development is effective (industrial infrastructure).

Looking at topics with a high necessity of government involvement for technological realization, 7 of the top 10 topics are in the frontier field.

2.2. Major results regarding areas

2.2.1. Impacts

(1) Overview

Looking at current (from now until about ten years into the future) increased intellectual assets, economic impacts, and social impacts and their relationship with the medium term (from around 2016 to about ten years later), there is a positive correlation in each case (r = 0.90–0.95).

In the medium term, impact is expected to increase in almost all areas. Major increases in social impacts are in contribution to securing safety and security and contribution to improved social vitality and quality of life. Major increases in economic impacts are expected in contribution to the creation of new industries or businesses creation of new industries.

Looking at correlations between pairs of subcategories within increased intellectual assets, economic impacts, and social impacts (contribution of the relevant area itself to increased intellectual assets × contribution to the development of other fields, contribution to the development of existing Japanese industry × contribution to the creation of new industries or businesses, and contribution to safety and security × contribution to improved social vitality and quality of life), with the exception of a few areas, a positive correlation between current impact and medium-term impact was found.

Figure 2-9: Correlations between current impacts and medium-term impacts (examples)

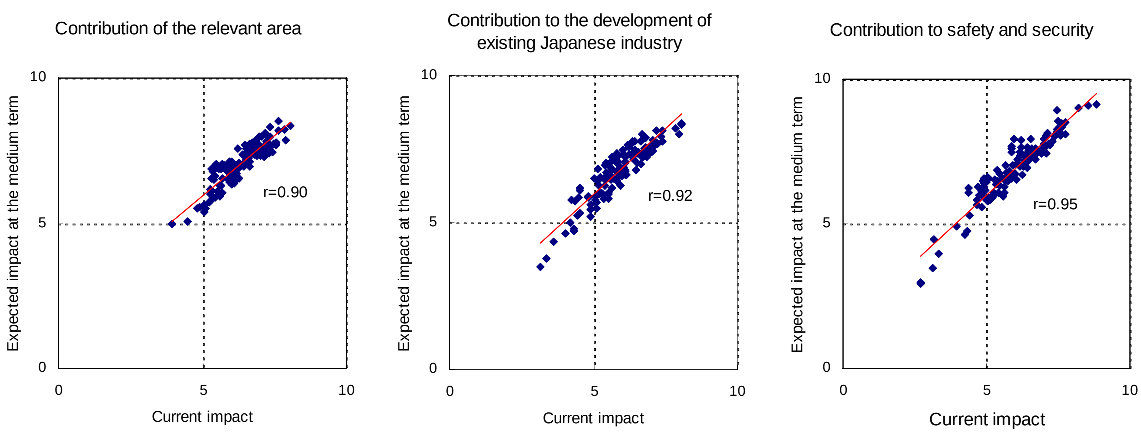
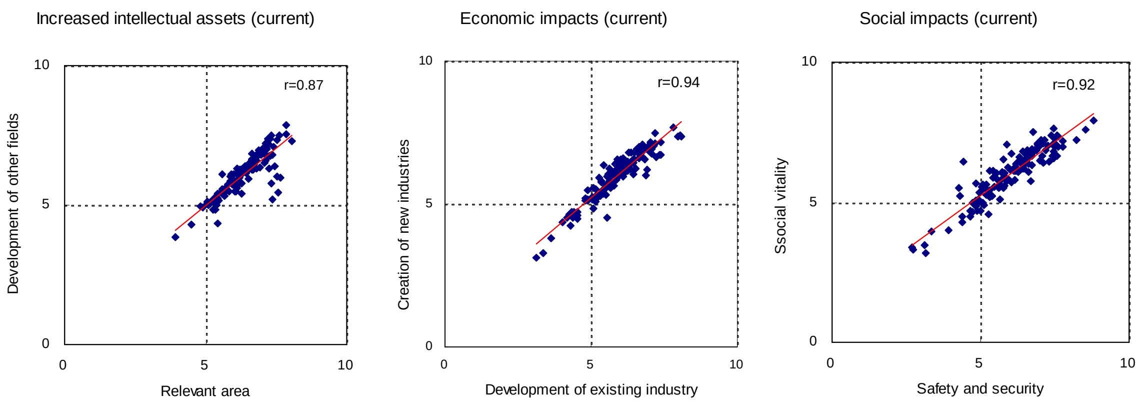


Figure 2-10: Correlation between pairs of subcategories from within increased intellectual assets, economic impacts, and social impacts (examples of current impact)



(2) Areas with large impacts

Regarding increased intellectual assets (contribution of the relevant area itself to increased intellectual assets and contribution to the development of other fields), economic impacts (contribution to the development of existing Japanese industry and contribution to the creation of new industries or businesses), and social impacts (contribution to safety and security and contribution to improved social vitality and quality of life), we extracted the top one third (43 areas) for both the current time and the medium term by taking the values of categories with high scores as representative values.

A. Increased intellectual assets

A combined 51 areas were extracted as having major impacts at the current time or in the medium term. Of these, 35 areas, 70 percent, have major impacts during both periods. Many of these areas were in the electronics, frontier, and nanotechnology/materials fields. In the medium term, impacts are expected in areas in the life science field.

Table 2-7: Areas with large increase in intellectual assets

C	M	Area
x	x	001: Very large scale information processing
x	x	010: Integrated systems
x	x	011: Silicon electronics
x	x	012: Optical and photonic devices
x	x	013: Wireless electronics
x	x	014: Bioelectronics
x	x	016: Storage
x	x	017: Displays
x	x	018: Energy conversion/storage devices
x	x	019: Digital home appliances
x	x	020: Ubiquitous electronics
x	x	021: Robot electronics
x	x	025: Basic research in drug development
x	x	031: Monitoring and sensor technology for biological substances
x	x	048: Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology
x	x	049: Planetary exploration technology
x	x	050: Earthlike life and extrasolar planetary exploration technology
x	x	051: Space and particle research
x	x	052: Basic technology for space transportation and manned space activity
x	x	053: Space utilization technology—basic satellite technology—
x	x	054: Technology for high precise observation of Earth environments and for prediction of change
x	x	055: Technology to explore, capture, and keep extreme life forms

C	M	Area
x	x	056: Deep Earth observation technology
x	x	057: Ocean and deep ocean floor observation research technology
x	x	059: Space, ocean, and Earth technology that drives science and technology innovation
x	x	063: Fuel cells
x	x	078: Nano measurement and analysis technology
x	x	079: Nano processing, molding, and manufacturing technology
x	x	080: Matter and materials origination, synthesis technology and process technology
x	x	081: New materials from nanolevel structure control
x	x	082: Nano devices and sensors
x	x	085: Nanobiology [Nanotechnology and Materials field]
x	x	090: Nano-machining/ micromachining technology
x	x	092: Human and robot participation in manufacturing
x	x	097: Knowledge management
x		005: Information security
x		022: Car electronics
x		023: Network electronics
x		036: Personalized medicine
x		039: Application of IT to medicine
x		058: Space, ocean, and Earth technology for a safe and secure society
x		062: Hydrogen energy systems
x		095: Surface modification and interface control technology
	x	008: Ubiquitous networking
	x	015: Molecular and organic electronics
	x	026: Basic research for new medical technologies
	x	030: Regenerative medicine
	x	033: Information biology
	x	035: Nanobiology [Life Science field]
	x	083: NEMS technology
	x	084: Environment and energy materials

C = Current: Areas with current impacts in the top one third are marked with a "x". M = Medium-term: Areas with medium-term impacts in the top one third are marked with a "x".

B. Economic impacts

A combined 54 areas were extracted as having major impacts at the current time or in the medium term. Of these, 32 areas have major impacts during both periods. These areas were in the electronics, nanotechnology/materials, and manufacturing fields. In the medium term, impacts are expected in areas in the life science field and in areas that integrate other fields with life science.

Table 2-8: Areas with large economic impacts

C	M	Area
x	x	001: Very large scale information processing
x	x	005: Information security
x	x	011: Silicon electronics
x	x	012: Photonic devices
x	x	013: Wireless electronics
x	x	016: Storage
x	x	017: Displays
x	x	018: Energy conversion/storage devices
x	x	019: Digital home appliances
x	x	020: Ubiquitous electronics
x	x	021: Robot electronics
x	x	022: Car electronics
x	x	023: Network electronics
x	x	039: Application of IT to medicine
x	x	045: Biological solutions to environmental problems and achievement of a sustainable society
x	x	047: Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life
x	x	048: Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology
x	x	053: Space utilization technology—basic satellite technology—
x	x	059: Space, ocean, and Earth technology that drives science and technology innovation
x	x	062: Hydrogen energy systems
x	x	063: Fuel cells

C	M	Area
x	x	079: Nano processing, molding, and manufacturing technology
x	x	080: Matter and materials origination, synthesis technology and process technology
x	x	081: New materials from nanolevel structure control
x	x	087: Manufacturing technology utilizing advanced information technology
x	x	089: Manufacturing technology for high-value added products
x	x	090: Nano-machining/ micromachining technology
x	x	092: Human and robot participation in manufacturing
x	x	097: Knowledge management
x	x	101: Human resources management (relationship among education, competition, and cooperation)
x	x	102: Competition and cooperation in business
x	x	104: Environmental management
x		036: Personalized medicine
x		038: Recovery of biological functions focusing on QOL and support for it
x		043: Medicine and welfare for an aging society
x		067: Efficient energy conversion and use
x		088: Manufacturing technology using virtual design
x		091: Recycling-oriented manufacturing technology with a low environmental load
x		094: Advanced manufacturing technology for social infrastructure
x		095: Surface modification and interface control technology
x		103: Higher productivity in service industries and the services sector
x		109: Social infrastructure technology responsive to an aging society
x		116: New transport system technology
	x	008: Ubiquitous networking
	x	014: Bioelectronics
	x	024: Security electronics
	x	030: Regenerative medicine
	x	031: Monitoring and sensor technology for biological substances
	x	035: Nanobiology [Life Science field]
	x	078: Nano measurement and analysis technology
	x	082: Nano devices and sensors
	x	083: NEMS technology
	x	084: Environment and energy materials
	x	085: Nanobiology [Nanotechnology and Materials field]

C = Current: Areas with current impacts in the top one third are marked with a "x". M = Medium-term: Areas with medium-term impacts in the top one third are marked with a "x".

C. Social impacts

A combined 53 areas were extracted as having major impacts at the current time or in the medium term. Of these, 33 areas, 60 percent, have major impacts during both periods. Many of these areas are in the fields of electronics, health/medical care/welfare, environment, and social infrastructure.

Table 2-9: Areas with large social impacts

C	M	Area
x	x	005: Information security
x	x	013: Wireless electronics
x	x	017: Displays
x	x	018: Energy conversion/storage devices
x	x	019: Digital home appliances
x	x	020: Ubiquitous electronics
x	x	022: Car electronics
x	x	023: Network electronics
x	x	024: Security electronics
x	x	038: Recovery of biological functions focusing on QOL and support for it
x	x	041: Preventive medicine
x	x	042: Measures against emerging and reemerging infectious diseases
x	x	043: Medicine and welfare for an aging society
x	x	046: Development of production technology that harmonizes with ecosystems and improves the environment
x	x	047: Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life
x	x	054: Technology for high precise observation of Earth environments and for prediction of change
x	x	058: Space, ocean, and Earth technology for a safe and secure society
x	x	071: Urban environment
x	x	072: Focus on identification and mitigation of ecological effects (including soil and water)

C	M	Area
x	x	075: Environmental disasters
x	x	076: Water resources
x	x	091: Recycling-oriented manufacturing technology with a low environmental load
x	x	104: Environmental management
x	x	107: Improvement of structure performance
x	x	108: Revitalization, maintenance, and management of social infrastructure
x	x	109: Social infrastructure technology responsive to an aging society
x	x	110: Environmental technology in social infrastructure
x	x	111: Comprehensive water management technology
x	x	113: Security technology as social infrastructure
x	x	114: Disaster prevention technology
x	x	117: Traffic safety technology
x	x	118: Environmental management in the transport sector
x	x	121: Urban safety, security, and stability
x		011: Silicon electronics
x		036: Personalized medicine
x		037: Elucidation of biological defense mechanisms and therapeutic application
x		039: Application of IT to medicine
x		040: Human-centered medicine and construction of healthcare support systems
x		073: Environmental economic index
x		094: Advanced manufacturing technology for social infrastructure
x		112: Environmental measures appropriate to architectural scale
x		115: Total management of social infrastructure that includes public involvement
x		116: New transport system technology
	x	006: Information technology for developing social systems
	x	008: Ubiquitous networking
	x	021: Robot electronics
	x	029: Understanding and treating brain conditions
	x	030: Regenerative medicine
	x	034: Environmental and ecological biology
	x	070: Global environment (focus on global warming)
	x	085: Nanobiology [Nanotechnology and Materials field]
	x	086: Nanoscience for a safe and secure society
	x	123: Support for the elderly and the disabled

C = Current: Areas with current impacts in the top one third are marked with a "x". M = Medium-term: Areas with medium-term impacts in the top one third are marked with a "x".

(3) Change in impacts

Regarding increased intellectual assets, economic impacts, and social impacts, if we divide each of them into two subcategories and take those with high scores as representative values, in the majority of areas the representative value for increased intellectual assets is "contribution of the relevant area itself to increased intellectual assets," while for economic impacts it is "contribution to the creation of new industries or businesses." For social impacts, there are areas where the representative value is "contribution to safety and security" and areas where it is "contribution to improved social vitality and quality of life."

In the medium term, "contribution to the development of other fields" is the representative value for increased intellectual assets in a high percentage of areas, while "contribution to the creation of new industries or businesses" is the representative value for economic impacts in a high percentage of areas.

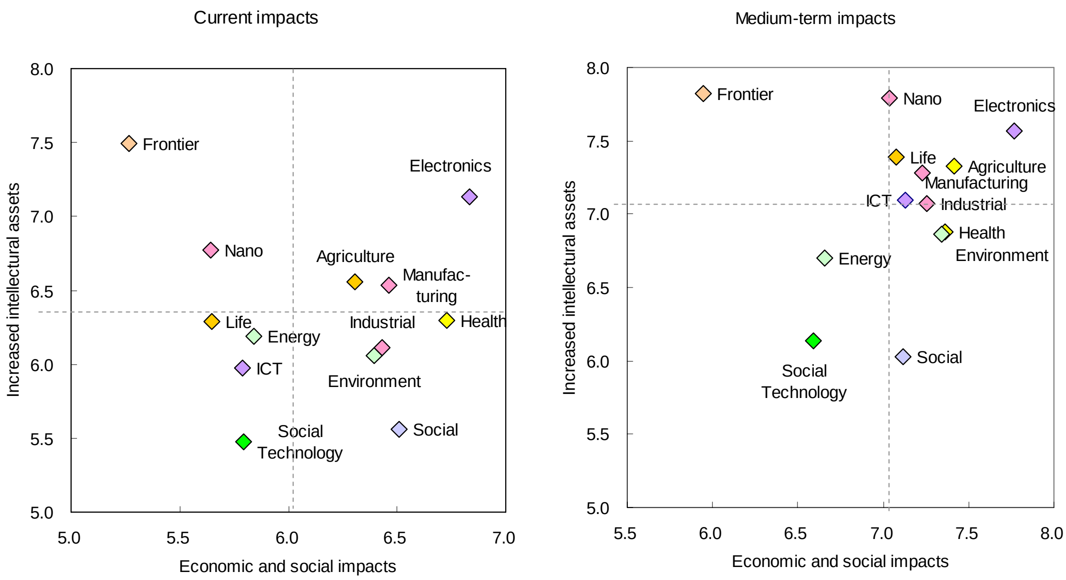
Table 2-10: Ratio of each subcategory becoming the representative value of the impact

Impact	Subcategory	Current	Medium-term
A. Increased intellectual assets	A-1. Relevant area	108 (83%)	99 (76%)
	A-2. Development of other fields	22 (17%)	31 (24%)
B. Economic impacts	B-1. Development of existing industry	43 (33%)	29 (22%)
	B-2. Creation of new industries	87 (67%)	101 (78%)
C. Social impacts	C-1. Safety and security	61 (47%)	62 (48%)
	C-2. Social vitality	69 (53%)	68 (52%)

The chart below shows the field averages for impacts. The horizontal axes are the average economic and social impacts. Currently, the fields of electronics; agriculture/forestry/fisheries/foods; and manufacturing exceed the all-area averages in economic and social impacts and in increased intellectual assets. In the medium term, the fields of information/communications, life science, and industrial infrastructure also exceed the average for all areas.

Table 2-11 shows the top 10 areas in growth (difference between index of medium-term impacts and index of current impacts) for each type of impact. The 5 areas of new principles for information and telecommunications, ultra-transparent communications (space sharing)/human interface (muscular strength support), ubiquitous networking, environmental and ecological biology, brain generation and growth, and nanoscience for a safe and secure society are in the top 10 for all three types of impacts. If nanobiology in the life science field and nanobiology in the nanotechnology/materials field are combined, it also makes the top 10 for all three impacts. Overall, the growth in economic and social impacts is large for areas related to life science, information and communications, and nanotechnology.

Figure2-11: Changes in increased intellectual assets and economic and social impacts



*Field abbreviations: ICT (information and communications), Life (life science), Health (health, medical care, and welfare), Agriculture (agriculture, forestry, fisheries, and foods), Energy (energy and resources), Nano (nanotechnology and materials), Industrial (industrial infrastructure), Social (social infrastructure)

*The dotted line is the average for all areas.

Table 2-11: Top 10 areas in impact growth

	A. Increased intellectual assets	Current	Medium-term
1	007: New principles for information and telecommunications	5.5	7.0
2	034: Environmental and ecological biology	5.4	7.0
3	096: Optimization of industrial infrastructure through regional dispersion and concentration	5.3	6.9
4	004: Ultra-transparent communications; human interface	5.3	6.8
5	009: Software technology for large-scale networks	5.7	7.0
6	008: Ubiquitous networking	6.2	7.6
7	035: Nanobiology [Life Science field]	6.5	7.8
8	027: Brain generation and growth	5.7	7.0
9	086: Nanoscience for a safe and secure society	5.6	6.9
10	077: Nanomaterials modeling simulation	5.8	7.0
	B. Economic impacts	Current	Medium-term
1	007: New principles for information and telecommunications	4.6	6.5
2	034: Environmental and ecological biology	5.3	7.1
3	004: Ultra-transparent communications; human interface	5.2	6.9

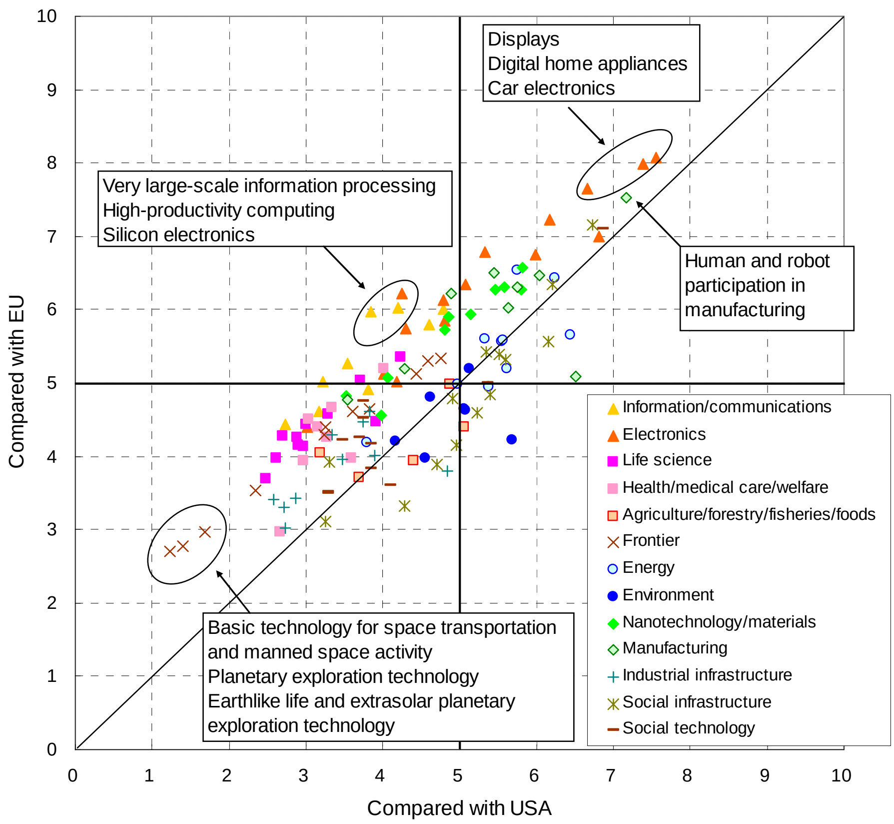
4	008: Ubiquitous networking	6.3	8.0
5	086: Nanoscience for a safe and secure society	5.4	7.1
6	010: Integrated systems	5.4	7.0
7	015: Molecular and organic electronics	5.8	7.4
8	035: Nanobiology [Life Science field]	6.3	7.9
9	033: Information biology	6.0	7.5
10	027: Brain generation and growth	4.6	6.1
	C. Social impacts	Current	Medium-term
1	086: Nanoscience for a safe and secure society	6.0	7.9
2	004: Ultra-transparent communications; human interface	5.1	7.0
3	034: Environmental and ecological biology	5.9	7.7
4	010: Integrated systems	4.5	6.3
5	008: Ubiquitous networking	5.9	7.7
6	007: New principles for information and telecommunications	4.4	6.1
7	085: Nanobiology [Nanotechnology/materials field]	6.2	7.9
8	027: Brain generation and growth	5.1	6.7
9	014: Bioelectronics	5.9	7.5
10	015: Molecular and organic electronics	5.0	6.5

2.2.2. R&D level

(1) Current R&D level

Looking at the current level of Japanese R&D, areas in which Japan leads the EU or leads both the EU and the USA are prominent in the electronics and nanotechnology/materials fields. On the other hand, Japan trails the EU and the USA in many areas in the life science field.

Figure 2-12 : Current R&D levels vis-à-vis the USA and the EU



There are 35 areas in which Japan's level is at least equal to (5 points) that of the USA and the EU. The largest number are found in the electronics field (7 areas) and the energy/resources field (7 areas), followed by the fields of manufacturing (6 areas), social infrastructure (6 areas), and nanotechnology/ materials (5 areas). These areas in the energy/resources and manufacturing fields account for almost 70 percent of all areas in those fields. There are no such areas in the fields of life science; health/medical care/welfare; agriculture/forestry/fisheries/foods; frontier; and industrial infrastructure fields.

Table2-12: Areas in which Japan is at least equal (5 points or more) to the level of the USA and the EU

Area	5 years ago*	Delphi field**
012: Optical and photonic devices	x	ICT
016: Storage	x	Electronics
017: Displays	x	Electronics
018: Energy conversion/storage devices	x	Electronics
019: Digital home appliances	x	Electronics
020: Ubiquitous electronics		Electronics
021: Robot electronics	x	Electronics
022: Car electronics	x	Electronics
062: Hydrogen energy systems		Energy
063: Fuel cells		Energy
064: Decentralized energy systems	x	Energy
065: Renewable energy		Energy
066: Clean-coal technology	x	Energy
067: Efficient energy conversion and use	x	Energy
069: Recycling system (including biomass and waste)	x	Energy
076: Water resources		Environment
078: Nano measurement and analysis technology		Nano/Materials
079: Nano processing, molding, and manufacturing technology	x	Nano/ Materials
080: Matter and materials origination, synthesis technology and process technology	x	Nano/Materials
081: New materials from nanolevel structure control	x	Nano/Materials
084: Environment and energy materials	x	Nano/Materials
089: Manufacturing technology for high-value added products	x	Manufacturing
090: Nano-machining/ micromachining technology	x	Manufacturing
091: Recycling-oriented manufacturing technology with a low environmental load		Manufacturing
092: Human and robot participation in manufacturing	x	Manufacturing
094: Advanced manufacturing technology for social infrastructure	x	Manufacturing
095: Surface modification and interface control technology	x	Manufacturing
107: Improvement of structure performance	x	Social Infrastructure
108: Revitalization, maintenance, and management of social infrastructure		Social Infrastructure
114: Disaster prevention technology	x	Social Infrastructure
116: New transport system technology	x	Social Infrastructure
117: Traffic safety technology		Social Infrastructure
118: Environmental management in the transport sector	x	Social Infrastructure
127: Handing down and preserving culture and technology		Social Technology
129: Entertainment technology	x	Social Technology

* Areas that were at least equal to the USA and the EU five years ago are marked with a "x".
**Field abbreviations: ICT (information/communications), Energy (energy/resources), Nano/materials (nanotechnology/ materials)

(2) Changes in R&D level

Levels vis-à-vis the USA and the EU rose in every field. Five years ago, Japan was roughly equal or ahead in the three fields of electronics, energy/resources, and manufacturing. This time, it has added the fields of nanotechnology/materials, social infrastructure, and environment as well. Fields with significant improvements from five years ago are information/communications (compared to the USA), life science (compared to the EU), agriculture/forestry/fisheries/foods (compared to the USA and the EU), energy/ resources (compared to the USA and the EU), and environment (compared to the USA).

Almost all areas have improved compared to the technological R&D levels of the USA and the EU. Areas with major improvements are ubiquitous networking (compared to the USA), fuel cells (compared to both the USA and the EU), application of IT to medical care (compared to the USA), basic research for new medical technologies (compared to the EU), and hydrogen energy systems (compared to the USA). Japan's relative level declined in 9 areas, including silicon electronics (compared to both the USA and the EU), basic technology for space transportation and manned space activity (compared to the EU), and planetary exploration technology (compared to the EU).

Compared to Asian levels, Japan is ahead but the lead is shrinking in areas such as those related to electronics. Leads shrunk in 83 areas. Areas with major reductions in lead size are basic technology for space transportation and manned space activity, silicon electronics, displays, planetary exploration technology, and integrated systems.

Figure 2-13: Comparisons with the current USA R&D level and that of 5 years ago

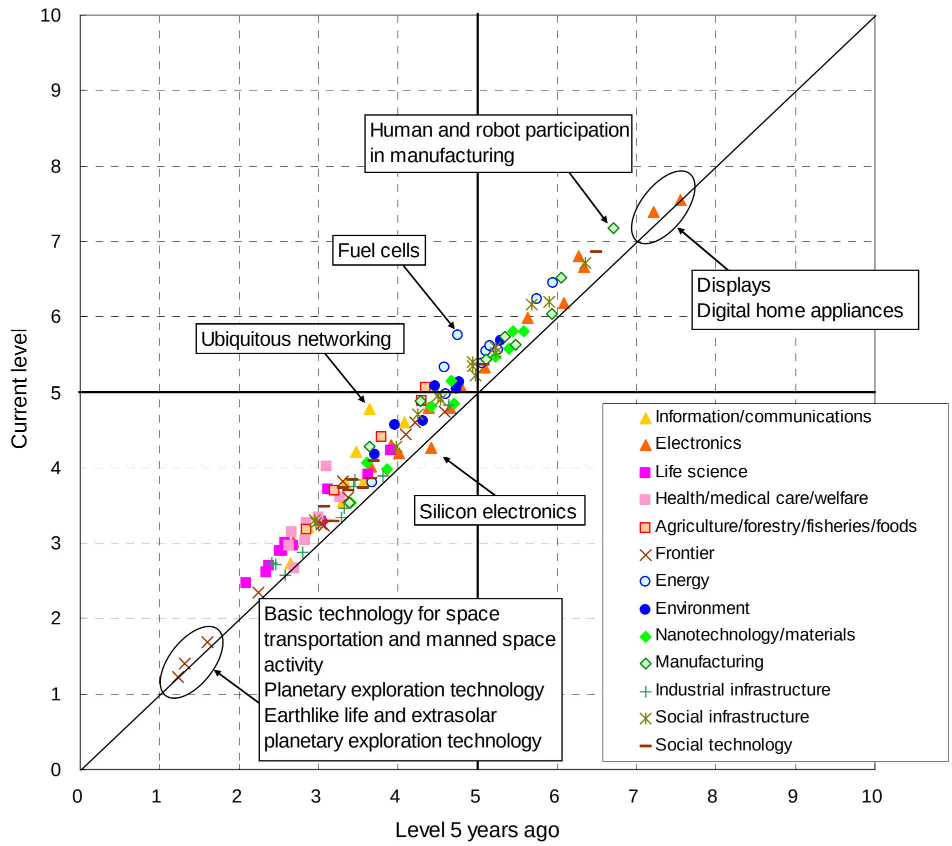


Table 2-13: Areas with large changes in level

A. Areas with major increases in level vis-à-vis the USA or the EU (areas with an increase of at least 0.5 points)

Area	Current level USA*	Current level EU*	Growth USA*	Growth EU*	Delphi field**
008: Ubiquitous networking	4.8	6.0	1.1	0.6	Electronics
063: Fuel cells	5.8	6.5	1.0	1.0	Energy
039: Application of IT to medical care	4.0	5.2	0.9	0.6	Health
062: Hydrogen energy systems	5.3	5.6	0.7	0.7	Energy
001: Very large scale information processing	4.2	6.0	0.7	0.5	ICT
046: Development of production technology that harmonizes with ecosystems and improves the environment	5.1	4.4	0.7	0.5	Agriculture
088: Manufacturing technology based on virtual design	4.3	5.2	0.6	0.5	Manufacturing
070: Global environment	5.1	4.6	0.6	0.4	Environment

Area	Current level USA*	Current level EU*	Growth USA*	Growth EU*	Delphi field**
045: Biological solutions to environmental problems and achievement of a recycling-oriented society	4.4	3.9	0.6	0.4	Agriculture
087: Manufacturing technology utilizing advanced information technology	4.9	6.2	0.6	0.4	Manufacturing
073: Environmental economic indicators	4.6	4.0	0.6	0.4	Environment
031: Monitoring and sensor technology for biological substances	3.7	5.0	0.6	0.5	Life science
047: Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life	4.9	5.0	0.6	0.5	Agriculture
022: Car electronics	6.8	7.0	0.5	0.3	Electronics
004: Ultra-transparent communications ; human interface	4.6	5.8	0.5	0.3	ICT
054: Technology for high precise observation of Earth environments and prediction of change	3.8	4.6	0.5	0.2	Frontier
026: Basic research for new medical technologies	2.7	4.3	0.3	0.8	Health
036: Personalized medicine	3.2	4.4	0.5	0.5	Health
033: Information biology	2.6	4.0	0.3	0.5	Health

* USA: compared to the USA, EU: compared to the EU

** Field abbreviations: ICT (information and communications), Health (health, medical care, and welfare), Agriculture (agriculture, forestry, fisheries, and foods), Energy (energy and resources)

B. Areas with major decreases in level vis-à-vis Asia (areas with a decrease of at least 0.5 points)

Area	Current level	Decline	Delphi field**
052: Basic technology for space transportation and manned space activity	5.9	-1.4	Frontier
011: Silicon electronics	7.6	-1.1	Electronics
017: Displays	7.8	-1.1	Electronics
049: Planetary exploration technology	7.4	-0.8	Frontier
010: Integrated systems	8.2	-0.6	Electronics
025: Basic research in drug development	8.1	-0.5	Life Science

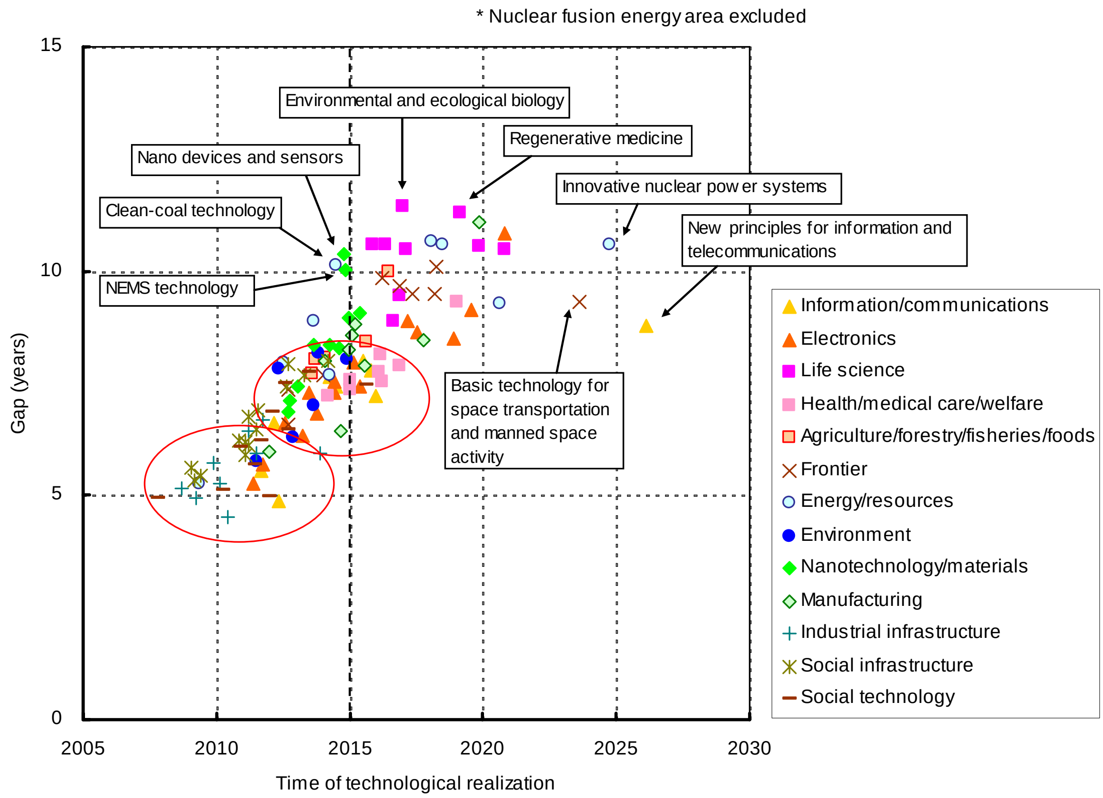
2.2.3. Forecast time of realization and government involvement (reference)

Utilizing the results for the topics, we examined forecast times of technological realization/ social application and necessity of government involvement for areas. We took the average values for forecast times of realization/application, necessity of government involvement (index), and effective measures that should be taken by government (ratio) for the topics within an area as the area's value.

(1) Time of technological realization and period until social application

Technological realization for 70 percent of the 130 areas is predicted to be accomplished by 2015. Fields in which the forecast times of technological realization for all areas are no later than 2015 are nanotechnology/materials, social infrastructure, and social technology. In the fields of information/ communications; agriculture/forestry/fisheries/foods; environment; manufacturing; and industrial infrastructure as well, technological realization is predicted for almost all areas by 2015. However, the information and communications field has both early and late areas. On the other hand, realization in the life science field is predicted for 2016 or later for all but one area.

Figure 2-14: Periods between technological realization and social application



The table below shows areas for which technological realization is early and areas for which it is late. Many of the early areas are in the industrial infrastructure field, while many of the late areas are in the energy/resources and life science fields.

Looking at the periods from technological realization to social application, many areas are expected to take six to eight years. Areas for which technological realization is late tend to have long periods until social application. Areas predicted for technological realization by 2015 can be roughly divided between those taking about five more years until social application and those taking about seven to eight years. In the fields of life science and energy/resources, almost all areas require more than nine years until social application. In order, the areas with the longest periods from technological realization to social application are environmental and ecological biology area (11.4 years), regenerative medicine area (11.3 years), manufacturing technology in special environments area (11.1 years), molecular and organic electronics area (10.8 years), and resource assessment area (10.7 years). Technological realization for those areas is 2015 or later, so there is an element of uncertainty as to whether their technological realization will be accomplished at all.

Table 2-14: Areas with early or late technological realization

Areas with early technological realization

	Area	Year T*	Year S*	Delphi field
1	122: Universal availability of services	2007	2012	Social Technology
2	102: Competition and cooperation in business	2008	2013	Industrial Infrastructure
3	115: Total management of social infrastructure that includes public involvement	2009	2014	Social Infrastructure
4	113: Security technology as social infrastructure	2009	2014	Social Infrastructure
5	103: Higher productivity in service industries and the services sector	2009	2014	Industrial Infrastructure
6	069: Recycling system (including biomass and waste)	2009	2014	Energy/Resources
7	112: Environmental measures appropriate to architectural scale	2009	2014	Social Infrastructure

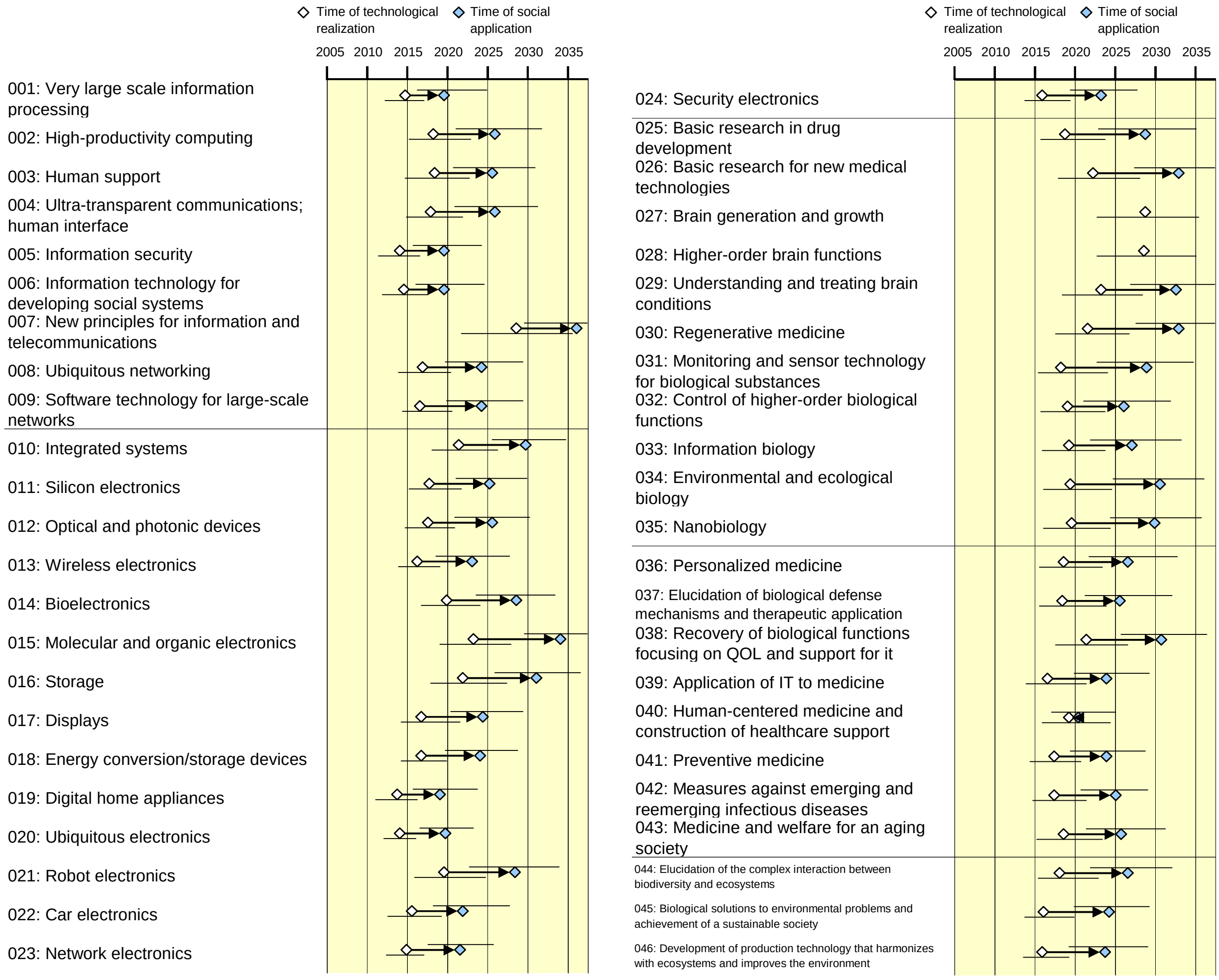
	Area	Year T*	Year S*	Delphi field
8	104: Environmental management	2009	2014	Industrial Infrastructure
9	097: Knowledge management	2010	2014	Industrial Infrastructure
10	126: Technology that supports education and learning	2010	2015	Social Technology

Areas with late technological realization

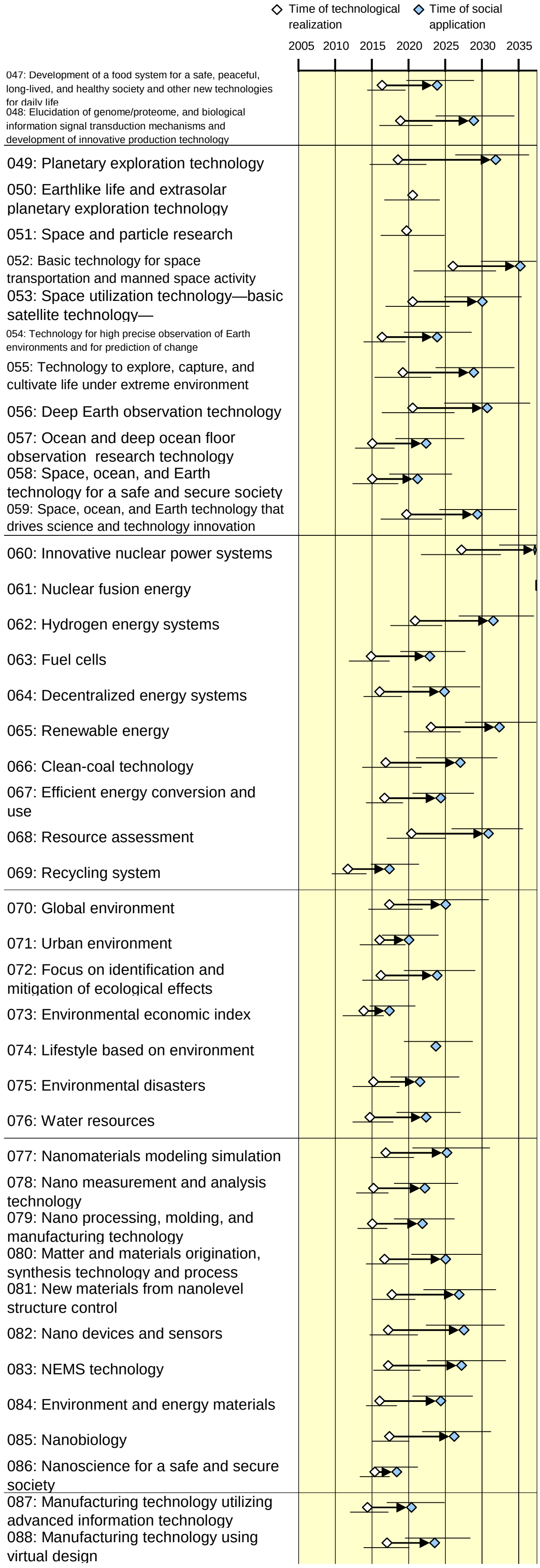
	Area	Year T*	Year S*	Delphi field
1	061: Nuclear fusion energy	2036-	2036-	Energy/Resources
2	027: Brain generation and growth	2026	—	Life Science
3	007: New principles for information and telecommunications	2026	2033	Information/Communications
4	028: Higher-order brain functions	2026	—	Life Science
5	060: Innovative nuclear power systems	2024	2035	Energy/Resources
6	052: Basic technology for space transportation and manned space activity	2023	2032	Frontier
7	029: Understanding and treating brain conditions	2020	2030	Life Science
8	015: Molecular and organic electronics	2020	2031	Electronics
9	065: Renewable energy	2020	2029	Energy/Resources
10	026: Basic research for new medical technologies	2019	2030	Life Science

*Year T: time of technological realization　　Year S: time of social application
Times of technological realization and social application are averages for the topics in each area.

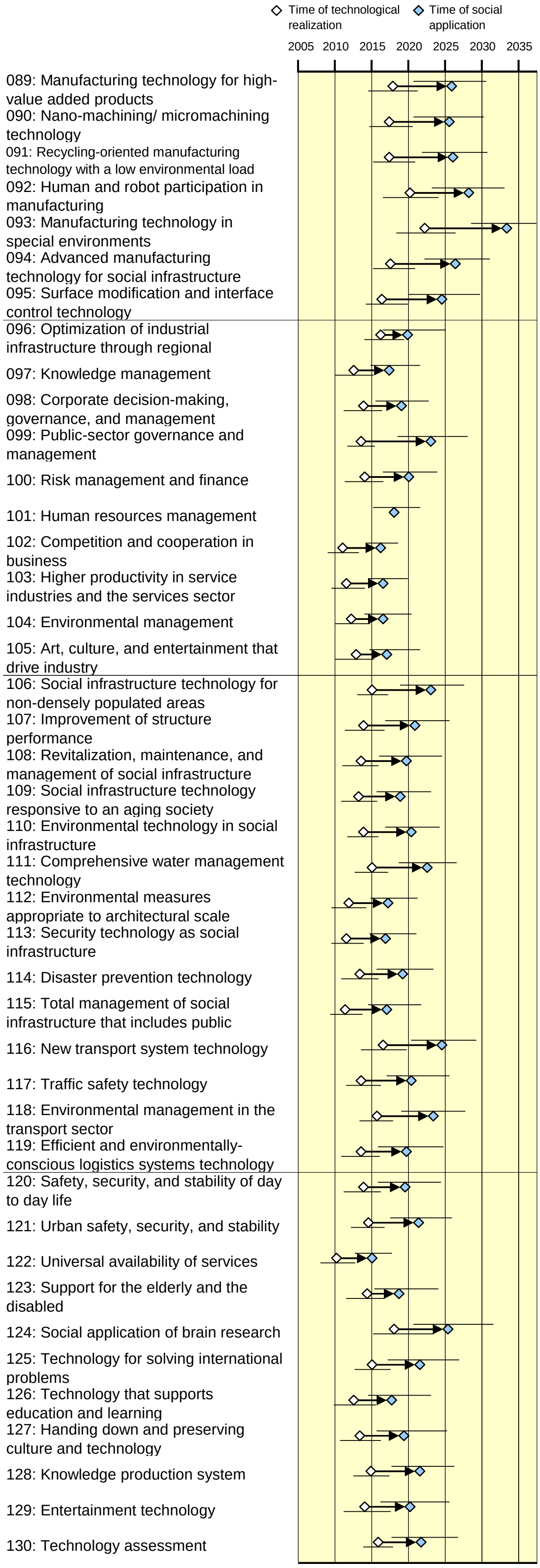
Figure 2-15: Times of technological realization and social application for each area



1. The "◊" represents the median (Q2) of the forecast time of realization, while the line above or below it represents the range (Q1–Q3) of answers. (See section 1.3 (5))
2. The time of social application for innovative nuclear power systems (060) and the times of technological realization and social application for nuclear fusion energy are after 2036 and thus are not depicted in the chart.



Time of technological realization
Time of social application
2005 2010 2015 2020 2025 2030 2035
047: Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life
048: Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology
049: Planetary exploration technology
050: Earthlike life and extrasolar planetary exploration technology
051: Space and particle research
052: Basic technology for space transportation and manned space activity
053: Space utilization technology—basic satellite technology—
054: Technology for high precise observation of Earth environments and for prediction of change
055: Technology to explore, capture, and cultivate life under extreme environment
056: Deep Earth observation technology
057: Ocean and deep ocean floor observation research technology
058: Space, ocean, and Earth technology for a safe and secure society
059: Space, ocean, and Earth technology that drives science and technology innovation
060: Innovative nuclear power systems
061: Nuclear fusion energy
062: Hydrogen energy systems
063: Fuel cells
064: Decentralized energy systems
065: Renewable energy
066: Clean-coal technology
067: Efficient energy conversion and use
068: Resource assessment
069: Recycling system
070: Global environment
071: Urban environment
072: Focus on identification and mitigation of ecological effects
073: Environmental economic index
074: Lifestyle based on environment
075: Environmental disasters
076: Water resources
077: Nanomaterials modeling simulation
078: Nano measurement and analysis technology
079: Nano processing, molding, and manufacturing technology
080: Matter and materials origination, synthesis technology and process
081: New materials from nanolevel structure control
082: Nano devices and sensors
083: NEMS technology
084: Environment and energy materials
085: Nanobiology
086: Nanoscience for a safe and secure society
087: Manufacturing technology utilizing advanced information technology
088: Manufacturing technology using virtual design



Time of technological realization
Time of social application
2005 2010 2015 2020 2025 2030 2035
089: Manufacturing technology for high-value added products
090: Nano-machining/ micromachining technology
091: Recycling-oriented manufacturing technology with a low environmental load
092: Human and robot participation in manufacturing
093: Manufacturing technology in special environments
094: Advanced manufacturing technology for social infrastructure
095: Surface modification and interface control technology
096: Optimization of industrial infrastructure through regional
097: Knowledge management
098: Corporate decision-making, governance, and management
099: Public-sector governance and management
100: Risk management and finance
101: Human resources management
102: Competition and cooperation in business
103: Higher productivity in service industries and the services sector
104: Environmental management
105: Art, culture, and entertainment that drive industry
106: Social infrastructure technology for non-densely populated areas
107: Improvement of structure performance
108: Revitalization, maintenance, and management of social infrastructure
109: Social infrastructure technology responsive to an aging society
110: Environmental technology in social infrastructure
111: Comprehensive water management technology
112: Environmental measures appropriate to architectural scale
113: Security technology as social infrastructure
114: Disaster prevention technology
115: Total management of social infrastructure that includes public
116: New transport system technology
117: Traffic safety technology
118: Environmental management in the transport sector
119: Efficient and environmentally-conscious logistics systems technology
120: Safety, security, and stability of day to day life
121: Urban safety, security, and stability
122: Universal availability of services
123: Support for the elderly and the disabled
124: Social application of brain research
125: Technology for solving international problems
126: Technology that supports education and learning
127: Handing down and preserving culture and technology
128: Knowledge production system
129: Entertainment technology
130: Technology assessment

(2) Necessity of government involvement and effective measures

It is apparent that areas with a high necessity of government involvement towards technological realization are those requiring enormous expenses for large-scale facilities and equipment and those responding to matters that affect the public without their choice, such as disasters and environmental issues. Areas with a low necessity of government involvement are those where private-sector corporations lead the way, such as those related to information and communications and corporate management.

As effective measures that should be taken by government for technological realization, first comes expansion of R&D funding, followed by strengthened industry-academia-government and interdisciplinary collaboration, human resources development, and development of R&D infrastructure.

Categorizing areas by measures for which the percentage of responses was 50 percent or more, 8 areas had three effective measures, 74 had two, and 42 had one. Of those with three measures, areas that integrate or collaborate on life science and electronics, such as bioelectronics and monitoring and sensor technology for biological substances, require expansion of R&D funding, human resources development, and strengthened industry-academia-government and interdisciplinary collaboration. Areas in the frontier field require expansion of R&D funding, human resources development, and development of R&D infrastructure. Of areas with two effective measures, those with human resources development and expansion of R&D funding include almost every area in the life science and frontier fields. Many of the areas with strengthened industry-academia-government and interdisciplinary collaboration and expansion of R&D funding as effective measures are found in the fields of electronics, energy/resources, nanotechnology/ materials, manufacturing, and social infrastructure. Of the areas with one measure, those with expansion of R&D funding include almost every area in information/communications. Many of the areas for which human resources development are seen as the effective measure are those integrating sciences and the humanities, such as risk management/ finance and technology assessment, while many of those for which strengthened industry-academia-government and interdisciplinary collaboration is effective are related to the solving of social problems such as population decline, aging, response to urban environmental issues, and so on.

Scattered among areas with a high necessity of government involvement towards social application are those oriented towards securing safety and those related to the environment.

As effective measures that should be taken by government, strengthened industry-academic-government and interdisciplinary collaboration has the highest ratio, followed by support through taxation, subsidies, and procurement and human resources development. Compared with measures towards technological realization, the ratios for relaxation or elimination of relevant regulations and tightened or new regulations are higher.

Categorizing areas by measures for which the ratio was 50 percent or more, 3 areas have three effective measures, 56 have two measures, and 61 have one measure. Compared with the measures for technological realization, effective measures for social application tend to be more specialized.

Areas for which three measures (strengthened industry-academia-government and interdisciplinary collaboration; support through taxation, subsidies, and procurement; human resources development) are effective are in medical science that responds to issues that are major social problems (measures against emerging and reemerging infectious diseases and social application of brain research). Among areas for which two measures are effective, areas in the electronics, manufacturing, and social infrastructure fields stand out as common among those where strengthened industry-academia-government and interdisciplinary collaboration and support through taxation, subsidies and procurement are effective. Areas where strengthened industry-academia-government and interdisciplinary collaboration and human resources development are effective are found mainly in the life science and frontier fields. Of areas where one measure is effective, strengthened industry-academia-government and interdisciplinary collaboration is often found in the nanotechnology/materials field. Support through taxation, subsidies and procurement is seen as effective in areas in the energy/resources and social infrastructure fields. Many of the areas for which human resources development are effective are those that integrate sciences and humanities (risk management/finance, total management of social infrastructure that includes public involvement, technology assessment, etc.). Relaxation or elimination of relevant regulations is seen as effective mainly in industry-related areas such as car electronics, while tightened or new regulations is effective for environment-related areas such as urban environment.

Table 2-15: Areas with a high necessity of government involvement

	Towards technological realization	Towards social application
1	Space, ocean, and Earth technology for a safe and secure society	Space, ocean, and Earth technology for a safe and secure society
2	Planetary exploration technology	Lifestyle based on environment
3	Nuclear fusion energy	Nuclear fusion energy
4	Space utilization technology —basic satellite technology—	Disaster prevention technology
5	Public-sector governance and management	Space utilization technology—basic satellite technology—
6	Space and particle research	Urban environment
7	Global environment	Global environment
8	Technology for high precise observation of Earth environments and for prediction of change	Environmental disasters
9	Environmental disasters	Innovative nuclear power systems
10	Basic technology for space transportation and manned space activity	Technology for high precise observation of Earth environments and for prediction of change

2.3. Overview of areas

In this section, we select one or two areas from each field to provide an overview of its characteristics. The 28 areas below are used. The following categories are shown in this order for each area.

(1) The area's path of development
(2) Current and medium-term impacts, along with the Japanese R&D level
(3) Times of technological realization / social application for the topics included in the area
Time of technological realization ("◊" in the chart) and the range of responses (the line below the "◊")
Time of social application ("♦" in the chart) and the range of responses (the line above the "♦")
*Times of realization and response ranges for topics with forecast times after 2036 are not depicted.
(4) Necessity of government involvement (average value for included topics)
Necessity of government involvement towards technological realization (bar graph) and effective measures (radar chart)
Necessity of government involvement towards social application (bar graph) and effective measures (radar chart)

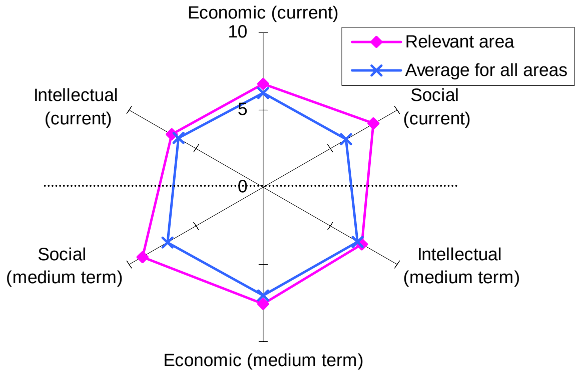
Abbreviations for measures: HR (Human resources development), Collaboration (Strengthened industry-academia-government and interdisciplinary collaboration), Infrastructure (Development of R&D infrastructure), Funding (Expansion of R&D funding), Internationalization (Internationalization of R&D activities), Business startups (Improvement of environment for business startups), Procurement (Support through taxation, subsidies, and procurement), Relaxed reg. (Relaxation or elimination of relevant regulations), Tightened reg. (Tightened or new regulations)

Delphi field	Total areas	Areas depicted
Information/ Communications	9	Information security Ubiquitous networking
Electronics	15	Silicon electronics Optical and photonic devices
Life Science	11	Regenerative medicine Monitoring and sensor technology for biological substances Nanobiology
Health/Medical care/Welfare	8	Personalized medicine Measures against emerging and reemerging infectious diseases
Agriculture/Forestry /Fisheries/Foods	5	Elucidation of the complex interaction between biodiversity and ecosystems Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology
Frontier	11	Space utilization technology—basic satellite technology— Deep Earth observation technology
Energy/Resources	10	Hydrogen energy systems Resource assessment
Environment	7	Focus on identification and mitigation of ecological effects (including soil and water) Water resources
Nanotechnology/ Materials	10	Nano measurement and analysis technology New materials from nanolevel structure control Nanobiology
Manufacturing	9	Manufacturing technology for high-value added products Human and robot participation in manufacturing
Industrial Infrastructure	10	Knowledge management Risk management and finance
Social Infrastructure	14	Social infrastructure technology responsive to an aging society Disaster prevention technology
Social Technology	11	Safety, security, and stability of day to day life Social application of brain research

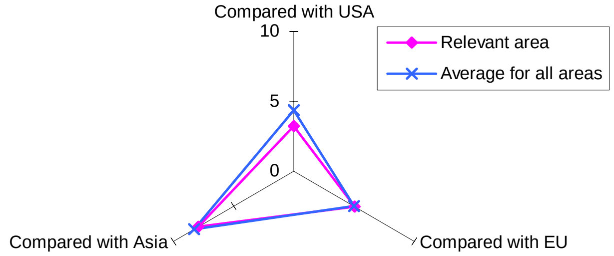
5 Information security

In information security, it is noteworthy that Japan's research level is behind that of the USA. It is substantially ahead of that of Asia, and roughly equal with that of the EU. Regarding impacts, expectations for social impacts are high. Time of technical realization is relatively early, with improved security for existing social infrastructure, such as a spam-free e-mail system and the capability to trace the origin of Internet communications, anticipated first. Subsequently, following achievement of precision individual recognition and improved security levels, development of crime and disaster prevention for public spaces, earthquake detection, and other systems related to safety and security are conceivable.

Expected impacts



Japan's R&D level



Realization timeline

39 Technology to detect intrusions and viruses on the Internet backbone.

40 Capability of tracing back the source address of suspect packet in the Internet to detect intrusions.

41 A spam-free e-mail system.

37 Cyber-policing technology to automatically monitor online illegal acts associated with the copyright of multimedia software, privacy protection, etc.

36 A highly reliable network system capable of protecting the privacy and secrecy of individuals and groups from intrusion by malicious hackers.

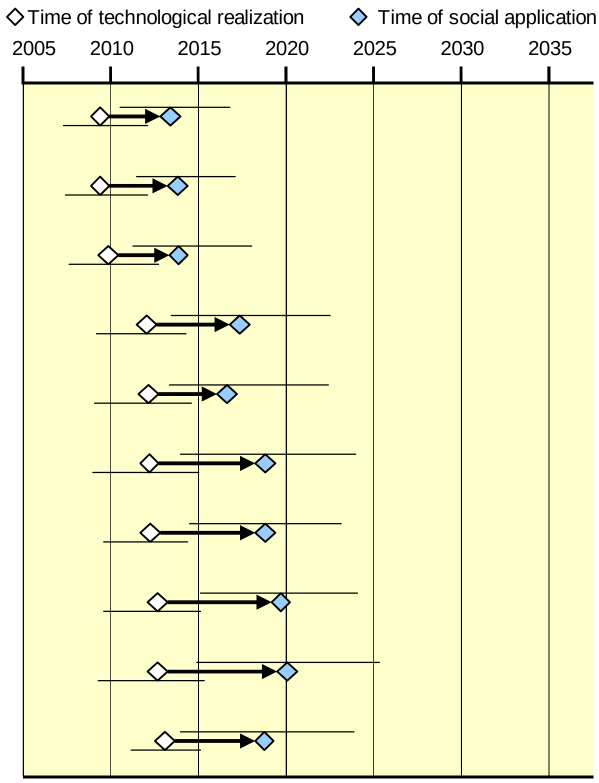
38 A security system capable of identifying individuals through facial and vocal recognition at an accuracy of 99.9% or higher.

33 Theory for designing the stringency of a system's security and privacy protection (theory for the quantitative evaluation of security stringency based on the system's components, architecture, and environmental conditions or for the estimation of security limitations; theory for defining the architecture and environmental conditions that facilitate such evaluations and estimations).

34 Technology that helps to locate wanted criminals and material witnesses by analyzing the facial features, behavior, looks, and voice of people captured by surveillance cameras set in public spaces.

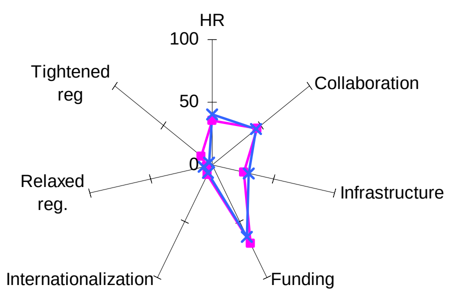
35 Generalized technology, extended from total building management systems and home security systems, which is coupled with seismic detection systems so that the safety of human life can be ensured before seismic waves arrive, in an earthquake whose epicenter is distant.

42 A publicly available algorithm with theoretically proven safety concerning the prevention of digital watermark removal.

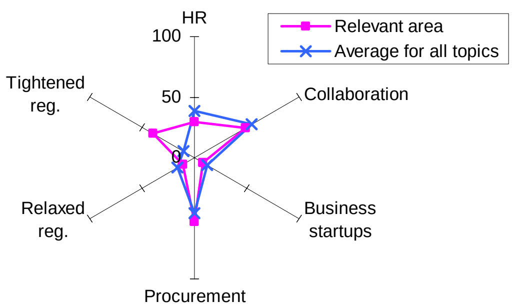


Government involvement

Effective measures for technological realization



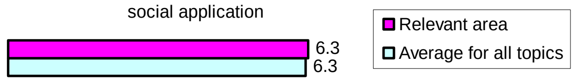
Effective measures for social application



Necessity of government involvement towards technological realization is roughly equivalent to the overall average. For social application, a strong necessity for involvement through tightened regulation is indicated.

Necessity of government involvement towards technological realization

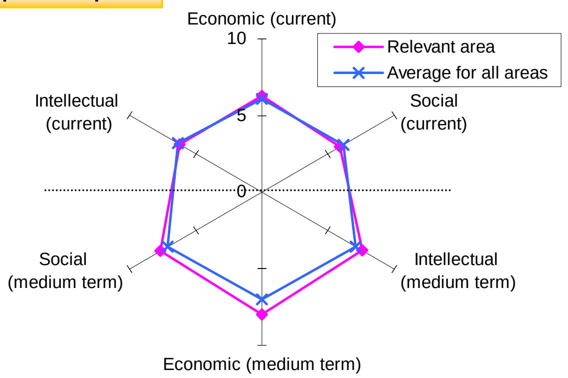
Necessity of government involvement towards social application



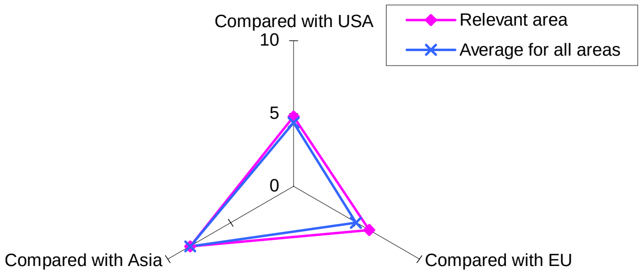
8 Ubiquitous networking

Looking at the progress of typical technologies in this area, first, the realization of improved convenience through technologies related to communications and networks is advancing. Second, elemental technology to control sensors and systems may enable the realization of complex systems involving cooperation among multiple microrobots, followed by the development of the fusion of systems with living organisms.
Hopes are high for expected impacts in the medium term (after 2015) in relation to increased intellectual assets, economic impacts, and social impacts. The R&D level in Japan has improved over the last five years relative to the USA and Europe and is now nearly equal to them.

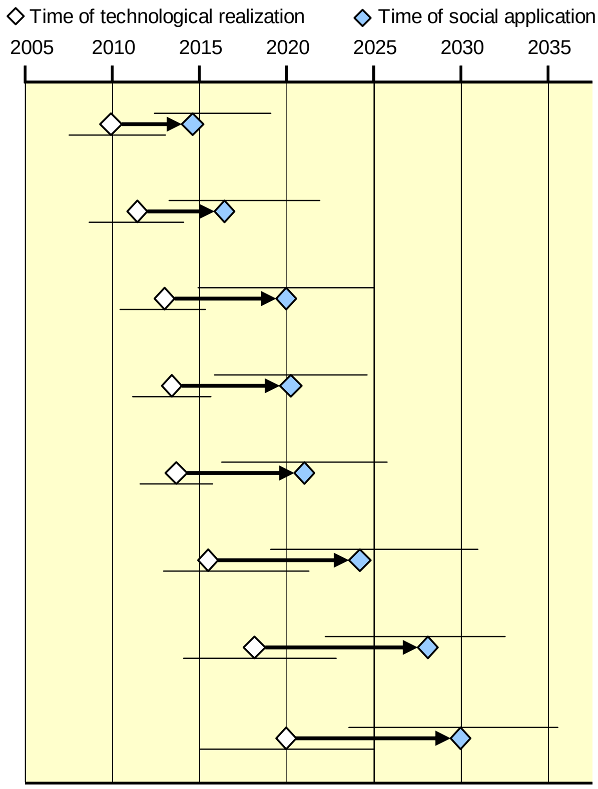
Expected impacts



Japan's R&D level



Realization timeline



67 A system to allow ad hoc communication between wireless information terminals within a certain range (with capability to seamlessly access the Internet, including applications)

61 An administration system for networks with about 1,000 users that can automatically connect terminals and operate networks with no need for a network administrator

62 Technology that allows objects to recognize mutual presence, nature, and condition so that they can automatically avoid dangerous situations and work in a coordinated manner

64 A micro communications chip or sensor that can run semi-permanently, powered by heat, light, radio waves, or noise

68 Technology to manage the identity (ID) of an infinite number of constantly emerging or disappearing objects, organize the definition and information of each ID assigned, and automatically remove obsolete data

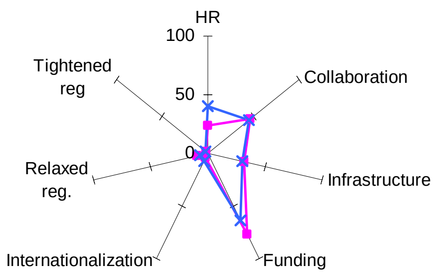
63 Technology to allow many small single-function (small-scale function) robots to cooperate and share tasks to achieve more complex functionality

65 A medical chip that can be embedded in the human body and run semi-permanently powered by bioenergy sources such as body heat or blood flow, providing vital function support such as health condition monitoring and heart pacemakers

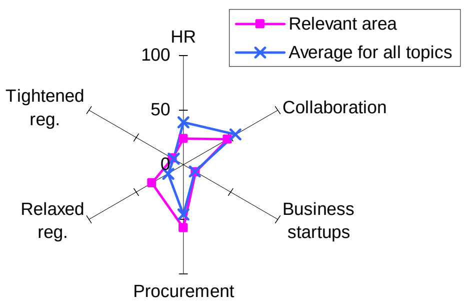
66 Medical technology based on nanochips and microsensors that have external communications and control capabilities and can be embedded in the human body or move through blood vessels

Government involvement

Effective measures for technological realization



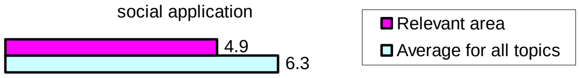
Effective measures for social application



Human resource and Funding are emphasized in technological realization. The need to develop multifaceted policies, including Human resources, Procurement, and Relaxed regulations stand outs out as a characteristic related to social application. For example, it includes Relaxed regulations on the use of radiowaves.

Necessity of government involvement towards technological realization

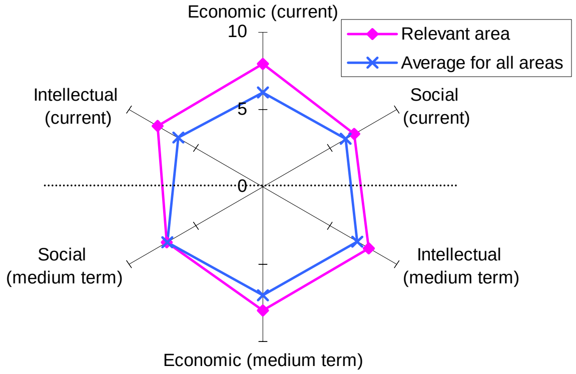
Necessity of government involvement towards social application



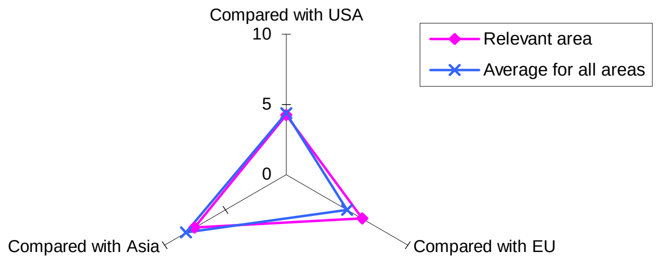
11 Silicon electronics

Devices that utilize silicon are expected to remain in the mainstream for some time. Expectations are high for all three types of impacts, with economic impacts making an especially strong appearance. Although slightly behind the USA, Japan can be called a leader in the field. The technological topics listed are relatively difficult research problems whose realization is expected in 2010 or later. First, categories that present a roadmap for the extension of current semiconductor manufacturing, such as the realization of nonvolatile LSI, semiconductor plants with reduced capital investment, and microprocessors with clock frequencies of 50 GHz or above, will be achieved, followed by self-repairing LSI, LSI utilizing optical interconnect, and so on. LSI using high-temperature superconducting material is considered difficult, so the time of realization is far off.

Expected impacts



Japan's R&D level



Realization timeline

11 An LSI operating based on nonvolatile logic.

13 A small-scale semiconductor fabrication plant that supports high-mix, low-volume production and allows a two orders of magnitude reduction in capital investment from the current levels.

6 A 100M-gate LSI whose logical function changes in real time.

5 A microprocessor LSI with a clock frequency of 50 GHz or higher.

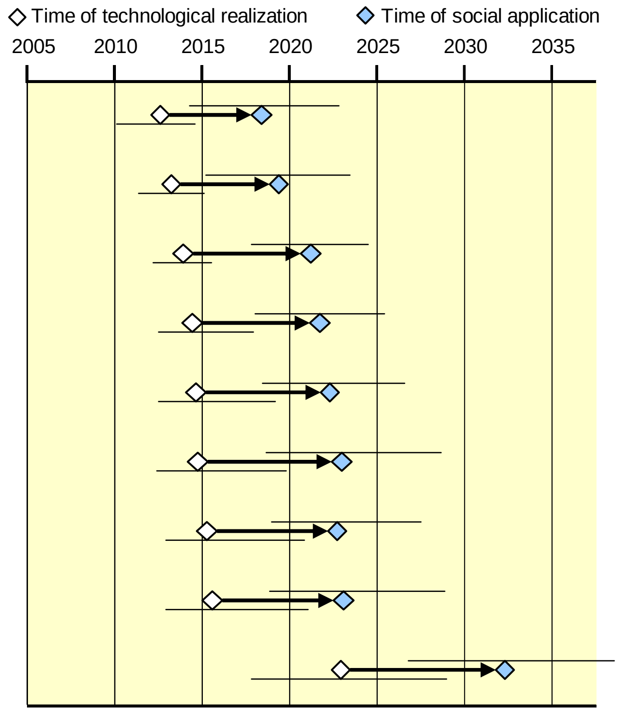
12 A fault-tolerant logic LSI with self-repair capability.

10 An LSI with on-chip optical interconnect.

8 An LSI chip with a storage capacity of 256 gigabits or larger.

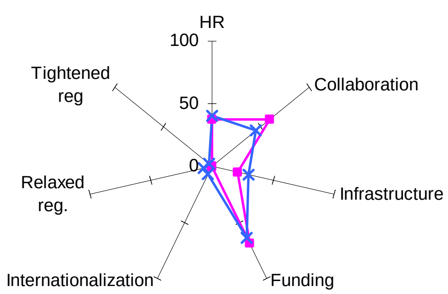
7 An LSI containing transistors with a gate length of 3 nm.

9 An LSI using high-temperature superconductivity material for wiring.

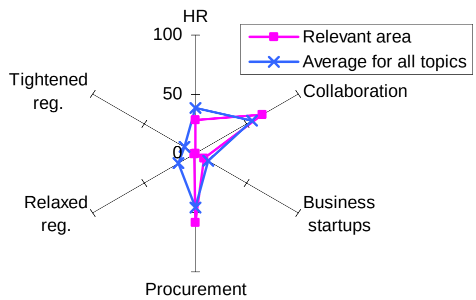


Government involvement

Effective measures for technological realization



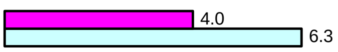
Effective measures for social application

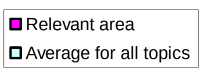


Although industry leads technological evolution in this area, Collaboration with universities and so on is needed for new design theories. Government involvement in Infrastructure is seen as somewhat important, while Human resources are important for social realization.

Necessity of government involvement towards technological realization

Necessity of government involvement towards social application

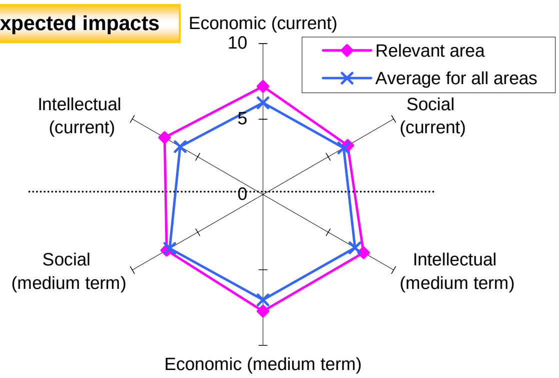




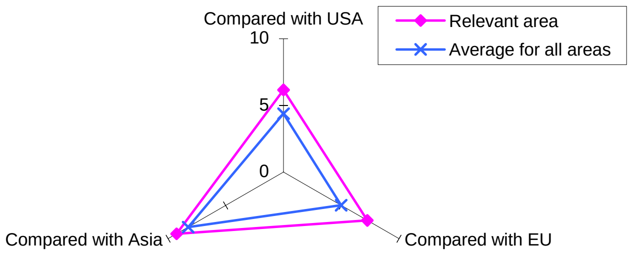
12 Optical and photonic devices

In optical electronics, Japan is in a leading position. In the medium term, increased intellectual assets and economic impacts are expected. Japan's R&D level is ahead of both the USA and Europe.
As for typical technologies, against the backdrop of the spread of broadband, the realization of 10 Gbps subscriber lines and high-frequency lasers, 100 Tbps multiplex equipment that presumes a ubiquitous network environment, and the realization of 10 THz photonics technology are forecast. In the long term, the realization of still-experimental technology such as optical buffer memory and optical communications systems for quantum information is seen as being realized around 2020 and applied in society about 10 years after that.

Expected impacts



Japan's R&D level



Realization timeline

17 Almost all indoor lighting is replaced by semiconductor light sources.

15 Widespread home use of 10-Gbps access networks.

19 Ultraviolet/deep-ultraviolet laser diodes

14 Organic material devices (e.g. lasers and switches).

20 Optical multiplex communications equipments capable of transmitting multiplexed signals at 100 Tbps over a single optical fiber.

18 Photonic sensing technology using an unused radio frequency range of 1-10 THz

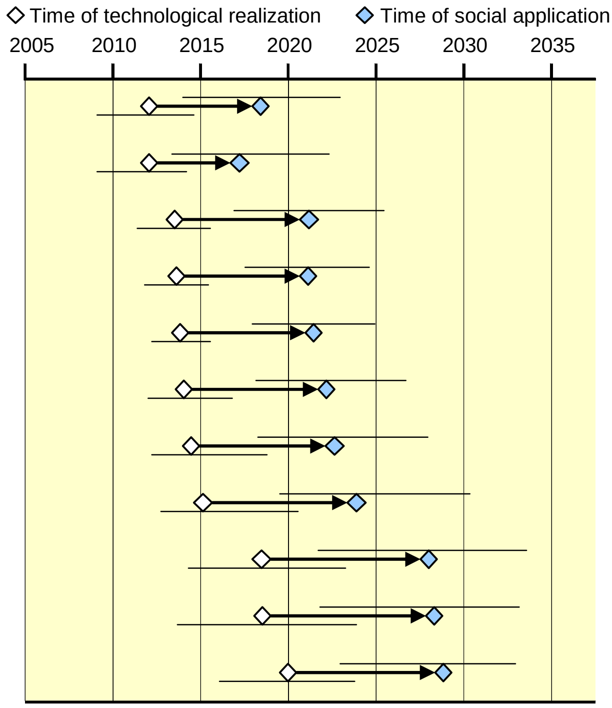
21 Ultralow-loss (e.g. 0.1 dB/km or lower) holey fibers (photonic crystal fibers)

23 Photonic-crystal-based photonic integrated circuits.

24 Large-capacity optical buffer memory.

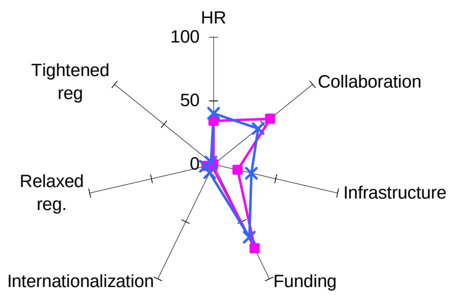
22 Secure optical quantum communications system.

16 Soft X-ray laser at a few tens of angstroms of wavelength.

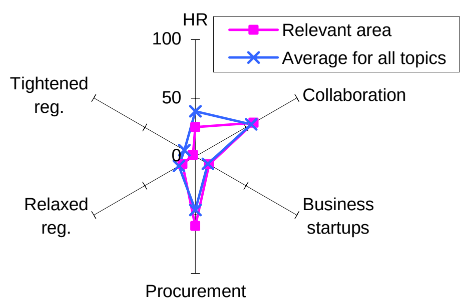


Government involvement

Effective measures for technological realization



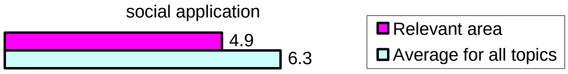
Effective measures for social application



Because relatively large-scale, advanced experimental facilities are required, government involvement with Collaboration and Infrastructure are considered necessary. Regarding social application, Human resources are considered most important.

Necessity of government involvement towards technological realization

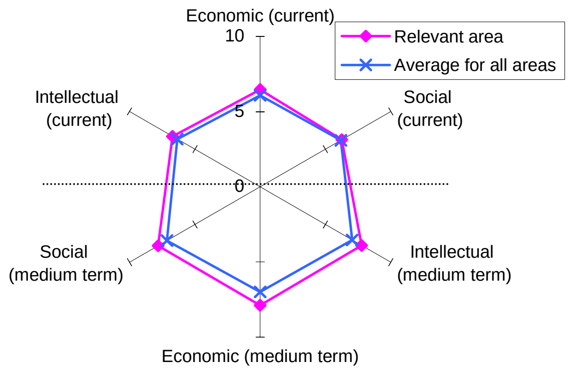
Necessity of government involvement towards social application



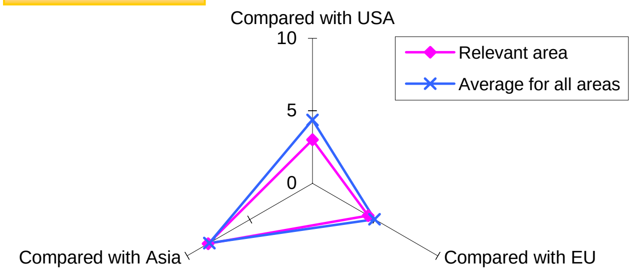
30 Regenerative medicine

Social application of technologies typical of regenerative medical science is expected to be realized around 2030. Therefore the expected impacts—increased intellectual assets, economic impacts, and social impacts—are all expected to be large in the medium term. The R&D level has improved from five years ago, pulling almost level with the EU. There is still a large gap with the USA.
Elemental technologies such as those for long-term cultivation and preservation of organs and creation of stem cells and regulation of their differentiation are predicted for realization after 2015, with transplant organs, artificial retinas, and artificial organs following around 2020. Their social application, use in medicine, will require another 10 to 15 years after that.

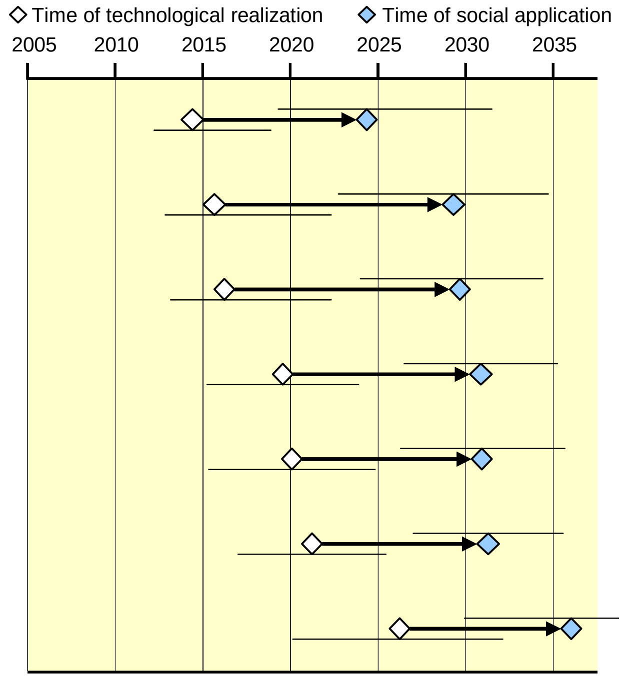
Expected impacts



Japan's R&D level



Realization timeline



30 Long-term organ cultivation and preservation technology for organ transplants.

28 Reprograming technology to create stem cells from differentiated somatic cells.

29 Technology to manipulate stem cell differentiation and growth for induction of functional cells to use for therapy.

27 Technology to utilize animals as a bioreactor to produce organs and tissues to transplant into humans.

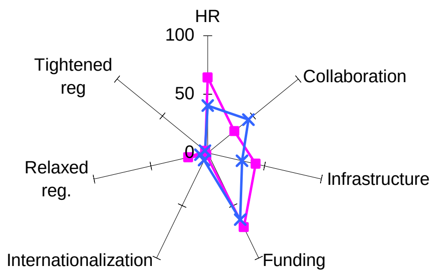
31 Artificial retinas to give sight to the visually impaired.

26 Artificial organs (pancreases, kidneys, livers, etc.) incorporating human cells and tissue.

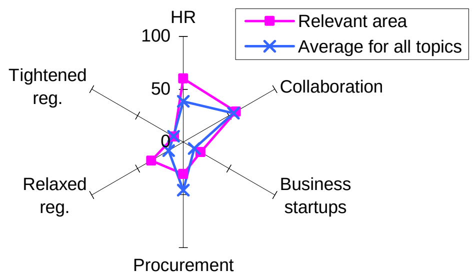
25 Synthetic technology for artificial cells with functions such as cell membrane transport, material transfer, and energy conversion.

Government involvement

Effective measures for technological realization



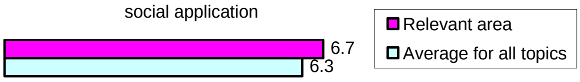
Effective measures for social application



Regarding technological realization, expectations are high for Human resources and Infrastructure. Human resources are desired for social application as well. Furthermore, expectations are high for government action on Relaxed regulations in order to form a social consensus for application to medicine.

Necessity of government involvement towards technological realization

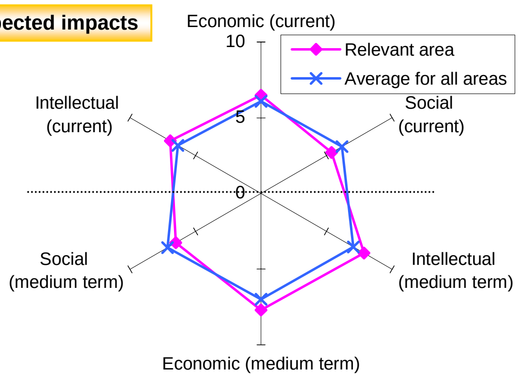
Necessity of government involvement towards social application



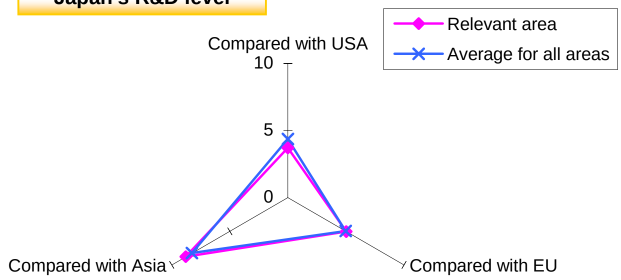
31 Monitoring and sensor technology for biological substances

This area can be considered infrastructure for the development of the various fields of life science. The expected impacts are major contributions to increased intellectual assets now and in the medium term. At the same time, because of expectations for commercialization and growth from the results of life science research, economic impacts from this fundamental area are also projected. Due to improvements over the last five years, Japan's R&D level is equal to or greater than Europe's. Technological realization of high sensitivity, improved speed and spatial resolution to measure individual subjects such as tissues, genomes, and sugar chains is projected for around 2015. However, realization of simultaneous measurement of the mutual effects of multiple substances is expected to take somewhat longer, with self-propulsion inside living bodies even further behind. Social application is expected to require at least more 10 years.

Expected impacts



Japan's R&D level



Realization timeline

33 Technology to detect a cancerous tissue of the diameter smaller than 1 mm presenting anywhere in the body.

34 Technology for molecular imaging in the body with the precision of single molecule detection.

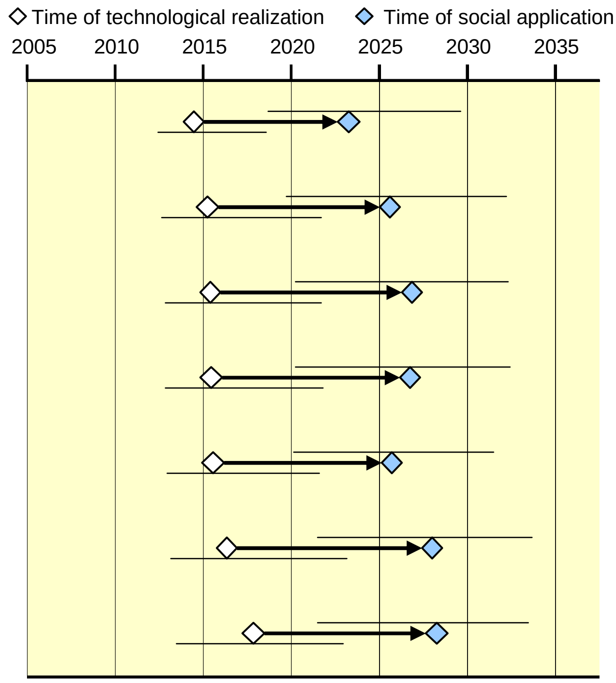
36 Technology that can sequence the whole human genome in one day.

37 Equipment that can sample a single cell and measure all kinds of mRNAs with their copy numbers within the cell.

38 Equipment to automatically analyze the sequences of sugar chains with 20 or more linked sugars with their branching and linkage patterns.

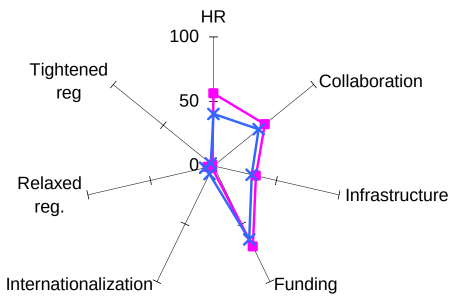
35 Technology to observe the interactions among various substances inside and outside cells, to simultaneously identify these substances, and to monitor their distribution

32 Self-propelled micromachines for diagnosis and treatment inside the body (organ lumina)

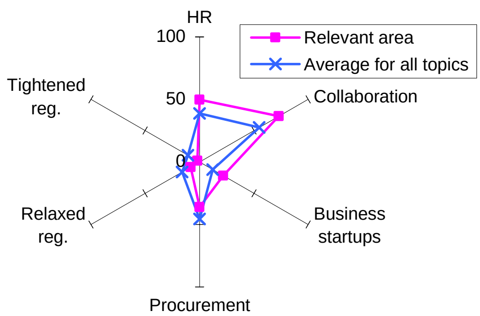


Government involvement

Effective measures for technological realization

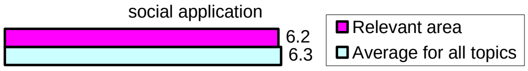


Effective measures for social application



Necessity of government involvement towards technological realization

Necessity of government involvement towards social application

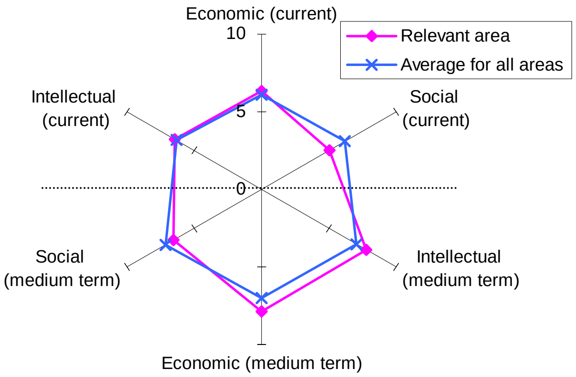


This is an interdisciplinary area fusing life science, chemistry, physics, and so on, and collaboration for applying it to basic research and equipment is needed. Therefore, initiatives on developing human resources with knowledge and experience in wide-ranging research, and strengthened industry-academia-government and interdisciplinary collaboration in both technological realization and social application are expected. Hopes are particularly high for such collaboration in the promotion of social application, where the commercialization of research results is important.

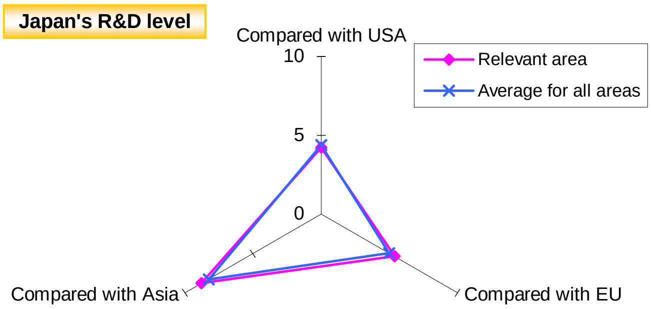
35 Nanobiology (life science)

Technological realization for each of the technologies representing this area is predicted between 2015 and 2020, with social application requiring another 10 years after that. The expected impacts are therefore expected to grow much larger in the medium term than they are currently. Expectations are particularly high for increased intellectual assets and social impacts. The R&D level has improved compared to five years ago, and is somewhat ahead of the USA and at least equal to the EU. Technological realization of measuring technologies such as nanochamber arrays and sensors that mimic ion channels is expected around 2015, with social application following around 2025. Realization of molecular motors, biofuel cells, and other technologies that apply biomolecular functions is expected five years after realization of the measuring technologies.

Expected impacts



Japan's R&D level



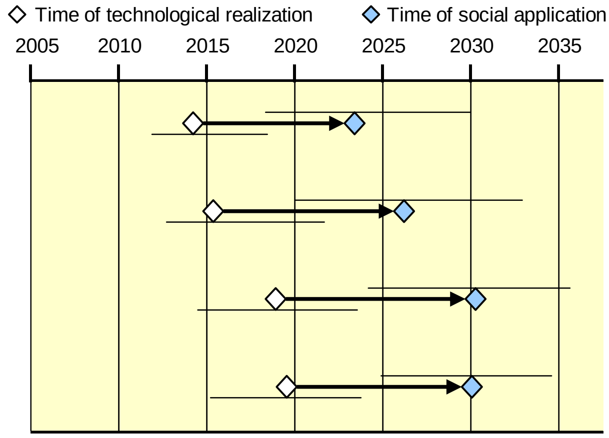
Realization timeline

64 Nanochamber arrays that enable simultaneous detection of many biological reactions by concentrating thousands or tens of thousands of receptors on a single semiconductor chip.

63 Chemical sensor technology that mimics the ion selection function of the ion channels that exist in cell membranes.

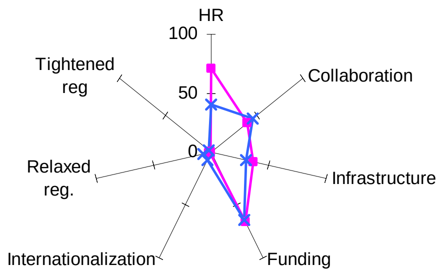
62 Highly efficient energy conversion technology that utilizes motor proteins (molecular motors) that convert chemical energy to mechanical energy.

65 Biofuel cells that reconstruct the reactions of enzyme molecules in bodies on a nano scale.

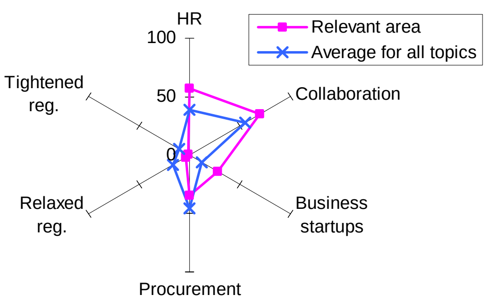


Government involvement

Effective measures for technological realization



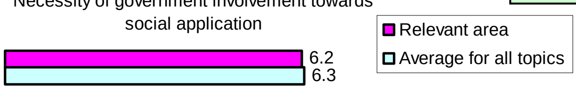
Effective measures for social application



This field integrates biology, chemistry, physics, and so on, and basic and applied research must proceed collaboratively. Expectations are therefore high for the development of human resources with such knowledge and experience. For social application, in addition to human resources development, industry-academia-government and interdisciplinary collaboration are significant, and broad-based initiatives are recognized as important.

Necessity of government involvement towards technological realization

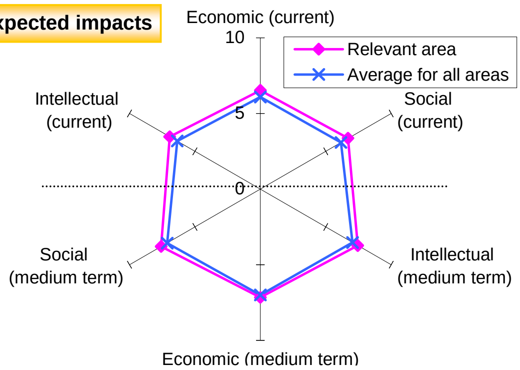
Necessity of government involvement towards social application



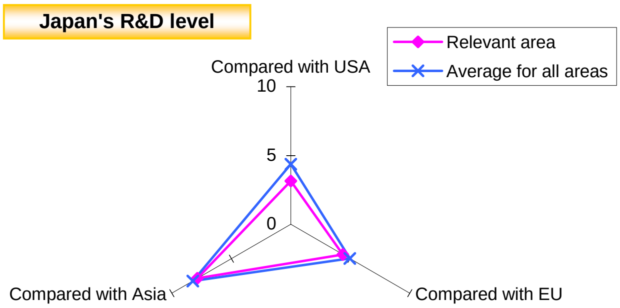
36 Personalized medicine

Typical technologies in this area are diagnostic and treatment technologies for cancer and other lifestyle-related diseases. Among these technologies, those for cancer treatment are projected to advance through a process of improvements in the drug and radiation therapies that are now the primary treatments, tailor-made treatment technology, immunological treatment technology, and genetic treatment technology, until treatment technology based on elucidation of the mechanisms of cancerization is finally realized. In addition to cancer, the main technologies for individualized healthcare, including genetic treatments for conditions such as arteriosclerosis, high cholesterol, and diabetes, are expected to advance to social application (as generally available treatment) between 2025 and 2030. Expected impacts currently include increased intellectual assets, economic impacts, and social impacts. Although Japan's R&D level still lags significantly behind that of the USA, it has improved over the past five years.

Expected impacts

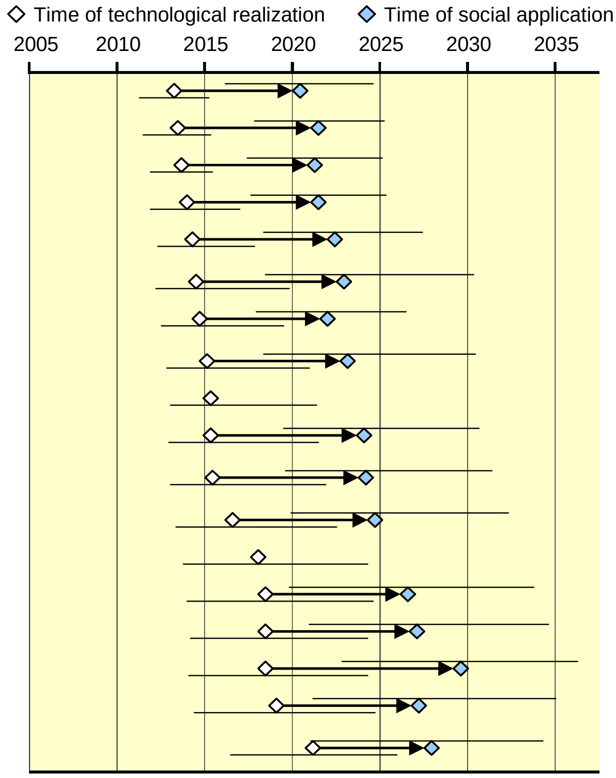


Japan's R&D level

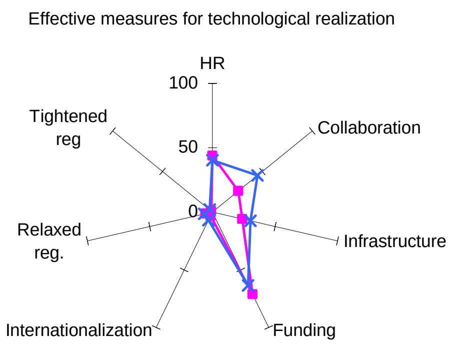


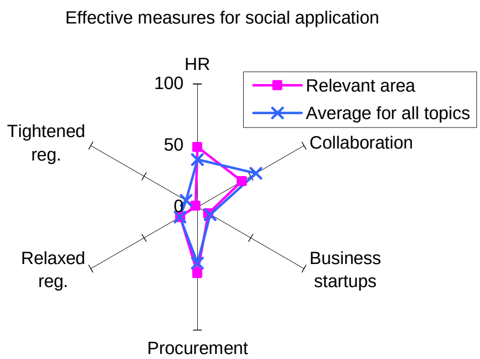
Realization timeline

15 Drug delivery systems (DDS)
13 Assays of drug resistance of cancers.
14 Effective radiological therapy and intensifying drugs for cancer treatment.
7 Oral administation of insulin
11 Hemocatharsis devices that selectively remove target substances from the blood.
16 Tailored cancer treatments.
18 Immunological therapy with high specificity and long effects against target infections.
9 Immunological therapy effective for cancer.
3 Elucidation of the pathogenesis of atherosclerosis.
17 Hypothermic treatment of cancer (an innovative treatment aiming at slowing cancer development and lengthening the time spent for coexistence with cancer).
12 Gene therapy that allows for localized treatment of atheroclerotic lesions.
8 Gene therapy of familial hypercholesterolemia.
1 Elucidation of the pathophysiology of cancer metastasis.
4 Early-phase diagnosis of almost all types of cancer by blood testing.
6 Gene therapy of diabetes mellitus.
10 Gene therapy of cancer.
5 Diagnostic methods to help select appropriate treatment of kidney disorders without performing a renal biopsy.
2 Therapeutic application of the achievements on the pathophysiology of cancerization

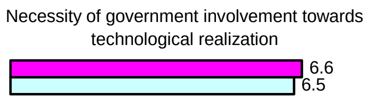


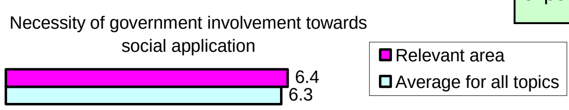
Government involvement





Expectations are high for Human resource towards social application. In the future, individualized medicine may become the primary type of healthcare in the world, but there is a shortage of personnel. Government involvement in Human resource is therefore expected.

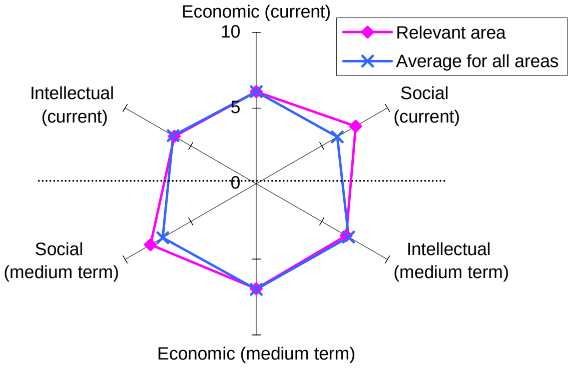




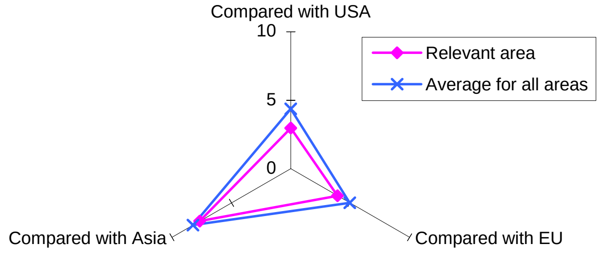
42 Measures against emerging and reemerging infectious diseases

Emerging and reemerging infections such as SARS and avian influenza that suddenly and rapidly spread on a global scale are major threats to public health. Contribution to social impacts is therefore the largest expected impact. Although Japan's relative R&D level has improved from five years ago, it is still somewhat behind the USA and the EU. Technological realization of the representative technologies in this area, such as quick identification of disease agents, detection of infected persons at airports and other prevention methods, treatments for HIV, and measures against drug resistance, is expected by around 2015, with social application following relatively quickly, about five years later. Technological and social application for prion diseases is expected to require an additional five years.

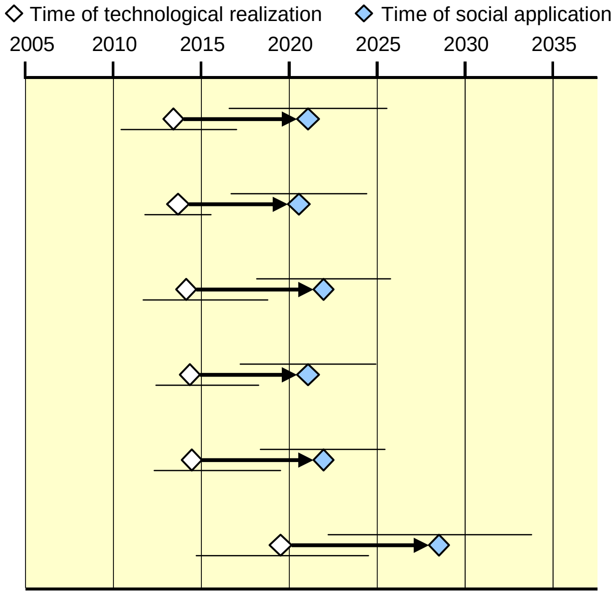
Expected impacts



Japan's R&D level



Realization timeline



68 Automatic devices to identify pathogens and evaluate their drug susceptibility within 1 hour.

70 Methods to prevent and treat human infection with highly pathogenic avian influenza found in poultry.

69 Systems to almost perfectly detect infected people and carriers of imported pathogens at airports and seaports.

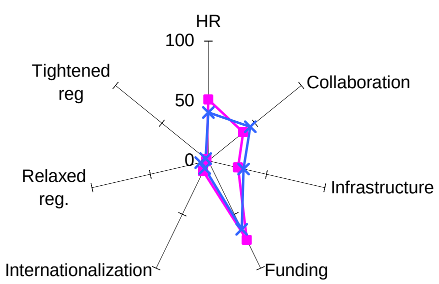
66 Treatment that completely cure HIV infection.

71 Methods to overcome drug resistance in infections.

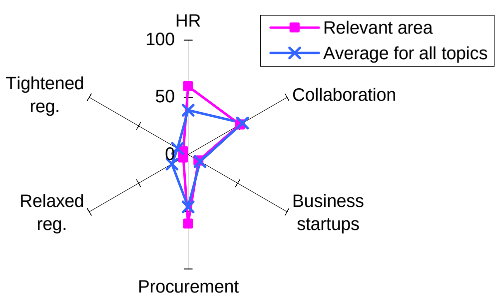
67 Treatment for prion diseases.

Government involvement

Effective measures for technological realization



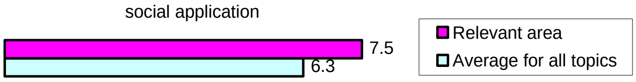
Effective measures for social application



The appearance of emerging and reemerging infections is difficult to predict at this time, so rapid response is the key. Human resources to carry out science and technology R&D and to examine social systems are therefore needed. Expectations are high for government involvement in the form of Human resources for both technological realization and social application.

Necessity of government involvement towards technological realization

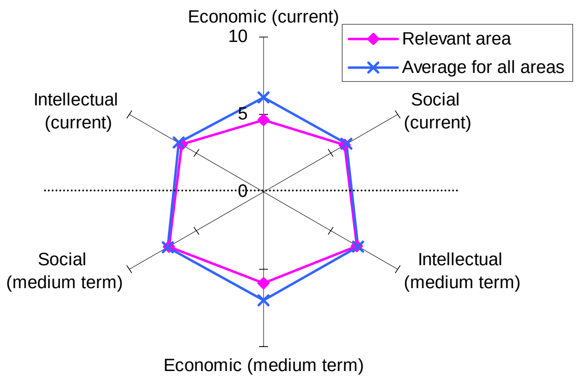
Necessity of government involvement towards social application



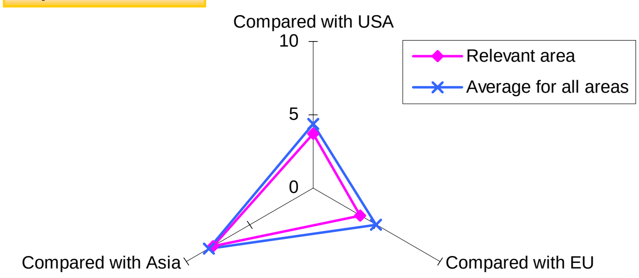
44 Elucidation of the complex interaction between biodiversity and ecosystems

Of the representative technologies in this field, technological realization of technologies to monitor or predict changes in marine resources and ocean ecosystems, plants, forests, and farmland is expected around 2015, followed by six to seven years for social realization around 2025. Technology for systematically monitoring the material cycles of agricultural, forestry, and fisheries ecosystems on a global scale is predicted for realization five years later, with social application around 2030. The expected economic impact is high both now and in the medium term. Expectations are high for this area as a foundation for agriculture, forestry and fisheries that coexist with nature and living things. Japan's R&D level is behind those of the USA and the EU, but it has made up ground compared to five years ago.

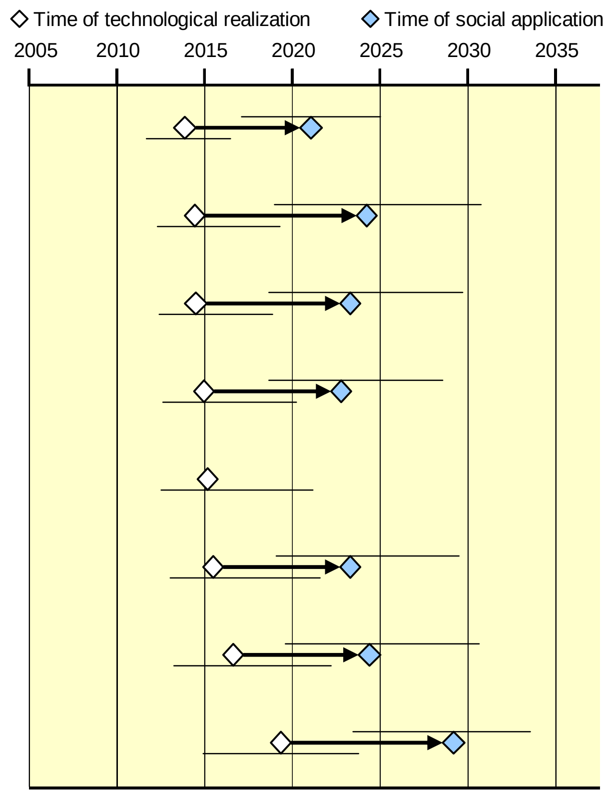
Expected impacts



Japan's R&D level



Realization timeline



7 Completely control pine wilt in Japan.

6 Understand genetic geographic classification through molecular markers to analyze regional differentiation and genetic diversity of the world's major commercial tree types.

4 Systems that utilize remote sensing technology to periodically provide useful data on agriculture, forestry, and fisheries resources for all climate zones and topographies in order to estimate agricultural product harvests, forest biomass, and real-time ocean environment data.

2 Technology to estimate long-term changes in resource amounts in order to appropriately manage true sardines and other important fisheries resources.

8 Elucidation of the mechanisms by which nonpathogenic microorganisms (endophytes) become established inside plants and how they influence plant growth.

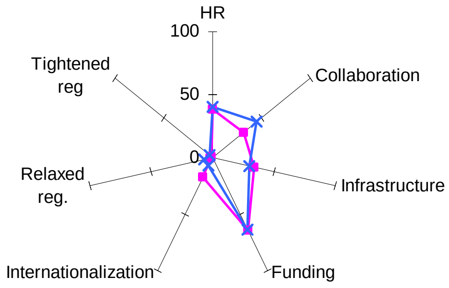
1 Technology to assess the impact of global climate change and environmental changes on an ocean-wide scale in particular on changes in the amount of large migratory fish resources such as salmon and tuna.

3 Technology to assess various species living in a one mass through school detection systems that enable accurate measurement of fish length and differentiation of fish species.

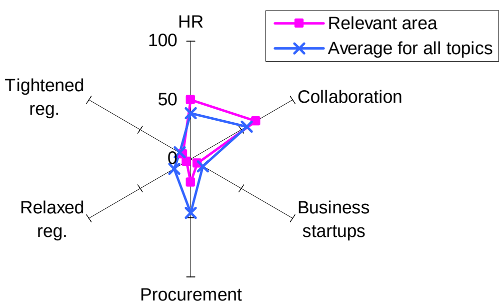
5 Systems that use global sensor networks to monitor major element and material cycles in agriculture, forestry, and fisheries ecosystems.

Government involvement

Effective measures for technological realization



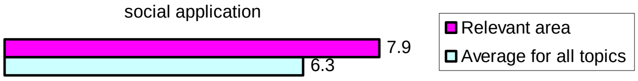
Effective measures for social application



The necessity of government involvement is high for both technological realization and social application. Expectations are especially strong for Human resources and Collaboration as measures towards social application. Human resources in order to realize research results as actual systems and collaboration between research and industry are needed.

Necessity of government involvement towards technological realization

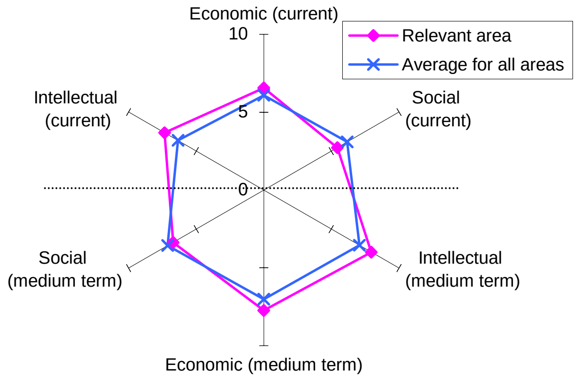
Necessity of government involvement towards social application



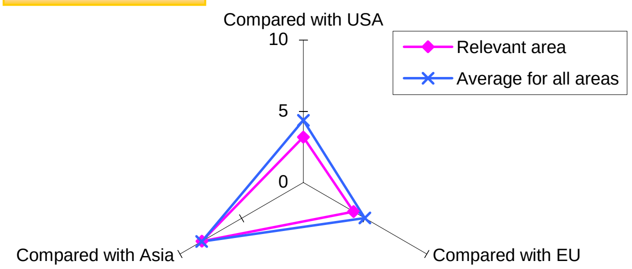
48 Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology

Technological realization of technology for the creation of insects, plants, and animals is expected to be relatively early, around 2015. Social application, however, will require 7 to 10 years, occurring from around 2020 to after 2025. As for technology to control organisms based on elucidation of immune mechanisms and the functions of all genes, technological realization is expected to be a few years to five years later, with social application around 2025 to 2030. The time required to form a social consensus must be added to the time needed to turn basic research results into concrete applications.
Regarding expected impacts, increased intellectual assets are high both now and in the medium term, indicating that initiatives on basic research are large. In the medium term, high economic impact is also expected from growth in the agriculture, forestry, and fisheries industries as social application proceeds.

Expected impacts



Japan's R&D level



Realization timeline

38 Industrial production of useful substances such as medicines through the utilization of insect cell cultures and other transformants.

35 Production of transformed livestocks with secreted antibacterial proteins, blood coagulation factor and other physiologically active substances in milk.

42 Production of livestock cloned from somatic cells based on elucidation of epigenetic and other nuclear genetic information reprogramming mechanism.

41 Production of aquaculture varieties fixed preferred properties (disease resistance, high growth) through chromosomal manipulation cloning.

46 Genetically engineered plants in which artificially introduced genes do not spread over the environment because of the special timing/site expression of genes.

37 Improvement and farming of new organisms for fisheries with advantageous characteristics (e.g., environmental tolerance and resistance to disease) by applying DNA markers and other genome technology.

39 Crop production and greening in the strict environment, such as deserts, by using new plants enhanced/added salt, drought or cold tolerance.

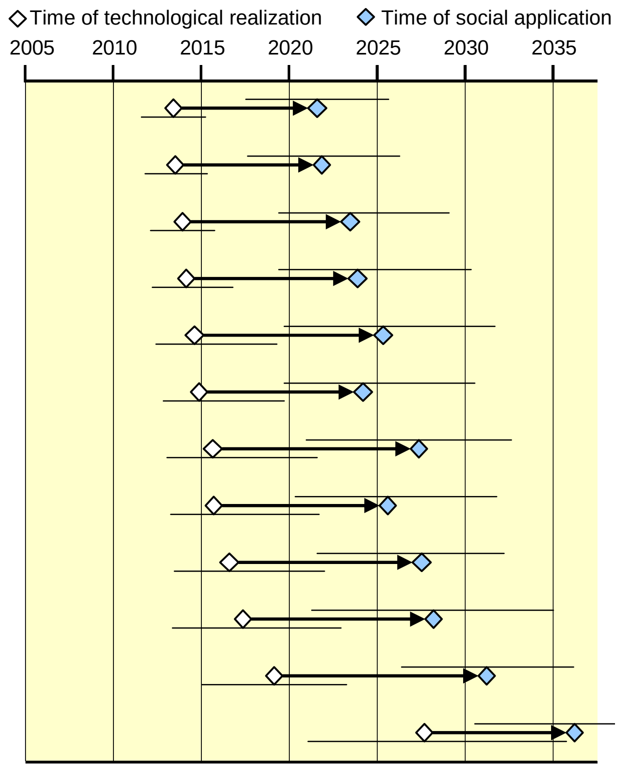
36 Preventation of diseases, recovery of homeostasis, improvement of feeding and milk production control based on elucidation of immune system and endocrine mechanisms of adenohypophysis.

43 Prevention of infection disease based on the knowledge of the immune system and its regulatory factors of fish.

40 Modeling of all process about the rice plant growth based on the complete elucidation of gene functions and interaction of transcripts.

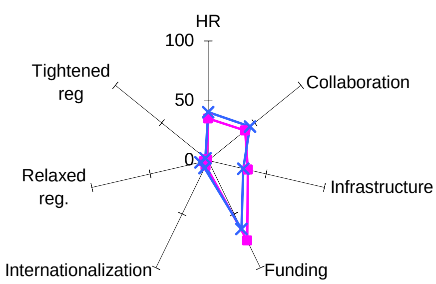
45 Growth regulation of crop/tree based on the knowledge of the mechanism about biosynthesis, transport, and receptor-mediated signaling by regulators in plants.

44 Communication technology between human and livestock utilized sensing of the neuro-transmission in the brain.

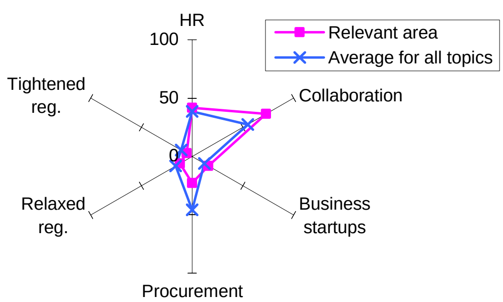


Government involvement

Effective measures for technological realization



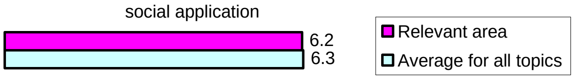
Effective measures for social application



For social application, expectations are high for Collaboration. Government is expected to build systems to advance research-industry and interdisciplinary collaboration to apply basic research results to production technology.

Necessity of government involvement towards technological realization

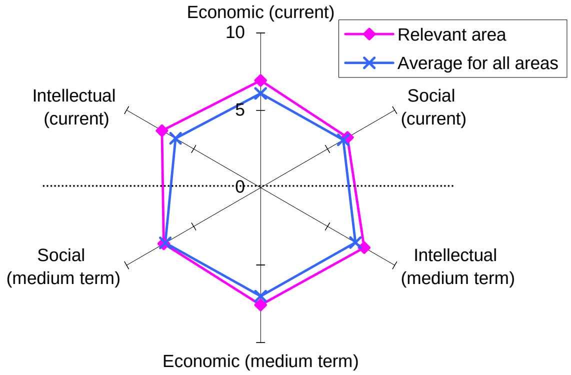
Necessity of government involvement towards social application



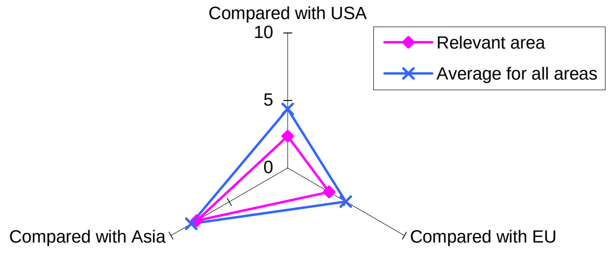
53 Space utlilization technology—basic satellite technology—

This area comprises next-generation technologies basic to satellites, such as communications, broadcasting, weather observation, and positioning. Because the technologies in this area have a broad range of applications, it is evaluated as having its greatest impact in increased intellectual assets, both at present and in the medium term. In terms of R&D level, not only is Japan behind the USA and the EU, compared to five years ago, it has lost some of its lead over Asia.
In addition, technological realization is predicted for 10 or more years from now, with social application taking about 20 years. Because these are innovative major technologies, the survey indicated a strong desire for government involvement through national R&D funding.

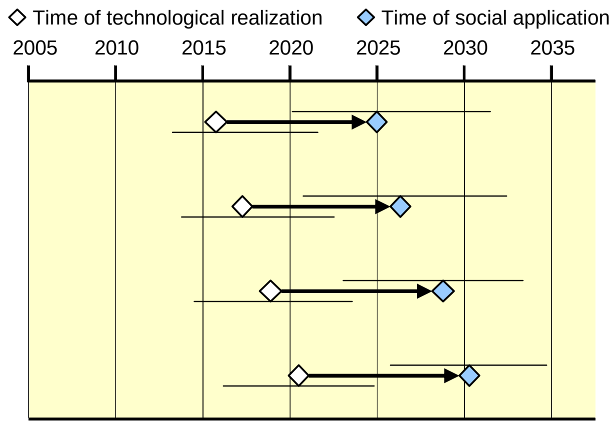
Expected impacts



Japan's R&D level



Realization timeline



21 To respond to the increase in satellite-based communications volume accompanying the growth of Earth-based communications volume, a system of multiple stationary platforms with transmission capacities in the several terabits/second class, linked by optical intersatellite communications.

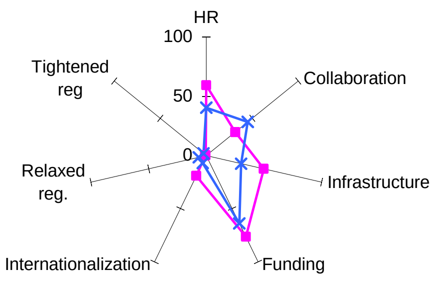
19 Satellite systems whose maintenance, repair, and functional upgrade may be performed by robots in orbit.

20 Operation of semi-permanent large platforms (a system in which mission apparatuses can appropriately exchanged and maintenance, inspection, and repair can be performed in orbit) in order to effectively utilize the limited stationary orbits available.

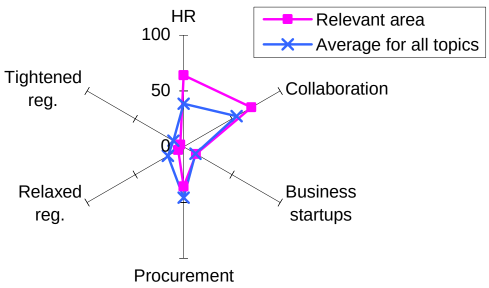
22 Drastic technological measures (debris-free space systems, collection of debris already left, disposal by injection into the atmosphere, etc.) against the debris problem.

Government involvement

Effective measures for technological realization



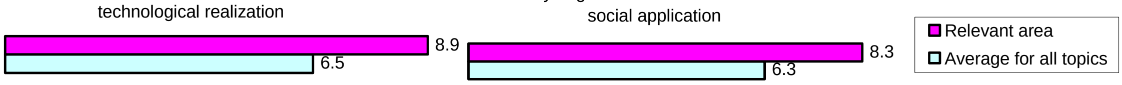
Effective measures for social application



Major government involvement is needed for both technological realization and social application. Human resources is needed at both stages.
Funding and Infrastructure are expected for technological realization, with Collaboration needed for social application.

Necessity of government involvement towards technological realization

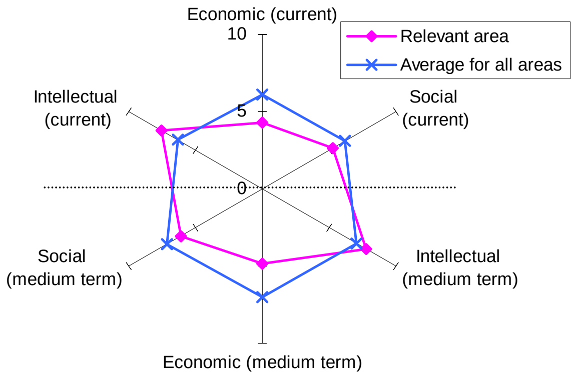
Necessity of government involvement towards social application



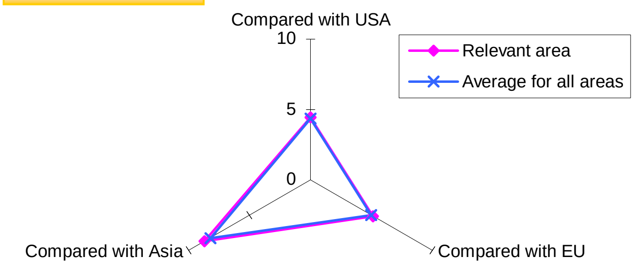
56 Deep Earth observation technology

The representative technologies for this area that are predicted for technological realization around 2015 are for monitoring the Earth's surface and crust and obtaining data from deep inside it. These will be followed by technologies for observation of movement deep inside the Earth and direct sampling. However, social application that actually utilizes the technologies is seen as requiring until 2025 to 2030.
Because the area deals with technologies for increasing our understanding of the deep ocean and the deep Earth, increased intellectual assets are expected to have the largest impact. Japan's R&D level is somewhat behind that of the USA, even with that of the EU, and ahead of Asia's.

Expected impacts



Japan's R&D level



Realization timeline

39 Technology to place permanent geophysical observation bases on the deep ocean floor and radically increase the precision of exploration of the Earth's interior by networking them.

45 Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones.

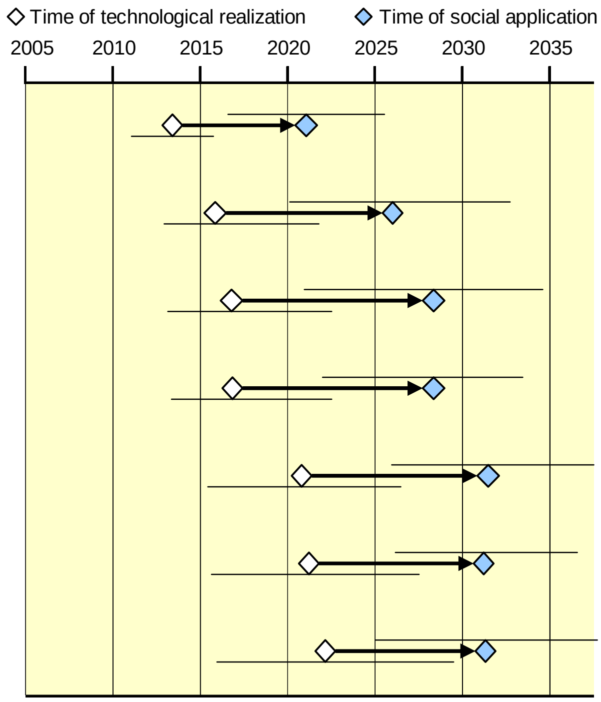
42 Technology to statically achieve samples of a size of a few centimeters or more from the high-temperature, high-pressure conditions near the center of the Earth.

43 Technology to use satellite magnetic field observation and surface observation to estimate the core's current dynamo action and future changes in the magnetic field.

44 Technology sensitive enough to detect shifts in matter of a few centimeters a year deep inside the Earth.

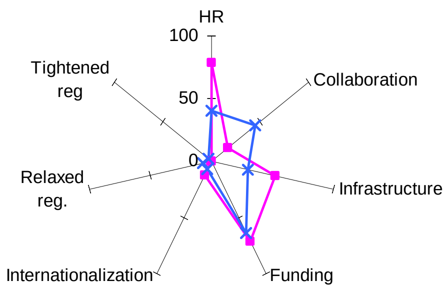
41 Technology to extract mantle matter by deep drilling into the Earth from any location.

40 Technology to extract matter from the Earth's core in order to identify the light elements included there.

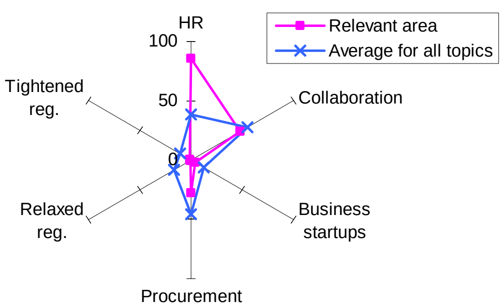


Government involvement

Effective measures for technological realization



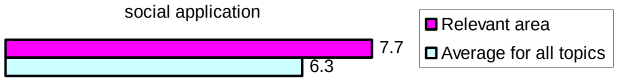
Effective measures for social application



Major government involvement is needed for both technological realization and social application.
As concrete measures, expectations are high for Human resources for both stages. Funding and Infrastructure for technological realization are also strongly hoped for.

Necessity of government involvement towards technological realization

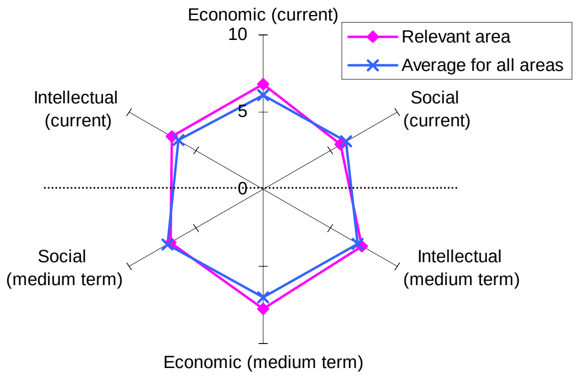
Necessity of government involvement towards social application



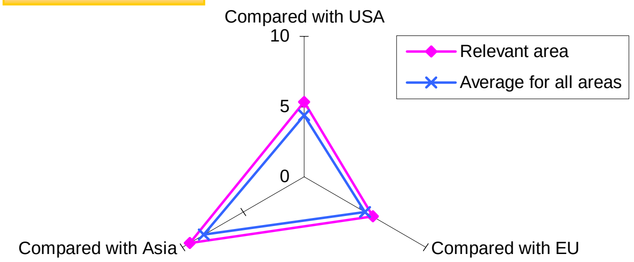
62 Hydrogen energy systems

In the short term, the focus in building a hydrogen-based society will be on introducing a hydrogen-energy market through the commercialization of fuel-cell automobiles and the creation of a hydrogen-energy supply system. Following this, multifaceted use of hydrogen energy is expected to become simple. In the long-term, a large-scale hydrogen infrastructure narrowed down to CO2-free hydrogen manufacturing with renewable and nuclear energy must be built with a view towards a hydrogen society. Realization of hydrogen energy systems is expected to increase intellectual assets and bring about economic impact through numerous technological breakthroughs and the development and creation of industries, but there is low awareness of social impact through contributions to environmental and energy problems.

Expected impacts



Japan's R&D level



Realization timeline

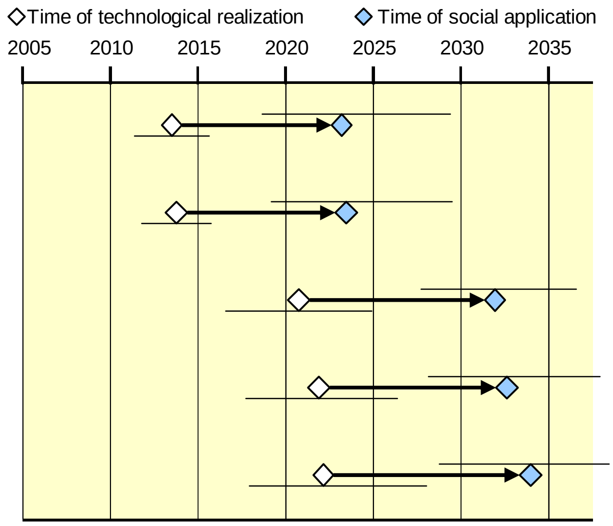
9 Hydrogen fueled automobile engines.

10 Hydrogen supply infrastructure networks for fuel cell automobiles.

8 A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.

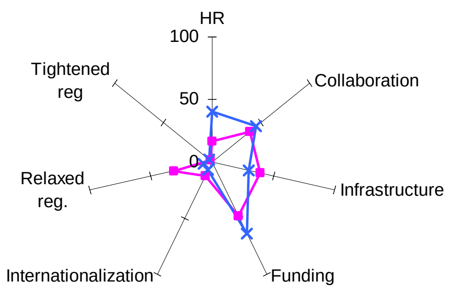
7 Hydrogen production processes by thermochemical method using nuclear heart.

11 Hydrogen production by ultrahigh temperature using solar heat.

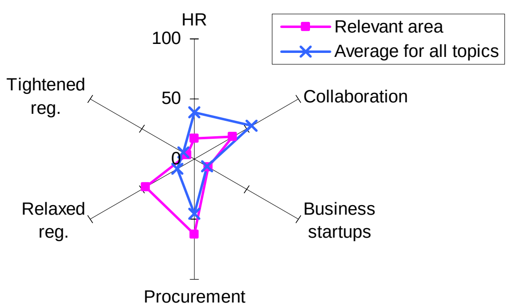


Government involvement

Effective measures for technological realization



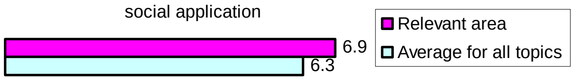
Effective measures for social application



Development of infrastructure for a hydrogen supply system and hydrogen manufacture, transport, storage, and usage technology will be a major social and industrial enterprise. Because that development will take at least 20 years, government support is essential for technological development and social application.

Necessity of government involvement towards technological realization

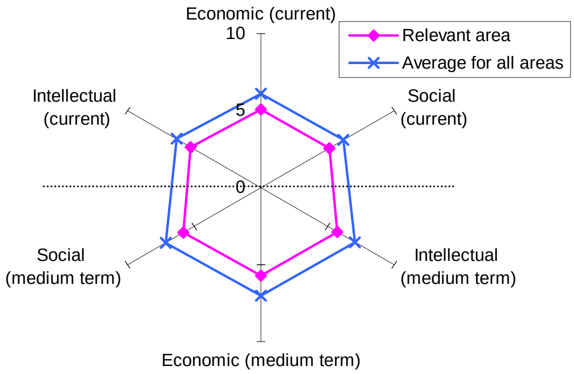
Necessity of government involvement towards social application



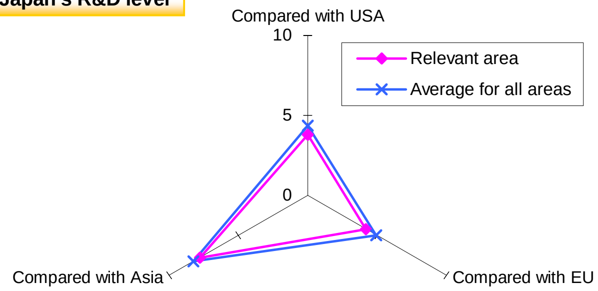
68 Resource assessment

Because resource development has been carried out with economy as a priority, in recent years development has become increasingly expensive, and the resources being developed have become increasingly remote and deep, with development risks climbing sharply. Therefore, efficient and reliable technology must be developed, beginning with technology to forecast which resources will be depleted to what degree in the future, and including the use of satellites for resource exploration. Mining is also preconditioned on maintaining economy through reducing systemic energy use and so on while responding to increasingly remote and deep resources. In addition, extracting and separating useful resources from incineration ash, resource reuse, and other cyclical forms of resource utilization are seen as important.

Expected impacts



Japan's R&D level



Realization timeline

36 Wet smelting technology whose extraction rate of copper and precious metals is equivalent to that of the process cimbining ore dressing and dry smelting (e.g. 85% x 98% = 83% approx.).

37 High-efficient unmanned mining technology including robotics.

40 Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.

42 Technology to extract methane hydrate from continental permafrost areas.

45 Technology to assess ultimate reserves of conventional resources.

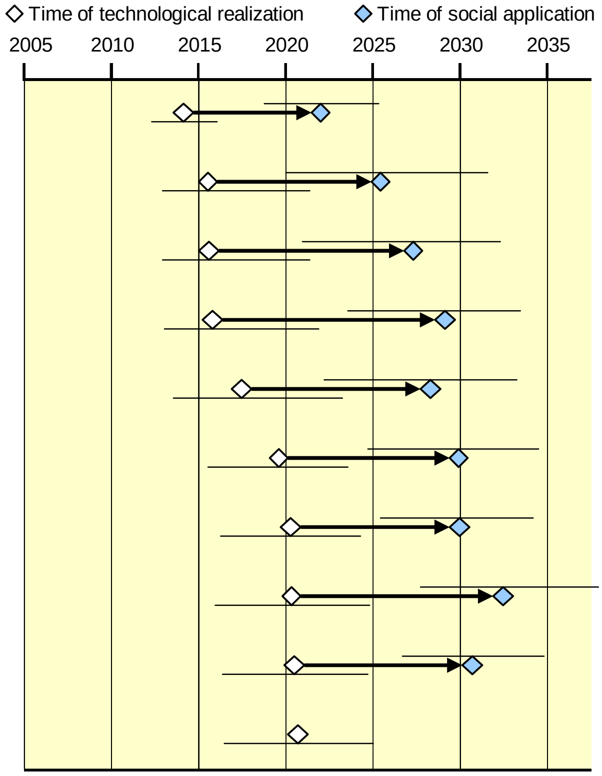
41 Ultra-deep drilling technology whose specifications are for depths of 15 km and temperatures of 400°C.

38 Extraction and separation technology of metallic elements based on biotechnology.

43 Technology to extract methane hydrate from sediments under the deepsea floor.

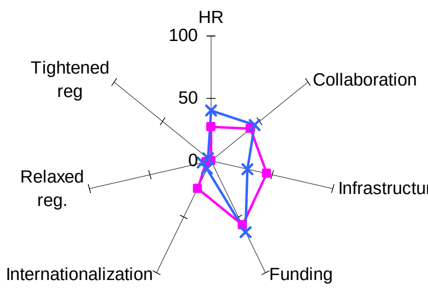
39 Technology to economically extract seafloor metal resources such as manganese nodules, cobalt crusts, heavy metal sludge, and hydrothermal mineral deposits.

44 Discovery of unconventional underground resources such as methane hydrate (energy resources) and seafloor hydrothermal deposits (mineral resources) as a result of changes in economic conditions, advances in earth sciences, and development of exploration technology (improved estimation, development of materials resistant to ultrahigh temperature and pressure, increased exploration depth).

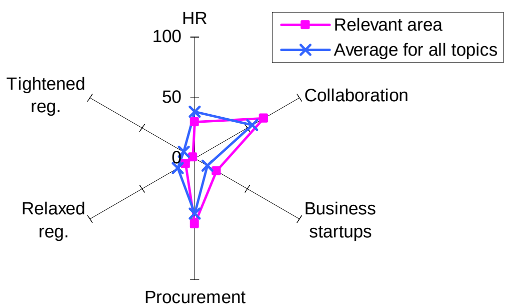


Government involvement

Effective measures for technological realization



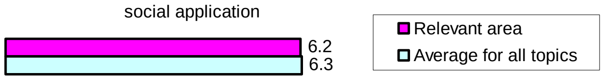
Effective measures for social application



Resource development is limited to certain areas, so locations cannot be selected, and long periods of time are needed to build roads, ports, and other infrastructure. In light of this, Internalization is needed for technological realization, as is Collaboration for social application.

Necessity of government involvement towards technological realization

Necessity of government involvement towards social application

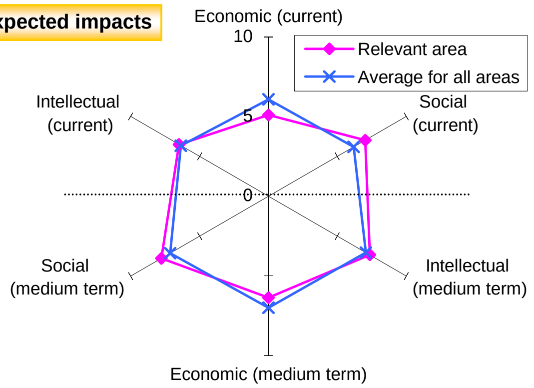


72 Focus on identification and mitigation of ecological effects (including soil and water)

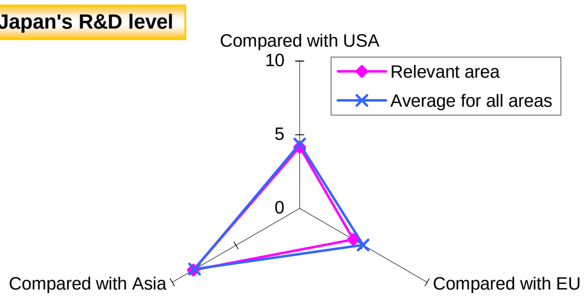
As for typical technologies in this area, the technological realization of technologies for environmental monitoring and assessing the impact of human activities on the environment is first expected. Subsequently, the realization of technologies for the removal of pollutants, the recovery of ecosystems, and the control of ecosystems is projected. The time of technological realization is expected to be from about 2010 to 2015 and beyond, with social application proceeding between about 2020 and 2025.

Major effects are expected in social impacts in terms of safety, peace of mind, and quality of life. A significant increase in intellectual assets is expected through a greater understanding of ecosystems. Japan's R&D level has markedly improved over the past five years relative to Europe and the USA.

Expected impacts

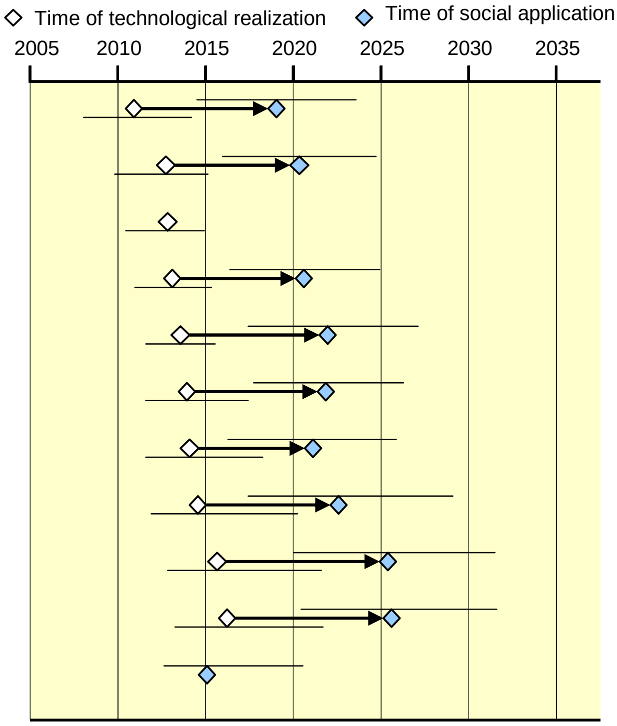


Japan's R&D level



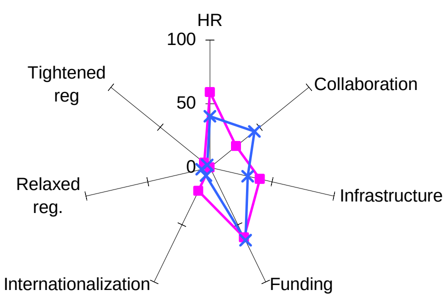
Realization timeline

24 Environmental monitoring technology based on high-precision satellite sensors and the Internet for vegetation mapping
25 Quantitative elucidation of the effect of flow structure on tideland ecosystem structure and function
20 Elucidation of the mechanism of the effect of acid rain on flora and fauna and the ecosystem
27 Technology for addressing endocrine disruptors emitted from sewage into rivers
23 Technology for ecologically identifying invasive foreign species
29 Technology for removing dioxins and other POPs (Persistent Organic Pollutants) from ocean floor soil
21 Technology for restoring the ecosystem and the biodiversity of wetlands
30 Technology for efficient revegetation in deserts
22 Technology for conserving and restoring the genetic diversity of endangered species
26 Technology for controlling species inhibiting the conservation and restoration of the natural ecosystem
28 Establishment of a system to ensure that development projects involve setting targets concerning ecosystem conservation and restoration through a consensus-building process

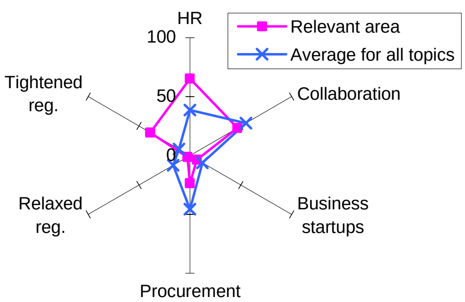


Government involvement

Effective measures for technological realization



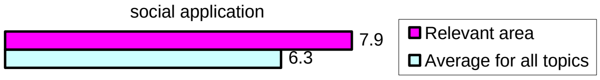
Effective measures for social application



Because the conservation of biodiversity and ecosystems is a global issue, internationalization of responsive technology is needed.
In this area, there are strong expectations for Human resource in research and application. Moving towards social application, government is expected to play a role in combining S&T initiatives with Tightened regulations to reduce the impact on ecosystems.

Necessity of government involvement towards technological realization

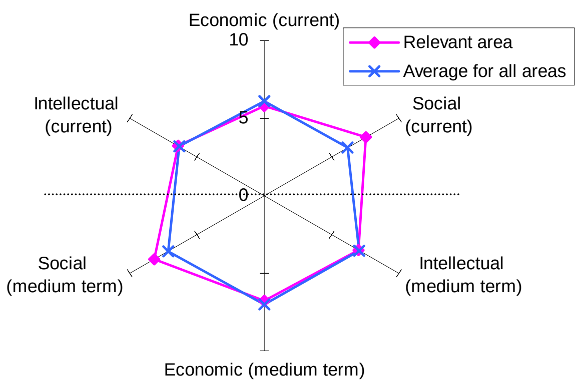
Necessity of government involvement towards social application



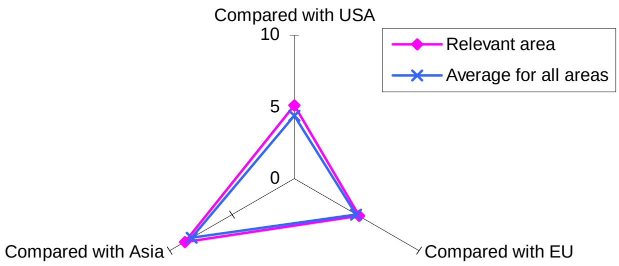
76 Water resources

Realization is predicted for responsive technologies reflecting individual social needs, such as technology for desalinization using membranes, technology using isotopes for specific pollution sources, and technology to restore salt-damaged soil. In all environment-related areas, the role of prediction technology through simulation with quantitative models is seen as very large. Reflecting conditions in a water-rich nation, prediction technology from the perspective of preventing flood damage in particular is needed. A global observation network utilizing satellites, etc., is needed in order to obtain observation data required to construct predictive models, but its realization is predicted to come after that of the above-mentioned simulation technology. In light of the fact that observation data is essential to predictive modeling, creation of a global observation network must be accelerated for earlier realization.

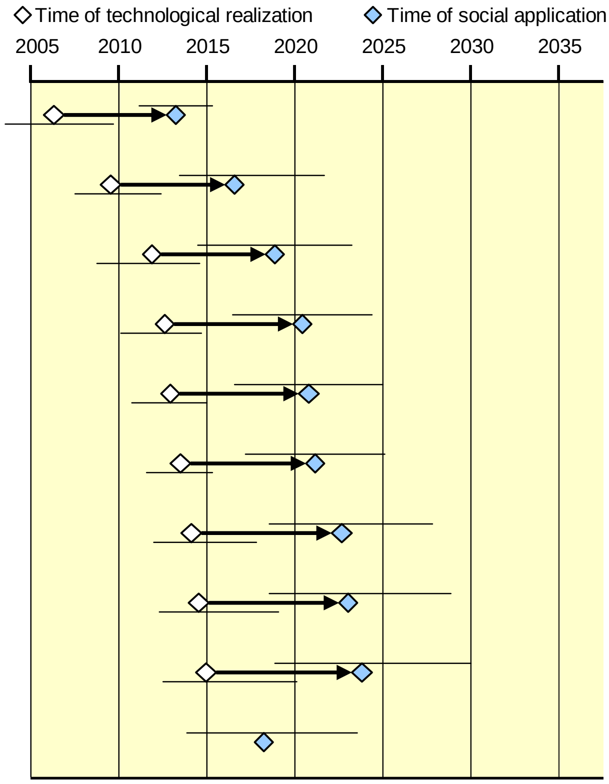
Expected impacts



Japan's R&D level



Realization timeline



52 Technology for economically and practically desalinating seawater and purifying polluted water using reverse osmosis membrane or other methods.

53 Technology for identifying the groundwater pollution sources using isotopes.

50 Meso-scale (about 10-km mesh) precipitation simulation.

47 Streamflow measurement and flood forecasts to prevent unexpected disasters by using satellite observation.

54 Technology for reclamation of salinized soils.

51 Integration of hydrology (basin water cycle) and meteorology on the Earth Simulator.

49 Construction of a hydrologic prediction model (including soil, snow/ice, and groundwater) for basins where there are poor ground observations.

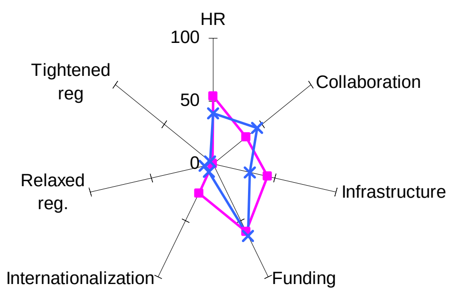
46 Global-scale observation of water use and water contaminants (data acquisition with a global 1-km mesh; including rivers, lakes and marshes, ground water, extraction, drainage, siltation in dams, urban pollution, industrial pollution, natural chemical substances).

48 Groundwater observation from satellites (improvement of spatial resolution from a few hundreds to a few kilometers).

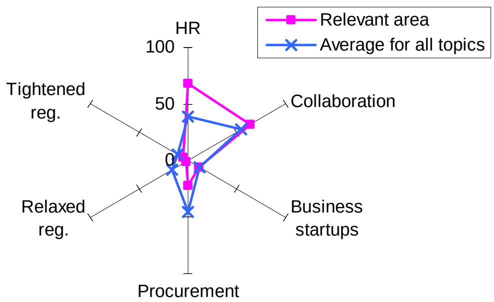
55 Social consensus building on the process for avoiding water conflicts associated with development.

Government involvement

Effective measures for technological realization



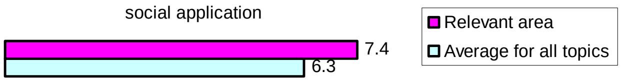
Effective measures for social application



Because water is an international, global issue, internationalization of responsive technologies is necessary. In addition, because increasing social needs in the environment field are recent phenomena, Human resources and Infrastructure are needed for both technological realization and social application.

Necessity of government involvement towards technological realization

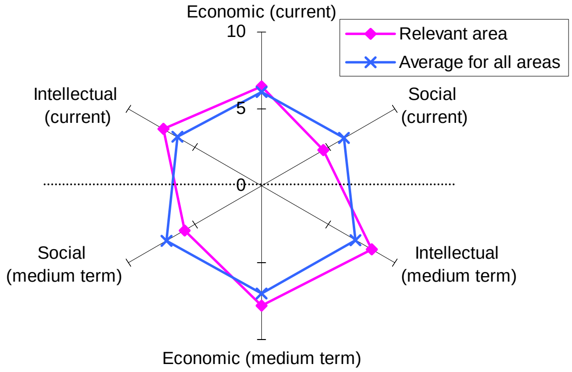
Necessity of government involvement towards social application



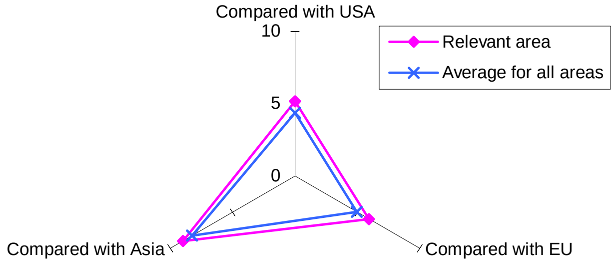
78 Nano measurement and analysis technology

Increased intellectual assets and economic impact were assessed as having major effects, becoming even larger in the medium term. Japan's R&D level is ahead of the EU's, and roughly equal with that of the USA. Technological realization for all technologies is expected by the early to mid 2010s, with social application expected in 2020 or later. Because this area includes basic technologies such as "technology to continuously observe and analyze individual atoms and molecules" that are essential to the development of nanotechnology, its early realization is predicted and expected.

Expected impacts



Japan's R&D level



Realization timeline

6 Technology to continuously observe and analyze individual atoms and molecules.

5 Ultrahigh-resolution electron microscope (resolution of 0.05 nm) with aberration correction.

8 Scanning probe analysis methods that enable fixed composition analysis and quantitative property measurement at the nanometer scale.

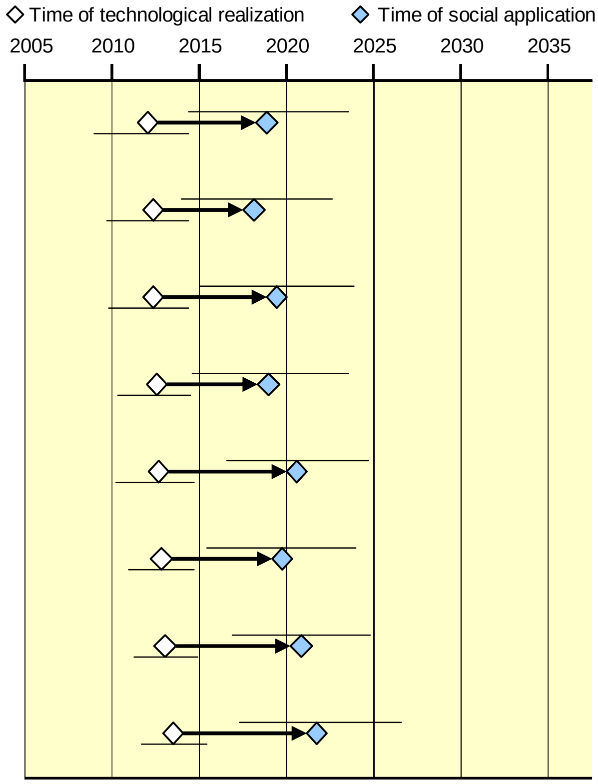
4 Technology for nondestructive inspection of fatigue in metal materials for in situ prediction of remaining life in light of usage conditions.

10 Three-dimensional microscope techniques for cells and other soft samples (materials).

7 In situ observation technology for high-temperature reactions (near 1500°C).

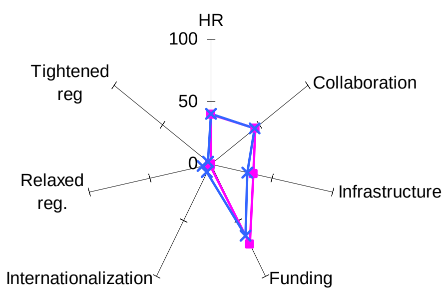
9 Chip-type scanning probe analysis equipment.

11 Three-dimensional fault imaging devices with a resolution on a several nanometer scale.

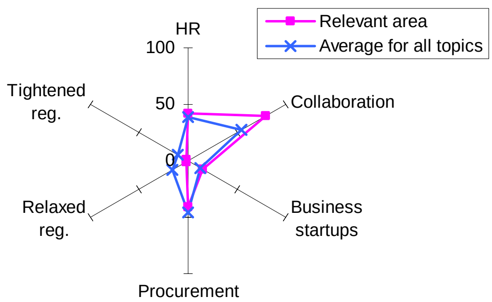


Government involvement

Effective measures for technological realization



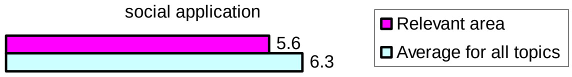
Effective measures for social application



Funding and Infrastructure are needed for technological realization. Collaboration and Human resources are seen as necessary for social application.

Necessity of government involvement towards technological realization

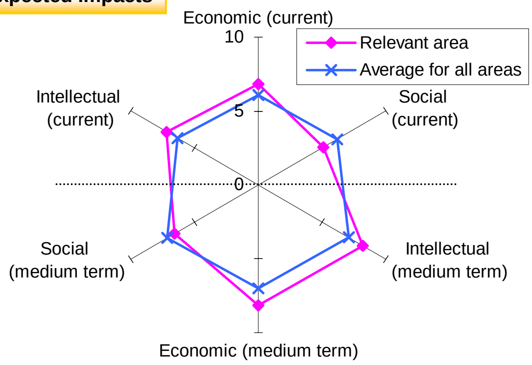
Necessity of government involvement towards social application



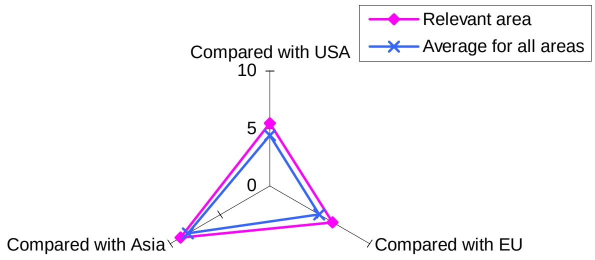
81 New materials from nanolevel structure control

Technological realization of the majority of the typical technologies in this area is projected by 2015, with social application following seven or eight years later. On the other hand, technologies such as all-organic ferromagnets and room-temperature superconductors where electron multibody effects and other complex phenomena in addition to structural control must be considered are expected to be realized after 2015, with social application around 2030. Expected current effects are significant in terms of increased intellectual assets and economic impacts. Because the social realization of typical technologies is expected after 2020, medium-term effects are expected to be even larger. Japan's R&D level today as well as five years ago is ahead of the rest of Asia and slightly ahead of Europe and the USA.

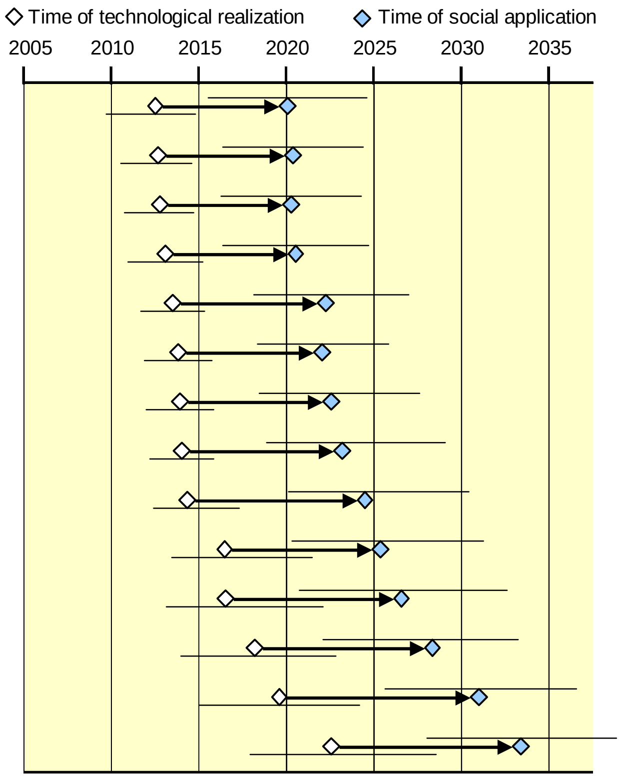
Expected impacts



Japan's R&D level



Realization timeline



42 Light, composite-structure materials from carbon nanotubes

38 Large-area amorphous silicon solar cells with a conversion efficiency above 20 percent

29 Biomedical ceramics that function approximately in the same way as human bone

37 Insulating materials with a dielectric constant of 1.3 or less for ultra LSI

39 Organic and inorganic compound materials that express new functions or innovative properties through structures controlled at nanometer level

32 Lead-free ferroelectrics with a piezoelectric modulus equivalent to PZT (Pb [Zr, Ti] O3)

41 Semiconductor diamonds at a practical level

40 Nanomaterials that show a practical, meaningful stimulus response at necessary times and places

34 Heat-resistant alloys that can bear a load of 15 kgf/mm2 (about 150 MPa) for 1,000 hours or more at a high (atmospheric) temperature of 1200°C

36 Anisotropic nanocomposite magnets with a (BH)max=400 kJ/m3(50.3 MGOe) or greater through the nanometer-scale control of heterostructure

31 Macromolecule materials with conductivity and environment resistance equivalent to copper at room temperature

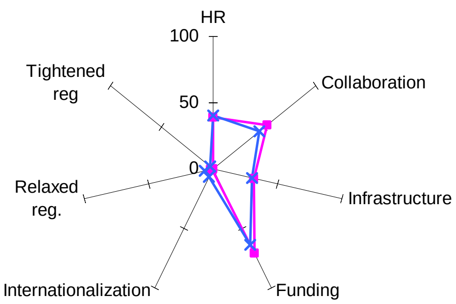
30 All-organic ferromagnets with a Curie point above room temperature

33 Macromolecule superconducting materials with a transfer point above the temperature of liquid nitrogen

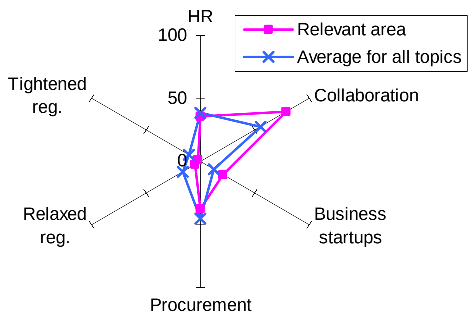
35 Superconductors with a transfer point at room temperature and above

Government involvement

Effective measures for technological realization



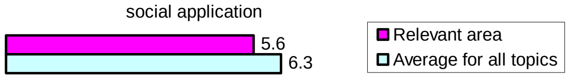
Effective measures for social application



Funding is highly desired for technological realization, as is Collaboration for social application. Stronger collaboration is needed to move the technologies realized through basic research into industry.

Necessity of government involvement towards technological realization

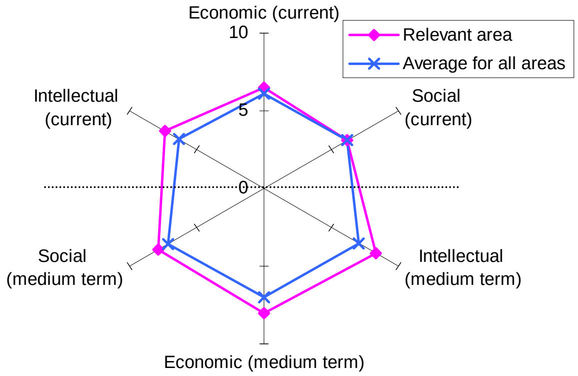
Necessity of government involvement towards social application



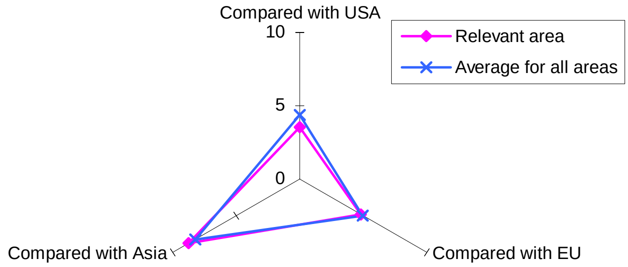
85 Nanobiology (nanotechnology and materials)

Of technologies representative of this area, first, biochips, sensors, and other diagnostic technologies, and basic technologies for drug delivery are expected to be established, followed by the realization of treatment technologies such as artificial organs and microsurgery. Technological realization for all will come relatively early, by 2015, but social application is seen as taking until after 2020 to 2025, requiring long-term efforts.
Current contribution to increased intellectual assets is seen as high, with all three types of impacts becoming important in the medium term. Japan's R&D level is behind that of the USA and roughly even with that of the EU. Japan has improved slightly relative to both the USA and the EU compared with five years ago.

Expected impacts



Japan's R&D level



Realization timeline

65 Biochip diagnostic systems that can accurately diagnose onset risk for cancer and other serious diseases and supply information for setting treatment within a very short time.

63 Cell tissue sensors (biosensors composed of cells and tissue) used in place of animal experimentation.

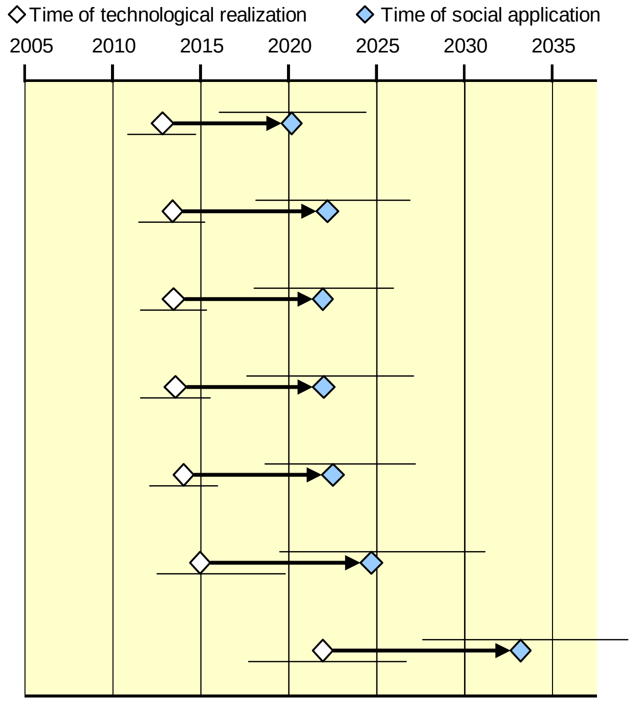
62 Nanocarrier systems that deliver drugs and genes to target cells in the body and are directed by outside signals.

59 Technology to predict three-dimensional structure from the primary sequence structure of proteins with about 30,000 molecules.

60 Actuators made from intelligent materials that can be utilized in medical devices for the in vivo use such as microsurgery.

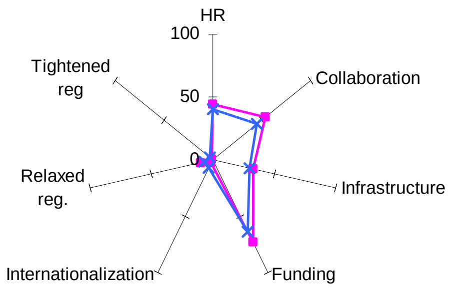
61 Hybrid-type artificial organs with self-organized tissue derived from stem cells.

64 Biocomputer devices utilizing cultured nerve cell networks.

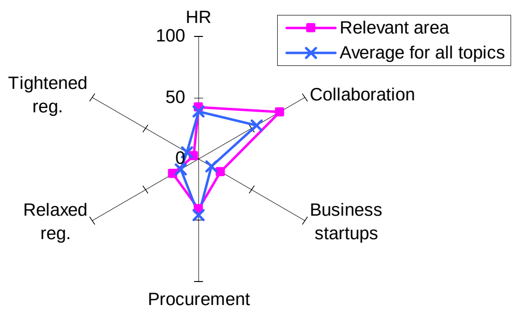


Government involvement

Effective measures for technological realization



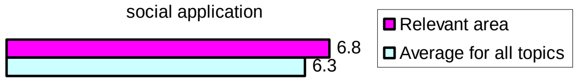
Effective measures for social application



Expectations for government involvement are high. Concretely, Funding for technological realization and Collaboration are needed for technological realization.

Necessity of government involvement towards technological realization

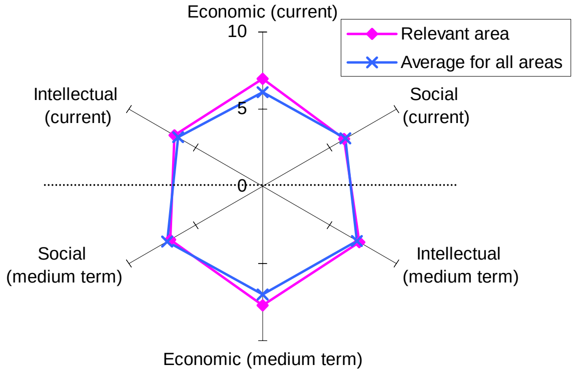
Necessity of government involvement towards social application



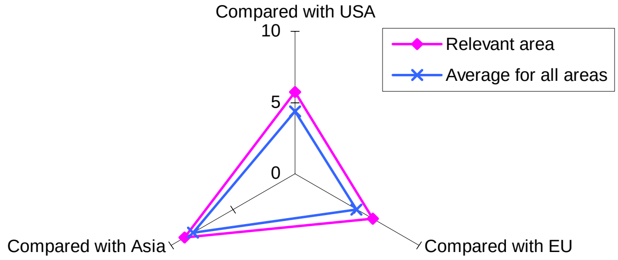
89 Manufacturing technology for high-value added products

All three kinds of impacts can be considered important, with the importance of this area increasing particularly in the medium term. Japan is in a leading position. First, forming technology that does not require dies will be realized. Reflecting the trend towards high-mix, low-volume production, reconfigurable realization of manufacturing systems, microreactor-based on-demand manufacturing for the chemical industry, etc., can be expected around 2020. In the long term, such trends in product manufacturing can be seen as connected with the realization of customization based on individual characteristics and with simulation technology to forecast unformed market needs.

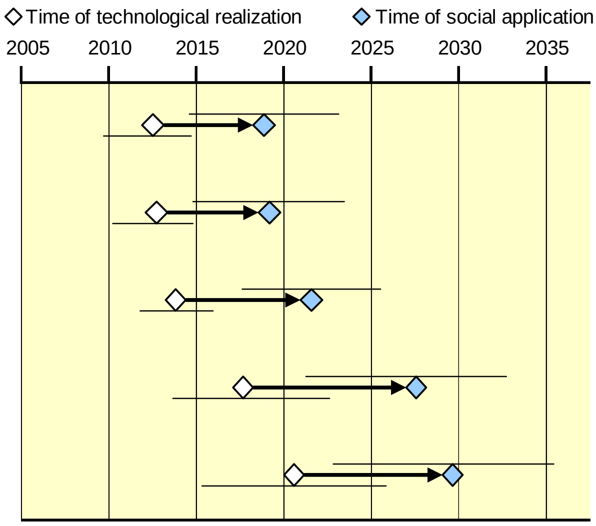
Expected impacts



Japan's R&D level



Realization timeline



16 Technology for forming and machining a one-off product without using a mold.

14 A reconfigurable manufacturing system in which production volume can be quickly and flexibly adjusted to each of many different products.

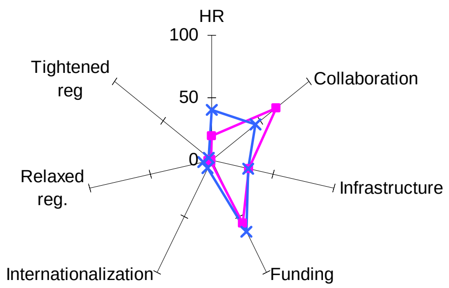
15 On-demand manufacturing technology for pharmaceutical drugs and chemicals based on microreactors.

12 Technology for making customized products for which distinctive characteristics (e.g. physical constitution, sensibilities, five senses, stress, genetic information) of individuals are measured, analyzed and used for product design.

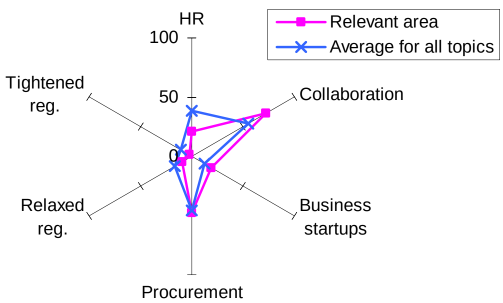
13 Simulation technology for detecting and embodying values in need among people before specific needs are formulated.

Government involvement

Effective measures for technological realization



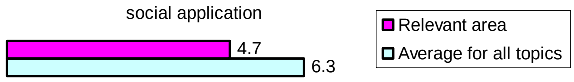
Effective measures for social application



Government involvement through Human resources is seen as important for both technological realization and social application. This can be considered a manifestation of awareness that creation of the value that contributes to the manufacture of high-value added products is based on the creative activities of advanced human resources.

Necessity of government involvement towards technological realization

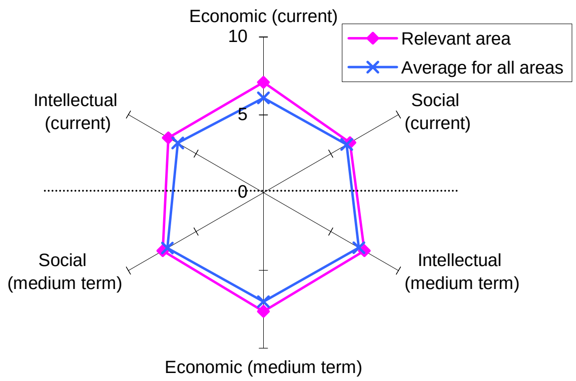
Necessity of government involvement towards social application



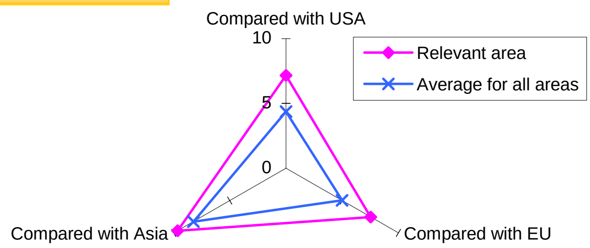
92 Human and robot participation in manufacturing

Japan leads in this sector, and all three types of impacts are large. This area can be roughly divided into topics likely to be achieved in the medium term (around 2020) and those likely to require longer times for realization (2020–2030). The former include robots for work in hazardous environments, the impact of robot use on employment opportunities in manufacturing, and avoidance of human error. In the long term, the path towards integration of humans, machines, and data can be seen, and beyond that lies biological integration including biotechnology and robot control utilizing advanced detection of human brain waves.

Expected impacts



Japan's R&D level



Realization timeline

32 Technology for using robots in dangerous or hazardous work in manufacturing processes to ensure human operators' safety.

31 Digitization and advanced industrial robots reshape the job market and the employment practices in the manufacturing sector.

33 A system that issues an alert when a possibility of human error is detected through real-time analysis of human behavior across the shop floor.

37 An operator support system that creates work environments friendly to all workers including women, the elderly, and the disabled.

39 Manufacturing technology based on robots that can adapt to change in the operational environment with real-time 3D image processing and force control functions.

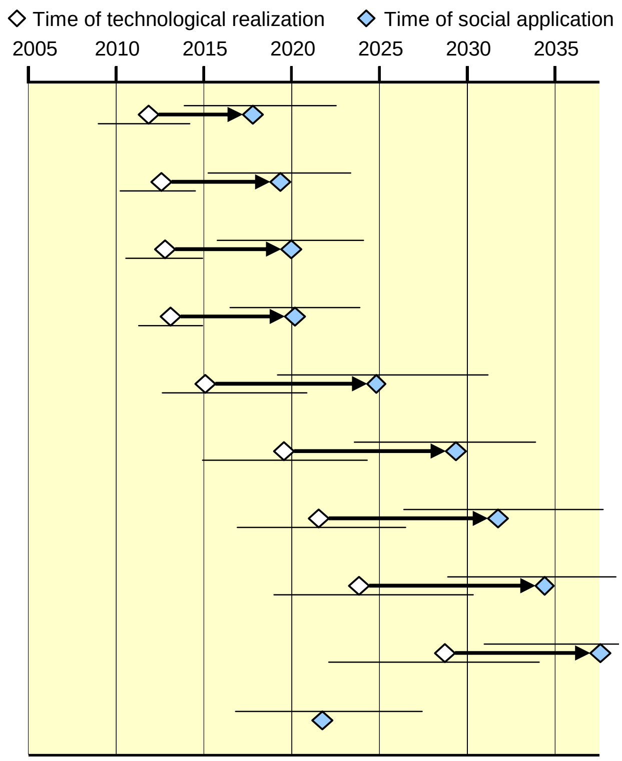
35 A common global language (including software) to express manufacturing information and knowledge is established, resulting in an interface technology through which communications (including intentions) between humans, machines, and information systems can be conducted accurately across different cultures and languages.

38 Production system technology based on robots with self-repair capability.

36 Manufacturing and process design technologies resulting from the discovery of new laws based on life science.

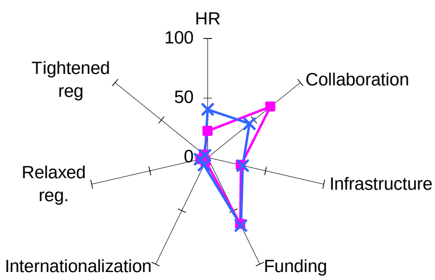
40 Technology for controlling robots in human-robot cooperative tasks using high-accuracy detection of human brain waves.

34 In the manufacturing sector, women account for 50% of researchers and engineers.

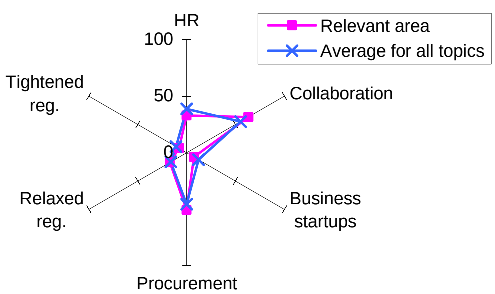


Government involvement

Effective measures for technological realization



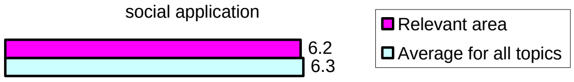
Effective measures for social application



The relatively low value for Collaboration for technological realization is probably due to the strong image of this area as led by corporations with their own technological prowess. Expectations are particularly high government involvement through Human resources.

Necessity of government involvement towards technological realization

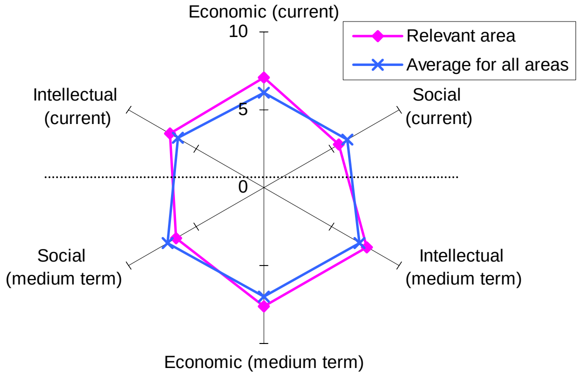
Necessity of government involvement towards social application



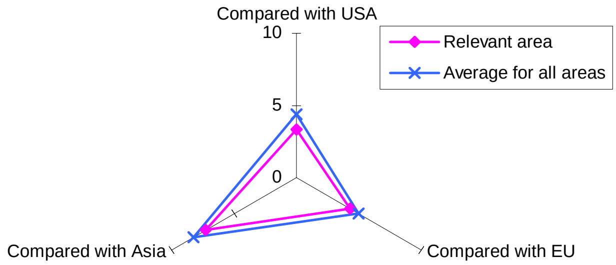
97 Knowledge management

This area supports the knowledge creation activities of business, government, non-profit organizations, and so on, aiming to maximize intellectual production. From the perspective of project management, it seeks to move from traditional intellectual creation activities in single organizations or sectors to free participation in such activities through project systems. In order to turn knowledge bases into data assets that can be reused, intellectual creation support systems that manage and share text documents and so on within organizations are needed. Such systems must be able not only to collect documents and manage them in a uniform way, they must be able to analyze their meanings. Furthermore, so that users have easy access to their contents, the systems must have the ability to know what kind of data users want and to collect data that are relevant to users. The area may play an important role in economic activity by increasing efficiency through the modularization of intellectual creation. In addition, experiments in creating quasi-markets for trading information within an organization as a means of motivating individuals towards more intellectual creation and the formation of knowledge bases are also known to exist. This method could also tie in with indirect value assessment of knowledge bases.

Expected impacts



Japan's R&D level



Realization timeline

9 Methods of assessing and utilizing the database, knowledge base, and knowledge network (a social network in which people with knowledge are known and accessible) built within an organization are established and made widely available.

7 As with the case of open source software, diverse goods and services, regardless of price, are developed, produced, sold, and supported primarily by consumers to meet their needs.

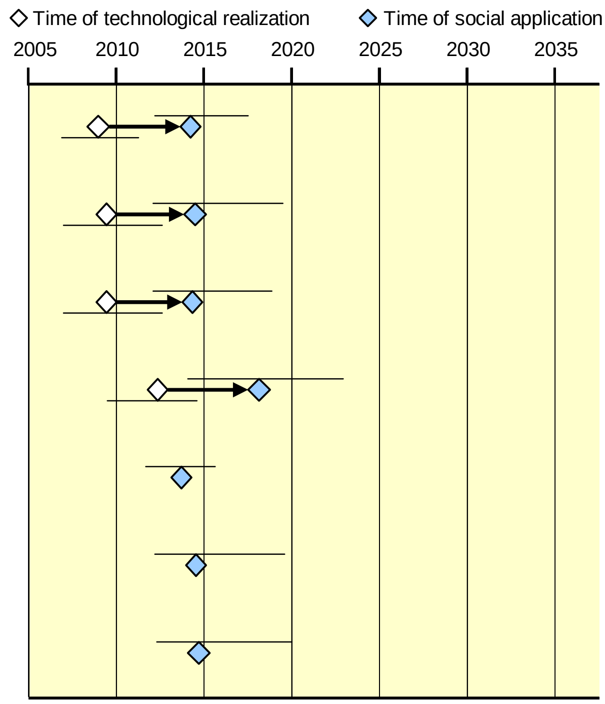
8 For diverse goods and services, technology standardization and module-based research and development practices intensify, resulting in improved efficiency in overall R&D for any goods and services.

10 In the area of R&D project management, methods of planning, performing, controlling, and assessing research projects are established, enabling an average 50% increase in labor productivity in R&D.

6 It becomes the standard business practice for listed companies that operations such as product development and strategy building are conducted under independent projects in which individuals or freelancers can participate without having to belong to any company.

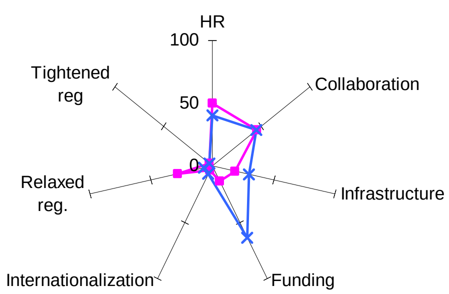
12 It becomes a common approach to accelerating new discoveries and new technological developments that technological problems of companies and industries are widely publicized for a public call for solutions or for a contest in which proposed solutions are examined.

11 A system for trading corporate databases and knowledge bases within and across corporate boundaries is built, allowing the wide and active trading of such knowledge based on economic incentives.

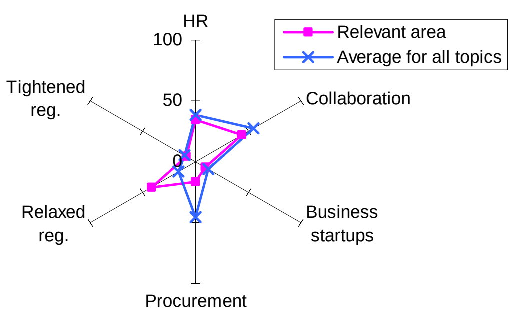


Government involvement

Effective measures for technological realization

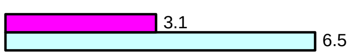


Effective measures for social application

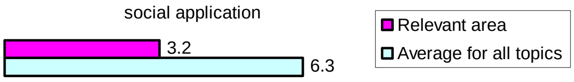


There is a clear division between research on knowledge management in organizational theory and on knowledge management systems in information technology. Integration of science and the humanities in this field is expected to create new business opportunities in the information industry. Strengthened policy collaboration and interdisciplinary human resource development are therefore needed.

Necessity of government involvement towards technological realization



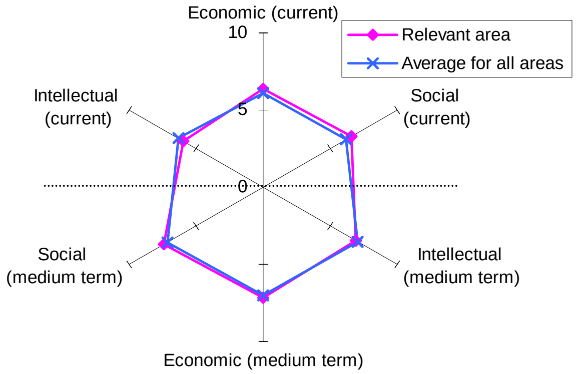
Necessity of government involvement towards social application



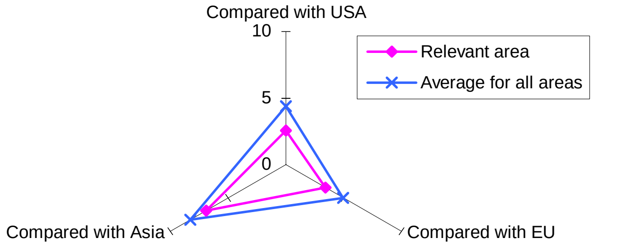
100 Risk management and finance

Risk can be divided into "natural disaster risks" such as earthquakes, droughts, wind and flood damage, and global warming; "social risks" such as population explosions, population declines, aging populations, the breakdown of communities, crime, disease, and workplace accidents; "political risks" such as war, terrorism, ethnic conflict, and famine; "economic risks" such as stocks, commodities trading, interest rates, currency, credit, and other aspects of economic activity; and individual "lifestyle risks" such as employment, income, health, and safety. Ways of handling risk include designing and implementing risk avoidance, risk reduction, risk transfer, and risk response in the public sector, corporate systems, and individual lives. In order to manage risk in these ways, rational analysis of risk is necessary.

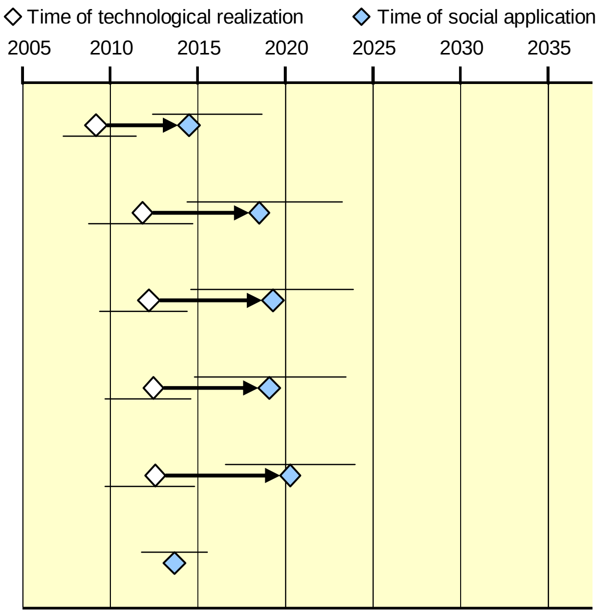
Expected impacts



Japan's R&D level



Realization timeline



29 To reduce market risks arising from the fluctuation of currency values and international commodity (e.g. energy) prices, major Japanese companies (over 30% of those listed) measure and control risk amounts daily by identifying in advance the risk factors.

30 A rapid increase in the amount of data available to companies and advances in data analysis technology result in better prediction technologies that allow companies to evaluate diverse risks. To take advantage of these technologies, scenario planning and other tools are developed, enabling risk control that can reduce fluctuations in operating profits by half.

33 As fusion between insurance and capital markets progresses, a risk control method called alternative risk transfer (ART) advances in structure. Thus, various risks of companies and individuals are diversified and transferred to investors on a large scale to achieve integrated risk management.

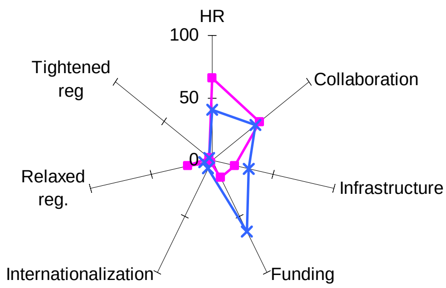
32 Common, universal systems for evaluating and controlling project risks are established.

31 In Japan, advances in the behavioral scientific analysis of the strategy building process in the public and corporate sectors lead to the ability to promptly and effectively make decisions under competitive circumstances.

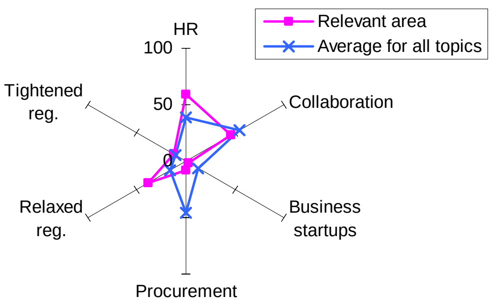
34 In Japan, securities markets where relatively small, unlisted companies can raise small funds that range from a few tens to hundreds of millions of yen are formed.

Government involvement

Effective measures for technological realization

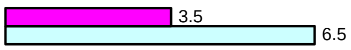


Effective measures for social application

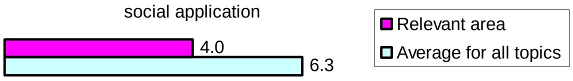


Close collaboration among corporate, government, and social systems is inseparable from the realization of industrial infrastructure technology. Strengthened collaboration is desirable as proper promotion policy. In addition, the integration of scientific and humanities education is essential in this area. Development of advanced human resources at the university and postgraduate level to develop and spread these technologies is seen as important.

Necessity of government involvement towards technological realization



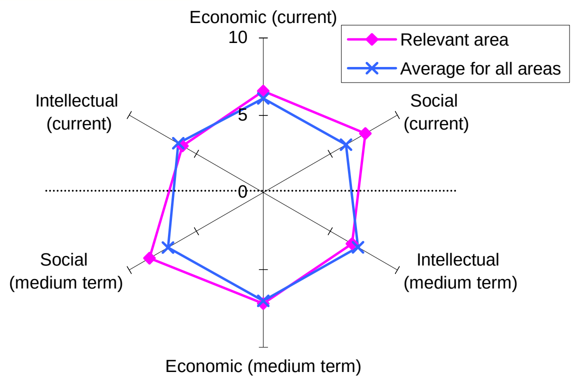
Necessity of government involvement towards social application



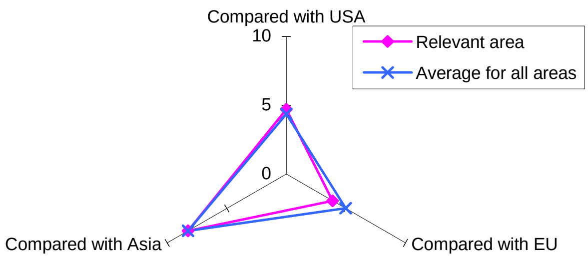
109 Social infrastructure technology responsive to an aging society

Technology to create urban facilities and public spaces that are safe for everyone, including the elderly and people with disabilities, will be realized technologically before 2010 and applied in society by around 2015. In addition, social application of ubiquitous computing and robot technology that can be securely enjoyed by individuals anywhere at any time will be accomplished around 2020.
Social impact is the largest expected impact, both currently and in the medium term, but economic impact is also expected. Japan's R&D level is about even with that of the USA. Japan is somewhat behind the EU, but has made up some ground compared with five years ago.

Expected impacts



Japan's R&D level



Realization timeline

21 A sensor-applied guidance system for people with visual impairment on railway platforms.

26 A public sign system (e.g. for traffic signs) that takes account of age-related deterioration in dynamic vision.

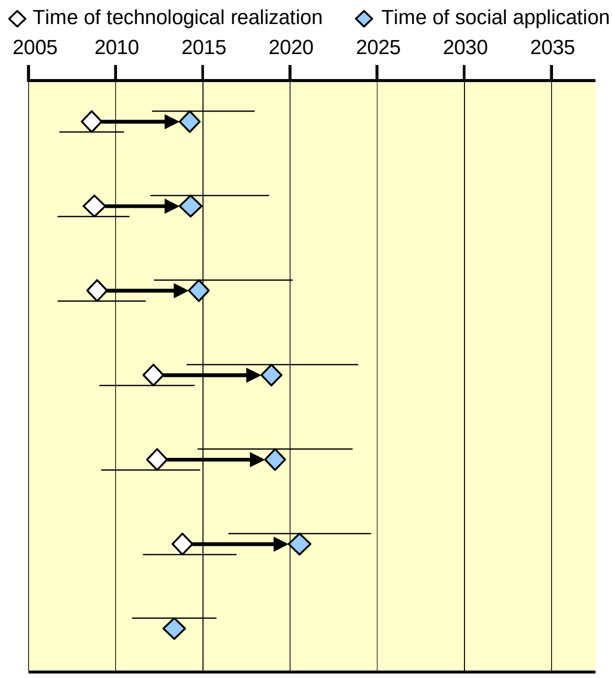
25 Technology for designing public spaces where anyone can move around safely and without barriers.

24 An information sharing system in which all accidents and crimes, from a slight injury to a fatal accident to a murder, and their sites are recorded so that anyone approaching the site can be informed of the potential risk and avoid it.

22 A ubiquitous computing environment that provides helpful information for the elderly and the disabled (visually impaired) in urban public spaces so that they can freely and safely move around (intelligent wearable devices and sensor, combined with embedded sensing networks and the communication environment to support them).

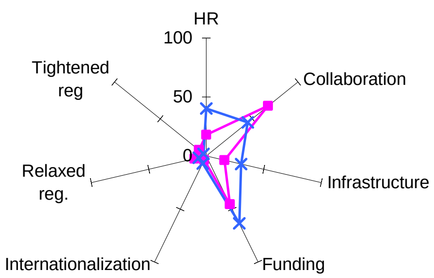
20 A house equipped with robots and devices that assist an elderly person in eating, bathing, using the toilet, and enjoying pastimes without any help from a caregiver.

23 Proliferation of collective houses (shared by groups of individuals), group homes (shared by groups of elderly people), and other type of houses adapted to the aging society with a declining birthrate.

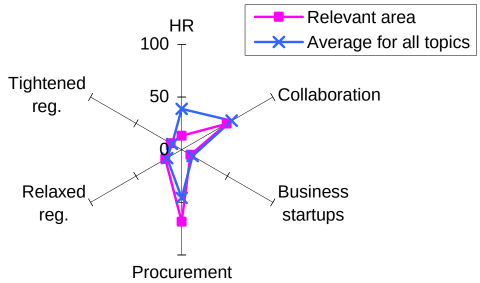


Government involvement

Effective measures for technological realization



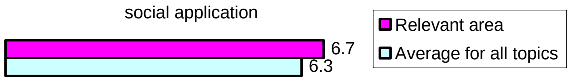
Effective measures for social application



Collaboration for technological realization is especially strongly desired. R&D must proceed with Collaboration across sectors such as city planning, construction, information, and psychology.
For social application, there is a strong desire for Relaxed regulation and Procurement.

Necessity of government involvement towards technological realization

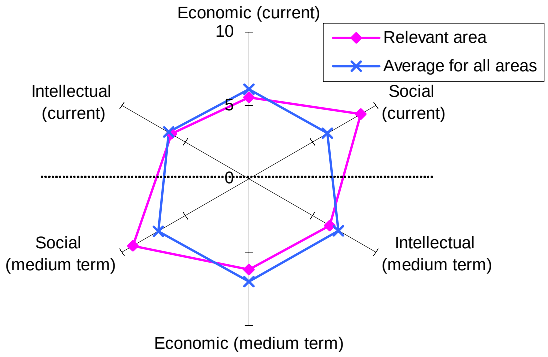
Necessity of government involvement towards social application



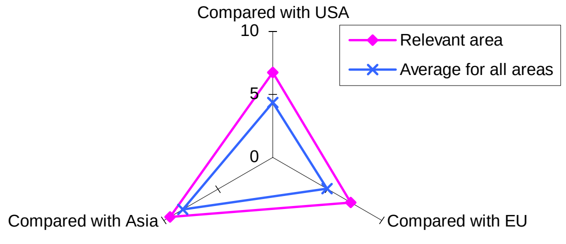
114 Disaster prevention technology

Measures now progressing, such as warning of earthquakes before they arrive and evacuation navigation, will be technologically realized by 2010, with social application requiring until 2015. Technology for disaster simulation, accurate prediction, recovery support, and so on will be realized over a few years after 2010, with social application taking about five years after that. Social application of medium-term prediction of major earthquakes will come after 2020, so there is a wide range of dates in the area. The impacts expected to be largest are social impacts such as contributions to safety and peace of mind and improved quality of life. Japan's research level is ahead of both the USA and the EU, and the lead is larger than it was five years ago.

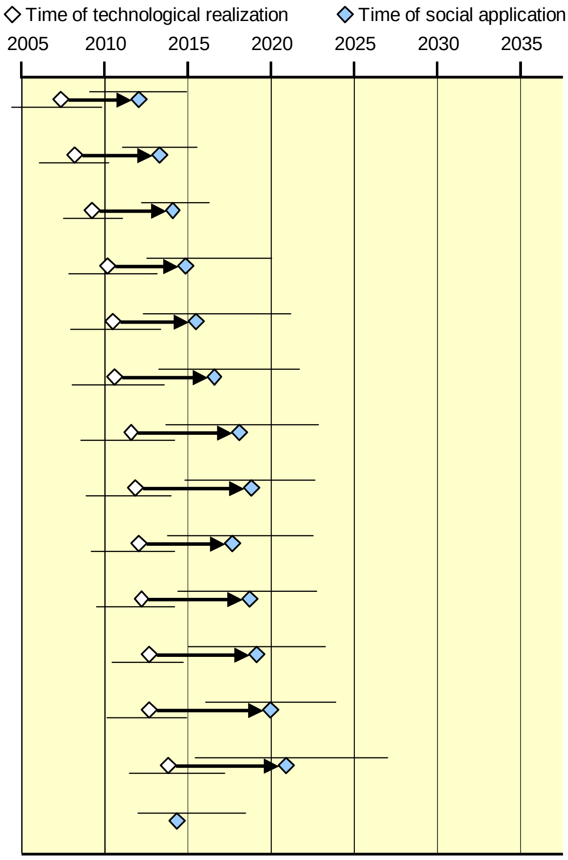
Expected impacts



Japan's R&D level



Realization timeline



60 System technology for promptly providing provisional housing after disasters.

47 A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.

52 A disaster prevention system that ensures smooth evacuation, using navigation with personal mobile terminals.

50 Technology for accurately simulating the behavior of structures and the ground motion in response to a strong earthquake.

59 Technology for formulating an effective response strategy in the event of a major disaster, using systems for efficiently assessing the damage and predicting its spread.

49 Fire extinguishing and rescue technology adapted to fires in high-rise buildings.

57 Widespread adoption of earthquake risk management as a result of the establishment of the technique for long-term estimation of the probability of earthquake occurrence.

55 Technology for supporting the restoration of the functions of an urban city that has been severely and extensively paralyzed by a large-scale power failure or a long-duration break in the water supply.

54 A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management (transport, storage, treatment) and in systems for warning, evacuation, and regulation.

53 The elucidation of the slope failure mechanism leads to the development of a system that can detect the possibility of slope failure and help appropriate actions (e.g. closing the road) to be taken to prevent accidents.

51 High-accuracy rainfall prediction technology capable of providing reliable forecast information on floods and landslides.

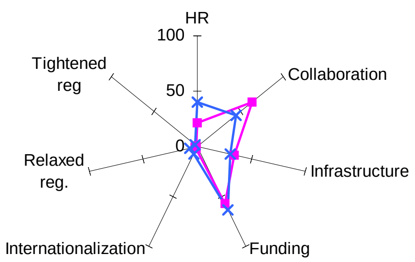
56 Disaster rescue robot technology applicable to human search and rescue at the site of a disaster.

48 Technology for medium-term (5-10 years) prediction of major earthquakes (magnitude 8 or greater) by the analysis of crustal strain distribution and the records of past earthquakes.

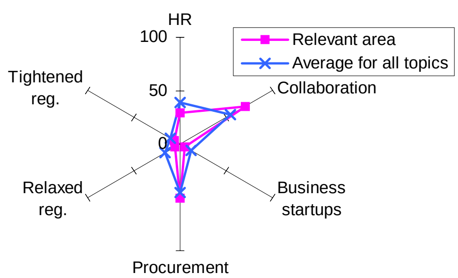
58 Construction of effective information and social systems that help improve the capacity of community-based activities for disaster prevention and welfare.

Government involvement

Effective measures for technological realization



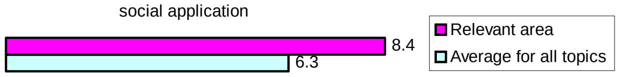
Effective measures for social application



The necessity of government involvement is high. For both technological realization and social application, the desired concrete measure is Collaboration. Collaboration across a wide array of fields to concretely apply research results and industry-academia collaboration for technological realization are important.

Necessity of government involvement towards technological realization

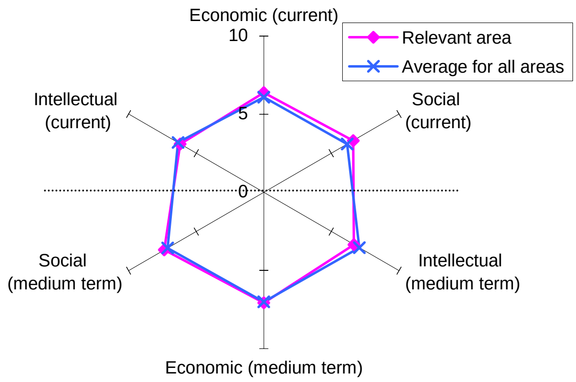
Necessity of government involvement towards social application



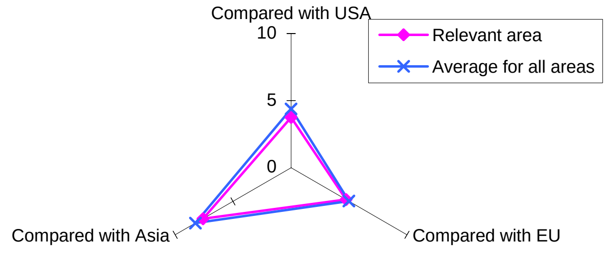
120 Safety, security, and stability of day to day life

The USA is well ahead in this area, and Japan is somewhat behind the EU as well. Its social impacts are seen as important in the future, as are its economic aspects. The realization of multifunction smart cards and low-cost biometric recognition is anticipated in the relatively near future (2008). This can lead to safety and security extending beyond this type of individual security, to areas such as family lifestyle risk assessment and the formation of local communities. Constructs in which robots and information provision systems support such an environment can be imagined.

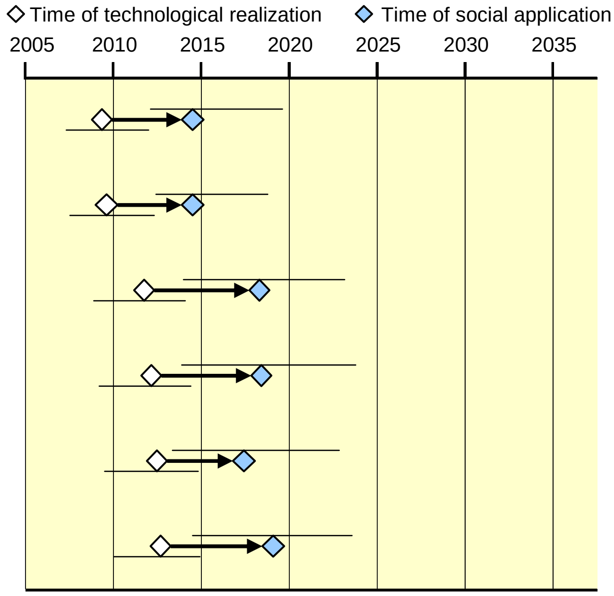
Expected impacts



Japan's R&D level



Realization timeline



5 A multi-function smart card that performs personal authentication and other security functions, electronic payments, etc. and may be used for almost all transactions and purchases across the world.

6 Low-cost, fast, and secure biometrics authentication technology as a means of identification verification to prevent crime.

2 Technology for promoting the formation of local communities using disaster prevention, crime prevention, and welfare as the key concepts.

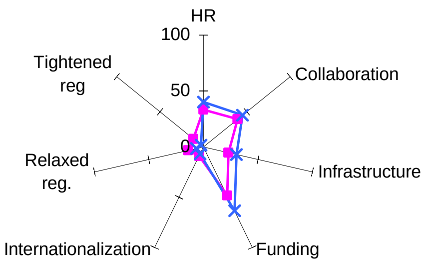
3 An assessment system for the domestic risk of individual households and a system for supporting concrete safeguards against each risk item.

1 A robot that provides diverse information and services to enrich people's lives and allows distant family members to monitor each other's safety and health.

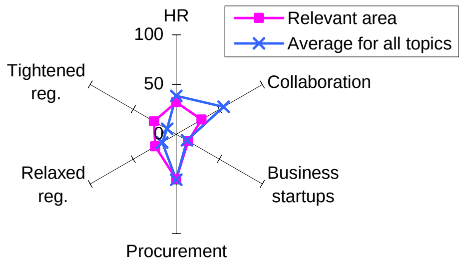
4 An information service system that contributes to reducing anxieties about old age by supporting the decision-making process based on future prediction.

Government involvement

Effective measures for technological realization



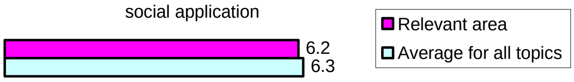
Effective measures for social application



This area is characterized by high overall expectation for government involvement for technological realization, with little overall expectation for involvement for social application. Interestingly, values are relatively high for both Tightened and Relaxed regulation for social application.

Necessity of government involvement towards technological realization

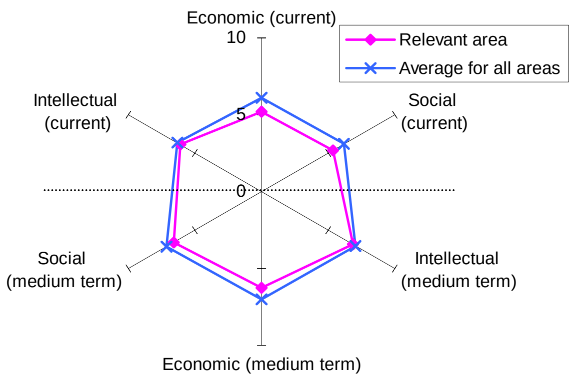
Necessity of government involvement towards social application



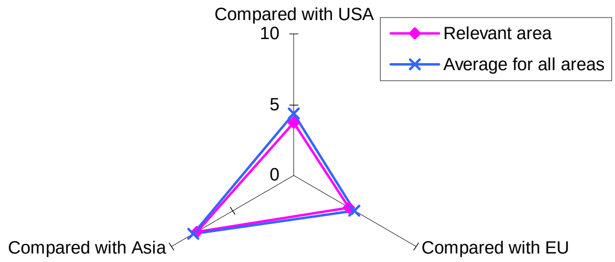
124 Social application of brain research

Realization of topics in this area is expected slightly ahead of those of other areas (around 2015). Japan's R&D level is seen as behind those of both the USA and the EU. This is an area without very high expected impacts currently or in the future. The topics will develop towards concrete contributions to society through research on the development of healthy children's brains and media, controlling decreased brain function in the elderly, elucidation of the mechanisms of learning disabilities, and so on. Laboratory understanding is anticipated around 2015, with diffusion in society following about 10 years later.

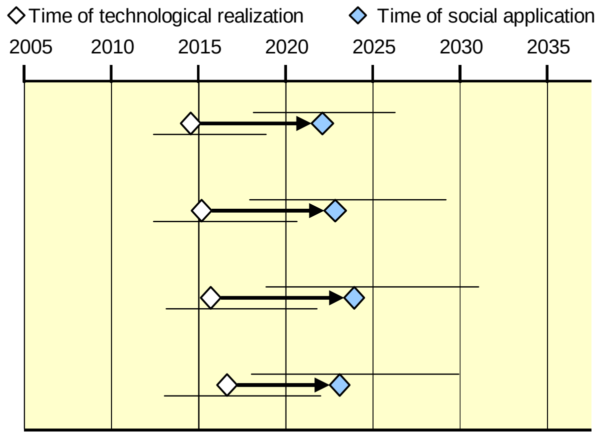
Expected impacts



Japan's R&D level



Realization timeline



25 Media technology that facilitates the sound development of children's brain functions for thinking, creating, and communicating.

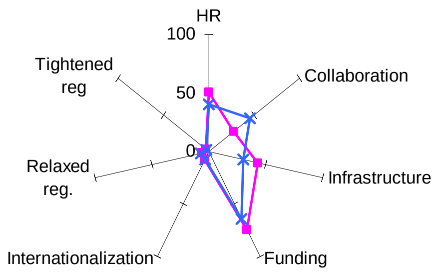
26 A system that prevents senile dementia by inhibiting impairment of an elderly person's brain function.

28 Technology for assisting people who cannot make oral or written conversation because of disease or other reasons in communicating smoothly with others by reading their thoughts based on brain activities.

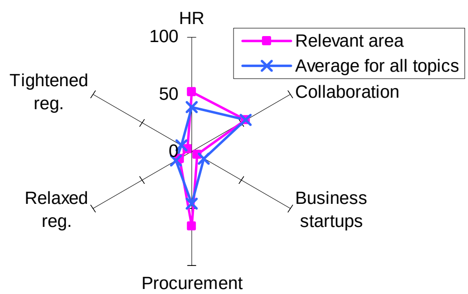
27 Remedies for truant students, classroom chaos, and learning disabilities as a result of the elucidation of the brain mechanisms behind them.

Government involvement

Effective measures for technological realization



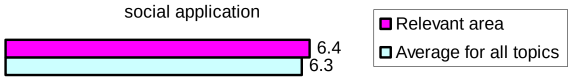
Effective measures for social application



Perhaps because it is seen as still at the level of basic research, for technological realization this area is seen as needing Infrastructure and Funding, with a low need for Collaboration. For social application, some weight is given to the importance of Human resources.

Necessity of government involvement towards technological realization

Necessity of government involvement towards social application



2.4. Field integration and collaboration

Integration and collaboration continue to advance not only in science and technology fields, but also in fields in the humanities and social sciences. As contributions to solving complex social problems become more and more necessary, field integration and collaboration may increase effectiveness by bringing about measures with new possibilities.

In this survey, we asked regarding the development of Japanese science and technology fields which fields should integrate and collaborate now with an eye to the coming 5 to 10 years (through 2015), and which have a high necessity for integration and collaboration in consideration of the 10 years after that (2016–2025). Figure 2-16 shows the results. Arrows show the fields among which integration and collaboration should take place.

(1) Fields in which integration and collaboration should move forward by 2015

The fields of information/communications, environment, and social technology attract many arrows, showing that they can be considered the centers of integration and collaboration by 2015. Information/ communications in particular draws arrows from 10 fields, all but environment and agriculture/forestry/ fisheries/foods, and in 7 of those fields the ratio of responses was above 50 percent. Meanwhile, the information/communications field should integrate and collaborate with 3 fields, electronics (73 percent), social technology (73 percent), and health/ medical care/welfare (38 percent). Fields with a high necessity of collaboration with the environment field are agriculture/ forestry/fisheries/foods (83 percent), frontier (72 percent), energy/resources (95 percent), social infrastructure (90 percent), and social technology (60 percent), as well as industrial infrastructure (43 percent). Fields with which the environment field should integrate and collaborate are agriculture/forestry/fisheries/foods (48 percent), energy/resources (82 percent), social infrastructure (62 percent), and social technology (35 percent). Fields with a high necessity for integration and collaboration with the social technology field are information/ communications (73 percent), social infrastructure (72 percent), health/medical care/welfare (66 percent), industrial infrastructure (49 percent), agriculture/forestry/fisheries/foods (39 percent), and environment (35 percent). Of these, the social technology field should integrate and collaborate with the fields of information/communications; health/medical care/welfare; environment; and social infrastructure.

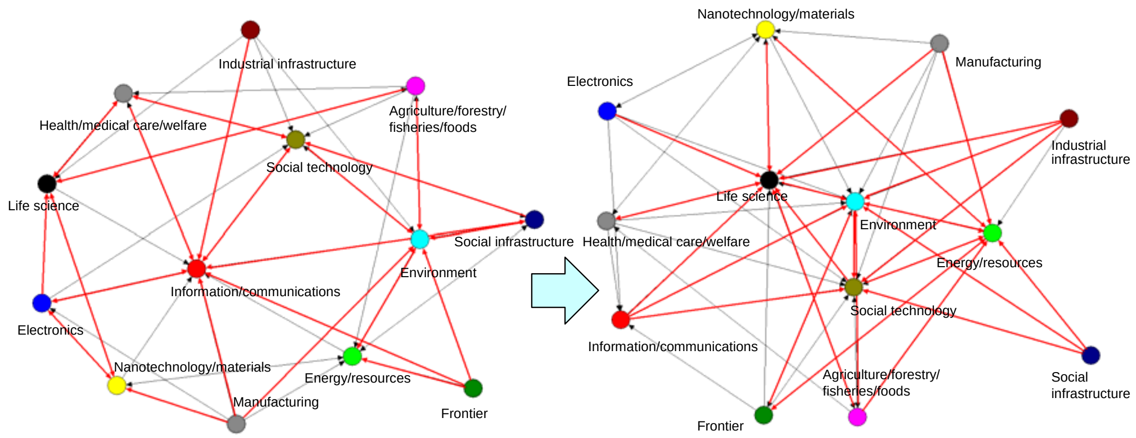
(2) Fields in which integration and collaboration should move forward after 2015

In 2016 and beyond, the fields of environment, life science, social technology, and energy/resources may become the centers of integration and collaboration. All twelve fields have a necessity for integration and collaboration with the environment field. Ten fields, all but energy/resources and social infrastructure, need to integrate with the life science field. Nine fields, all but information/communications, electronics, and health/medical care/welfare, require integration and collaboration with the energy/resources field. Meanwhile, the life science field should integrate and collaborate with 5 fields, health/medical care/welfare (56 percent), environment (52 percent), nanotechnology/materials (40 percent), energy/resources (34 percent), and agriculture/forestry/fisheries/foods (31 percent). The environment field should also integrate and collaborate with five fields, energy/ resources (58 percent), social technology (57 percent), frontier (44 percent), life science (38 percent), and agriculture/forestry/fisheries/foods (30 percent). Fields needing integration and collaboration with the energy/resources field are frontier (66 percent), nanotechnology/ materials (63 percent), agriculture/forestry/fisheries/foods (60 percent), manufacturing (60 percent), environment (58 percent), social technology (58 percent), social infrastructure (51 percent), and industrial infrastructure (45 percent). Targets for integration and collaboration by the energy/resources field are the fields of environment (83 percent), frontier (55 percent), nanotechnology/materials (48 percent), and social technology (37 percent).

Of the fields requiring integration and collaboration by 2015, 29 pairs are considered to need continued integration and collaboration in 2016 and beyond, as shown in Table 2-16. The most common targets for collaboration are environment (7 fields), social technology (6 fields), energy/ resources (6 fields), and life science (5 fields).

It is therefore necessary to consider polices to promote integration and collaboration between the information/communications field and other fields, and to consider policies to form a basis for integration and collaboration with fields such as life science and energy/resources after 2015.

Figure 2-16: Integration and collaboration relationships that should be actively pursued



Integrated and collaborative relationships that should be actively pursued until 2015

Integrated and collaborative relationships that should be actively pursued between 2016-2025

(Note 1) Up to three fields other than the respondent's field with which the respondent's field should seek integration and collaboration
(Note 2) Fields indicated for integration and collaboration by over 30 percent of a field's respondents are connected by an arrow. Mutual cases are indicated by a double-pointed arrow.
(Note 3) Red lines connect fields indicated by 50 percent or more of a field's respondents.

Table 2-16: Fields for which ongoing integration and collaboration is needed over the coming 20 years

Delphi field	Target of collaboration
Information/communications	Social technology
Electronics	Information/communications; Life science; **Nanotechnology/materials;** Social technology
Life science	**Health/medical care/welfare; Agriculture/forestry/fisheries/foods; Nanotechnology/materials**
Health/medical care/welfare	Information/communications; **Life science; Social technology**
Agriculture/forestry/fisheries/foods	**Life science;** Health/medical care/welfare; Energy/ resources; **Environment;** Social technology
Frontier	Information/communications; Energy/resources; Environment
Energy/resources	**Environment; Nanotechnology/materials**
Environment	**Agriculture/forestry/fisheries/foods; Energy/resources; Social technology**
Nanotechnology/materials	**Electronics**; **Life science**; **Energy/resources**
Manufacturing	Energy/resources; Environment; Nanotechnology/materials
Industrial infrastructure	Life science; Environment; Social technology
Social infrastructure	Energy/resources; Environment; Social technology
Social technology	**Health/medical care/welfare; Environment**

*Fields in bold type are those named as targets for mutual collaboration.

Fields for which there is a gap in the perceived need for collaboration and integration are shown in the table below. Integration and collaboration between these pairs may not easily move forward. In order to expand and develop research, it may be necessary to examine initiatives to promote integration and collaboration.

Table 2-17: Fields with gaps in awareness of the necessity of integration and collaboration

	Field 1	Field 2	Field 1 ratio *1	Field 2 ratio*2
By 2015	Agriculture/forestry/fisheries/ foods	Social Technology	39	6
	Frontier	Information/communications	71	3
	Frontier	Energy /resources	60	15
	Frontier	Environment	72	17
	Energy/resources	Information/communications	43	8
	Manufacturing	Information/communications	74	3
	Manufacturing	Energy/resources	34	14
	Manufacturing	Environment	52	6
	Manufacturing	Nanotechnology/materials	73	11
	Industrial Infrastructure	Information/communications	72	10
	Industrial Infrastructure	Life Science	34	0
	Industrial Infrastructure	Environment	43	2
	Industrial Infrastructure	Social Technology	49	9
	Social Infrastructure	Information/communications	56	10
	Social Infrastructure	Social Technology	72	31
After 2016	Information/communications	Life Science	61	25
	Information/communications	Environment	53	17
	Information/communications	Social Technology	59	14
	Electronics	Life Science	78	16
	Electronics	Social Technology	39	8
	Frontier	Life Science	43	13
	Nanotechnology/materials	Life Science	78	40
	Health/medical care/welfare	Environment	43	7
	Agriculture/forestry/fisheries/ foods	Energy/resources	60	6
	Agriculture/forestry/fisheries/ foods	Environment	65	30
	Nanotechnology/materials	Environment	44	8
	Manufacturing	Life Science	54	2
	Manufacturing	Energy/resources	60	4
	Manufacturing	Environment	38	3
	Manufacturing	Nanotechnology/materials	48	11
	Industrial Infrastructure	Life Science	61	0
	Industrial Infrastructure	Energy/resources	66	3
	Industrial Infrastructure	Social Technology	53	3
	Social Infrastructure	Environment	65	25
	Social Infrastructure	Social Technology	58	22
	Social Technology	Life Science	67	24

*1: Percentage choosing Field 2 as target for collaboration with Field 1
*2: Percentage choosing Field 1 as target for collaboration with Field 2
Fields with at 30 percentage points difference. Those with differences of 50 or more percentage points are shaded.

2.5. Overall analysis

2.5.1. Classification of areas

When examining national research and development funding, it is necessary to clarify the effects that the technologies in question will bring about. On the other hand, there are technologies that the national government must address from a long-term perspective, regardless of the impacts that will be created by those technologies in the coming 20 years.

We therefore extracted areas with major impacts, along with those with a high necessity of government involvement towards technological realization, and classified them according to their characteristics. Conditions for extraction are as follows. In order to compensate for bias towards respondents' specialties, method (1) below was used to add extracted areas based on the results of evaluation experts in other fields (Questionnaire B). This enabled 118 areas to be extracted and classified, as shown in the chart below.

<Conditions for extraction>

(1) -1: Areas with major increased intellectual assets

Top one-third of areas in terms of contribution of the relevant area itself to increased intellectual assets (current and medium term)

Top one-third of areas in terms of contribution to the development of other fields (current and medium term)

(1) -2: Areas with major economic impacts

Top one-third of areas in terms of contribution to the development of existing Japanese industry (current and medium term)

Top one-third of areas in terms of contribution to the creation of new industries or businesses (current and medium term)

(1) -3: Top one-third of areas with major social impacts (current and medium term)

Top one-third of areas in terms of contribution to securing safety and peace of mind (current and medium term)

Top one-third of areas in terms of contribution to improved social vitality and quality of life (current and medium term)

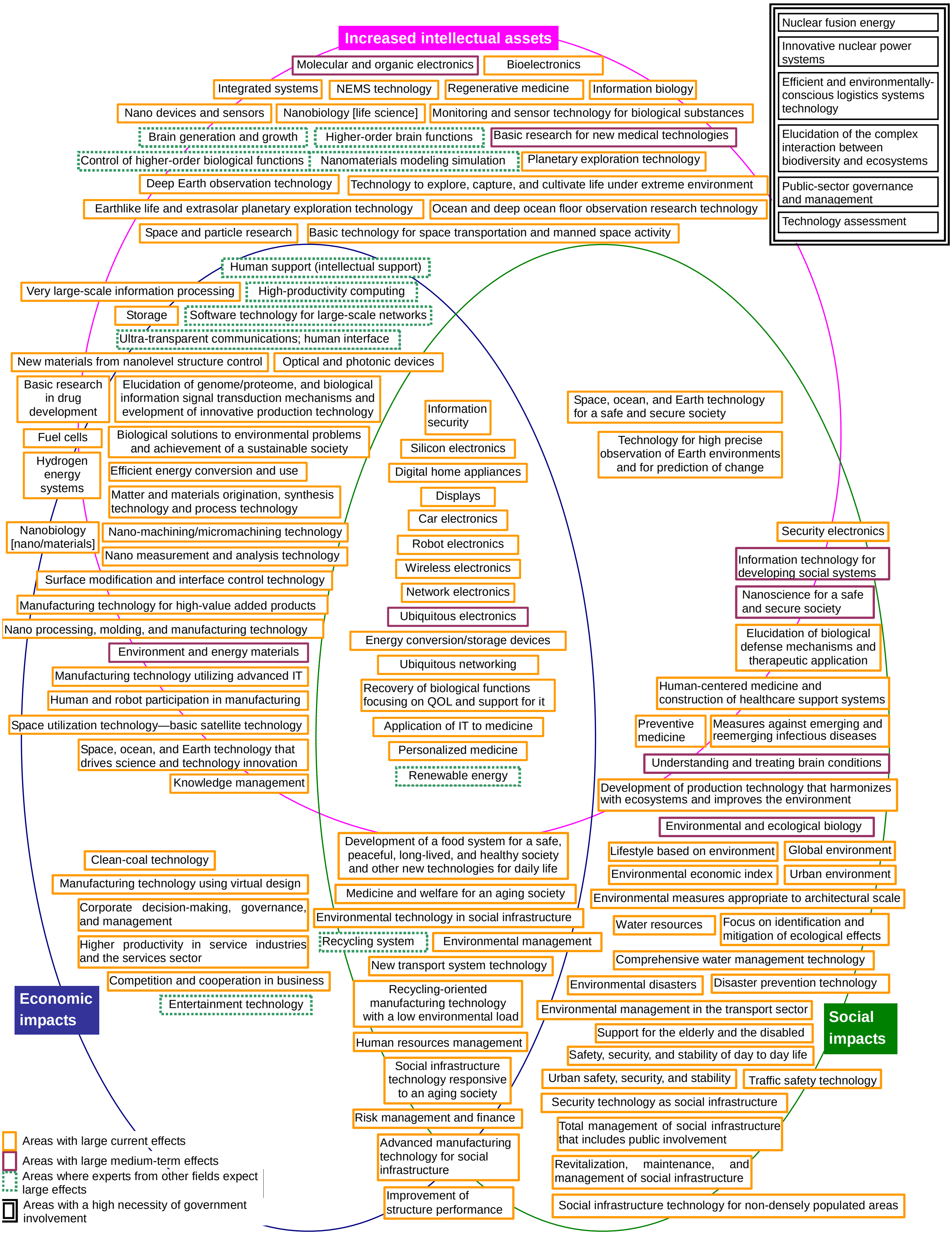
(2) Top one-third of areas in terms of necessity of government involvement towards technological realization (average values of included topics)

Looking at the results of this classification, economic impacts and increased intellectual assets are both large in many areas, suggesting that the tendency of scientific and technological knowledge to bring about economic impacts will further strengthen. In contrast, social impacts and increased intellectual assets are both large in only two areas. This can be seen as corroborating the ideas that shifting from the stage of new knowledge to that of technology in practical use in society often requires much time and that technologies useful in the real world are not necessarily on the cutting edge.

By area, many areas in the electronics field have large impacts of all three impacts, several areas in nanotechnology and materials field are significant in terms of increased intellectual assets and economic impacts, and many areas in the health/medical care/welfare and environment fields have large social impacts.

Areas with major medium-term impacts are those such as information technologies that develop social systems for infrastructure for other fields and life science and medical care related areas such as basic research for new medical technologies and environmental and ecological biology. Areas valued highly by experts from outside fields are brain research, high-productivity computing, software technology adapted to large-scale networks, and other areas related to advancing networks and computing environments.

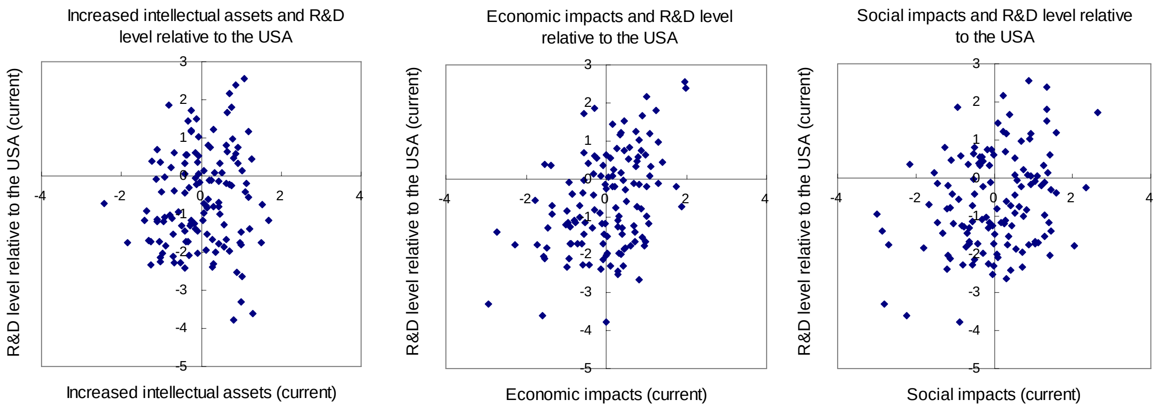
Figure 2-17: Areas with major impacts and high necessity of government involvement



2.5.2. Area impacts and R&D levels

Looking at the impacts brought about by each area (the higher value of the two categories) and R&D level relative to the USA, no trend is visible for either the current time or the medium term, as can be seen in the chart below.

Figure 2-18: Area impacts and R&D level relative to the USA (examples at current time)



*Areas are plotted with average value of each impact, and levels are plotted with "even" as the origin.

Looking at the R&D levels and necessity of government involvement of the high-impact areas discussed in Section 2.2.1., we found the following.

Looking at the R&D levels relative to the USA and necessity of government involvement for the fifty one areas with significant increased intellectual assets, areas with high necessity of government involvement tend to have low R&D levels relative to the USA. Of the 26 areas with a necessity of government involvement above the average for all areas, only three, hydrogen energy systems, fuel cells, and environmental and energy materials, have R&D levels even with or higher than the USA.

Regarding the fifty four areas with major economic impacts and their R&D levels relative to the USA and their necessity of government involvement, these areas are concentrated among those with moderate necessity of government involvement. Twenty-two of these areas have a necessity of government involvement higher than the average for all areas, with the need in the space exploitation technology area particularly high. Of these areas, four areas (hydrogen energy systems; fuel cells; recycling-oriented manufacturing technology with a low environmental load; environment and energy materials) have R&D levels even with or ahead of the USA.

As for the fifty three areas with large social impacts and their R&D levels relative to the USA and their necessity of government involvement, overall the necessity of government involvement is high. The necessity of government involvement exceeds the average for all areas in thirty seven of these areas. Of these, eight areas have R&D levels even with or ahead of USA, the most for any of the three types of impacts.

The table below depicts areas with R&D levels equal to or ahead of the USA's along with measures that should be taken by government for technological realization. Reflecting the overall trend, industry-government-academia and interdisciplinary collaboration and expansion of R&D funding are the most effective measures.

Figure 2-19: Relationship of R&D level and necessity of government involvement in areas with large current impacts

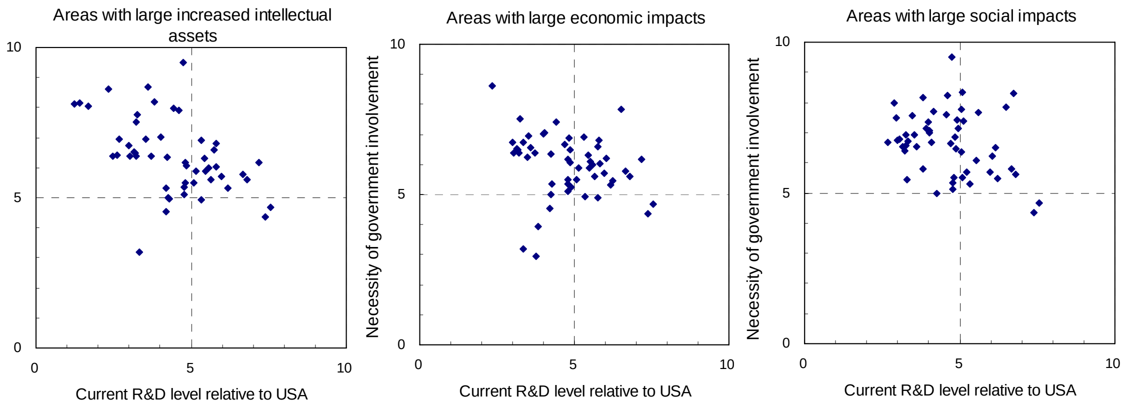


Table 2-18: Areas with major impacts and R&D levels even with or ahead of the USA's

Impact	Areas with R&D levels even with or ahead of USA's	Measures that should be taken by government* (Those with ratios of at least 30 %.)	
		Towards technological realization	Towards social application
Increased intellectual assets	062: Hydrogen energy systems	**Collaboration**, funding, relaxed regulation	Collaboration, **procurement**, relaxed regulation
	063: Fuel cells	**Collaboration**, funding,	Collaboration, **procurement,** relaxed regulation
	084: Environment and energy materials	Human resources, collaboration, **funding**	**Collaboration**, procurement
Economic impacts	062: Hydrogen energy systems	Collaboration, Infrastructure, **funding**, relaxed regulation	Collaboration, **procurement,** relaxed regulation
	063: Fuel cells	**Collaboration**, funding, relaxed regulation	Collaboration,**procurement**, relaxed regulation
	084: Environment and energy materials	Human resources, collaboration, **funding**	**Collaboration**, procurement
	091: Recycling-oriented manufacturing technology with a low environmental load	Collaboration, infrastructure, **funding**	Collaboration, **procurement**
Social impacts	046: Development of production technology that harmonizes with ecosystems and improves the environment	Collaboration, **funding**	**Collaboration**, procurement
	070: Global environment	Human resources, collaboration, **funding**, Internationalization	Human resources, **collaboration**
	071: Urban environment	Human resources, **collaboration,** funding	Collaboration, procurement, **tightened regulations**
	076: Water resources	Human resources, collaboration, infrastructure, **funding**	**Human resources**, collaboration
	091: Recycling-oriented manufacturing technology with a low environmental load	Collaboration, infrastructure, **funding**	Collaboration, **procurement**
	108: Revitalization, maintenance, and management of social infrastructure	**Collaboration**, funding	**Collaboration**, procurement
	114: Disaster prevention technology	**Collaboration**, infrastructure, funding	**Collaboration**, procurement
	118: Environmental management in the transport sector	Collaboration, **funding**	Collaboration, **procurement**

* Bold type indicates the highest ratio answer.

2.5.3. Policies to promote social application

For research and development with the final goal of implementation in society, technological realization without utilization in society cannot be considered a sufficient return on the R&D investment. In order for the fruits of research and development to have real-world impact, direct and indirect support policies, including changes in social systems, are needed. Particularly for items that require time for application in society, measures for social application must be taken along with research and development in order to increase the certainty of their expression in the real world. Furthermore, for items for which early technological realization is forecast, immediate efforts are needed.

Because this analysis asked for times of technological realization and times of social application, periods until social application can be calculated. We therefore examined measures to speed up social application for areas with many topics that require long periods until social application and areas with many topics for which technological realization is expected within 10 years but long periods are required until social application.

Table 2-19 shows the sixteen areas that require at least ten years until social application (average value of included topics). Many of them are in the life science field. Looking at the measures government should take towards social application for these areas, strengthened collaboration, human resources development, and support through taxation, subsidies, and procurement are seen as effective. Other distinctive characteristics are relaxed regulation (28 percent for understanding and treating brain conditions, 34 percent for regenerative medical science, 46 percent for hydrogen energy systems, and 26 percent clean-use technology for fossil resources), improved startup environment (nanobiology 28 percent).

The four areas shown in bold type are those for which immediate examination of measures to bring them to social application is required because their technological realization is expected relatively early, within the ten years ending in 2015, but their social application is expected to be slow, requiring at least ten years. Looking at the measures government should take for social application, strengthened industry-academia-government and interdisciplinary collaboration is seen as effective for each of them.

Table 2-19: The sixteen areas that take at least ten years until social application

Area	Year[*1]	Period	Measures (at least 50% of responses)	Major impacts[*2]
Molecular and organic electronics	2020	10.8	Collaboration, human resources	Int. (M)
Basic research in drug development	2016	10.6	Collaboration, human resources	Int. (C, M)
Basic research for new medical technologies	2019	10.6	Human resources, collaboration	Int. (M)
Understanding and treating brain conditions	2020	10.5	Human resources, collaboration	Soc. (M)
Regenerative medical science	2019	11.3	Human resources, collaboration	Int. (M), Econ. (M), Soc. (M)
Monitoring and sensor technology for biological substances	2015	10.6	Collaboration, human resources	Int. (C, M), Econ. (M)
Environmental and ecological biology	2016	11.4	Collaboration, human resources	Soc. (M)
Nanobiology	2017	10.5	Collaboration, human resources	Int. (M), Eco. (M)
Deep Earth observation technology	2018	10.1	Human resources, collaboration	Int. (C, M)
Space, ocean, and Earth technology that drives science and technology innovation	2017	10.6	Collaboration, human resources	Int. (C, M), Econ. (C, M)
Innovative nuclear power systems	2024	10.6	Procurement, collaboration	—
Hydrogen energy systems	2018	10.1	Procurement, relaxed regulations	Int. (C), Econ. (C, M)
Clean-coal technology	2014	10.7	Procurement, collaboration	—
Resource assessment	2018	10.4	Collaboration, procurement	—
Nano devices and sensors	2014	10.0	Collaboration, human resources	Int. (C, M), Econ. (M)

Area	Year*1	Period	Measures (at least 50% of responses)	Major impacts*2
NEMS technology	2014	11.1	Collaboration, human resources	Int. (M), Econ. (M)
Manufacturing technology in special environments	2019	10.8	Collaboration, procurement	—

*1: Year: Time of technological realization. Average value for the area's topics
*2: C: current; M: medium term Int. (increased intellectual assets), Econ. (economic impacts), Soc. (social impacts)

2.5.4. Examination based on the field classifications of the Science and Technology Basic Plan

We classified the 130 areas according to the eight fields described in the current Science and Technology Basic Plan (life science, information and communications, environment, nano- technology and materials, energy, manufacturing, social infrastructure, frontier) and outside these fields and analyzed them by Basic Plan field. Fields relative to more than one field were counted multiple times, so 178 areas were used as the basis for calculating values.

(1) Areas with major impacts

Table 2-20 shows the indexes for current (within the coming ten years or so) and medium-term (over the ten years from 2016) impacts. We can see that life science and information/ communications contribute to all three types of impacts, that environment contributes to social impacts, that nanotechnology/materials increased intellectual assets and economic impacts, that social infrastructure contributes to social impacts, and that frontier contributes to increased intellectual assets.

For current impacts, the life science field surpasses the average only for increased intellectual assets, but in the medium term they are above average for all three impacts. Only information and communications exceed the average for current impacts of all three types, while in the medium term both life science and information and communications are above average.

Table 2-20: Index of current and medium-term impacts

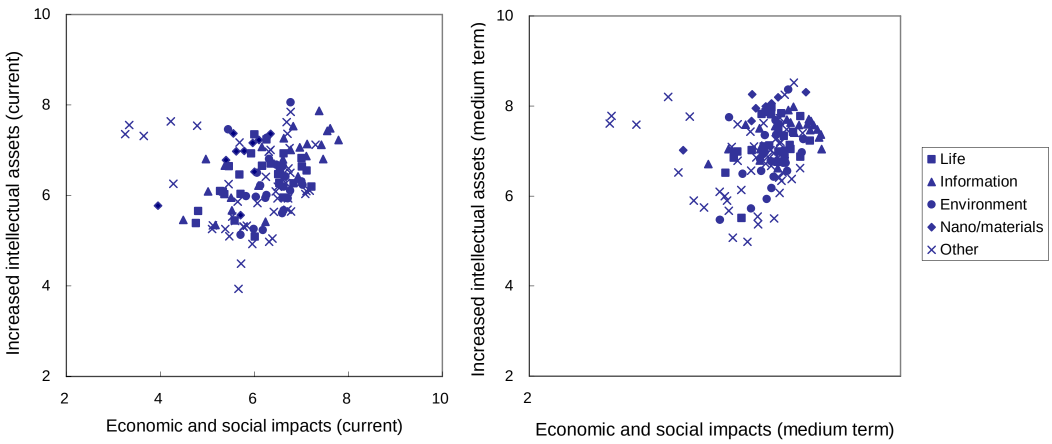
	Impacts	Life Science	Information/ communications	Environment	Nanotechnology/ Materials	Energy/ Resources	Manufacturing	Social Infrastructure	Frontier	Other areas	Average for all areas
Current	Intellectual assets	6.4	6.7	6.2	6.9	6.3	6.7	5.8	7.5	5.7	6.4
	Economic impacts	5.9	6.6	6.0	6.4	6.2	6.9	6.0	5.1	6.0	6.1
	Social impacts	6.2	6.2	6.6	5.3	5.9	5.9	7.2	5.4	5.9	6.2
Medium	Intellectual assets	7.3	7.4	6.9	7.8	6.9	7.5	6.3	7.8	6.6	7.1
	Economic impacts	7.0	7.6	7.0	7.7	7.0	7.7	6.7	5.8	6.8	7.0
	Social impacts	7.3	7.3	7.5	6.6	6.8	6.7	7.9	6.1	6.8	7.1

*Shaded values exceed the average for all areas

Figure 2-20 shows the distribution of current and medium-term impacts. The economic impacts index and the social impacts index are averaged into a single economic and social impact index. The areas of the eight fields are distributed with a certain amount of spread.

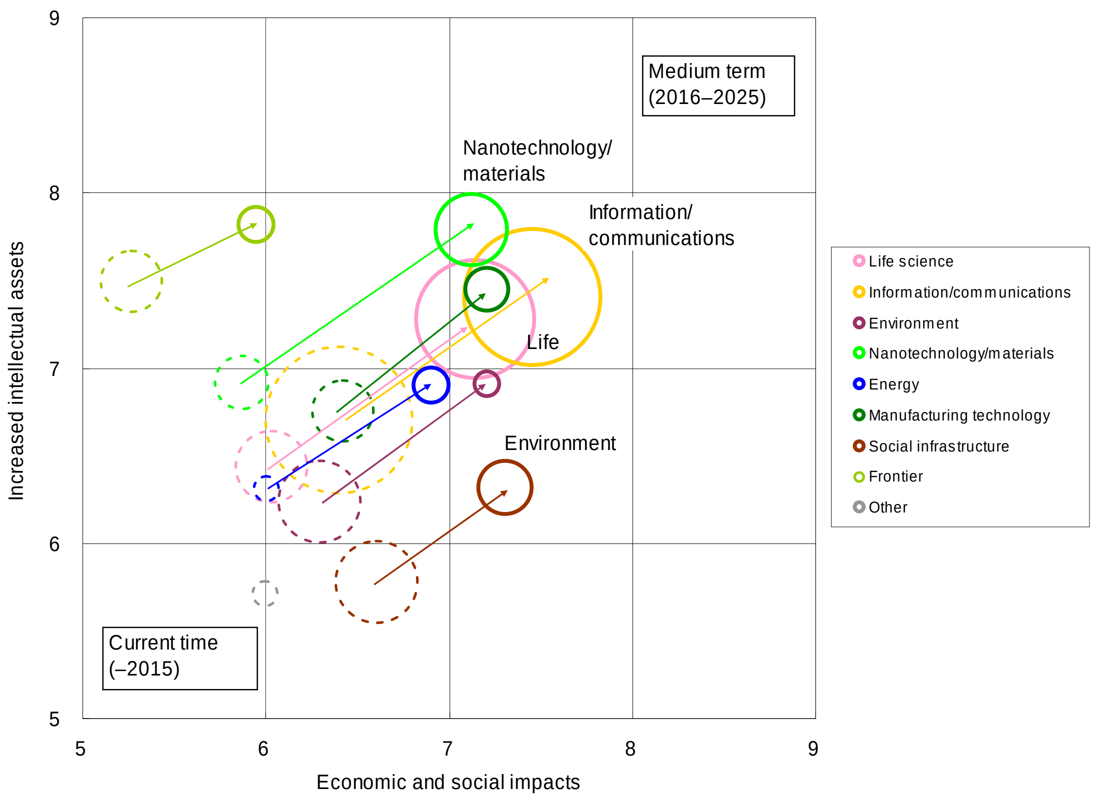
Figure 2-21 shows changes in impact from the current time to the medium term. Circle size depends on the number of areas* with large overall impacts. Information and communications, life science, nanotechnology and materials, and environment have many areas with large overall impacts, with major impacts in both increased intellectual assets and social/economic impacts and significant growth. Life science and nanotechnology and materials have many areas with major overall impact and will grow over time.

Figure 2-20: Current and medium-term impacts



Current (–2015) Medium-term (2016–2025)

Figure 2-21: Changes in the impacts of areas in the eight fields of the Basic Plan



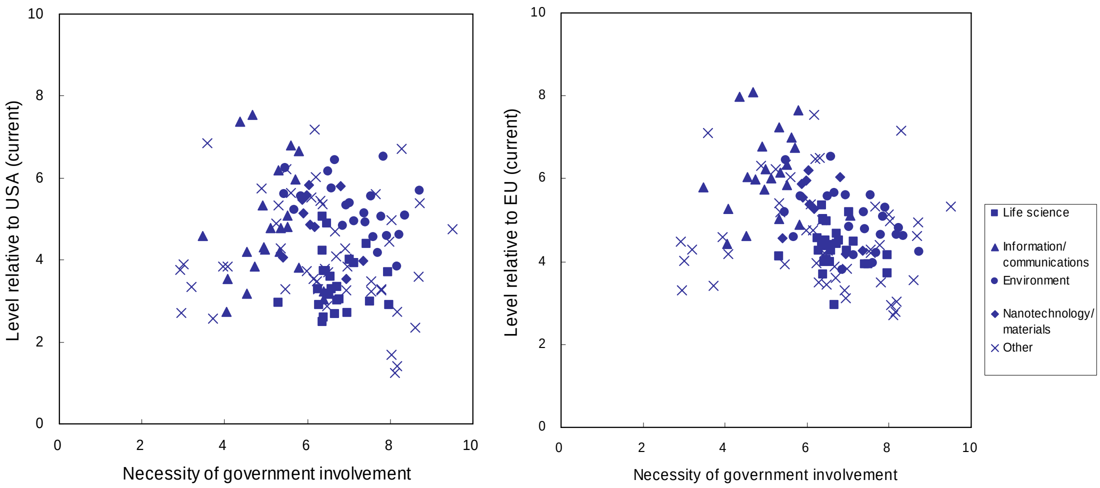
*Areas meeting the following conditions are considered areas with large overall impacts. Fifty-one areas with large current overall impacts and fifty areas with large medium-term overall impacts were extracted. These were allocated to the eight fields or to "other."
(1) Areas in the top one-third (43 areas) of areas in terms of the overall impact index (= $\sqrt{\ }${(increased intellectual assets index)^2+(economic impacts index)^2+(social impacts index)^2)})
(2) The top 10 percent in terms of the index for each impact (increased intellectual assets, economic impacts, and social impacts; 13 areas per impact, totaling 36 areas)

(2) R&D level

Figure 2-22 depicts the relationship between R&D level and necessity of government involvement. The chart averages necessity of government involvement for technological realization and for social application.

The information and communications field has many areas with a high R&D level, but necessity of government involvement is not high for most. The level for life science is not necessarily high, but the necessity of government involvement is high. The R&D level for environment and nanotechnology and materials is roughly even, and the necessity of government involvement is high in many areas. Energy and manufacturing technology show similar trends to environment and nanotechnology and materials. The frontier field has a particularly high necessity of government involvement.

Figure 2-22: Necessity of government involvement and current R&D level



(3) Examination of the spreads of fields and areas

Dividing the eight fields into four priority fields (life science, information and communications, environment, and nanotechnology and materials) and four other fields (energy, manufacturing technology, social infrastructure, and frontier), for areas that are included in more than one field, the chart below shows whether they are in priority fields or four other fields. For example, an area included in both the information and communications field and the social infrastructure field, is categorized to “Relevant field + four other field” in the information and communications, while it is categorized to "Relevant field + four priority field" in the social infrastructure field.

Of the four priority fields, the environment and nanotechnology and materials fields include more areas that overlap with four other fields than areas that belong exclusively to them. In addition, their interdisciplinary nature can be seen in the fact that some areas overlap the field in question, the other priority fields, and the four other fields. The environment field has several areas that overlap with the four other fields, while several areas in the nanotechnology and materials field overlap with the remaining priority fields. Looking at the four other fields, the energy, manufacturing technology, and social infrastructure fields include many areas that overlap with the four priority fields. Thus, there are many areas in the four priority fields and in the four other fields that span multiple fields.

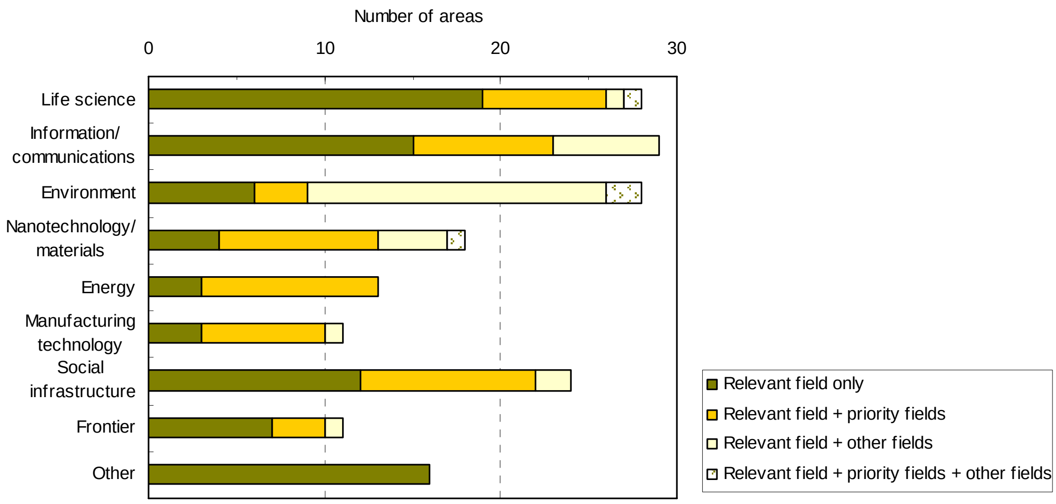
Tabulating the fields of areas with large overall impacts (see notes for Figure 2-21), we find that the percentage of areas in fields of information and communications, life science, nanotechnology and materials, and environment increase over time. For the energy and manufacturing technology fields, which two of the four other fields, a large portion of the extracted areas overlap with the four priority fields.

Table 2-21: Examples of areas spanning multiple fields

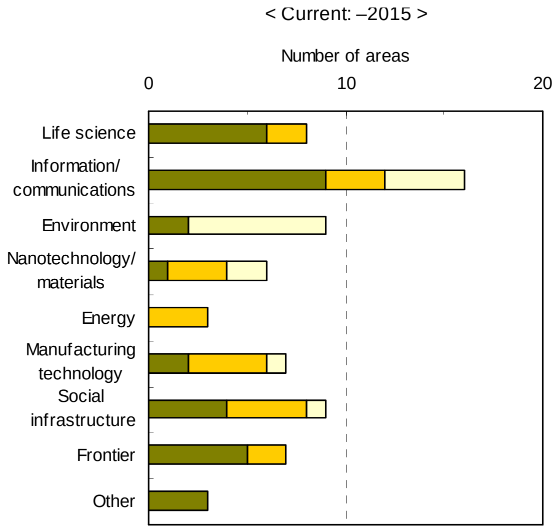
Area	Fields
Biological solutions to environmental problems and achievement of a recycling-oriented society	Life Science; Environment; Energy/resources
Nanobiology	Life Science, Nanotechnology/materials
Nano devices and sensors	Information/communications, Nanotechnology/materials
Manufacturing technology utilizing advanced information technology	Information/communications, Manufacturing
Security electronics	Information/communications, Social infrastructure
Recycling-oriented manufacturing technology with a low environmental load	Environment, Manufacturing
Environmental management in the transport sector	Environment, Social infrastructure
Technology for high precise observation of Earth environments and prediction of change	Environment, Frontier
Fuel cells	Environment, Energy/resources
Nano processing, molding, and manufacturing technology	Nanotechnology/materials, Manufacturing

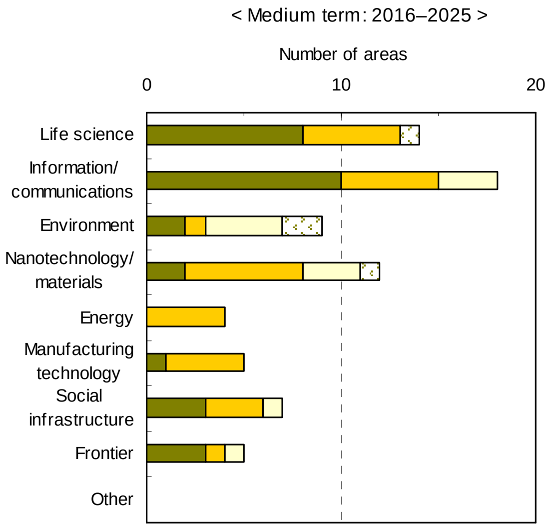
Figure 2-23: Tabulation of areas by field

All Areas



Areas with major overall impact





*Areas that do not belong to any of the eight fields are counted as "Other." All such areas are therefore "Relevant field only."

Reference: Comparison of areas with Basic Plan fields

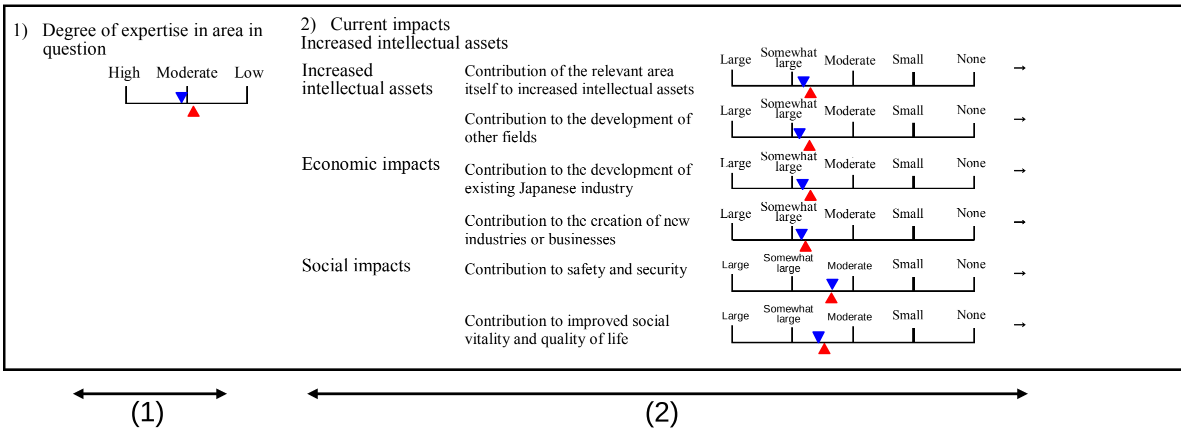
	Area	Life Science	Information & Communications	Environment	Nanotechnology and Materials	Energy and Resources	Manufacturing	Social Infrastructure	Frontier	Others
1	Very large scale information processing		○							
2	High-productivity computing		○							
3	Human support (intellectual support)		○							
4	Ultra-transparent communications; human interface		○							
5	Information security		○							
6	Information technology for developing social systems		○					○		
7	New principles for information and telecommunications		○							
8	Ubiquitous networking		○							
9	Software technology for large-scale networks		○							
10	Integrated systems		○		○					
11	Silicon electronics		○		○					
12	Optical and photonic devices		○							
13	Wireless electronics		○							
14	Bioelectronics	○	○		○					
15	Molecular and organic electronics		○		○					
16	Storage		○		○					
17	Displays		○							
18	Energy conversion/storage devices		○			○				
19	Digital home appliances		○							
20	Ubiquitous electronics		○							
21	Robot electronics		○							
22	Car electronics		○					○		
23	Network electronics		○							
24	Security electronics		○					○		
25	Basic research in drug development	○								
26	Basic research for new medical technologies	○								
27	Brain generation and growth	○								
28	Higher-order brain functions	○								
29	Understanding and treating brain conditions	○								
30	Regenerative medicine	○								
31	Monitoring and sensor technology for biological substances	○								
32	Control of higher-order biological functions	○								
33	Information biology	○								
34	Environmental and ecological biology	○		○						
35	Nanobiology	○			○					
36	Personalized medicine	○								
37	Elucidation of biological defense mechanisms and therapeutic application	○								
38	Recovery of biological functions focusing on QOL and support for it	○								
39	Application of IT to medicine	○	○							
40	Human-centered medicine and construction of healthcare support systems	○								
41	Preventive medicine	○								
42	Measures against emerging and reemerging infectious diseases	○								
43	Medicine and welfare for an aging society	○								
44	Elucidation of the complex interaction between biodiversity and ecosystems	○		○						
45	Biological solutions to environmental problems and achievement of a sustainable society	○		○		○				
46	Development of production technology that harmonizes with ecosystems and improves the environment	○		○						
47	Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life	○								
48	Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology	○								
49	Planetary exploration technology								○	
50	Earthlike life and extrasolar planetary exploration technology								○	
51	Space and particle research								○	
52	Basic technology for space transportation and manned space activity								○	
53	Space utilization technology—basic satellite technology—								○	
54	Technology for high precise observation of Earth environments and for prediction of change			○					○	
55	Technology to explore, capture, and cultivate life under extreme environment	○							○	
56	Deep Earth observation technology								○	
57	Ocean and deep ocean floor observation research technology			○					○	
58	Space, ocean, and Earth technology for a safe and secure society							○	○	
59	Space, ocean, and Earth technology that drives science and technology								○	
60	Innovative nuclear power systems					○				
61	Nuclear fusion energy					○				
62	Hydrogen energy systems			○		○				
63	Fuel cells			○		○				
64	Decentralized energy systems			○		○				
65	Renewable energy			○		○				
66	Clean-coal technology			○		○				
67	Efficient energy conversion and use			○		○				
68	Resource assessment					○				
69	Recycling system (including biomass and waste)			○		○				
70	Global environment (focus on global warming)			○						
71	Urban environment			○				○		
72	Focus on identification and mitigation of ecological effects			○						
73	Environmental economic index			○						
74	Lifestyle based on environment			○						
75	Environmental disasters			○				○		
76	Water resources			○						
77	Nanomaterials modeling simulation				○					
78	Nano measurement and analysis technology				○					
79	Nano processing, molding, and manufacturing technology				○		○			
80	Matter and materials origination, synthesis technology and process technology				○		○			
81	New materials from nanolevel structure control				○					
82	Nano devices and sensors		○		○					
83	NEMS technology		○		○					
84	Environment and energy materials			○	○	○				
85	Nanobiology	○			○					
86	Nanoscience for a safe and secure society				○					
87	Manufacturing technology utilizing advanced information technology		○				○			
88	Manufacturing technology using virtual design		○				○			
89	Manufacturing technology for high-value added products						○			
90	Nano-machining/ micromachining technology				○		○			
91	Recycling-oriented manufacturing technology with a low environmental load			○			○			
92	Human and robot participation in manufacturing						○			
93	Manufacturing technology in special environments						○			
94	Advanced manufacturing technology for social infrastructure						○	○		
95	Surface modification and interface control technology				○		○			
96	Optimization of industrial infrastructure through regional dispersion and concentration									○
97	Knowledge management									○
98	Corporate decision-making, governance, and management									○
99	Public-sector governance and management									○
100	Risk management and finance									○
101	Human resources management (relationship among education, competition, and cooperation)									○
102	Competition and cooperation in business									○
103	Higher productivity in service industries and the services sector									○
104	Environmental management			○						
105	Art, culture, and entertainment that drive industry									○
106	Social infrastructure technology for non-densely populated areas							○		
107	Improvement of structure performance							○		
108	Revitalization, maintenance, and management of social infrastructure							○		
109	Social infrastructure technology responsive to an aging society							○		
110	Environmental technology in social infrastructure			○				○		
111	Comprehensive water management technology			○				○		
112	Environmental measures appropriate to architectural scale			○				○		
113	Security technology as social infrastructure							○		
114	Disaster prevention technology							○		
115	Total management of social infrastructure that includes public involvement							○		
116	New transport system technology							○		
117	Traffic safety technology							○		
118	Environmental management in the transport sector			○				○		
119	Efficient and environmentally-conscious logistics systems technology			○				○		
120	Safety, security, and stability of day to day life							○		
121	Urban safety, security, and stability							○		
122	Universal availability of services							○		
123	Support for the elderly and the disabled									○
124	Social application of brain research	○								
125	Technology for solving international problems									○
126	Technology that supports education and learning									○
127	Handing down and preserving culture and technology									○
128	Knowledge production system									○
129	Entertainment technology									○
130	Technology assessment									○

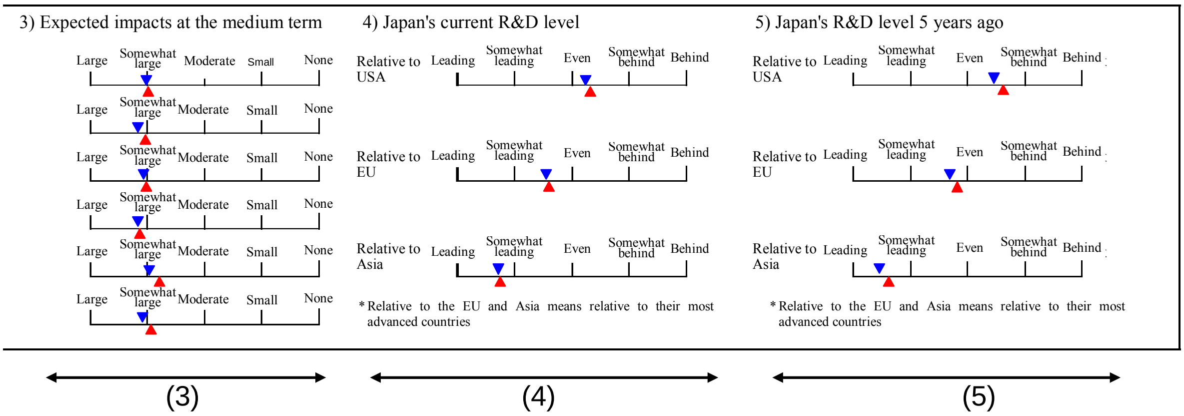
III. Particulars

[How to read the survey results]

The following chapters discuss results by field. The survey sheets at the end of each section can be read as follows.

○ Questions regarding areas





In the table, ▼ represents the results of the first questionnaire, and ▲ the results of the second. Details of the question categories and index calculation methods are as described in sections 1.3.3 and 1.3.5 above.

(1) Degree of expertise in area in question

The marks indicate average values calculated from the percentages responding "High," "Moderate," and "Low." Respondents select their "degree of expertise" from one of the following.

High : I posses specialized knowledge in the area because I am currently engaged in research or work in the area (may include survey research based on documents).
Moderate : I possess some specialized knowledge in the area because I have engaged in research or work in the area in the past or because I engage in research or work in a neighboring field.
Low : I have read specialist books and papers and/or listened to specialists in the relevant area, etc.
None : I have no specialized knowledge of the area.

(2) Current impacts

(3) Expected impacts at the medium term

The marks indicate average values calculated from the percentages chosen from the range "Large" to "None."

(4) Japan's current R&D level

(5) Japan's R&D level 5 years ago

The marks relative to the USA, the EU, and Asia indicate average values calculated from the percentages chosen from the range "(Japan is) Leading" to "(Japan is) Behind."

○ Questions regarding individual topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High	Moderate	Low	None	Importance to Japan: Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
1	A search system that satisfies advanced access needs, such as one whereby a person who is watching a video and wants to search for relevant video information, can output the most appropriate results by collecting through sensors information on the searcher such as the interest, skills, and search context	1	140	19	38	43	-	63	32	54	14	0							1	2
		2	130	11	35	54	-	54	14	73	13	0							0	1
		E	14	100	0	0	-	69	47	38	15	0							0	0

(1) (2) (3) (4) (5) (6)

Countries at the leading edge: Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	Regarding social application — Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
24	74	1	0	1	5	35	36	24	33	34	29	51	11	21	2	2						1	2	4	28	44	24	18	30	28	29	37	12	2
8	92	0	0	0	0	31	52	17	37	29	16	64	4	14	0	0						1	1	1	13	67	19	13	39	22	27	45	8	0
29	71	0	0	0	0	36	43	21	45	27	9	64	9	18	0	0						0	0	7	7	50	36	11	22	11	67	67	11	0

(7) (8) (9) (10) (11) (12)

(1) Topic column

Description of the topic being surveyed

(2) Questionnaire category

This shows the results of questionnaire categories "1," "2," and "experts" as follows.

1 : Results of Round 1 questionnaire (those responding "High," "Moderate," or "Low" on degree of expertise

2 : Results of Round 2 questionnaire (those responding "High," "Moderate," or "Low" on degree of expertise

E : Results of Round 2 questionnaire for those responding "High" on degree of expertise

(3) Number of respondents

Numbers for questionnaire categories "1" and "2" show the total of those answering "High," "Moderate," or "Low" on degree of expertise. (Those answering "None" are instructed not to answer subsequent questions and thus are not included.) The average collection rate for the Round 2 questionnaire was 84 percent, so the numbers for questionnaire category "2" respondents are lower than or equal to those for questionnaire "1."

The number of responses for questionnaire category "Experts" shows the number of respondents to the Round 2 questionnaire with a "High" degree of expertise.

(4) Degree of expertise

Degree of expertise is the ratio, expressed as percentages, of respondents in (3) choosing "High," "Moderate," and "Low" as their degree of expertise. Respondents selected one of the following as their degree of expertise.

High : I posses specialized knowledge in the topic because I am currently engaged in research or work in the topic (may include survey research based on documents).
Moderate : I possess some specialized knowledge in the topic because I have engaged in research or work in the topic in the past or because I engage in research or work in a neighboring field.
Low : I have read specialist books and papers and/or listened to specialists in the relevant topic, etc.
None : I have no specialized knowledge of the topic.

Those selecting "None" did not need to answer the remaining questions. However, we requested that those without specialist knowledge but with strong interest in a topic select "Low" and respond to the questions that followed.

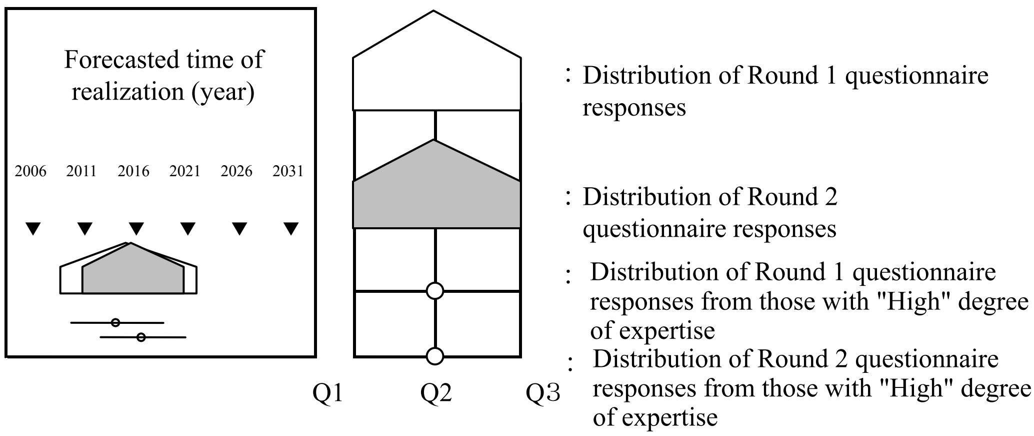
(5) Degree of importance to Japan

This shows as percentages the ratios of those selecting "High," "Moderate," and "Low" for the topic's degree of importance to Japan. The index was calculated as follows, with the cases of all respondents choosing "High" being 100 and all respondents choosing "None" being 0.

Degree of importance index = (No. of “High” x 100 + no. of “Moderate” x 50 + no. of “Low” x 25 + no. of “None” x 0) ÷ no. of responses on importance

(6) Time of technological realization
(10) Time of social application

This shows the distribution of forecasted times. The following method is used to calculate it from responses selecting one of the times.



<How to read forecasted times of technological realization and social application>

Q1 : With responses on times of realization/application in order from the earliest, the first one-fourth of all answers
Q2 : The median point of those answers
Q3 : The three-quarter point of those answers

The width of the pentagon (the distance from Q1 to Q3) represents the middle one-half of responses on time of realization, with the first and last fourths removed. A narrow pentagon indicates a strong consensus among respondents.

In addition, when times of realization are used in timelines and so on, Q2 is the value used. The ratio responding "Will not be realized," "Will not be applied," and "Do not know" are expressed as percentages of all responses.

(7) Countries currently at the leading edge

Regarding the topic, the ratios of respondents selecting from among Japan, the USA, the EU, Asia, and Other as the country on the leading edge, as percentages of all responses to the question.

(8) Necessity of government involvement towards technological realization
(11) Necessity of government involvement towards social application

Regarding the necessity of government involvement towards technological realization or social application, the ratios of those selecting "High," "Moderate," "Low," and "None" as a percentage of all responses to the question.

(9) Effective measures that should be taken by government in Japan towards technological realization
(12) Effective measures that should be taken by government in Japan towards social application

Of those choosing "High," "Moderate," or "Low" for (8) or (11), the ratios of those selecting effective measures that should be taken by government towards the topic’s technological realization or social application, as a percentage of all those who answered "High," "Moderate," or "Low" for (8) or (11). Multiple responses are permissible.

3.1. Information and communications field

3.1.1. Overview

Obviously, the field of information and communications technology has made the most rapid technological advances of any field over the past half-century. The development of the information and communications field has also formed a base for the development of numerous related technologies. In other technology fields of this survey as well, topics directly related to the information and communications technology are included. Applications to other fields were separated to other fields in order to concentrate the general information and communications technology here. In this sense, the information and communications technology topics covered here are only a part of the whole. Moreover, in relation to the electronics field, development of the information and communications field is based in development of electronics, but information and communications plays the role of giving electronics real-world value.

Named areas in information and communications technology are areas that aim to make technology more advanced and larger in scale, to realize human interfaces that are easy for people to use, to make use more secure, and to utilize information and communications more broadly. In addition, new information and communications principles were named as an area for medium- and long-term research in which the principles are not yet clear.

Of these, if there are topics in both human interfaces and new information and communications principles for which the principles are not yet clear, then naturally their times of realization are far off. This foresight survey of the information and communications field comprises both topics for which the principles are understood and topics for which the principles have yet to be elucidated. Previously, in the 7th Foresight Survey, predictions were made primarily for topics whose principles are understood, so the information and communications field had fewer long-term topics than other fields, inviting the misunderstanding that the field's technologies would reach saturation in 10 to 20 years. However, a broad variety of research on topics whose principles are not fully understood is taking place in the information and communications field, and it is important in terms of the development of long-term technology to address such topics and include them in forecasting. Adding such advanced topics should do away with any misunderstanding that the development of the information and communications field is approaching saturation.

Presentation of more advanced topics that accompany technical progress and moving forward with visionary technical research are vital to future development. As the methodologies for solving such medium- and long-term topics becomes clear, more concrete topics will develop, and a trend towards technical development will form.

(1) Social acceptance of technology

Information and communications technology integrates with many related technologies to create value. In this sense, it requires integration and collaboration with diverse fields. It is noteworthy that according to the survey results, integration and collaboration with the social technology field is important. Unfortunately, however, safety and security, urban issues, solving international issues, and other reactive areas are prominent as social technologies in the current survey. The information and communications subcommittee, however, discussed the view that the kind of social technologies that require information and communications technology are somewhat different from those reactive technologies.

Underlying the view that social technology is important in the information and communications field is the opinion that technological development has changed society, and will have an ever broader connection with society. As a result of development both of hardware and of the software that forms the nucleus of technology, products are becoming more advanced is increasing. Thus, if a developed product is not used on a mass scale, its development costs cannot be recovered. If it is used widely, a computer, for example, that 20 years ago cost several hundred million yen, can now be realized for a price that is 10,000-fold cheaper. Information and communications technology has achieved both this complexity and this mass production, and their utilization has changed the lifestyles and cultures of many individuals and indeed of society itself. If we look at the broad changes in society brought about by social acceptance of advanced devices during the past five years in particular, we can understand the importance of the relationship between society and information and communications technology.

Obviously, expectations are high for information and communications technology to continue into the future as technology that can increase productivity and contribute to building a safe and secure society, as it has done until the present. In this case, social technology will take advantage of the development of information and communications technology and form a more advanced society. In the current foresight survey, many of the topics in the social technology field are reactive, and few are formative. When looking at the relationship between information and communications technology and social technology, this gap should be borne in mind.

The area information technology for developing social systems was set for the information and communications field, and forecasting for 12 topics with concrete information and communications applications were carried out. The information and communications subcommittee believes that the topics examined in this area should be surveyed in a more general way as social technology.

(2) Government involvement

There is a broad sense that the spread of information and communications technology in society has formed a new society. In many cases, past social orders formed without information and communications are not in alignment with new technologies. Expectation for new orders is expressed in the foresight survey in the categories relaxation or elimination of relevant regulations and tightened or new regulations.

Regulations at a given time reflect the technology of that time. They maximize social utility and prevent bad practices, so in that sense appropriate regulation is always necessary. At the same time, when businesses take root based on such regulation, even though rule changes to maximize the social utility of new technologies are indicated, if the profits of businesses based on the old rules would be harmed, there will be opposition to the formation of new rules. This scenario means that rule changes take time, and in many cases there are aspects that suppress the new technology itself. If the timing is off in relation to changes in international rules, this can negatively influence the new technology's international competitiveness as well.

The words "relaxed" or "changed" regulations most often actually express a situation in which old and new industries are battling. An example that the subcommittee discussed is copyright issues. Of course, copyrights support and motivate the creation of works, and they are an important system for the creation of culture. In reality, however, to a remarkable extent it is also a system for protecting businesses that use them and businesses with old-fashioned earnings structure and distribution. Distributors are essential to returning profits to creators, and the protection of distributors by copyrights was rational as long as they dealt only with the technologies of the past. However, many aspects of efforts utilizing information and communications technology to further motivate creators and create broad culture are stopped right at the beginning by the old, monopolistic system. Such social rules cannot be expressed through stereotyped expressions like government involvement or relaxed regulation. Issues that demand the formation of a broader social consensus include remote medical care and cross-media services.

(3) Topics using the brain as a metaphor

As information and communications become more advanced, demand naturally arises for technology to make them easier to use. In addition, expectations are high for devices that operate not with computer-type programs, but with, for example, behavior similar to that of the human brain. These are a set of topics on artificial intelligence.

When one tries to express expectations for the functions of a device when no similar device exists, it is common to use something else as a metaphor. When there were no airplanes and expressions such as "machine that flies like a bird" were used, we can see that birds were used as such a metaphor.

In speaking of future information and communications devices, the word artificial intelligence is an expression using the brain as a metaphor. Understanding of such topics is divided between those who understand them as emphasizing brain physiology to create something similar to the brain, and those who understand them as pursuing advanced functions in information processing equipment, regardless of the brain itself. This tends to divide judgment on the time of technological realization as well. These topics can also be expected to develop into topics that can be expressed more technically as research advances in the future.

(4) Importance to Japan

This Delphi analysis surveyed the importance of each topic. A notable trend was the topics seen as important to be related to protection from perceived threats. These topics included high-security networks, detection of intrusions, and improved safety from natural disasters. This can be seen as reflecting society's current anxiety and social demand for greater safety.

Regarding the diverse causes of such social anxiety, including natural disasters, environmental destruction, disease, and food safety, it is notable that expectations are high for information and communications technologies as measures to improve safety. However, does the fact that socially important topics concentrate on these defensive areas mean that our society has lost the ability to dream? Or does it simply indicate a lack of imagination?

As we offer dreams to young people, train young engineers, and ask them to contribute to the world through technology, if visions of future technology are concentrated on protection issues, our words will ring hollow when we urge them to dream big.

In the information and communications subcommittee, we discussed the dream of living in a conveniently-located natural area, with employment and cultural and educational environments equivalent to those of urban areas. The people of the world breaking down barriers of distance and language and enabling the people of the world to talk and share joy with each other is a topic that is important to the world, and one with which technology can help.

The current state of affairs in which anxiety is felt and is important to be relieved cannot be dismissed, but at the same time understanding of the importance of speaking of straightforward dreams, motivating young people, and more forward-looking approaches should be propagated.

(5) Information and communications technology as a generic technology

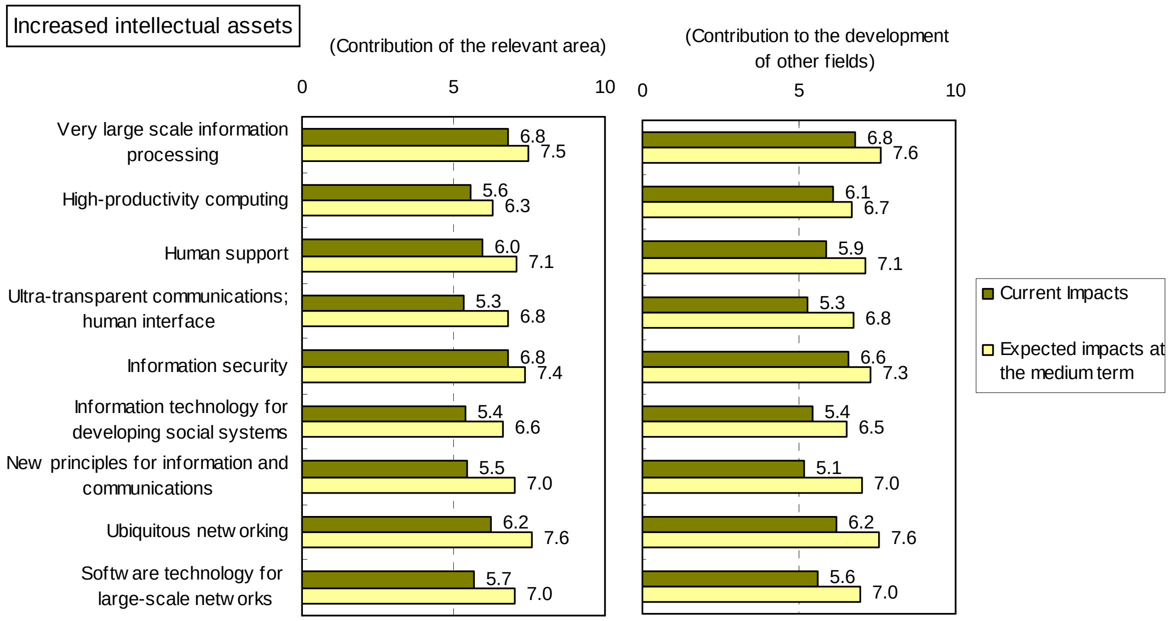
Expectations for and dependence on information and communications technology in areas outside information and communications are also remarkable. In both life-related and environment-related areas, expectations are high for basic information and communications technology that can make the impossible possible.

Clearly, advances in technology as a whole over the past 50 years have been driven by information and communications technologies that enable massive amounts of information to be quickly handled. Information and communications technology is expected to continue contributing to the development of many areas into the future as well. In this sense, information and communications can be considered core basic technology that accelerates the development of all technology areas. Although the importance of information and communications can thus be assessed in terms of the importance of each area, we should be aware that this is not a direct assessment of information and communications areas. Information and communications technology should be seen as important not only in terms of itself, but also in its role as the foundation of other technologies.

(SAITO Tadao)

3.1.2. Main results

A. Impacts



*Responses are indexed on a 10-point scale.

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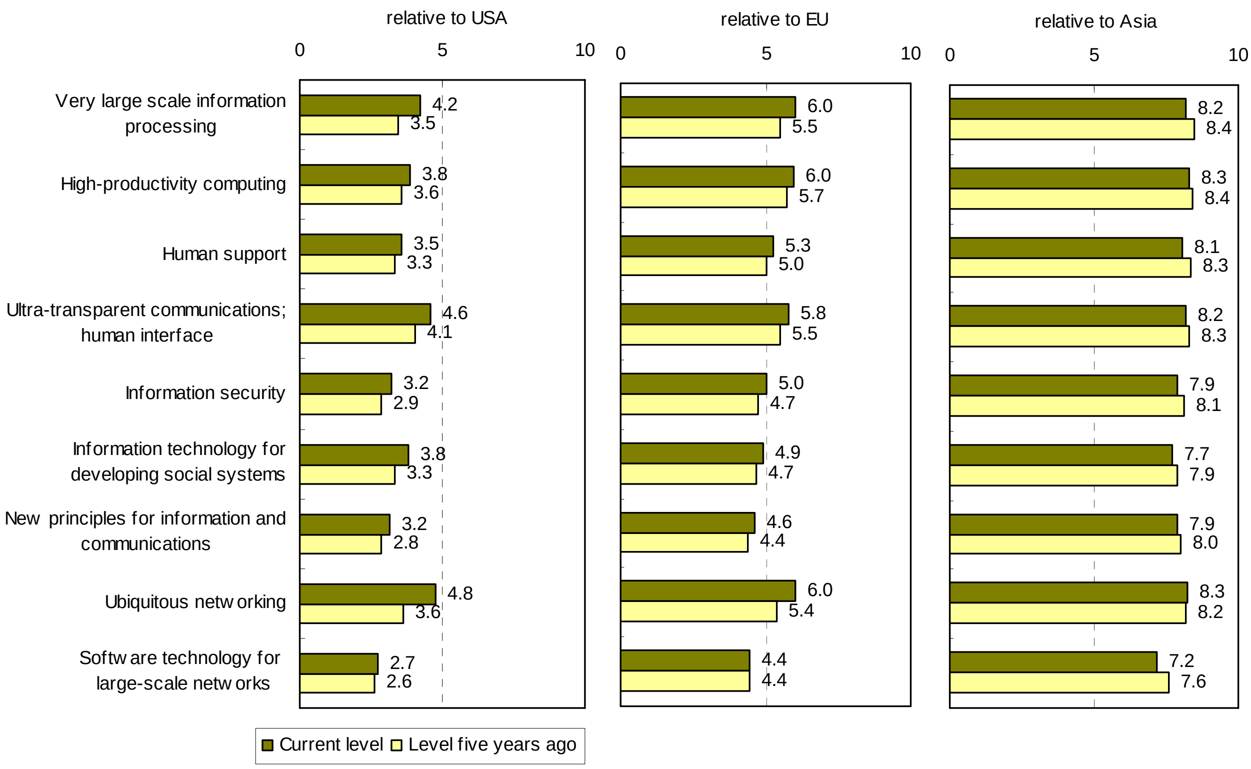
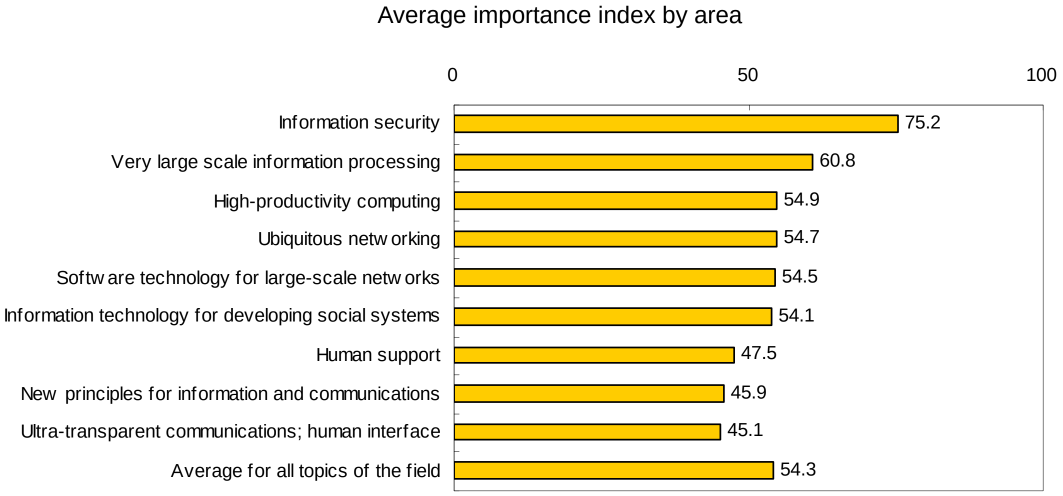
B. Japan’s R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan



The most important 10 topics

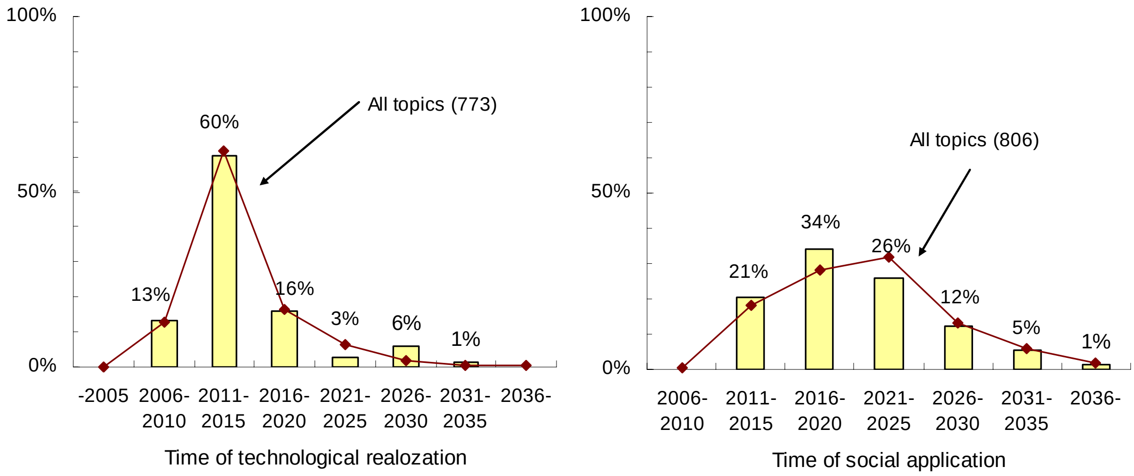
	Topics	Index	Year T*	Year S*
1	36: A highly reliable network system capable of protecting the privacy and secrecy of individuals and groups from intrusion by malicious hackers.	93	2012	2016
2	35: Generalized technology, extended from total building management systems and home security systems, which is coupled with seismic detection systems so that the safety of human life can be ensured before seismic waves arrive, in an earthquake whose epicenter is distant.	92	2012	2020
3	39: Technology to detect intrusions and viruses on the Internet backbone.	88	2009	2013
4	40: Capability of tracing back the source address of suspect packet in the Internet to detect intrusions.	86	2009	2013
5	07: Forecasts of diseases and disasters through advanced modeling and simulation technologies for large-scale ecological, environmental, or other systems.	86	2015	2023
6	33: Theory for designing the stringency of a system's security and privacy protection (theory for the quantitative evaluation of security stringency based on the system's components, architecture, and environmental conditions or for the estimation of security limitations; theory for defining the architecture and environmental conditions that facilitate such evaluations and estimations).	82	2012	2018
7	49: In Japan, all patient charts, including relevant video, are digitized and maintained by individual patients, and inspection and other data are shared among all medical institutions, leading to the emergence of health care agents, who intermediate between patients and medical institutions.	70	-	2016
8	54: Telemedicine in which a doctor performs diagnosis over the Internet based on the patient's medical data obtained at home, and provides treatment if standard instruction and prescription are applicable.	69	-	2015
9	51: A global traceability system that covers a majority of foods.	69	2011	2019
10	04: The emergence of equipment, including a software modem, that supports almost all media such as digital broadcasting, high-speed mobile communications, wireless LANs, and wired access leads to the widespread use of cross-media services, which allow for concurrent access to multiple media and automatically choose the optimum medium for the situation, to control and coordinate home gateways in households.	68	2011	2015

Year T: Time of technological realization Year S: Time of social application

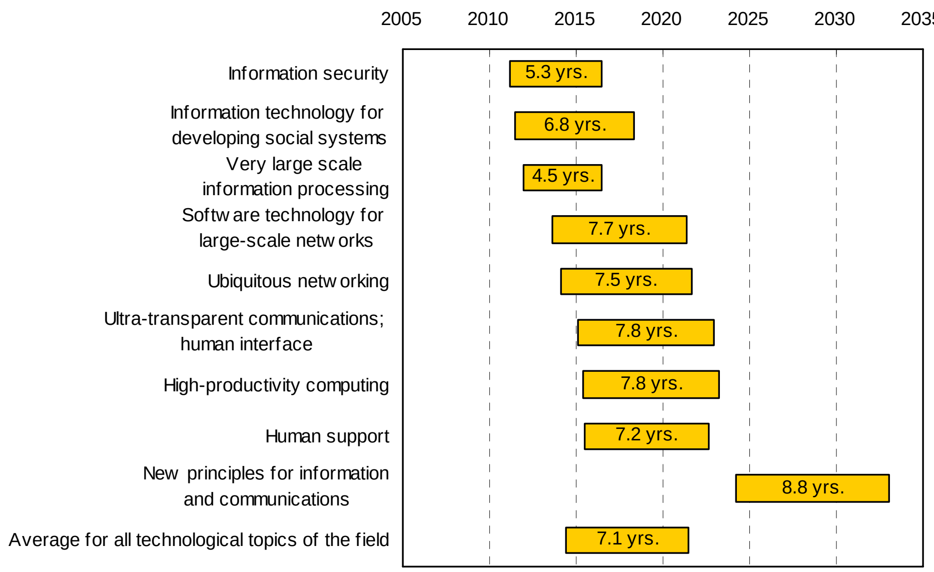
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

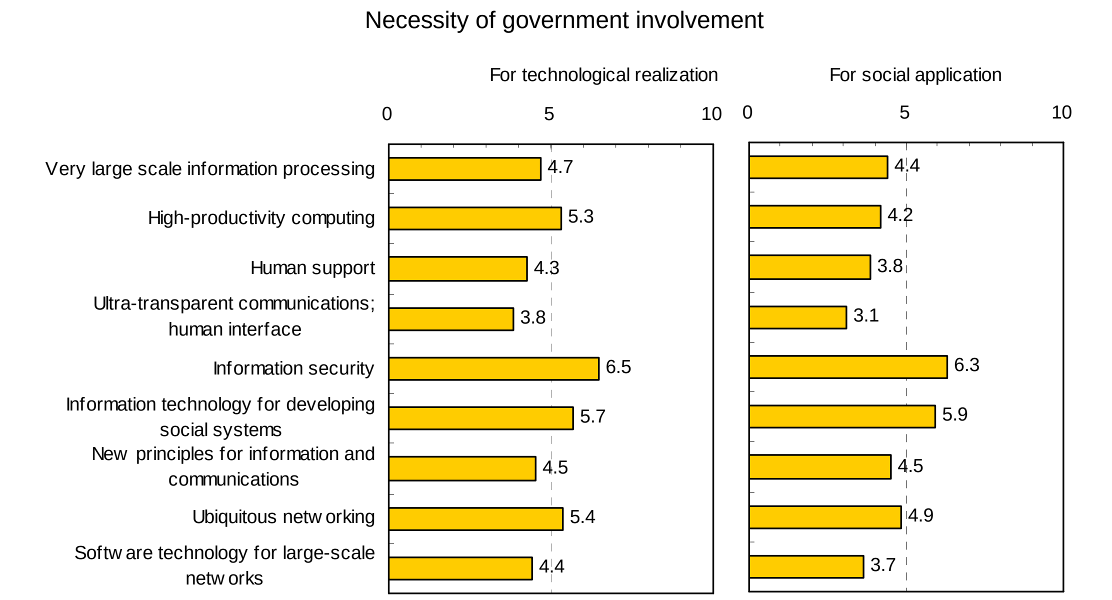
Topic	Year T*	Period*	Area
60: Information prediction technology to enable natural communications and controlling under the constraints of very long delays as in interplanetary communications.	2023	11	New principles for information and communications
15: Software (expert systems) capable of carrying out roughly half the work of professionals such as a judge, a lawyer, a patent agent.	2018	10	Human support
23: Widespread use of robots that can play against human players in sport (e.g. table tennis).	2017	10	Ultra-transparent communications; human interface
25: Widespread use of sound field shielding technology capable of isolating a specific spatial area from the surrounding noise, to ensure silence for residents around airports, highways, railroads, etc.	2016	10	Ultra-transparent communications; human interface
27: A sensibility expression system that can, when given a description of a certain image, present music and pictures suited to the person's sensibilities.	2015	10	Ultra-transparent communications; human interface

Topic	Year T*	Period*	Area
56: Practical quantum encryption.	2017	10	New principles for information and communications
65: A medical chip that can be embedded in the human body and run semi-permanently powered by bioenergy sources such as body heat or blood flows, providing vital function support such as health condition monitoring and a heart pacemaker.	2018	10	Ubiquitous networking
66: Medical technology based on nanochips and microsensors that have external communications and control capabilities and can be embedded in the human body or move through blood vessels.	2020	10	Ubiquitous networking

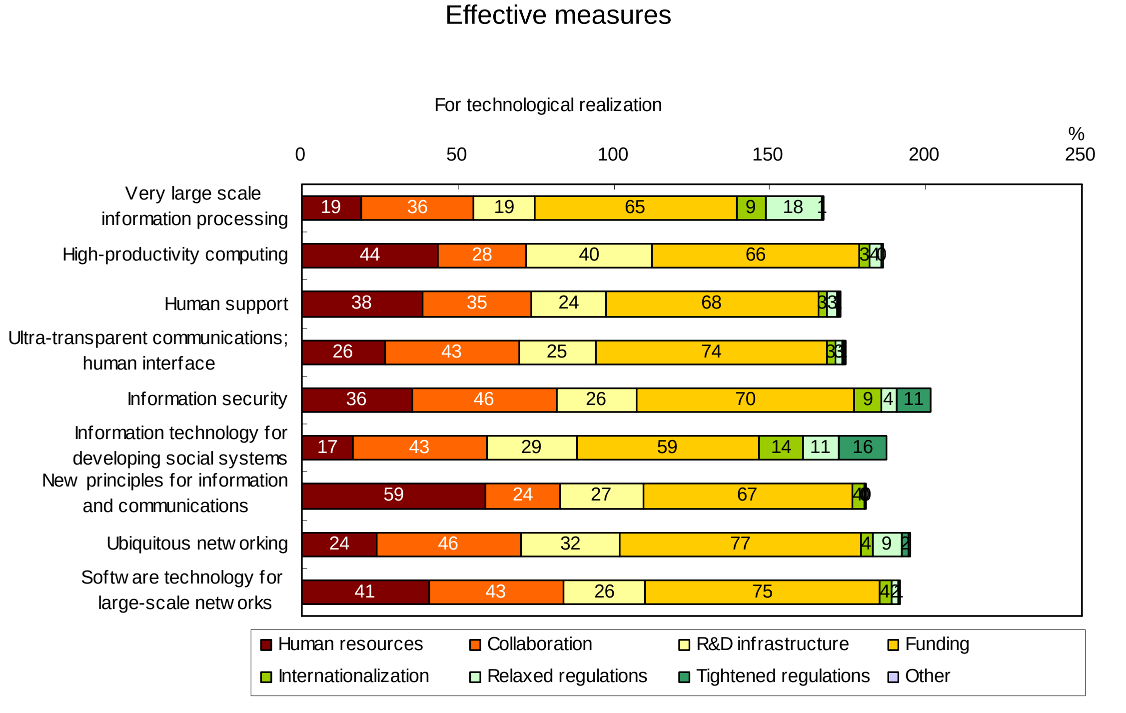
Topic	Year T*	Period*	Area
01: A search system that satisfies advanced access needs, such as one whereby a person who is watching a video and wants to search for relevant video information, can output the most appropriate results by collecting through sensors information on the searcher such as the interest, skills, and search context.	2012	3	Very large scale information processing
04: The emergence of equipment, including a software modem, that supports almost all media such as digital broadcasting, high-speed mobile communications, wireless LANs, and wired access leads to the widespread use of cross-media services, which allow for concurrent access to multiple media and automatically choose the optimum medium for the situation, to control and coordinate home gateways in households.	2011	4	Very large scale information processing
16: Technology that allows to utilize networked, but heterogeneous, global information sources (the Web, etc.) like an encyclopedia (including a summarization function of important items and a question-and-answer mechanism).	2010	4	Human support
36: A highly reliable network system capable of protecting the privacy and secrecy of individuals and groups from intrusion by malicious hackers.	2012	4	Information security
39: Technology to detect intrusions and viruses on the Internet backbone.	2009	4	Information security
40: Capability of tracing back the source address of suspect packet in the Internet to detect intrusions.	2009	4	Information security
41: A spam-free e-mail system.	2009	4	Information security
67: A system to allow ad hoc communications between wireless information terminals in a certain range (with capability of seamlessly accessing the Internet, including applications).	2010	4	Ubiquitous networking

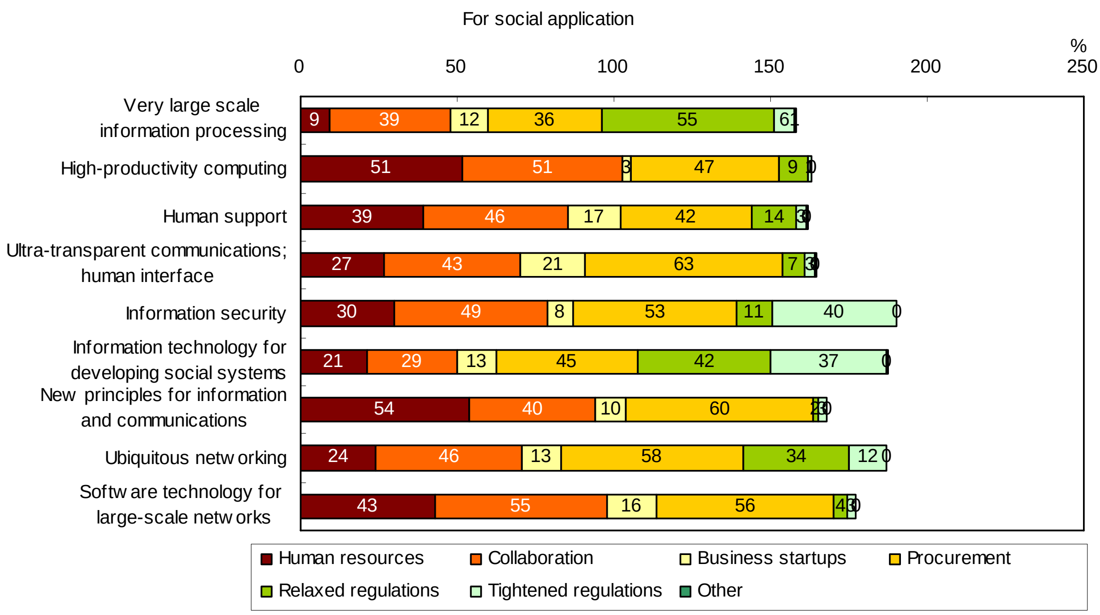
*Year T: Time of technological realization Period: period until social application (years)

E. Effective measures that should taken by government



*Responses are indexed on a 10-point scale.





F. Time-line of topics

Technological realization

year	topic
2009	39: Technology to detect intrusions and viruses on the Internet backbone.
	40: Capability of tracing back the source address of suspect packet in the Internet to detect intrusions.
	41: A spam-free e-mail system.
	46: Nearly half the municipalities introduce electronic voting systems that make direct voting by residents fair, secure, easy, and inexpensive.
2010	14: A system capable of automatically retrieving from the network new information and valuable knowledge with high relevance to the specified topic and presenting them.
	16: Technology that allows to utilize networked, but heterogeneous, global information sources (the Web, etc.) like an encyclopedia (including a summarization function of important items and a question-and-answer mechanism).
	20: Control technology to localize sound images anywhere in a given space.
	43: A system capable of identifying the online content harmful to young people and automatically checking it.
	67: A system to allow ad hoc communications between wireless information terminals in a certain range (with capability of seamlessly accessing the Internet, including applications).
2011	04: The emergence of equipment, including a software modem, that supports almost all media such as digital broadcasting, high-speed mobile communications, wireless LANs, and wired access leads to the widespread use of cross-media services, which allow for concurrent access to multiple media and automatically choose the optimum medium for the situation, to control and coordinate home gateways in households.
	10: Widespread use of electronic secretary terminals that offer functions such as voice recognition and fuzzy search, in addition to the information agent functions for schedule management and access to databases.
	19: A portable digital display that is so flexible (thin and soft) that it can be substituted for newspaper.
	51: A global traceability system that covers a majority of foods.
	61: An administration system for networks with about 1,000 users that can automatically connect terminals and operate networks with no need for a network administrator.
2012	01: A search system that satisfies advanced access needs, such as one whereby a person who is watching a video and wants to search for relevant video information, can output the most appropriate results by collecting through sensors information on the searcher such as the interest, skills, and search context.
	03: Technology that enables smooth concerted operation of home information appliances, which are great in number and diversity and are replaced in short cycles, not by a control system but in a self-organized manner so that individual appliances requiring information exchange can interact mutually.

year	topic
	33: Theory for designing the stringency of a system's security and privacy protection (theory for the quantitative evaluation of security stringency based on the system's components, architecture, and environmental conditions or for the estimation of security limitations; theory for defining the architecture and environmental conditions that facilitate such evaluations and estimations).
	34: Technology that helps to locate wanted criminals and material witnesses by analyzing the facial features, behavior, looks, and voice of people captured by surveillance cameras set in public spaces.
	35: Generalized technology, extended from total building management systems and home security systems, which is coupled with seismic detection systems so that the safety of human life can be ensured before seismic waves arrive, in an earthquake whose epicenter is distant.
	36: A highly reliable network system capable of protecting the privacy and secrecy of individuals and groups from intrusion by malicious hackers.
	37: Cyber-policing technology to automatically monitor online illegal acts associated with the copyright of multimedia software, privacy protection, etc.
	38: A security system capable of identitfying individuals through facial and vocal recognition at an accuracy of 99.9% or higher.
	53: Widespread use of a centralized system for comprehensively monitoring and reporting atmospheric pollution that can automatically detect chemical substances, pollen, and other fine particles in the air with sensors in homes and streets, analyze the results at special administrative or municipal facilities, and provide residents with emergency reports of the condition and actions to be taken and with on-demand information.
2013	02: A network that offers end-to-end transparent wavelength paths on the global level.
	26: An ultra low bit rate coding scheme capable of compressing HDTV images into 4-Mbps or smaller signals (about 1/250 compression ratio), and CD-level sound into 32-Kbps or smaller signals, while maintaining the original signal quality.
	28: A remote distributed conferencing system with high realism that enables, with the aid of a virtual agent, participants to share information material and hold natural-language conversations.
	30: General-purpose high-quality sound synthesis technology capable of vocalizing text information, with quality identical to human voice.
	31: Technology to automatically retrieve meta-data (data containing information-related data) from visual/audio content.
	42: A publicly available algorithm with theoretically proven safety concerning the prevention of digital watermark removal.
	52: Widespread use of a system that allows people to remotely enjoy paintings or music performances as if they were actually walking around a gallery, looking at each painting, or sitting in a concert hall, listening to a live performance.
	62: Technology that allows objects to recognize mutual presence, nature, and condition so that they can automatically avoid dangerous situations and work in a coordinated manner (e.g. when a car and a bicycle or a heater and a sofa are close enough to pose a danger, the two objects mutually communicate to automatically avoid a dangerous situation by generating an alarm signal, stopping, or turning off).
	64: A micro communications chip or sensor that can run semi-permanently, powered by heat, light, radio waves, or noise.
	68: Technology to manage the identity (ID) of an infinite number of constantly emerging or disappearing objects, organize the definition and information of each ID assigned, and automatically remove obsolete data.
	70: Software portability with which software can automatically adapt to any operating environment (OS, available hardware and performance, network conditions, etc.) and always provide requested services in the optimal method for the given environment.
	73: Search technology that allows searchers to find the desired information through fuzzy instructions.
2014	05: A large-scale P2P system capable of automatically forming a community that gives a person access to 1 petaflop computing power, by using grid technology to integrate high-performance computers that consume three orders of magnitude lower power per processing power than the current computers.
	08: A cluster parallel computing system capable of managing 100,000 or more processor errors or tasks to ensure effective operation.
	11: A portable conversation device that allows people with disabilities to convert their thoughts into speech.
	17: A system that can construct a text-based easy-to-understand story from fragmented facts and knowledge and show it as a presentation (and can also add presumably necessary figures and images when instructed).
	21: Technology to quantitatively measure the comfort in clothing, a vehicle, a place, etc.
	22: Wide accessibility to multi-modal environments where different means of input, such as sound, body action, manual gesture, and facial expression, may be used as human interfaces in a coordinated manner.
	24: Widespread use of 3D TV that may be watched without wearing special glasses and feeling fatigue in homes.

year	topic
	44: A regional security system in which home security systems are interconnected and use personal robots whose services are not limited to disaster prevention, crime prevention, and nursing care, but are much more diverse.
	69: Software technology to automatically construct a software application that offers desired services, using the available components enabling different functions.
	71: Automatic validation technology intended for large-scale software and capable of automatically correcting logical inconsistencies included in the program.
	72: Software capable of detecting failures and changes in hardware and responding to failures by automatically generating code that compensates for the failed functions, and to changes by modifying its own code to take advantage of them.
	74: A system capable of accumulating human cognitive knowledge to recognize diverse objects, such as buildings, humans, and cars, based on still or moving images at an accuracy of 99.9% or higher.
2015	07: Forecasts of diseases and disasters through advanced modeling and simulation technologies for large-scale ecological, environmental, or other systems.
	27: A sensibility expression system that can, when given a description of a certain image, present music and pictures suited to the person's sensibilities.
	63: Technology to allow many small single-function (small-scale function) robots to cooperate and share tasks to achieve more complex functionality.
2016	25: Widespread use of sound field shielding technology capable of isolating a specific spatial area from the surrounding noise, to ensure silence for residents around airports, highways, railroads, etc.
2017	06: Software capable of beating a professional shogi champion.
	09: High-productivity computing that enables, in addition to floating-point operation capability, roughly 10,000 times higher computing power (1 exaflop) than the current Earth Simulator, based on a benchmark that adopts viewpoints such as memory access.
	13: Widespread use of a telephone with real-time language translation capability.
	23: Widespread use of robots that can play against human players in sport (e.g. table tennis).
	56: Practical quantum encryption.
2018	15: Software (expert systems) capable of carrying out roughly half the work of professionals such as a judge, a lawyer, a patent agent.
	18: An external brain function system that is wearable and operable through a natural interface and can store general knowledge like dictionaries as well as a large amount of personal knowledge, experience, and information to extend and enhance the brain's memory function.
	65: A medical chip that can be embedded in the human body and run semi-permanently powered by bioenergy sources such as body heat or blood flows, providing vital function support such as health condition monitoring and a heart pacemaker.
2019	32: Technology to understand people's intentions from non-verbal information such as biometrics, facial expression, and eye movement.
2020	66: Medical technology based on nanochips and microsensors that have external communications and control capabilities and can be embedded in the human body or move through blood vessels.
2023	60: Information prediction technology to enable natural communications and controlling under the constraints of very long delays as in interplanetary communications.
2025	55: Models of human creativity and intuition are developed and new ideas created by machines are proven useful in many fields.
2027	12: Technology that allows the computer to electrically and magnetically read the information recorded in the human brain.
	59: A system that enables communications with people or devices in the deep sea or underground by new principles such as very high frequency oscillatory or gravitational waves (for deep-sea/underground resources exploration and environmental research).
2030	29: Mind-machine interfaces based on brain waves, etc. (certain thoughts conveyed to the computer).
	58: General-purpose quantum computing applicable to diverse algorithms.
2031	57: Discovery of a mechanism for the human brain to directly receive a greater amount of information faster by means of systems other than the visual (text) and auditory (sound) systems.

Social application

year	topic
2013	39: Technology to detect intrusions and viruses on the Internet backbone.
	40: Capability of tracing back the source address of suspect packet in the Internet to detect intrusions.
	41: A spam-free e-mail system.
	45: A copyright management system intended for the promotion of production and distribution of online content by facilitating reasonable financial compensation.
	48: A ¥100 billion-a-year virtual company that has no office building and conducts all business operations over the Internet.
2014	16: Technology that allows to utilize networked, but heterogeneous, global information sources (the Web, etc.) like an encyclopedia (including a summarization function of important items and a question-and-answer mechanism).
	47: Widespread use of electronic money, to allow anonymous transfers of money to be made with credibility as high as conventional money.
	67: A system to allow ad hoc communications between wireless information terminals in a certain range (with capability of seamlessly accessing the Internet, including applications).
	75: Most companies, regardless of size, go paperless and improve productivity through the digitization and networking of most office work.
2015	01: A search system that satisfies advanced access needs, such as one whereby a person who is watching a video and wants to search for relevant video information, can output the most appropriate results by collecting through sensors information on the searcher such as the interest, skills, and search context.
	04: The emergence of equipment, including a software modem, that supports almost all media such as digital broadcasting, high-speed mobile communications, wireless LANs, and wired access leads to the widespread use of cross-media services, which allow for concurrent access to multiple media and automatically choose the optimum medium for the situation, to control and coordinate home gateways in households.
	20: Control technology to localize sound images anywhere in a given space.
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	54: Telemedicine in which a doctor performs diagnosis over the Internet based on the patient's medical data obtained at home, and provides treatment if standard instruction and prescription are applicable.
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2018	33: Theory for designing the stringency of a system's security and privacy protection (theory for the quantitative evaluation of security stringency based on the system's components, architecture, and environmental conditions or for the estimation of security limitations; theory for defining the architecture and environmental conditions that facilitate such evaluations and estimations).
	38: A security system capable of identitfying individuals through facial and vocal recognition at an accuracy of 99.9% or higher.
	42: A publicly available algorithm with theoretically proven safety concerning the prevention of digital watermark removal.
	50: Fewer than 1% of Japanese (aged 15 or older) can neither browse the Web nor exchange e-mail through PCs, mobile phones, PDAs or other devices.

year	topic
2019	02: A network that offers end-to-end transparent wavelength paths on the global level.
	26: An ultra low bit rate coding scheme capable of compressing HDTV images into 4-Mbps or smaller signals (about 1/250 compression ratio), and CD-level sound into 32-Kbps or smaller signals, while maintaining the original signal quality.
	30: General-purpose high-quality sound synthesis technology capable of vocalizing text information, with quality identical to human voice.
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	51: A global traceability system that covers a majority of foods.
	53: Widespread use of a centralized system for comprehensively monitoring and reporting atmospheric pollution that can automatically detect chemical substances, pollen, and other fine particles in the air with sensors in homes and streets, analyze the results at special administrative or municipal facilities, and provide residents with emergency reports of the condition and actions to be taken and with on-demand information.
2020	28: A remote distributed conferencing system with high realism that enables, with the aid of a virtual agent, participants to share information material and hold natural-language conversations.
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	62: Technology that allows objects to recognize mutual presence, nature, and condition so that they can automatically avoid dangerous situations and work in a coordinated manner (e.g. when a car and a bicycle or a heater and a sofa are close enough to pose a danger, the two objects mutually communicate to automatically avoid a dangerous situation by generating an alarm signal, stopping, or turning off).
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	73: Search technology that allows searchers to find the desired information through fuzzy instructions.
2021	05: A large-scale P2P system capable of automatically forming a community that gives a person access to 1 petaflop computing power, by using grid technology to integrate high-performance computers that consume three orders of magnitude lower power per processing power than the current computers.
	11: A portable conversation device that allows people with disabilities to convert their thoughts into speech.
	17: A system that can construct a text-based easy-to-understand story from fragmented facts and knowledge and show it as a presentation (and can also add presumably necessary figures and images when instructed).
	44: A regional security system in which home security systems are interconnected and use personal robots whose services are not limited to disaster prevention, crime prevention, and nursing care, but are much more diverse.
	52: Widespread use of a system that allows people to remotely enjoy paintings or music performances as if they were actually walking around a gallery, looking at each painting, or sitting in a concert hall, listening to a live performance.
	68: Technology to manage the identity (ID) of an infinite number of constantly emerging or disappearing objects, organize the definition and information of each ID assigned, and automatically remove obsolete data.
	69: Software technology to automatically construct a software application that offers desired services, using the available components enabling different functions.
	74: A system capable of accumulating human cognitive knowledge to recognize diverse objects, such as buildings, humans, and cars, based on still or moving images at an accuracy of 99.9% or higher.
2022	08: A cluster parallel computing system capable of managing 100,000 or more processor errors or tasks to ensure effective operation.
	22: Wide accessibility to multi-modal environments where different means of input, such as sound, body action, manual gesture, and facial expression, may be used as human interfaces in a coordinated manner.
2023	07: Forecasts of diseases and disasters through advanced modeling and simulation technologies for large-scale ecological, environmental, or other systems.
	21: Technology to quantitatively measure the comfort in clothing, a vehicle, a place, etc.
	24: Widespread use of 3D TV that may be watched without wearing special glasses and feeling fatigue in homes.
	71: Automatic validation technology intended for large-scale software and capable of automatically correcting logical inconsistencies included in the program.

year	topic
	72: Software capable of detecting failures and changes in hardware and responding to failures by automatically generating code that compensates for the failed functions, and to changes by modifying its own code to take advantage of them.
2024	06: Software capable of beating a professional shogi champion.
	63: Technology to allow many small single-function (small-scale function) robots to cooperate and share tasks to achieve more complex functionality.
2025	13: Widespread use of a telephone with real-time language translation capability.
	27: A sensibility expression system that can, when given a description of a certain image, present music and pictures suited to the person's sensibilities.
2026	09: High-productivity computing that enables, in addition to floating-point operation capability, roughly 10,000 times higher computing power (1 exaflop) than the current Earth Simulator, based on a benchmark that adopts viewpoints such as memory access.
	25: Widespread use of sound field shielding technology capable of isolating a specific spatial area from the surrounding noise, to ensure silence for residents around airports, highways, railroads, etc.
2027	18: An external brain function system that is wearable and operable through a natural interface and can store general knowledge like dictionaries as well as a large amount of personal knowledge, experience, and information to extend and enhance the brain's memory function.
	23: Widespread use of robots that can play against human players in sport (e.g. table tennis).
	56: Practical quantum encryption.
2028	15: Software (expert systems) capable of carrying out roughly half the work of professionals such as a judge, a lawyer, a patent agent.
	32: Technology to understand people's intentions from non-verbal information such as biometrics, facial expression, and eye movement.
	65: A medical chip that can be embedded in the human body and run semi-permanently powered by bioenergy sources such as body heat or blood flows, providing vital function support such as health condition monitoring and a heart pacemaker.
2030	66: Medical technology based on nanochips and microsensors that have external communications and control capabilities and can be embedded in the human body or move through blood vessels.
2034	60: Information prediction technology to enable natural communications and controlling under the constraints of very long delays as in interplanetary communications.
2035	59: A system that enables communications with people or devices in the deep sea or underground by new principles such as very high frequency oscillatory or gravitational waves (for deep-sea/underground resources exploration and environmental research).
2036	12: Technology that allows the computer to electrically and magnetically read the information recorded in the human brain.
	58: General-purpose quantum computing applicable to diverse algorithms.
2038	29: Mind-machine interfaces based on brain waves, etc. (certain thoughts conveyed to the computer).

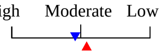
Appendix: Results of R1 and R2

I.. Very large scale information processing

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



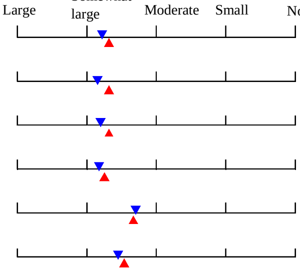
2) Current impacts

Large | Somewhat large | Moderate | Small | None

[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

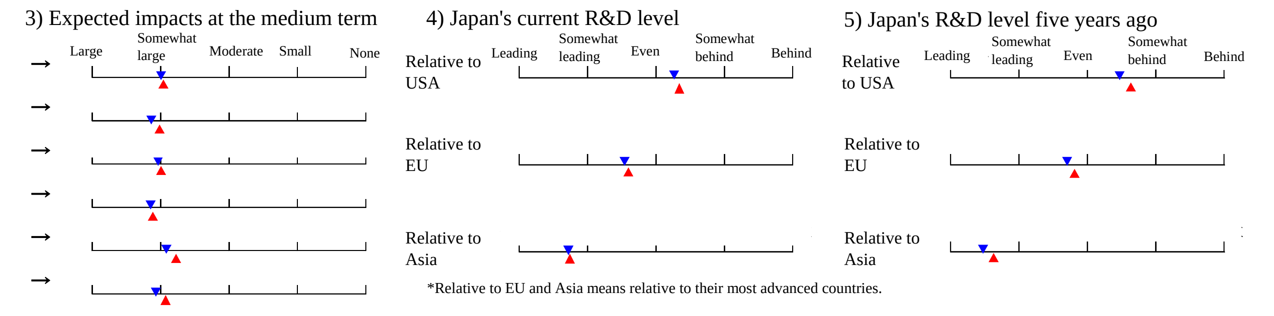
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

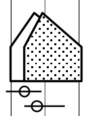
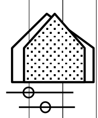
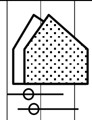
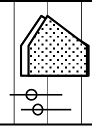
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
1	A search system that satisfies advanced access needs, such as one whereby a person who is watching a video and wants to search for relevant video information, can output the most appropriate results by collecting through sensors information on the searcher such as the interest, skills, and search context.	1	140	19	38	43	-	63	32	54	14	0							1	2
		2	130	11	35	54	-	54	14	73	13	0							0	1
		E	14	100	0	0	-	69	47	38	15	0							0	0
2	A network that offers end-to-end transparent wavelength paths on the global level.	1	110	16	37	47	-	67	37	56	6	1							1	6
		2	105	13	25	62	-	57	17	76	7	0							0	2
		E	14	100	0	0	-	79	57	43	0	0							0	0
3	Technology that enables smooth concerted operation of home information appliances, which are great in number and diversity and are replaced in short cycles, not by a control system but in a self-organized manner so that individual appliances requiring information exchange can interact mutually.	1	136	19	38	43	-	69	44	45	11	0							0	1
		2	127	12	35	53	-	64	33	60	7	0							0	0
		E	15	100	0	0	-	80	64	29	7	0							0	0
4	The emergence of equipment, including a software modem, that supports almost all media such as digital broadcasting, high-speed mobile communications, wireless LANs, and wired access leads to the widespread use of cross-media services, which allow for concurrent access to multiple media and automatically choose the optimum medium for the situation, to control and coordinate home gateways in households.	1	146	27	39	34	-	72	47	45	7	1							1	1
		2	131	17	41	42	-	68	39	56	5	0							0	0
		E	22	100	0	0	-	76	52	48	0	0							0	0

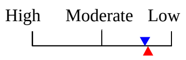


Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
24	74	1	0	1	5	35	36	24	33	34	29	51	11	21	2	2		1	2	4	28	44	24	18	30	28	29	37	12	2
8	92	0	0	0	0	31	52	17	37	29	16	64	4	14	0	0		1	1	1	13	67	19	13	39	22	27	45	8	0
29	71	0	0	0	0	36	43	21	45	27	9	64	9	18	0	0		0	0	7	7	50	36	11	22	11	67	67	11	0
54	45	0	1	0	28	44	19	9	14	31	36	59	29	16	0	0		1	6	25	43	21	11	18	35	10	51	36	4	3
62	38	0	0	0	12	64	19	5	12	20	27	80	20	9	1	0		0	1	14	57	25	4	9	44	4	66	31	5	1
71	29	0	0	0	23	61	8	8	8	33	50	92	33	8	0	0		0	0	36	50	14	0	7	50	0	93	21	7	0
59	39	2	0	0	10	33	36	21	15	39	28	48	20	20	6	2		1	2	8	34	37	21	14	30	17	37	46	13	2
70	28	2	0	0	3	27	54	16	10	48	17	62	10	15	1	0		1	0	1	28	54	17	7	34	9	35	68	5	1
46	47	7	0	0	13	53	27	7	7	57	14	79	29	29	0	0		0	0	7	33	53	7	7	50	21	43	57	14	0
38	59	1	1	1	15	38	34	13	25	38	28	44	14	39	6	1		1	2	13	37	33	17	17	32	21	26	58	15	1
23	76	1	0	0	2	51	38	9	16	49	17	53	3	33	1	1		0	1	2	47	39	12	8	38	13	17	76	7	1
36	64	0	0	0	0	68	18	14	5	58	21	63	5	47	0	5		0	0	0	57	29	14	6	22	11	28	78	22	0

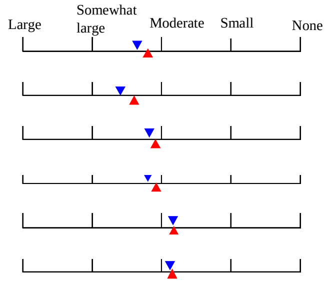
II. High-productivity computing

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

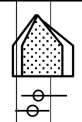
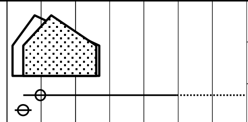
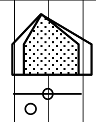
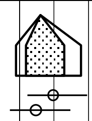
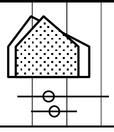


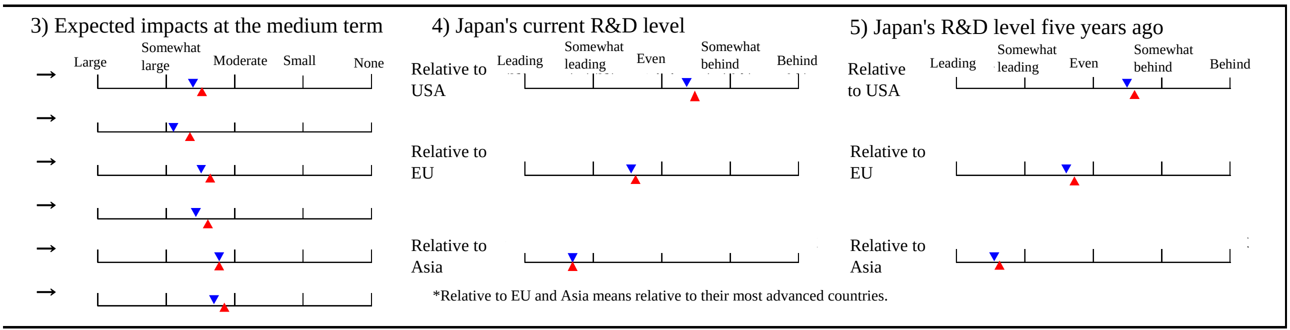
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

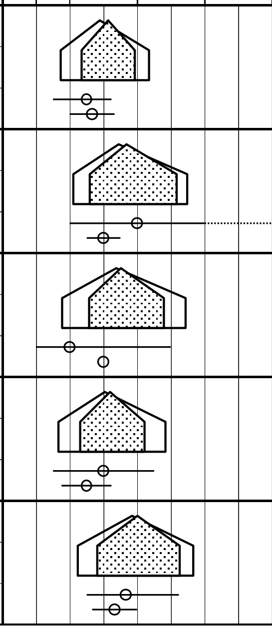
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
5	A large-scale P2P system capable of automatically forming a community that gives a person access to 1 petaflop computing power, by using grid technology to integrate high-performance computers that consume three orders of magnitude lower power per processing power than the current computers.	1	113	5	32	63	-	58	25	60	11	4		3	5
		2	103	4	26	70	-	54	14	73	12	1		0	2
		E	4	100	0	0	-	56	25	50	25	0		0	0
6	Software capable of beating a professional shogi champion.	1	89	4	21	75	-	31	5	25	57	13		4	11
		2	86	2	12	86	-	26	0	11	83	6		3	6
		E	2	100	0	0	-	38	0	50	50	0		0	0
7	Forecasts of diseases and disasters through advanced modeling and simulation technologies for large-scale ecological, environmental, or other systems.	1	104	4	22	74	-	76	58	32	10	0		0	8
		2	100	1	15	84	-	86	73	24	2	1		1	0
		E	1	100	0	0	-	50	0	100	0	0		0	0
8	A cluster parallel computing system capable of managing 100,000 or more processor errors or tasks to ensure effective operation.	1	106	6	30	64	-	59	25	65	7	3		2	5
		2	100	3	19	78	-	54	11	84	4	1		1	0
		E	3	100	0	0	-	75	67	0	33	0		0	0
9	High-productivity computing that enables, in addition to floating-point operation capability, roughly 10,000 times higher computing power (1 exaflop) than the current Earth Simulator, based on a benchmark that adopts viewpoints such as memory access.	1	95	8	27	65	-	64	35	54	8	3		1	9
		2	93	4	14	82	-	55	14	78	7	1		0	1
		E	4	100	0	0	-	56	25	50	25	0		0	0

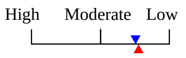


Countries at the leading edge					Regarding technological realization												Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't											Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
12	87	0	0	1	19	51	19	11	36	36	40	67	7	3	1	1		5	6	12	27	37	24	37	43	10	43	18	4	1
4	96	0	0	0	9	63	17	11	30	34	42	73	5	3	0	0		0	1	6	27	50	17	39	49	7	52	16	5	0
25	75	0	0	0	25	50	25	0	25	0	0	100	0	0	0	0		0	0	25	25	50	0	25	50	25	25	0	25	0
65	30	2	2	1	2	11	35	52	67	21	31	33	3	3	0	0		8	20	1	8	31	60	65	24	12	26	6	0	6
87	10	1	1	1	0	2	30	68	75	11	32	39	0	7	0	0		6	9	0	3	17	80	83	28	0	22	11	0	0
50	50	0	0	0	0	0	100	0	50	0	50	50	0	0	0	0		0	0	0	0	100	0	50	100	0	0	0	0	0
24	71	5	0	0	46	38	11	5	43	35	48	59	16	4	0	1		2	10	32	39	21	8	46	56	11	44	11	0	1
10	89	1	0	0	51	37	7	5	43	30	43	73	5	3	0	1		1	0	28	51	15	6	51	67	3	50	7	0	1
0	100	0	0	0	0	0	100	0	0	0	0	100	0	0	0	0		0	0	0	0	100	0	0	100	0	0	0	0	0
9	90	1	0	0	14	47	30	9	31	39	48	57	6	3	0	0		3	6	9	35	36	20	34	44	13	51	9	1	1
0	100	0	0	0	5	69	18	8	34	33	42	73	3	3	0	0		1	0	3	36	50	11	41	57	2	52	6	0	0
0	100	0	0	0	34	33	33	0	33	33	0	100	0	0	0	0		0	0	0	33	67	0	33	33	0	67	0	0	0
32	67	1	0	0	20	50	22	8	39	38	49	73	6	2	0	0		2	9	11	39	37	13	34	36	11	51	8	0	0
12	88	0	0	0	10	70	16	4	37	34	43	73	2	3	0	0		0	2	7	45	38	10	43	56	1	61	5	0	0
25	75	0	0	0	50	25	25	0	50	25	25	100	0	0	0	0		0	0	25	50	25	0	25	50	0	75	0	0	0

III. Human support (Intellectual support)

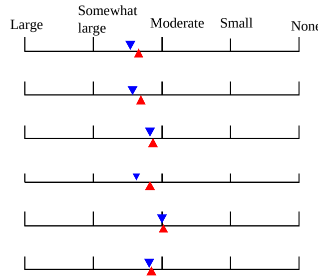
1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

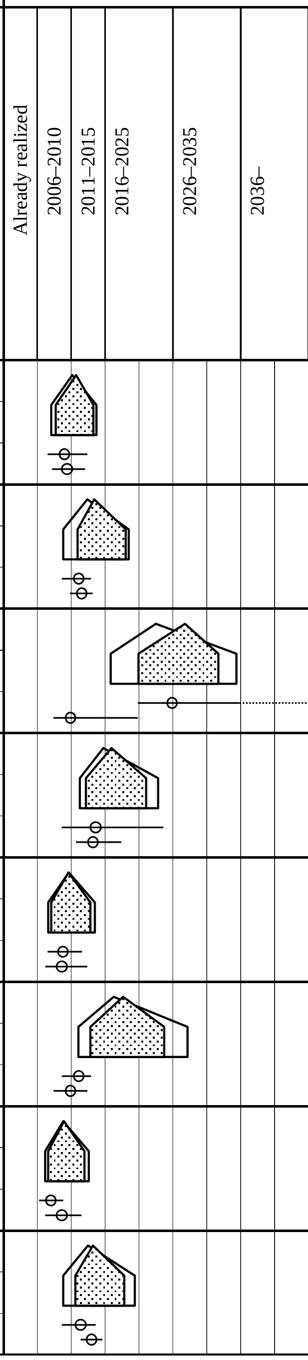
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

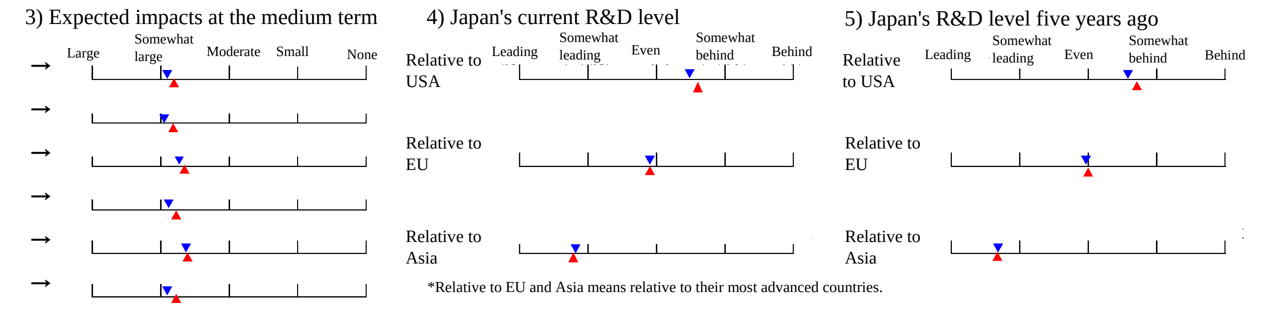


2. Questions regarding topics

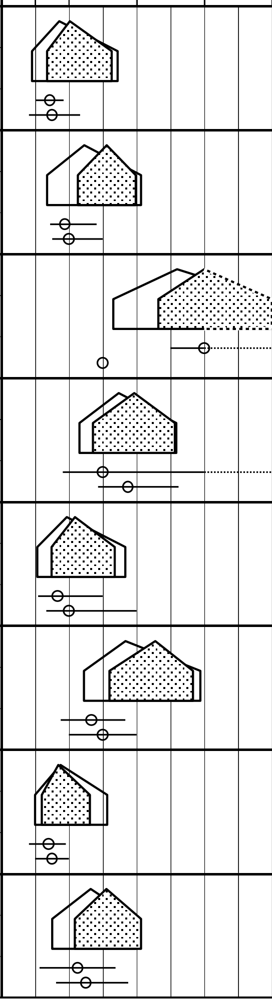
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Will not be realized (%)	Do not know (%)
10	Widespread use of electronic secretary terminals that offer functions such as voice recognition and fuzzy search, in addition to the information agent functions for schedule management and access to databases.	1	125	10	33	57	-	49	11	63	24	2	0	1
		2	111	9	30	61	-	47	5	72	22	1	0	2
		E	10	100	0	0	-	58	20	70	10	0	0	0
11	A portable conversation device that allows people with disabilities to convert their thoughts into speech.	1	106	8	25	67	-	57	23	61	16	0	0	5
		2	100	5	15	80	-	50	6	82	12	0	0	2
		E	5	100	0	0	-	50	20	40	40	0	0	0
12	Technology that allows the computer to electrically and magnetically read the information recorded in the human brain.	1	98	5	19	76	-	46	17	43	33	7	15	15
		2	95	4	13	83	-	43	5	64	26	5	15	10
		E	4	100	0	0	-	25	0	25	50	25	25	25
13	Widespread use of a telephone with real-time language translation capability.	1	123	8	30	62	-	65	40	43	15	2	3	3
		2	110	6	27	67	-	63	33	51	16	0	2	1
		E	7	100	0	0	-	75	57	29	14	0	0	0
14	A system capable of automatically retrieving from the network new information and valuable knowledge with high relevance to the specified topic and presenting them.	1	123	12	28	60	-	60	28	55	17	0	0	2
		2	108	7	25	68	-	52	12	73	15	0	0	1
		E	8	100	0	0	-	59	25	62	13	0	0	0
15	Software (expert systems) capable of carrying out roughly half the work of professionals such as a judge, a lawyer, a patent agent.	1	99	8	17	75	-	44	8	57	31	4	5	8
		2	98	4	12	84	-	42	0	70	30	0	0	2
		E	4	100	0	0	-	38	0	50	50	0	0	0
16	Technology that allows to utilize networked, but heterogeneous, global information sources (the Web, etc.) like an encyclopedia (including a summarization function of important items and a question-and-answer mechanism).	1	121	8	30	62	-	51	13	67	17	3	0	2
		2	111	7	27	66	-	50	9	75	16	0	0	1
		E	8	100	0	0	-	53	13	74	13	0	0	0
17	A system that can construct a text-based easy-to-understand story from fragmented facts and knowledge and show it as a presentation (and can also add presumably necessary figures and images when instructed).	1	102	9	22	69	-	40	7	42	47	4	5	7
		2	105	5	19	76	-	34	1	35	61	3	4	2
		E	5	100	0	0	-	40	0	60	40	0	0	0

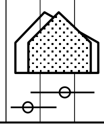
Time of technological realization

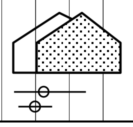




Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
24	74	1	0	1	1	29	43	27	38	38	23	54	9	6	0	2						0	2	2	17	41	40	40	39	29	40	10	0	1
10	89	1	0	0	1	18	54	27	46	30	16	66	1	1	0	0						0	1	0	10	50	40	52	34	23	48	5	0	0
10	90	0	0	0	0	50	20	30	57	29	43	57	14	14	0	0						0	0	0	20	50	30	57	43	29	29	14	0	0
19	76	4	0	1	28	43	25	4	32	35	29	75	4	6	0	1						1	5	25	47	22	6	28	34	15	70	7	3	1
7	91	2	0	0	16	63	16	5	34	38	22	81	1	3	1	0						0	1	15	65	15	5	25	41	12	80	12	1	0
40	60	0	0	0	0	60	20	20	25	0	50	50	0	0	0	0						0	0	0	40	40	20	75	0	0	50	0	0	0
11	80	2	0	7	16	35	29	20	39	32	35	61	3	6	8	3						19	18	13	34	31	22	33	41	5	32	12	23	5
3	93	2	0	2	4	52	32	12	51	29	33	61	1	4	6	0						23	10	5	53	26	16	43	59	0	35	15	17	3
25	75	0	0	0	25	0	50	25	33	0	100	33	33	0	0	0						33	33	0	25	25	50	50	50	0	50	0	0	0
54	37	4	1	4	10	48	27	15	29	37	37	66	17	4	3	2						5	3	8	34	35	23	28	43	24	43	17	1	2
74	26	0	0	0	4	58	28	10	27	40	26	74	8	1	1	0						1	3	2	35	46	17	28	53	18	52	8	0	0
71	29	0	0	0	0	57	29	14	33	33	67	50	0	0	0	0						0	0	0	43	43	14	50	67	17	17	0	0	0
7	90	2	0	1	5	37	37	21	37	39	28	61	4	4	0	1						0	3	3	26	40	31	37	34	24	33	19	5	3
2	98	0	0	0	2	26	57	15	33	43	22	61	1	2	0	0						0	1	1	13	62	24	35	47	22	37	10	0	0
13	87	0	0	0	0	25	50	25	50	17	33	83	0	0	0	0						0	0	0	25	50	25	83	50	33	17	17	0	0
7	89	2	0	2	15	41	28	16	34	35	29	48	6	22	6	1						8	12	17	39	29	15	35	33	15	27	50	18	3
3	96	0	0	1	1	58	33	8	32	44	18	66	5	13	0	1						0	7	6	49	35	10	36	30	8	17	60	7	0
25	75	0	0	0	0	50	25	25	67	33	67	67	0	33	0	0						0	0	0	25	50	25	100	33	33	33	33	0	0
10	89	0	0	1	4	30	41	25	30	30	31	58	19	5	0	0						1	3	3	25	40	32	32	40	33	37	15	4	1
2	98	0	0	0	0	18	62	20	32	29	26	67	4	1	0	0						0	2	0	11	64	25	30	52	31	36	9	0	0
13	87	0	0	0	0	37	25	38	80	20	20	80	0	0	0	0						0	0	0	25	50	25	100	33	33	17	17	0	0
5	91	1	0	3	0	23	46	31	35	29	32	58	5	0	2	3						7	10	0	16	47	37	39	39	25	25	12	0	3
3	96	0	0	1	0	12	64	24	43	26	20	66	0	0	0	0						3	3	0	8	63	29	54	46	15	33	6	1	0
20	80	0	0	0	0	20	40	40	100	33	33	67	0	0	0	0						0	0	0	20	60	20	100	25	25	25	25	0	0



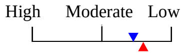
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan (%)					Time of technological realization							(%)
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
18	An external brain function system that is wearable and operable through a natural interface and can store general knowledge like dictionaries as well as a large amount of personal knowledge, experience, and information to extend and enhance the brain's memory function.	1	**99**	**9**	**23**	**68**	**-**	**48**	**15**	**52**	**30**	**3**							**3**	**5**
		2	**100**	**6**	**15**	**79**	**-**	**46**	**8**	**61**	**28**	**3**							**1**	**7**
		E	**6**	**100**	**0**	**0**	**-**	**71**	**50**	**33**	**17**	**0**							**0**	**0**

Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
6	**91**	**1**	**0**	**2**	**7**	**32**	**45**	**16**	**40**	**41**	**40**	**58**	**11**	**3**	**1**	**1**						**4**	**9**	**5**	**27**	**40**	**28**	**43**	**44**	**28**	**38**	**12**	**10**	**1**
4	**95**	**0**	**0**	**1**	**2**	**30**	**55**	**13**	**48**	**36**	**34**	**71**	**4**	**0**	**1**	**0**						**1**	**7**	**3**	**17**	**62**	**18**	**48**	**55**	**21**	**38**	**4**	**4**	**0**
33	**67**	**0**	**0**	**0**	**17**	**33**	**17**	**33**	**100**	**25**	**25**	**75**	**0**	**0**	**0**	**0**						**0**	**0**	**17**	**33**	**33**	**17**	**80**	**40**	**20**	**40**	**20**	**0**	**0**

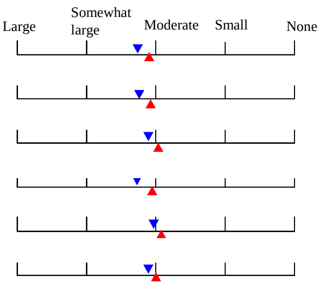
IV. Ultra-transparent communications; human interface

1. Questions regarding the relevant area

1) Degree of expertise in the area

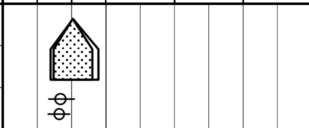
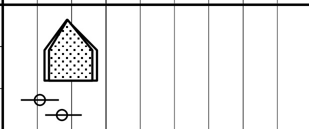
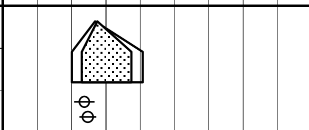
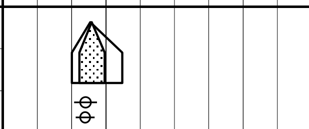
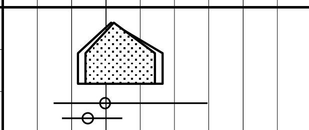
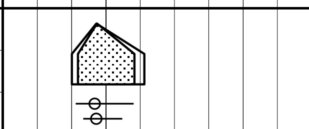
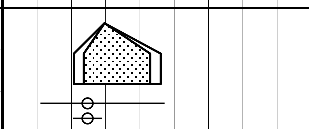
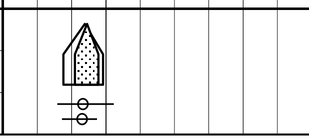


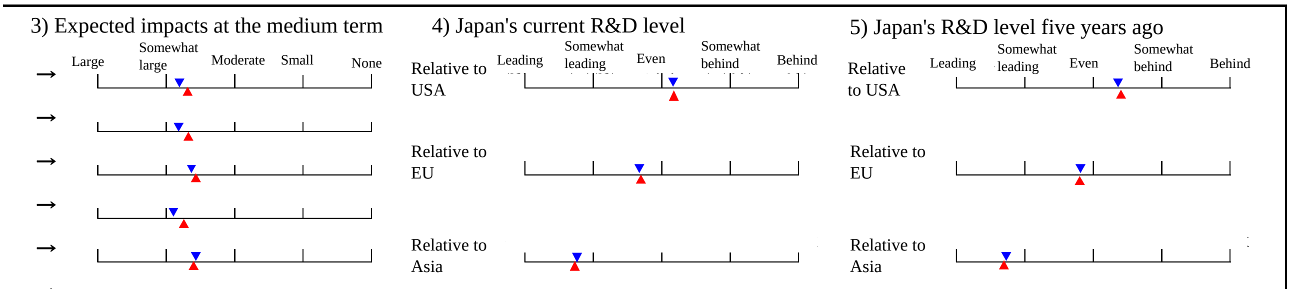
2) Current impacts



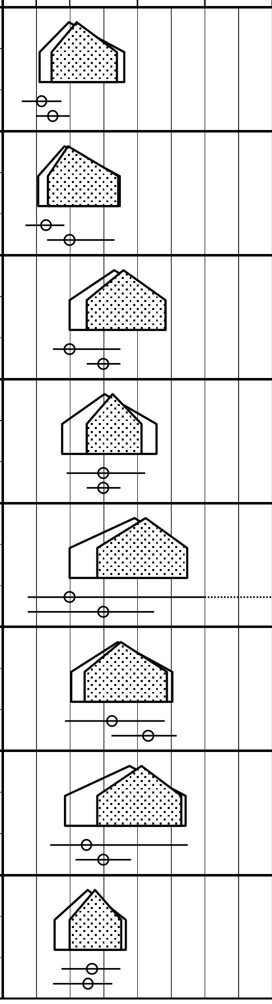
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
19	A portable digital display that is so flexible (thin and soft) that it can be substituted for newspaper.	1	114	6	18	76	-	65	38	47	14	1		2	0
		2	115	3	12	85	-	60	25	66	8	1		0	1
		E	4	100	0	0	-	81	75	0	25	0		0	0
20	Control technology to localize sound images anywhere in a given space.	1	101	11	29	60	-	45	10	50	39	1		1	2
		2	105	9	17	74	-	40	3	56	36	5		0	3
		E	9	100	0	0	-	41	0	74	13	13		0	11
21	Technology to quantitatively measure the comfort in clothing, a vehicle, a place, etc.	1	88	8	24	68	-	49	14	55	29	2		4	6
		2	92	2	16	82	-	41	7	50	38	5		1	6
		E	2	100	0	0	-	63	50	0	50	0		0	0
22	Wide accessibility to multi-modal environments where different means of input, such as sound, body action, manual gesture, and facial expression, may be used as human interfaces in a coordinated manner.	1	110	11	27	62	-	54	20	57	22	1		1	2
		2	107	7	18	75	-	47	8	68	22	2		0	3
		E	8	100	0	0	-	59	25	62	13	0		0	0
23	Widespread use of robots that can play against human players in sport (e.g. table tennis).	1	96	6	20	74	-	41	9	41	46	4		3	1
		2	106	3	9	88	-	33	3	29	64	4		2	2
		E	3	100	0	0	-	58	34	33	33	0		0	0
24	Widespread use of 3D TV that may be watched without wearing special glasses and feeling fatigue in homes.	1	109	10	31	59	-	55	24	49	25	2		4	1
		2	110	5	25	70	-	47	10	60	28	2		2	1
		E	6	100	0	0	-	63	33	50	17	0		0	0
25	Widespread use of sound field shielding technology capable of isolating a specific spatial area from the surrounding noise, to ensure silence for residents around airports, highways, railroads, etc.	1	87	10	24	66	-	63	32	55	13	0		6	9
		2	94	6	14	80	-	54	14	73	13	0		3	4
		E	6	100	0	0	-	42	0	67	33	0		17	0
26	An ultra low bit rate coding scheme capable of compressing HDTV images into 4-Mbps or smaller signals (about 1/250 compression ratio), and CD-level sound into 32-Kbps or smaller signals, while maintaining the original signal quality.	1	115	20	29	51	-	63	33	53	14	0		6	7
		2	108	16	24	60	-	54	15	71	14	0		4	4
		E	17	100	0	0	-	56	18	70	12	0		6	0

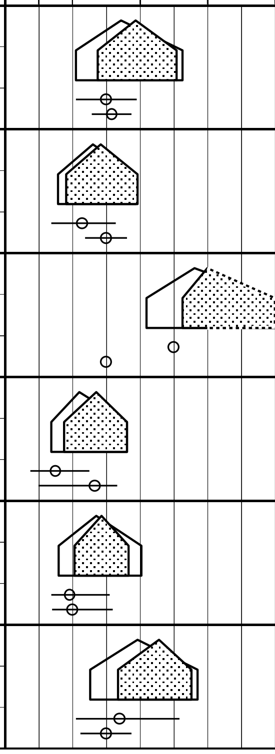


*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
63	32	4	0	1	13	36	29	22	20	41	31	69	8	5	1	0		2	1	8	27	30	35	30	34	34	62	14	3	0
86	12	2	0	0	2	49	29	20	19	47	18	86	1	2	0	0		0	1	0	19	44	37	30	29	26	70	7	0	0
75	0	25	0	0	34	33	0	33	0	100	0	100	0	0	0	0		0	0	0	50	0	50	0	0	50	100	50	0	0
34	64	1	0	1	0	22	48	30	25	41	28	59	4	3	0	0		1	7	0	14	40	46	31	37	31	44	12	2	2
21	79	0	0	0	0	11	57	32	25	36	13	80	1	1	0	0		1	2	1	6	45	48	32	34	23	62	2	0	0
62	38	0	0	0	0	25	13	62	33	0	0	100	0	0	0	0		0	11	11	22	11	56	25	50	25	75	0	0	0
34	56	5	0	5	5	35	38	22	41	42	32	58	3	3	2	0		2	8	2	25	44	29	36	48	22	45	9	7	0
22	76	1	0	1	1	19	54	26	38	40	18	74	0	2	0	0		1	2	0	13	55	32	37	51	20	56	2	3	0
50	50	0	0	0	0	100	0	0	100	100	100	100	0	0	0	0		0	0	0	50	0	50	100	100	100	100	0	0	0
35	62	1	0	2	4	45	32	19	34	42	36	68	4	4	1	0		4	3	4	33	34	29	32	44	32	51	7	3	0
18	81	1	0	0	1	45	39	15	30	47	22	82	1	1	0	0		0	2	1	19	55	25	30	34	25	68	4	0	0
50	50	0	0	0	14	72	0	14	67	33	50	67	0	0	0	0		0	0	13	49	13	25	50	83	50	67	17	0	0
68	30	0	0	2	2	34	42	22	29	48	30	64	5	5	1	0		4	4	2	20	48	30	25	44	34	55	17	6	0
88	12	0	0	0	2	20	52	26	31	52	25	75	0	4	1	0		3	1	0	10	62	28	25	39	21	60	11	3	0
100	0	0	0	0	0	50	0	50	100	100	100	100	0	0	0	0		0	0	0	0	33	67	100	100	100	100	100	100	0
69	29	1	0	1	5	31	45	19	21	49	29	75	2	7	2	0		6	2	6	25	38	31	28	44	30	51	20	11	1
91	9	0	0	0	0	22	60	18	18	42	17	82	3	1	1	0		3	2	0	15	60	25	25	43	14	68	10	3	0
67	33	0	0	0	0	80	20	0	20	40	40	80	0	0	0	0		0	17	0	33	17	50	33	100	33	67	0	0	0
53	38	5	0	4	25	39	24	12	33	40	44	68	5	14	7	0		5	11	30	37	23	10	30	36	21	63	18	21	1
76	19	5	0	0	14	56	21	9	28	42	40	75	0	7	1	0		4	3	15	55	22	8	20	39	16	76	16	12	1
83	17	0	0	0	0	40	20	40	0	0	67	67	0	0	0	0		17	0	0	50	0	50	0	0	33	100	33	0	0
46	51	2	0	1	8	37	36	19	32	41	35	58	30	7	1	1		5	8	7	26	35	32	27	48	25	47	16	8	5
50	50	0	0	0	0	40	44	16	28	36	27	72	18	3	0	0		4	5	0	22	53	25	19	47	18	68	6	1	1
71	29	0	0	0	0	41	35	24	23	46	15	62	38	8	0	0		0	6	0	12	47	41	30	60	30	50	10	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Degree of expertise (%) Moderate	Degree of expertise (%) Low	Degree of expertise (%) None	Importance to Japan Index	Importance to Japan (%) High	Importance to Japan (%) Moderate	Importance to Japan (%) Low	Importance to Japan (%) None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
27	A sensibility expression system that can, when given a description of a certain image, present music and pictures suited to the person's sensibilities.	1	86	13	21	66	-	38	8	32	56	4		7	10
		2	95	7	15	78	-	30	1	22	72	5		2	5
		E	7	100	0	0	-	39	0	57	43	0		0	0
28	A remote distributed conferencing system with high realism that enables, with the aid of a virtual agent, participants to share information material and hold natural-language conversations.	1	110	13	31	56	-	50	13	66	17	4		1	4
		2	109	9	25	66	-	45	3	73	23	1		1	1
		E	10	100	0	0	-	53	10	80	10	0		0	0
29	Mind-machine interfaces based on brain waves, etc. (certain thoughts conveyed to the computer).	1	66	6	18	76	-	39	10	36	43	11		13	16
		2	78	1	12	87	-	32	3	28	62	7		22	14
		E	1	100	0	0	-	25	0	0	100	0		0	0
30	General-purpose high-quality sound synthesis technology capable of vocalizing text information, with quality identical to human voice.	1	105	6	26	68	-	52	18	57	24	1		1	3
		2	103	4	18	78	-	48	5	76	18	1		0	2
		E	4	100	0	0	-	56	25	50	25	0		0	0
31	Technology to automatically retrieve meta-data (data containing information-related data) from visual/audio content.	1	110	13	31	56	-	56	25	53	20	2		2	3
		2	105	11	24	65	-	53	15	68	15	2		0	1
		E	12	100	0	0	-	60	25	67	8	0		0	0
32	Technology to understand people's intentions from non-verbal information such as biometrics, facial expression, and eye movement.	1	84	17	20	63	-	55	23	56	17	4		2	4
		2	88	7	20	73	-	47	8	67	24	1		1	5
		E	6	100	0	0	-	63	33	50	17	0		0	0

Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
	(%)					(%)						(%)										(%)			(%)						(%)			
33	**61**	**3**	**0**	**3**	**5**	**25**	**35**	**35**	**37**	**47**	**35**	**49**	**6**	**4**	**0**	**4**						**7**	**13**	**2**	**23**	**36**	**39**	**35**	**50**	**33**	**46**	**7**	**0**	**2**
21	**78**	**0**	**0**	**1**	**1**	**11**	**50**	**38**	**21**	**49**	**19**	**67**	**2**	**2**	**0**	**0**						**1**	**7**	**0**	**7**	**50**	**43**	**19**	**60**	**19**	**52**	**6**	**2**	**0**
57	**43**	**0**	**0**	**0**	**0**	**43**	**14**	**43**	**50**	**50**	**50**	**100**	**0**	**0**	**0**	**0**						**0**	**0**	**0**	**14**	**43**	**43**	**50**	**75**	**50**	**75**	**0**	**0**	**0**
27	**69**	**2**	**0**	**2**	**6**	**40**	**29**	**25**	**36**	**40**	**42**	**59**	**12**	**9**	**1**	**0**						**1**	**4**	**3**	**34**	**26**	**37**	**35**	**54**	**32**	**43**	**11**	**3**	**0**
13	**87**	**0**	**0**	**0**	**0**	**38**	**40**	**22**	**25**	**42**	**30**	**70**	**4**	**4**	**0**	**0**						**1**	**1**	**0**	**21**	**46**	**33**	**23**	**53**	**17**	**59**	**14**	**3**	**0**
22	**78**	**0**	**0**	**0**	**0**	**50**	**10**	**40**	**33**	**50**	**67**	**83**	**0**	**0**	**0**	**0**						**0**	**0**	**0**	**30**	**30**	**40**	**50**	**33**	**33**	**67**	**17**	**0**	**0**
10	**67**	**6**	**2**	**15**	**7**	**39**	**32**	**22**	**48**	**26**	**50**	**46**	**7**	**2**	**2**	**0**						**18**	**20**	**7**	**33**	**32**	**28**	**35**	**23**	**23**	**40**	**18**	**18**	**0**
1	**93**	**1**	**1**	**4**	**1**	**32**	**39**	**28**	**44**	**20**	**47**	**55**	**0**	**4**	**4**	**2**						**25**	**17**	**0**	**20**	**42**	**38**	**41**	**30**	**30**	**52**	**9**	**11**	**0**
100	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**						**0**	**0**	**0**	**0**	**0**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
57	**41**	**2**	**0**	**0**	**5**	**31**	**41**	**23**	**19**	**47**	**41**	**63**	**7**	**1**	**0**	**0**						**3**	**2**	**4**	**24**	**37**	**35**	**23**	**49**	**31**	**49**	**3**	**3**	**0**
76	**22**	**2**	**0**	**0**	**1**	**26**	**50**	**23**	**13**	**49**	**26**	**68**	**1**	**1**	**0**	**0**						**0**	**2**	**0**	**12**	**52**	**36**	**21**	**41**	**22**	**63**	**2**	**2**	**0**
100	**0**	**0**	**0**	**0**	**0**	**25**	**0**	**75**	**100**	**0**	**0**	**100**	**0**	**0**	**0**	**0**						**0**	**0**	**0**	**25**	**0**	**75**	**100**	**0**	**0**	**100**	**0**	**0**	**0**
30	**67**	**2**	**0**	**1**	**10**	**33**	**35**	**22**	**38**	**50**	**38**	**69**	**14**	**6**	**3**	**1**						**2**	**3**	**5**	**33**	**29**	**33**	**34**	**50**	**26**	**51**	**10**	**4**	**1**
16	**84**	**0**	**0**	**0**	**1**	**34**	**46**	**19**	**23**	**56**	**18**	**77**	**2**	**2**	**0**	**0**						**0**	**1**	**0**	**30**	**40**	**30**	**20**	**57**	**19**	**61**	**9**	**3**	**0**
42	**58**	**0**	**0**	**0**	**0**	**41**	**17**	**42**	**33**	**33**	**33**	**83**	**0**	**0**	**0**	**0**						**0**	**0**	**0**	**25**	**17**	**58**	**40**	**80**	**20**	**60**	**20**	**0**	**0**
27	**66**	**4**	**0**	**3**	**14**	**49**	**28**	**9**	**41**	**48**	**39**	**58**	**3**	**1**	**0**	**0**						**6**	**4**	**10**	**44**	**29**	**17**	**43**	**44**	**25**	**44**	**8**	**8**	**0**
5	**93**	**1**	**0**	**1**	**2**	**51**	**36**	**11**	**28**	**49**	**25**	**72**	**1**	**1**	**0**	**0**						**5**	**5**	**4**	**40**	**36**	**20**	**31**	**48**	**21**	**66**	**7**	**3**	**0**
17	**83**	**0**	**0**	**0**	**0**	**50**	**0**	**50**	**67**	**33**	**33**	**100**	**0**	**0**	**0**	**0**						**0**	**0**	**0**	**33**	**17**	**50**	**33**	**67**	**33**	**100**	**33**	**0**	**0**

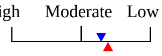


V. Information security

1. Questions regarding the relevant area

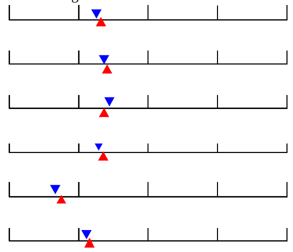
1) Degree of expertise in the area

High Moderate Low



2) Current impacts

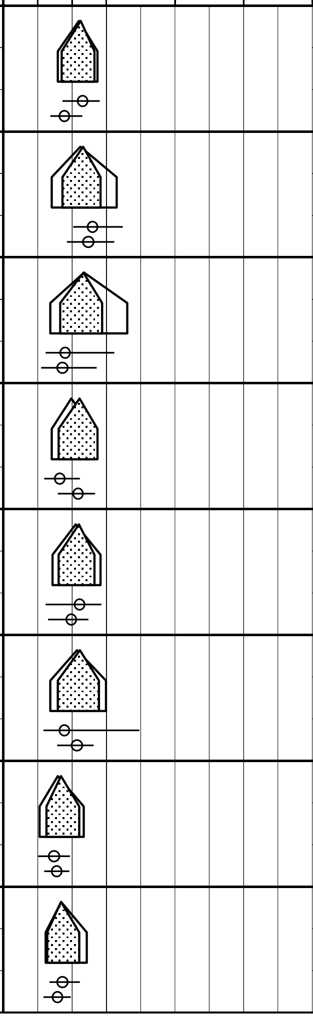
		Large	Somewhat large	Moderate	Small	None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets					
	Contribution to the development of other fields					
[Economic impacts]	Contribution to the development of existing Japanese industry					
	Contribution to the creation of new industries or businesses					
[Social impacts]	Contribution to safety and security					
	Contribution to improved social vitality and quality of life					

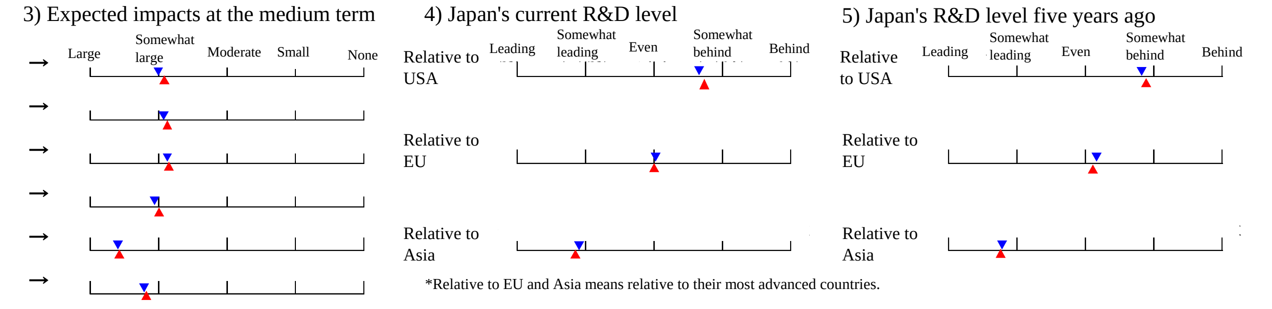


2. Questions regarding topics

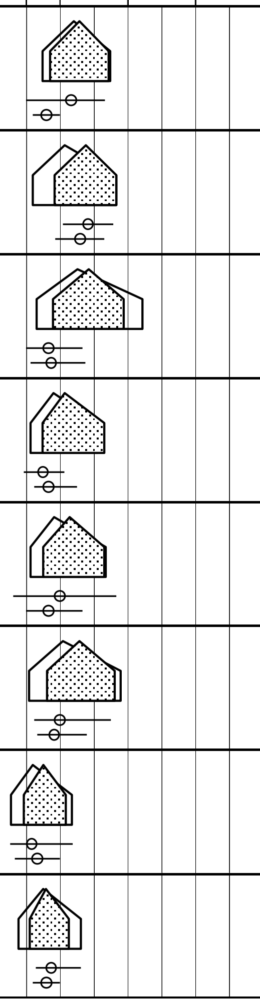
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Will not be realized (%)	Do not know (%)
33	Theory for designing the stringency of a system's security and privacy protection (theory for the quantitative evaluation of security stringency based on the system's components, architecture, and environmental conditions or for the estimation of security limitations; theory for defining the architecture and environmental conditions that facilitate such evaluations and estimations).	1	104	12	34	54	-	78	59	37	4	0	1	6
		2	109	7	19	74	-	82	65	34	1	0	0	1
		E	8	100	0	0	-	94	87	13	0	0	0	0
34	Technology that helps to locate wanted criminals and material witnesses by analyzing the facial features, behavior, looks, and voice of people captured by surveillance cameras set in public spaces.	1	119	8	30	62	-	62	33	48	18	1	2	2
		2	117	6	22	72	-	61	28	61	11	0	0	2
		E	7	100	0	0	-	79	57	43	0	0	0	0
35	Generalized technology, extended from total building management systems and home security systems, which is coupled with seismic detection systems so that the safety of human life can be ensured before seismic waves arrive, in an earthquake whose epicenter is distant.	1	100	8	22	70	-	84	70	25	5	0	5	3
		2	105	5	10	85	-	92	84	13	3	0	0	2
		E	5	100	0	0	-	80	60	40	0	0	0	0
36	A highly reliable network system capable of protecting the privacy and secrecy of individuals and groups from intrusion by malicious hackers.	1	124	14	40	46	-	86	72	26	2	0	9	6
		2	120	8	34	58	-	93	86	13	1	0	3	2
		E	10	100	0	0	-	95	90	10	0	0	0	0
37	Cyber-policing technology to automatically monitor online illegal acts associated with the copyright of multimedia software, privacy protection, etc.	1	117	9	33	58	-	68	43	44	13	0	1	4
		2	115	7	24	69	-	64	33	57	10	0	1	3
		E	8	100	0	0	-	78	62	25	13	0	0	0
38	A security system capable of identitfying individuals through facial and vocal recognition at an accuracy of 99.9% or higher.	1	117	11	25	64	-	60	32	48	17	3	3	1
		2	116	10	24	66	-	58	21	69	9	1	1	1
		E	12	100	0	0	-	71	42	58	0	0	0	0
39	Technology to detect intrusions and viruses on the Internet backbone.	1	128	11	29	60	-	77	56	41	3	0	1	9
		2	118	8	24	68	-	88	76	22	2	0	0	3
		E	9	100	0	0	-	94	89	11	0	0	0	0
40	Capability of tracing back the source address of suspect packet in the Internet to detect intrusions.	1	119	11	33	56	-	75	54	37	9	0	1	5
		2	116	7	26	67	-	86	75	22	3	0	0	1
		E	8	100	0	0	-	94	87	13	0	0	0	0

Time of technological realization: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–

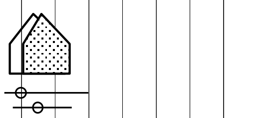
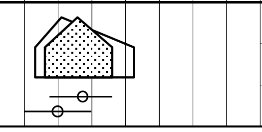




Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application					(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
2	94	3	0	1	35	40	17	8	46	46	34	59	18	10	7	1						1	7	27	37	25	11	44	44	13	43	14	31	2
1	98	1	0	0	26	60	9	5	50	50	24	67	8	5	9	0						0	1	15	60	18	7	42	55	9	58	14	20	0
0	100	0	0	0	29	29	42	0	57	43	14	71	0	0	0	0						0	0	13	49	25	13	43	29	0	57	0	14	0
14	76	7	0	3	31	42	20	7	23	37	33	64	9	19	20	2						2	8	34	40	18	8	20	34	11	48	32	48	5
5	95	0	0	0	17	58	21	4	23	46	28	70	4	8	14	1						1	4	20	62	13	5	21	43	8	56	18	49	1
29	71	0	0	0	57	29	0	14	33	50	17	67	17	17	17	0						0	0	72	14	0	14	17	17	0	50	17	50	0
79	19	1	0	1	51	29	14	6	27	53	49	69	3	11	6	2						4	3	53	28	14	5	24	41	13	66	17	22	4
93	7	0	0	0	69	24	4	3	20	63	41	77	5	5	3	0						0	2	70	24	2	4	26	49	8	84	9	13	0
80	20	0	0	0	60	40	0	0	20	60	20	60	0	0	20	0						0	0	60	40	0	0	20	20	0	60	0	20	0
3	95	1	0	1	40	34	17	9	38	45	39	64	17	8	21	1						3	10	39	35	14	12	30	43	15	48	19	45	1
0	100	0	0	0	56	32	8	4	41	54	33	74	10	5	8	0						1	3	42	46	5	7	32	46	6	62	11	50	0
0	100	0	0	0	50	50	0	0	80	40	10	70	20	0	10	0						0	0	50	50	0	0	50	40	10	40	10	30	0
4	93	1	0	2	35	31	26	8	34	46	25	52	16	12	27	3						4	8	32	35	23	10	28	39	11	35	24	55	4
1	99	0	0	0	31	47	18	4	37	57	21	60	13	3	14	0						2	2	21	59	13	7	28	46	6	41	11	57	0
0	100	0	0	0	61	13	13	13	71	14	14	57	43	0	0	0						0	0	49	38	0	13	57	14	14	57	14	14	0
28	70	2	0	0	17	32	35	16	28	46	25	66	7	11	11	1						5	3	19	28	34	19	26	30	18	49	18	30	3
19	80	1	0	0	6	50	35	9	26	57	17	72	5	3	8	1						3	1	9	40	38	13	27	44	11	58	9	26	0
33	67	0	0	0	17	50	25	8	27	73	9	55	18	9	18	0						0	0	25	42	25	8	30	50	10	50	20	30	0
2	97	0	0	1	27	41	16	16	38	37	30	58	18	6	24	1						1	8	24	40	18	18	35	40	15	39	16	45	2
0	100	0	0	0	15	63	16	6	39	31	26	74	11	3	18	0						1	2	14	68	12	6	34	51	7	47	13	49	1
0	100	0	0	0	33	56	0	11	50	38	38	63	25	0	13	0						11	0	56	33	11	0	44	44	0	33	33	33	0
1	95	1	1	2	33	40	15	12	38	37	30	58	17	9	23	1						2	7	30	38	19	13	29	38	19	36	17	54	2
0	100	0	0	0	18	58	18	6	38	35	25	71	14	5	18	0						1	1	19	61	13	7	25	48	7	41	13	55	0
0	100	0	0	0	25	62	13	0	50	25	38	75	13	0	25	0						0	0	49	38	13	0	38	50	0	50	38	38	0



No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Degree of expertise: Moderate (%)	Degree of expertise: Low (%)	Degree of expertise: None (%)	Importance to Japan: Index	Importance to Japan: High (%)	Importance to Japan: Moderate (%)	Importance to Japan: Low (%)	Importance to Japan: None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
41	A spam-free e-mail system.	1	**119**	**5**	**33**	**62**	**-**	**66**	**39**	**47**	**13**	**1**							**4**	**15**
		2	**112**	**4**	**24**	**72**	**-**	**66**	**36**	**55**	**9**	**0**							**4**	**4**
		E	**4**	**100**	**0**	**0**	**-**	**75**	**50**	**50**	**0**	**0**							**25**	**0**
42	A publicly available algorithm with theoretically proven safety concerning the prevention of digital watermark removal.	1	**97**	**8**	**29**	**63**	**-**	**67**	**40**	**48**	**12**	**0**							**4**	**14**
		2	**102**	**5**	**24**	**71**	**-**	**63**	**30**	**62**	**8**	**0**							**3**	**9**
		E	**5**	**100**	**0**	**0**	**-**	**70**	**40**	**60**	**0**	**0**							**20**	**0**

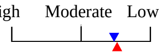
Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application							Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
1	95	1	1	2	16	39	29	16	34	30	32	51	17	8	23	1						3	13	18	37	28	17	31	40	20	34	11	40	7
0	100	0	0	0	5	56	32	7	36	29	18	64	11	4	13	0						3	4	6	54	31	9	26	48	11	37	6	48	1
0	100	0	0	0	0	75	25	0	75	25	0	50	0	0	0	0						25	0	25	75	0	0	75	50	50	0	50	25	0
17	76	1	0	6	16	41	28	15	41	38	36	49	11	7	15	1						3	12	12	38	31	19	36	42	14	34	14	30	1
10	90	0	0	0	4	60	28	8	44	41	24	69	7	3	6	0						3	10	4	56	29	11	37	59	7	41	6	30	1
40	60	0	0	0	0	60	40	0	60	20	0	80	0	0	0	0						20	0	20	80	0	0	80	40	0	60	20	0	0

VI. Information technology for developing social systems

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

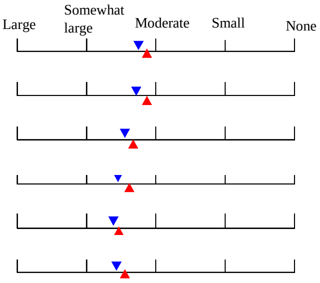


2) Current impacts

[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

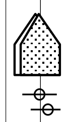
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

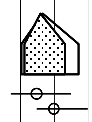
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

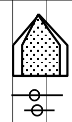


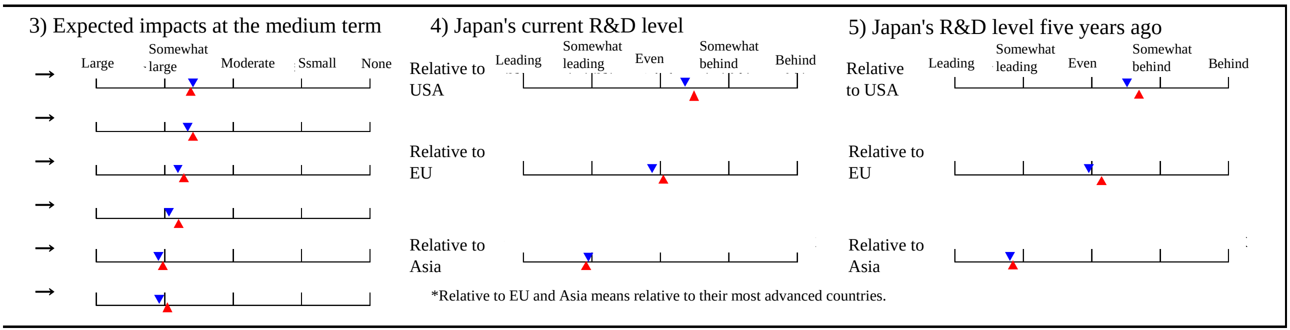
2. Questions regarding topics

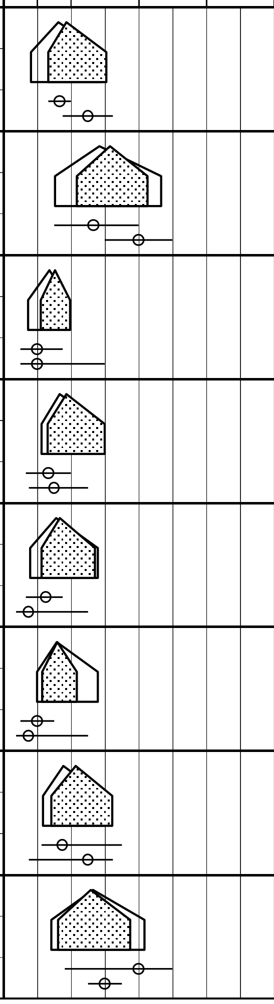
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
43	A system capable of identifying the online content harmful to young people and automatically checking it.	1	117	3	27	70	-	52	17	58	25	0							4	2
		2	112	3	21	76	-	49	10	65	25	0							4	1
		E	3	100	0	0	-	50	33	0	67	0							0	0
44	A regional security system in which home security systems are interconnected and use personal robots whose services are not limited to disaster prevention, crime prevention, and nursing care, but are much more diverse.	1	115	8	27	65	-	63	35	48	15	2							2	2
		2	116	3	22	75	-	58	19	74	7	0							2	0
		E	4	100	0	0	-	56	25	50	25	0							0	0
45	A copyright management system intended for the promotion of production and distribution of online content by facilitating reasonable financial compensation.	1	110	6	33	61	-	66	39	46	15	0								
		2	107	3	29	68	-	58	20	70	10	0								
		E	3	100	0	0	-	58	34	33	33	0								
46	Nearly half the municipalities introduce electronic voting systems that make direct voting by residents fair, secure, easy, and inexpensive.	1	118	7	26	67	-	53	22	51	24	3							0	2
		2	113	3	19	78	-	49	7	74	19	0							1	0
		E	3	100	0	0	-	42	0	67	33	0							0	0
47	Widespread use of electronic money, to allow anonymous transfers of money to be made with credibility as high as conventional money.	1	117	7	25	68	-	55	23	56	18	3								
		2	114	5	22	73	-	51	12	71	16	1								
		E	6	100	0	0	-	71	50	33	17	0								
48	A ¥100 billion-a-year virtual company that has no office building and conducts all business operations over the Internet.	1	100	3	22	75	-	43	10	44	42	4								
		2	99	3	17	80	-	40	3	53	41	3								
		E	3	100	0	0	-	50	33	0	67	0								
49	In Japan, all patient charts, including relevant video, are digitized and maintained by individual patients, and inspection and other data are shared among all medical institutions, leading to the emergence of health care agents, who intermediate between patients and medical institutions.	1	102	5	26	69	-	71	47	45	7	1								
		2	111	3	15	82	-	70	42	52	5	1								
		E	3	100	0	0	-	58	34	33	33	0								
50	Fewer than 1% of Japanese (aged 15 or older) can neither browse the Web nor exchange e-mail through PCs, mobile phones, PDAs or other devices.	1	128	14	39	47	-	55	27	45	24	4								
		2	118	6	42	52	-	48	11	63	22	4								
		E	7	100	0	0	-	54	29	29	42	0								





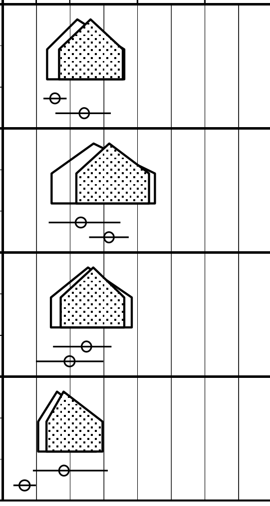




Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
13	82	2	1	2	17	34	34	15	23	44	22	43	19	7	33	1		3	5	23	34	28	15	25	32	11	32	12	59	1
2	97	0	1	0	6	49	35	10	19	50	18	52	8	3	32	0		3	3	14	44	31	11	18	34	5	33	11	74	0
33	67	0	0	0	0	34	33	33	50	50	0	50	0	0	0	0		0	0	34	0	33	33	50	50	0	50	50	100	0
52	46	0	0	2	17	45	24	14	29	54	41	68	9	14	13	1		4	4	24	39	24	13	30	35	27	63	29	25	1
68	32	0	0	0	7	70	17	6	16	60	30	74	2	8	6	0		0	0	11	57	26	6	21	43	21	69	26	21	0
75	25	0	0	0	50	25	0	25	33	33	0	33	33	0	0	0		0	0	75	0	0	25	33	0	0	67	33	33	0
																		4	7	31	34	25	10	22	32	19	26	36	56	4
																		0	3	11	56	25	8	16	36	7	19	33	67	0
																		0	33	0	0	33	67	0	0	0	0	100	100	0
34	56	6	2	2	38	38	14	10	19	27	32	34	3	31	24	3		1	1	52	31	14	3	15	27	7	42	42	39	3
18	80	2	0	0	26	61	8	5	14	28	35	48	5	22	20	0		0	2	62	29	6	3	11	23	5	46	56	46	0
67	33	0	0	0	0	33	0	67	100	0	0	100	0	0	0	0		0	0	0	67	0	33	0	0	0	0	100	0	0
																		4	5	29	30	30	11	17	25	17	22	53	37	3
																		1	4	27	40	25	8	15	26	10	20	71	39	0
																		0	0	17	17	17	49	67	33	33	33	100	33	0
																		6	9	11	16	39	34	13	15	42	22	63	25	2
																		5	2	2	6	64	28	11	13	41	11	77	27	0
																		0	0	0	0	33	67	100	100	0	0	100	100	0
																		4	7	47	31	14	8	22	33	21	45	66	49	2
																		1	3	67	19	11	3	19	33	12	46	79	47	1
																		0	0	34	0	33	33	0	0	0	0	100	0	0
																		11	8	18	21	34	27	56	21	11	51	16	6	7
																		7	3	10	18	50	22	75	15	6	48	16	9	0
																		14	0	17	17	33	33	50	0	0	75	0	25	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan Index	High (%)	Moderate	Low	None	Time of technological realization Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know
51	A global traceability system that covers a majority of foods.	1	**105**	**11**	**26**	**63**	**-**	**67**	**41**	**47**	**12**	**0**							**2**	**3**
		2	**108**	**10**	**19**	**71**	**-**	**69**	**41**	**52**	**7**	**0**							**0**	**1**
		E	**11**	**100**	**0**	**0**	**-**	**80**	**64**	**27**	**9**	**0**							**0**	**0**
52	Widespread use of a system that allows people to remotely enjoy paintings or music performances as if they were actually walking around a gallery, looking at each painting, or sitting in a concert hall, listening to a live performance.	1	**119**	**7**	**37**	**56**	**-**	**34**	**3**	**36**	**54**	**7**							**7**	**4**
		2	**113**	**7**	**29**	**64**	**-**	**32**	**2**	**25**	**70**	**3**							**1**	**1**
		E	**8**	**100**	**0**	**0**	**-**	**32**	**0**	**29**	**71**	**0**							**0**	**0**
53	Widespread use of a centralized system for comprehensively monitoring and reporting atmospheric pollution that can automatically detect chemical substances, pollen, and other fine particles in the air with sensors in homes and streets, analyze the results at special administrative or municipal facilities, and provide residents with emergency reports of the condition and actions to be taken and with on-demand information.	1	**108**	**6**	**24**	**70**	**-**	**60**	**32**	**46**	**20**	**2**							**1**	**3**
		2	**110**	**4**	**19**	**77**	**-**	**57**	**19**	**71**	**10**	**0**							**0**	**0**
		E	**4**	**100**	**0**	**0**	**-**	**50**	**25**	**25**	**50**	**0**							**0**	**0**
54	Telemedicine in which a doctor performs diagnosis over the Internet based on the patient's medical data obtained at home, and provides treatment if standard instruction and prescription are applicable.	1	**112**	**10**	**24**	**66**	**-**	**69**	**44**	**46**	**9**	**1**								
		2	**114**	**4**	**18**	**78**	**-**	**69**	**40**	**56**	**4**	**0**								
		E	**4**	**100**	**0**	**0**	**-**	**50**	**33**	**0**	**67**	**0**								

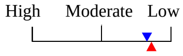
Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application							Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
45	48	7	0	0	39	39	16	6	22	37	39	37	48	23	30	1						7	3	47	30	17	6	18	25	19	47	36	60	2
50	49	1	0	0	34	50	11	5	18	32	29	35	57	20	27	0						0	2	61	24	11	4	13	25	9	55	29	70	1
46	45	9	0	0	55	18	18	9	30	30	20	40	40	50	30	0						0	0	64	18	9	9	30	30	20	60	40	50	0
34	55	6	0	5	1	21	46	32	28	35	38	54	12	5	3	3						9	8	1	17	43	39	27	36	24	44	11	8	3
23	77	0	0	0	1	6	58	35	19	33	30	70	9	7	0	0						2	1	2	3	50	45	25	42	17	67	12	2	0
29	71	0	0	0	0	29	42	29	50	25	25	75	0	0	0	0						0	0	0	14	57	29	60	20	20	60	20	0	0
47	38	12	0	3	36	40	15	9	28	48	43	56	9	18	19	1						4	3	38	38	17	7	20	34	20	66	23	25	2
71	24	5	0	0	23	58	13	6	14	52	31	73	3	8	8	0						0	1	36	49	9	6	15	37	10	79	16	19	1
100	0	0	0	0	25	25	25	25	33	33	0	67	0	33	0	0						0	0	25	50	0	25	33	0	0	67	33	0	0
																						2	4	39	37	17	7	19	27	15	42	70	32	1
																						0	0	47	37	12	4	16	20	7	48	84	22	0
																						0	0	50	0	25	25	67	0	0	33	100	33	0



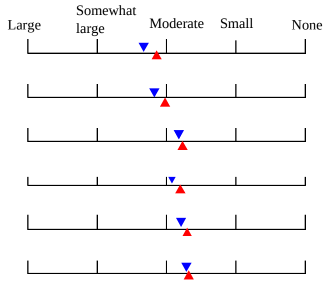
VII. New principles for information and telecommunications

1. Questions regarding the relevant area

1) Degree of expertise in the area

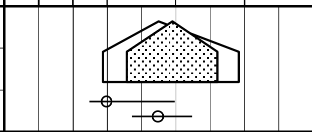
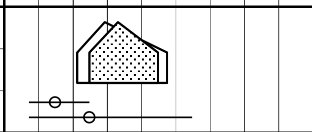
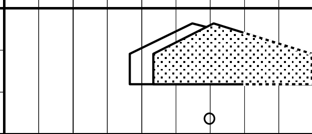
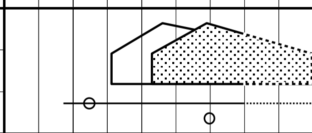
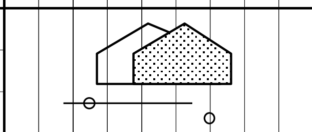
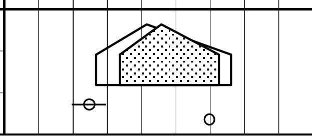


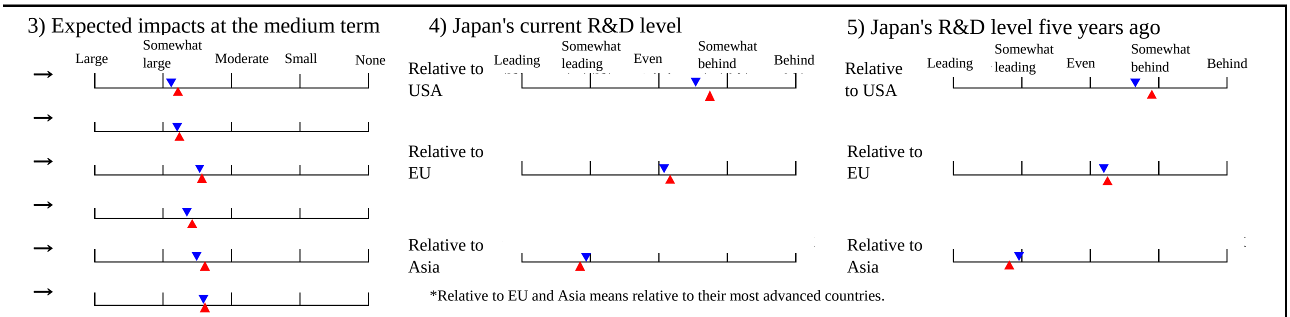
2) Current impacts

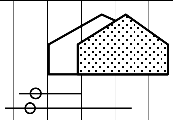
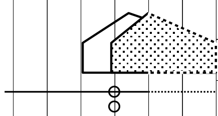
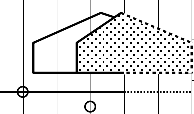
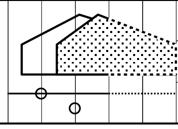


Category	Item
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
55	Models of human creativity and intuition are developed and new ideas created by machines are proven useful in many fields.	1	77	8	14	78	-	45	11	50	35	4		19	12
		2	79	4	8	88	-	42	1	64	35	0		8	6
		E	3	100	0	0	-	50	0	100	0	0		0	0
56	Practical quantum encryption.	1	100	6	22	72	-	64	34	55	11	0		1	4
		2	91	4	19	77	-	56	17	72	11	0		2	1
		E	4	100	0	0	-	63	25	75	0	0		25	0
57	Discovery of a mechanism for the human brain to directly receive a greater amount of information faster by means of systems other than the visual (text) and auditory (sound) systems.	1	76	4	17	79	-	46	14	48	31	7		25	12
		2	79	1	9	90	-	45	8	59	30	3		23	11
		E	1	100	0	0	-	50	0	100	0	0		0	0
58	General-purpose quantum computing applicable to diverse algorithms.	1	91	3	21	76	-	59	26	57	17	0		4	11
		2	86	2	17	81	-	50	9	75	16	0		8	12
		E	2	100	0	0	-	50	0	100	0	0		50	0
59	A system that enables communications with people or devices in the deep sea or underground by new principles such as very high frequency oscillatory or gravitational waves (for deep-sea/underground resources exploration and environmental research).	1	68	7	25	68	-	46	12	51	34	3		6	17
		2	78	3	12	85	-	47	7	67	26	0		4	17
		E	2	100	0	0	-	50	0	100	0	0		50	0
60	Information prediction technology to enable natural communications and controlling under the constraints of very long delays as in interplanetary communications.	1	81	7	27	66	-	37	6	33	56	5		13	18
		2	80	3	16	81	-	35	5	27	67	1		8	9
		E	2	100	0	0	-	25	0	50	0	50		50	0

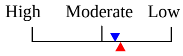


Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
8	74	5	0	13	6	23	47	24	55	28	32	53	11	0	0	2		0	0	100	0	0	0	0	0	0	0	0	0	0
3	94	0	0	3	0	27	54	19	63	20	19	63	3	0	0	0		0	0	100	0	0	0	0	0	0	0	0	0	0
33	67	0	0	0	0	100	0	0	67	33	33	67	33	0	0	0		0	0	100	0	0	0	0	0	0	0	0	0	0
22	71	5	0	2	21	43	22	14	49	40	37	63	10	1	1	1		2	8	15	39	26	20	34	44	23	51	4	11	4
9	88	3	0	0	3	71	16	10	60	32	18	67	5	0	0	0		1	8	3	51	31	15	40	42	12	67	0	7	0
50	50	0	0	0	25	50	0	25	33	0	0	67	0	0	0	0		25	0	25	50	0	25	33	0	0	67	0	0	0
3	87	3	0	7	6	29	41	24	52	29	40	56	10	2	4	2														
1	97	0	1	1	1	26	54	19	60	17	26	66	0	0	2	0														
0	100	0	0	0	0	100	0	0	100	0	0	0	0	0	0	0														
9	81	6	0	4	16	44	27	13	47	40	44	65	9	0	0	1		7	11	11	43	20	26	46	46	21	51	2	3	2
2	94	4	0	0	2	64	23	11	58	28	34	69	4	0	0	0		12	15	1	59	22	18	56	43	12	56	0	0	0
0	100	0	0	0	0	100	0	0	100	0	0	0	0	0	0	0		50	0	0	100	0	0	50	0	0	50	0	0	0
4	82	5	0	9	15	39	37	9	42	37	39	68	7	2	0	2		6	18	9	37	32	22	47	47	14	53	8	2	2
3	94	0	0	3	3	56	34	7	55	26	33	68	4	1	0	0		9	20	3	41	39	17	53	44	10	65	3	2	0
0	100	0	0	0	0	50	0	50	100	0	0	0	0	0	0	0		50	0	0	50	0	50	100	0	0	0	0	0	0
1	92	1	0	6	13	31	39	17	39	29	40	55	10	0	0	2		8	27	12	30	35	23	52	38	11	43	4	2	4
0	97	0	0	3	1	29	58	12	57	19	31	70	6	0	0	0		10	16	4	31	51	14	66	33	5	53	3	2	0
0	100	0	0	0	0	50	0	50	100	0	0	0	0	0	0	0		50	0	0	50	0	50	100	0	0	0	0	0	0

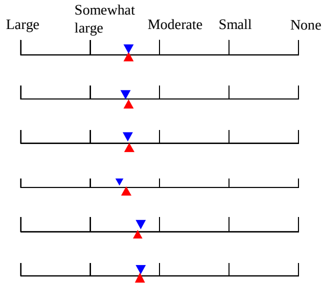
VIII. Ubiquitous networking

1. Questions regarding the relevant area

1) Degree of expertise in the area



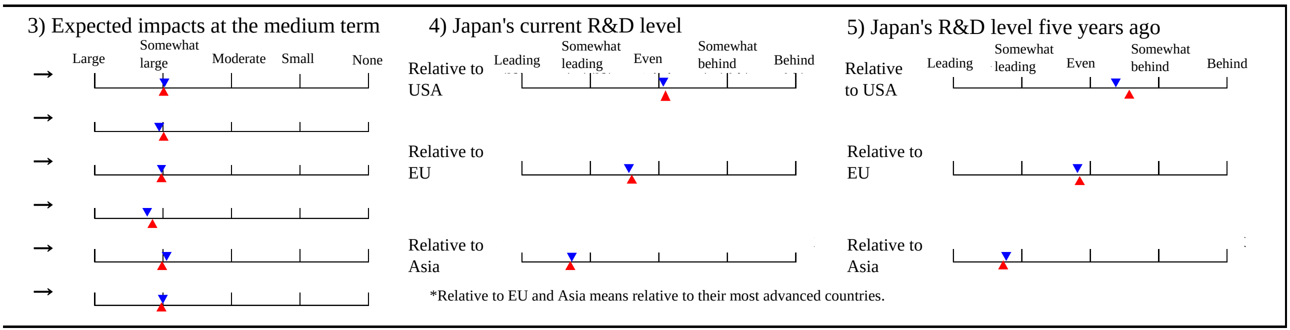
2) Current impacts



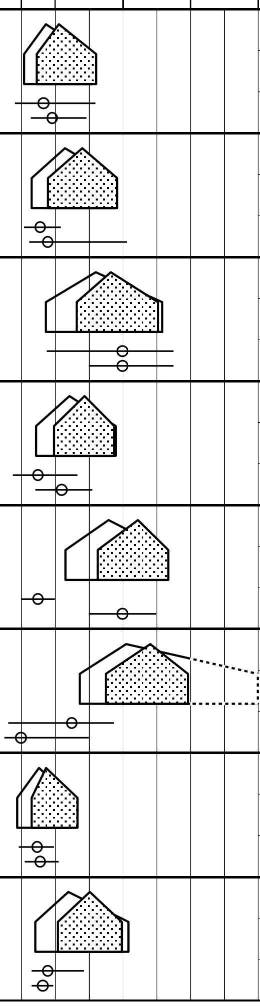
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
61	An administration system for networks with about 1,000 users that can automatically connect terminals and operate networks with no need for a network administrator.	1	122	20	30	50	-	62	32	52	15	1							3	2
		2	114	15	33	52	-	54	14	76	10	0							1	0
		E	17	100	0	0	-	63	27	73	0	0							0	0
62	Technology that allows objects to recognize mutual presence, nature, and condition so that they can automatically avoid dangerous situations and work in a coordinated manner (e.g. when a car and a bicycle or a heater and a sofa are close enough to pose a danger, the two objects mutually communicate to automatically avoid a dangerous situation by generating an alarm signal, stopping, or turning off).	1	127	13	35	52	-	64	34	54	11	1							1	2
		2	123	12	27	61	-	56	17	73	9	1							1	0
		E	15	100	0	0	-	70	40	60	0	0							0	0
63	Technology to allow many small single-function (small-scale function) robots to cooperate and share tasks to achieve more complex functionality.	1	99	7	34	59	-	56	22	58	19	1							1	4
		2	106	6	25	69	-	50	8	78	13	1							1	1
		E	6	100	0	0	-	58	17	83	0	0							0	0
64	A micro communications chip or sensor that can run semi-permanently, powered by heat, light, radio waves, or noise.	1	105	12	26	62	-	67	37	56	7	0							2	2
		2	103	9	23	68	-	61	24	73	3	0							0	0
		E	9	100	0	0	-	64	33	56	11	0							0	0
65	A medical chip that can be embedded in the human body and run semi-permanently powered by bioenergy sources such as body heat or blood flows, providing vital function support such as health condition monitoring and a heart pacemaker.	1	86	6	17	77	-	63	34	53	11	2							4	4
		2	91	2	13	85	-	55	15	77	8	0							0	0
		E	2	100	0	0	-	50	0	100	0	0							0	0
66	Medical technology based on nanochips and microsensors that have external communications and control capabilities and can be embedded in the human body or move through blood vessels.	1	82	7	18	75	-	62	29	61	9	1							3	1
		2	90	2	14	84	-	56	14	83	3	0							0	1
		E	2	100	0	0	-	38	0	50	50	0							0	0
67	A system to allow ad hoc communications between wireless information terminals in a certain range (with capability of seamlessly accessing the Internet, including applications).	1	131	27	35	38	-	58	25	58	16	1							0	2
		2	118	24	31	45	-	53	12	75	13	0							0	0
		E	28	100	0	0	-	64	32	61	7	0							0	0
68	Technology to manage the identity (ID) of an infinite number of constantly emerging or disappearing objects, organize the definition and information of each ID assigned, and automatically remove obsolete data.	1	95	15	28	57	-	56	27	45	26	2							3	11
		2	102	10	18	72	-	52	11	75	14	0							1	1
		E	10	100	0	0	-	73	50	40	10	0							0	0



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
8	89	0	0	3	14	35	31	20	33	44	48	62	15	9	0	1						3	3	10	32	28	30	33	37	24	50	38	6	0
4	96	0	0	0	2	51	36	11	25	41	31	78	4	4	0	0						1	1	1	41	38	20	30	28	13	70	27	6	0
13	87	0	0	0	14	65	21	0	36	36	29	71	7	0	0	0						0	0	7	27	46	20	58	17	17	50	17	8	0
44	51	3	0	2	15	43	29	13	27	49	42	68	14	17	6	1						2	2	17	42	25	16	25	42	25	57	35	21	0
49	50	1	0	0	4	59	31	6	13	52	26	75	4	9	3	0						0	3	4	56	28	12	17	38	13	64	34	13	0
79	21	0	0	0	13	67	13	7	14	50	29	86	0	7	7	0						0	0	20	54	13	13	8	38	23	69	8	31	0
44	53	2	0	1	10	39	32	19	41	39	49	71	9	4	0	0						3	6	5	37	31	27	39	51	31	52	18	7	1
37	63	0	0	0	1	57	34	8	35	36	40	75	3	1	0	0						0	3	1	43	41	15	30	60	11	64	8	0	0
50	50	0	0	0	0	83	17	0	50	50	50	83	17	0	0	0						0	0	0	33	50	17	60	60	40	60	20	0	0
42	56	1	0	1	15	38	30	17	31	48	44	65	12	7	1	0						2	5	12	34	28	26	36	51	25	60	18	14	0
32	68	0	0	0	6	56	30	8	25	49	29	82	1	3	1	0						0	1	3	43	38	16	29	56	13	65	6	2	0
78	22	0	0	0	11	67	11	11	38	50	38	63	0	13	0	0						0	0	0	56	33	11	50	63	13	50	0	13	0
8	88	0	0	4	23	40	23	14	37	49	44	57	10	26	13	0						2	11	21	41	25	13	29	48	22	42	46	33	0
3	96	0	0	1	8	69	20	3	27	49	35	76	2	12	5	0						0	4	9	58	30	3	20	52	11	42	61	22	0
50	50	0	0	0	0	100	0	0	100	0	0	0	0	0	0	0						0	0	0	0	100	0	100	0	0	0	0	0	0
9	87	0	0	4	21	40	26	13	38	47	45	59	11	29	11	0						1	7	28	35	23	14	30	39	18	41	48	35	0
6	94	0	0	0	8	65	22	5	29	46	36	81	4	12	5	0						0	3	12	52	30	6	26	48	11	41	56	21	0
100	0	0	0	0	0	50	0	50	100	0	0	0	0	0	0	0						0	0	0	0	50	50	100	0	0	0	0	0	0
18	78	4	0	0	11	41	26	22	21	44	37	70	13	33	9	1						2	2	10	37	33	20	22	37	23	42	47	23	2
9	91	0	0	0	3	61	25	11	17	49	22	74	5	23	2	1						0	0	3	50	32	15	18	37	17	50	54	11	1
11	89	0	0	0	11	64	18	7	35	62	38	77	15	35	8	0						0	0	7	68	14	11	28	60	44	56	60	20	0
12	84	0	0	4	9	44	29	18	29	43	45	62	20	14	11	1						3	14	11	35	34	20	33	46	24	54	25	25	1
4	95	0	0	1	3	62	27	8	21	49	35	75	11	10	2	0						0	2	3	47	40	10	22	53	13	68	22	19	1
10	90	0	0	0	20	70	10	0	30	50	40	60	10	20	10	0						0	0	10	80	0	10	22	67	22	67	33	33	0

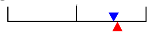


IX. Software technology for large-scale networks

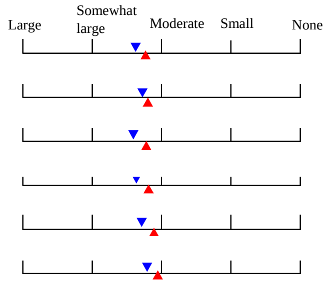
1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

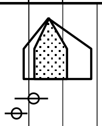
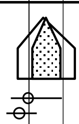
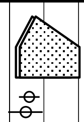
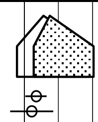
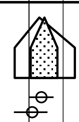
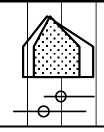


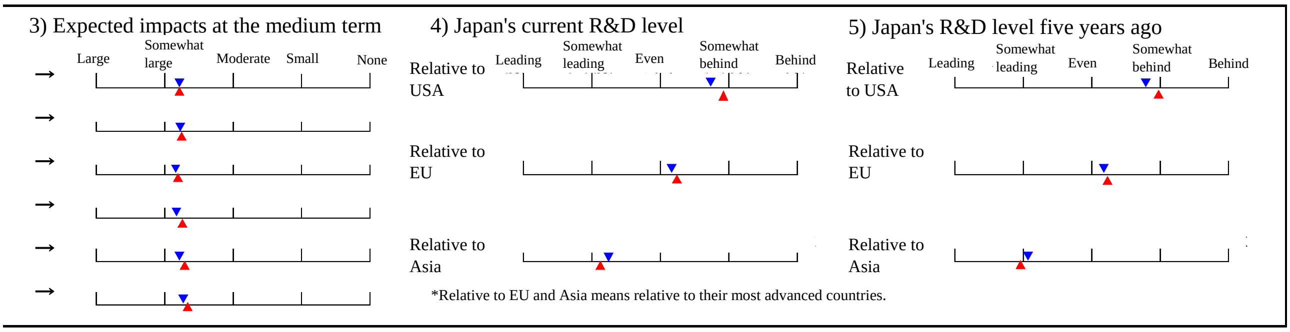
2) Current impacts



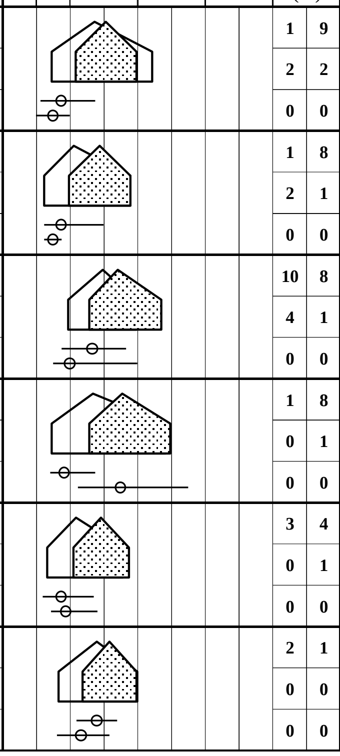
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
69	Software technology to automatically construct a software application that offers desired services, using the available components enabling different functions.	1	104	5	30	65	-	62	34	48	17	1		2	8
		2	99	4	22	74	-	57	20	70	9	1		2	2
		E	4	100	0	0	-	63	50	25	0	25		0	0
70	Software portability with which software can automatically adapt to any operating environment (OS, available hardware and performance, network conditions, etc.) and always provide requested services in the optimal method for the given environment.	1	100	8	34	58	-	60	30	49	21	0		1	5
		2	101	3	27	70	-	56	17	73	9	1		2	1
		E	3	100	0	0	-	67	67	0	0	33		0	0
71	Automatic validation technology intended for large-scale software and capable of automatically correcting logical inconsistencies included in the program.	1	91	7	32	61	-	63	35	46	19	0		10	6
		2	95	4	22	74	-	57	19	71	9	1		6	0
		E	4	100	0	0	-	63	50	25	0	25		0	0
72	Software capable of detecting failures and changes in hardware and responding to failures by automatically generating code that compensates for the failed functions, and to changes by modifying its own code to take advantage of them.	1	99	6	32	62	-	60	30	52	18	0		2	6
		2	97	5	21	74	-	55	15	76	8	1		0	0
		E	5	100	0	0	-	60	40	40	0	20		0	0
73	Search technology that allows searchers to find the desired information through fuzzy instructions.	1	113	12	24	64	-	56	23	54	22	1		2	3
		2	104	7	26	67	-	51	12	71	15	2		0	0
		E	7	100	0	0	-	57	29	57	0	14		0	0
74	A system capable of accumulating human cognitive knowledge to recognize diverse objects, such as buildings, humans, and cars, based on still or moving images at an accuracy of 99.9% or higher.	1	105	6	31	63	-	59	26	57	17	0		0	0
		2	107	5	27	68	-	51	9	79	11	1		0	0
		E	5	100	0	0	-	50	20	60	0	20		0	0



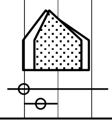
Countries at the leading edge: Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied	Do not know	Regarding social application — Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
3	92	3	0	2	11	39	30	20	46	46	46	59	10	3	0	3		1	9	6	33	32	29	46	45	29	51	9	4	1
2	98	0	0	0	1	49	36	14	46	35	33	77	7	2	1	0		2	2	2	37	37	24	46	46	18	59	4	3	0
25	75	0	0	0	0	75	0	25	33	33	33	67	0	0	0	0		0	0	0	25	50	25	33	33	0	33	0	0	0
2	96	1	0	1	9	38	34	19	43	50	49	57	20	4	0	1		1	8	5	32	35	28	47	52	33	45	8	3	2
1	99	0	0	0	2	45	38	15	48	46	28	75	5	2	1	0		2	1	1	33	39	27	48	59	16	53	4	1	0
33	67	0	0	0	0	67	0	33	0	50	50	50	0	0	0	0		0	0	0	34	33	33	0	50	0	50	0	0	0
4	89	6	0	1	13	38	29	20	46	43	42	60	10	1	0	1		10	8	6	32	30	32	48	44	17	46	6	4	2
2	96	0	2	0	3	44	39	14	48	38	25	69	4	1	0	0		4	1	2	29	44	25	45	46	14	61	4	4	0
25	75	0	0	0	0	50	25	25	33	67	67	67	33	0	0	0		0	0	0	25	25	50	50	100	50	50	50	50	0
5	92	1	0	2	10	37	36	17	35	41	47	63	9	1	0	1		1	8	7	36	29	28	38	48	27	49	5	6	3
3	97	0	0	0	3	42	44	11	36	38	33	68	4	2	0	0		0	1	2	36	42	20	37	53	16	60	4	3	0
20	80	0	0	0	0	40	40	20	50	50	50	75	25	0	0	0		0	0	0	20	40	40	33	67	33	67	33	33	0
15	80	3	0	2	6	36	36	22	37	51	33	58	9	2	0	1		3	4	5	25	39	31	41	52	24	39	7	1	3
5	95	0	0	0	0	38	48	14	35	51	15	76	2	1	0	0		0	1	0	22	55	23	44	64	17	50	3	1	0
29	71	0	0	0	0	29	29	42	75	50	25	100	25	0	0	0		0	0	0	0	43	57	100	67	33	100	0	0	0
17	82	1	0	0	9	37	38	16	32	52	47	62	11	5	2	1		2	1	7	27	39	27	34	50	21	49	14	10	3
8	92	0	0	0	1	38	49	12	32	48	25	84	2	4	2	0		0	0	3	23	53	21	39	60	13	54	7	5	0
60	40	0	0	0	0	60	0	40	67	33	33	67	33	0	0	0		0	0	0	40	0	60	100	100	0	0	0	0	0



Questions regarding other topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
75	Most companies, regardless of size, go paperless and improve productivity through the digitization and networking of most office work.	1	**125**	**10**	**30**	**60**	**-**	**64**	**34**	**53**	**11**	**2**								
		2	**114**	**4**	**29**	**67**	**-**	**55**	**17**	**70**	**11**	**2**								
		E	**5**	**100**	**0**	**0**	**-**	**55**	**40**	**20**	**20**	**20**								

Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other

Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
					**10**	**7**	**14**	**33**	**22**	**31**	**22**	**27**	**18**	**51**	**51**	**28**	**3**
					6	**1**	**3**	**47**	**28**	**22**	**15**	**15**	**7**	**67**	**63**	**18**	**1**
					0	**0**	**0**	**25**	**25**	**50**	**50**	**0**	**0**	**0**	**50**	**0**	**0**

2. Electronics field

2.1. Overview

Electronics is foundation technology that will support the future technological society. In FY 2020–25, it is expected to still be a core industry for Japan's economic and industrial competitiveness. Technology develops extremely fast, however, and because development competition, including price competition, is extremely harsh on a global scale, technological innovation and discernment of markets is vital. Both bottom-up approach and top-down approach, that is to say, both basic technologies and applications, play important roles.

For the notable technology areas in the electronics field as well, each area was selected with a view to its bottom-up device technology or top-down application. Integrated systems, silicon electronics, optical and photonic devices, wireless electronics, bioelectronics, and molecular and organic electronics belong to the former, while storage, displays, energy conversion/storage devices, digital home appliances, ubiquitous electronics, robot electronics, car electronics, network electronics, and security electronics belong to the latter.

The electronics field develops consistently associated with the development of other fields. The electronics field is an exit for the nanotechnology and materials and manufacturing fields, while the information and communications, life science, and environment fields are exits for electronics. The same conditions are expected to prevail 25 years from now as well.

This chapter discusses the outlook of notable technology areas in the electronics field, which plays a core role in science and technology in this way. Below, I provide a brief overview especially of those notable science and technology areas that are basic bottom-up technologies.

In the integrated systems area, new integrated systems related to silicon VLSI will not become the mainstream for at least 20 years. Therefore, in order to achieve higher-performance integrated systems and provide various new applications to society, silicon VLSI research and development should be emphasized over the coming 10 to 20 years. In silicon electronics, greater speed, storage, and performance and smaller size will further develop, with new materials, logic, and manufacturing methods using optical wiring expected as future technologies.

The optical and photonic devices area will have three major trends. First is the pioneering of new wavelength bands in the deep ultraviolet region with terahertz bandwidths. Second is the expected creation of technologies to innovate the photonics networks that are already a basic technology of the Information Society in terms of capacity and quality. Third, related to such photonic networks, is the development of innovative optical-function devices to move conventional signal processing including optical-electronic conversion towards full-optical signal processing technology such as photonic crystals and optical-buffer memory.

In the wireless electronics area, low-power, low-loss, and high energy-density devices will become more important. For example, for portable software wireless devices that can handle different transmission methods, device-level power reduction such as high-speed A/D conversion and large-scale signal processing is essential, so further development including design and modes is necessary.

The bioelectronics area has three aspects. First is the application of electronics and electronics-derived technologies to biological and chemical technologies to create sensors, measuring systems, and medical devices. Second are methods to address the high-performance electronics of organisms by integrating cells and biological molecules with electronic devices. Third is proof of the existence of bottom-up nanotechnology through proposals for research utilizing two-dimensional crystals formed from proteins and assembling structures based on the arrangement of DNA molecules to be used in the orderly arrangement of nanostructures.

In the molecular and organic electronics area, beyond today's electronics that have developed based on silicon and inorganic semiconductors, electronics with basic units in the form of organic semiconductors and molecules is expected to play a major role. As for the significance of and outlook for this area, expectations for post-CMOS, development towards large-area electronics, expected achievement of ubiquitous environments, development towards quantum computers, and propagation effects for environmental and energy problems through the achievement of ultralow power consumption can be listed.

In the area of storage, applications using the integration of optics and magnetism, the near field of light, and spintronics are being researched as technologies extending into the future, with the goal of a greater than 100-fold improvement in recording density. Expectations are also high for leading-edge research such as memory in which each atom or molecule holds one bit of data, probe arrays, and other forms of memory based on new principles that are not extensions of current technology. Display technology includes three-dimensional displays, large high-definition displays with outstanding realism, and flexible displays for use with ubiquitous data networks. Although some methods have yet to be determined, steady progress is being made.

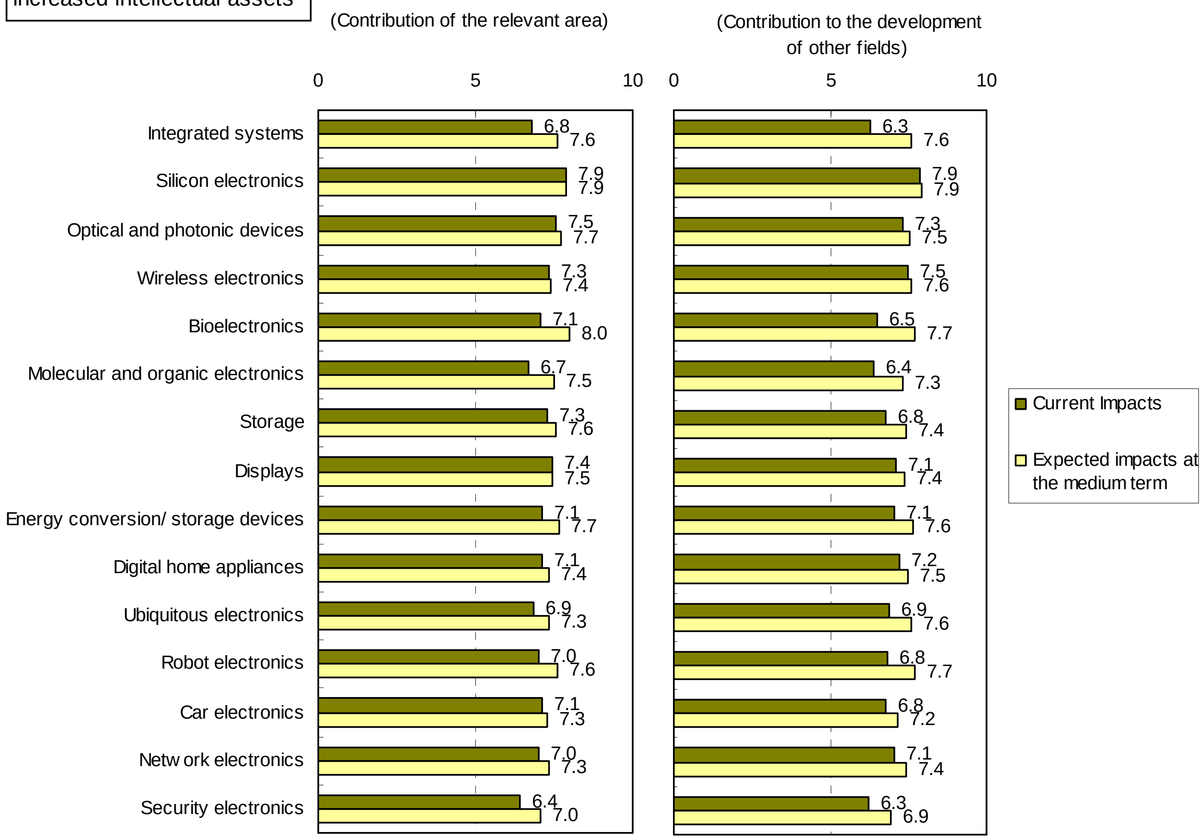
Development is expected in the energy conversion/storage devices area as well. Examples of conceivable compact, portable energy devices are solar cells that utilize light energy, fuel cells that utilize chemical energy, and compact generators that utilize heat and vibrational energy.

(ARAKAWA Yasuhiro)

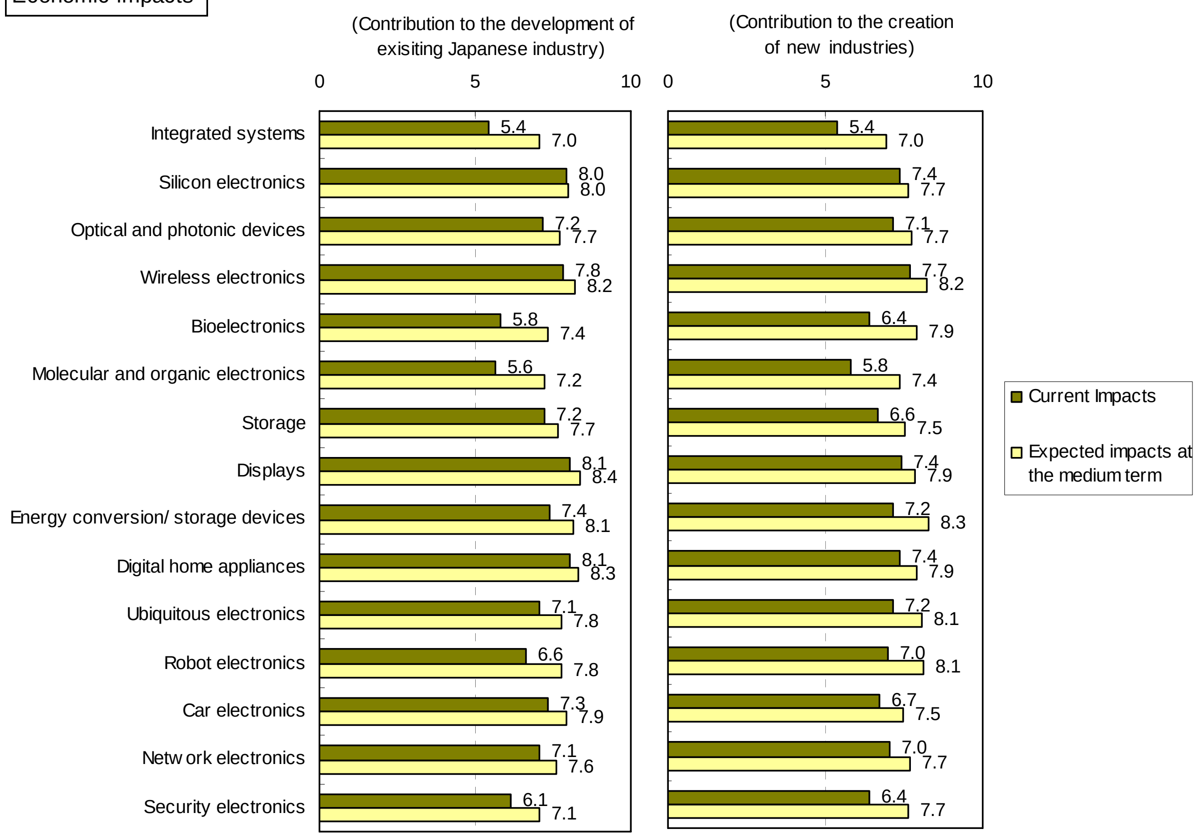
2.2. Main results

A. Impacts

Increased intellectual assets

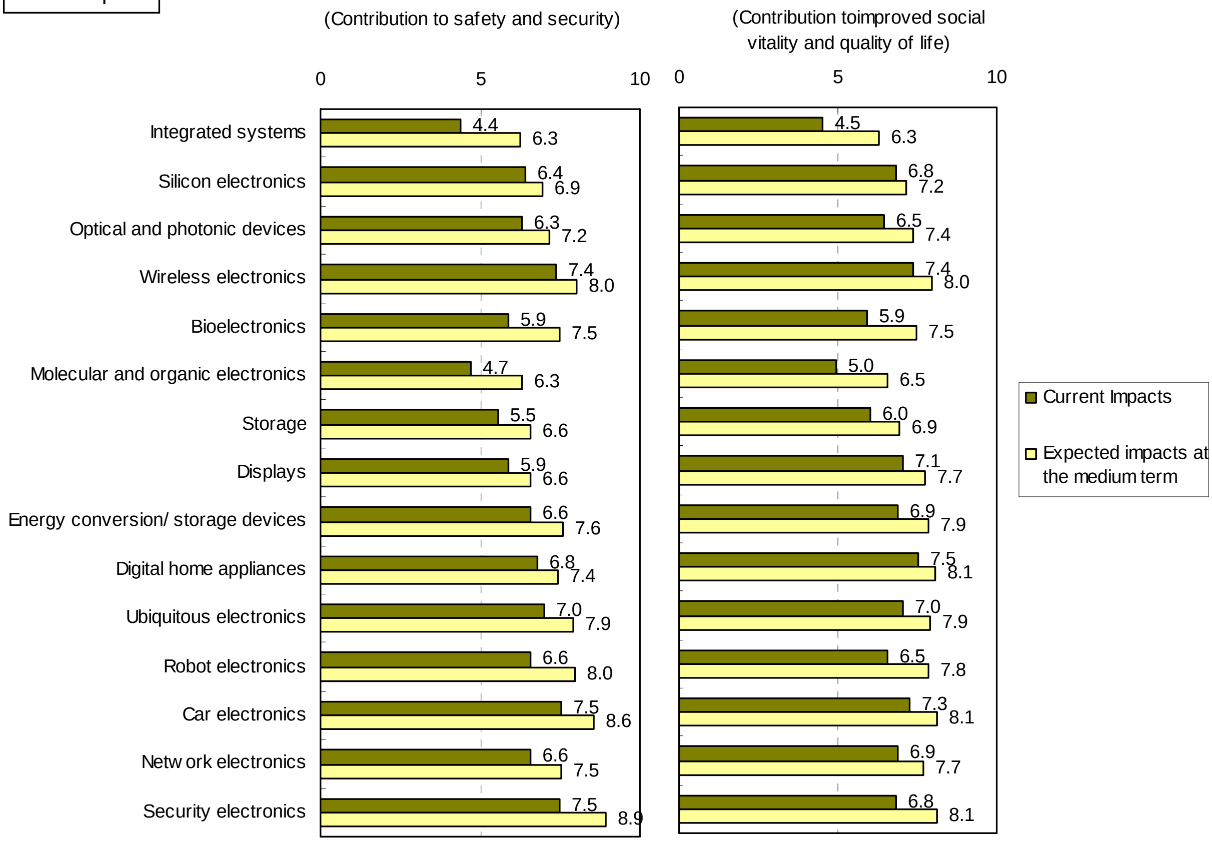


Economic impacts

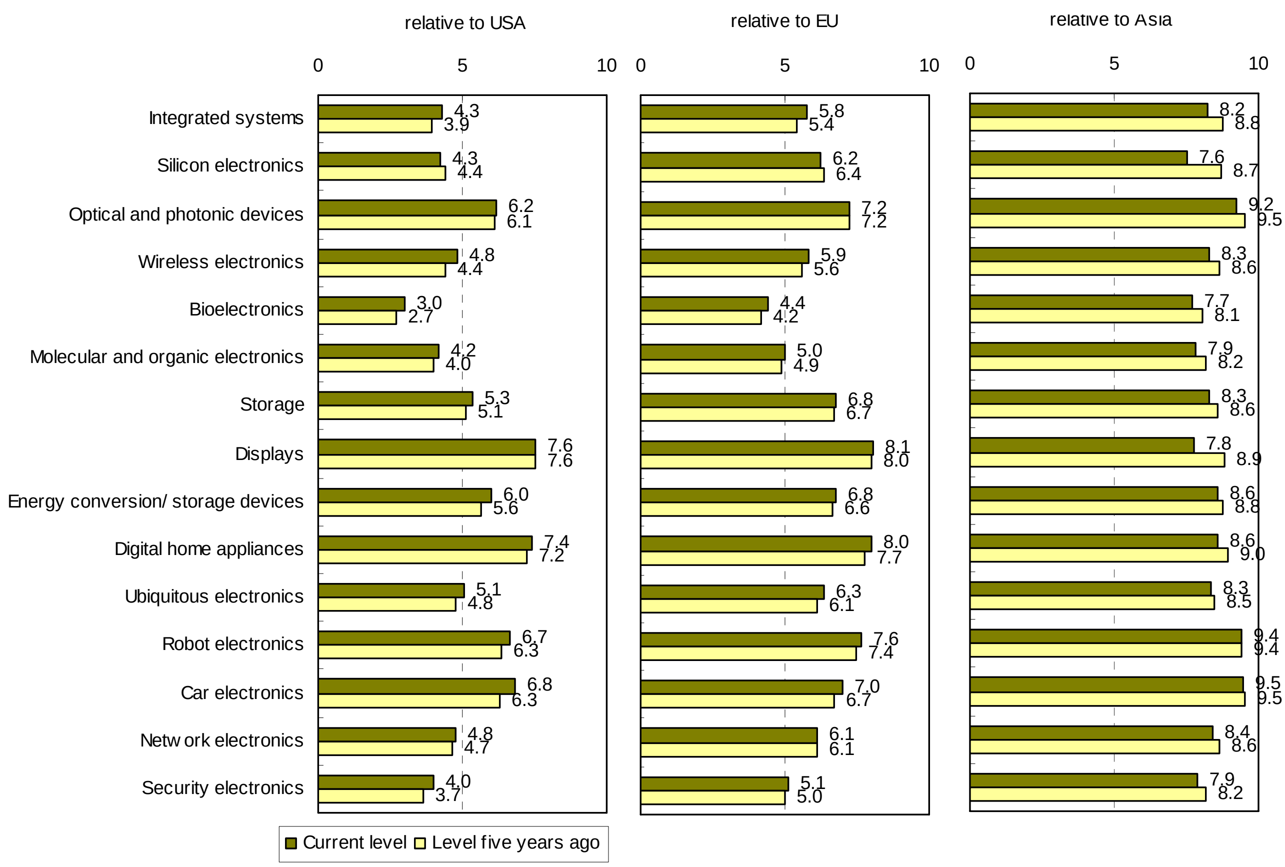


*Responses are indexed on a 10-point scale.

Social impacts

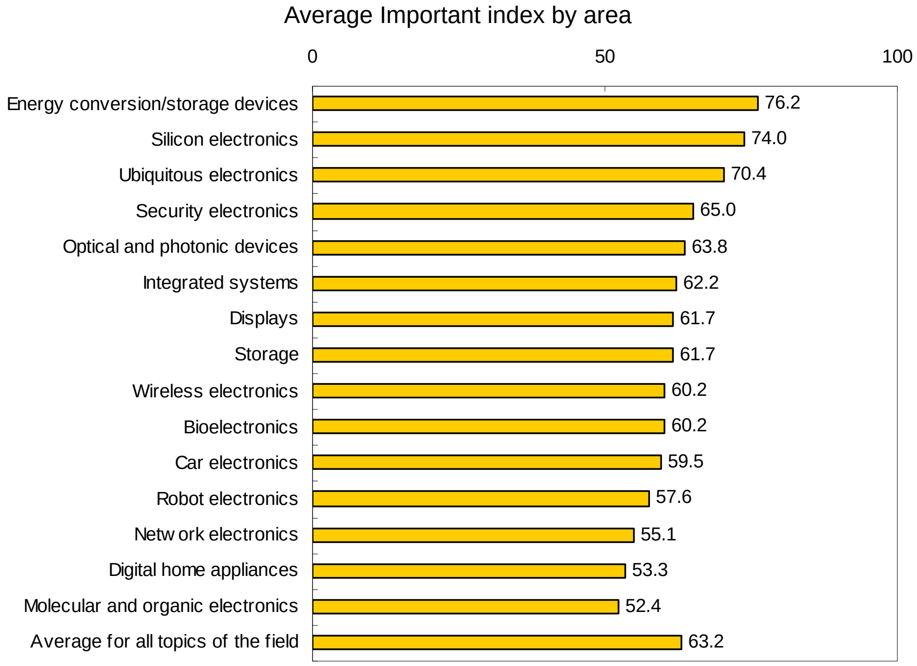


B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan



The most important 10 topics

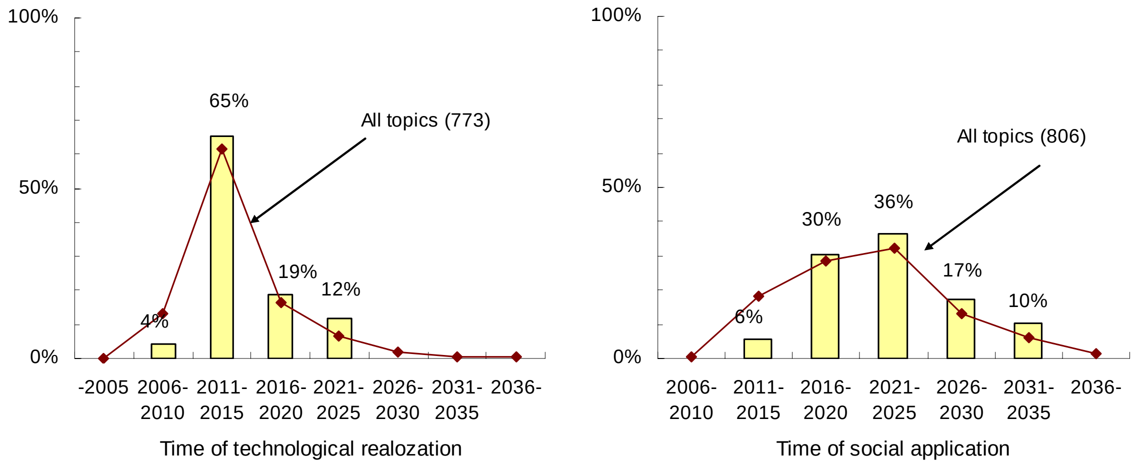
	Topic	Index	Year T*	Year S*
1	68: A crustal movement sensor that enables prediction of an earthquake a few minutes before it occurs.	93	2015	2023
2	13: A small-scale semiconductor fabrication plant that supports high-mix, low-volume production and allows a two orders of magnitude reduction in capital investment from the current levels.	88	2013	2019
3	17: Almost all indoor lighting is replaced by semiconductor light sources.	86	2012	2018
4	06: A 100M-gate LSI whose logical function changes in real time.	86	2013	2021
5	15: Widespread home use of 10-Gbps access networks.	85	2012	2017
6	05: A microprocessor LSI with a clock frequency of 50 GHz or higher.	85	2014	2021
7	07: An LSI containing transistors with a gate length of 3 nm.	84	2015	2023
8	08: An LSI chip with a storage capacity of 256 gigabits or larger.	83	2015	2022
9	46: The batteries of most mobile equipment (PCs, mobile phones, PDAs, etc.) are replaced by fuel cells.	83	2012	2018
10	47: A new material that offers a higher energy conversion efficiency than silicon or GaAs solar cells.	82	2016	2025

Year T: Time of technological realization Year S: Time of social application

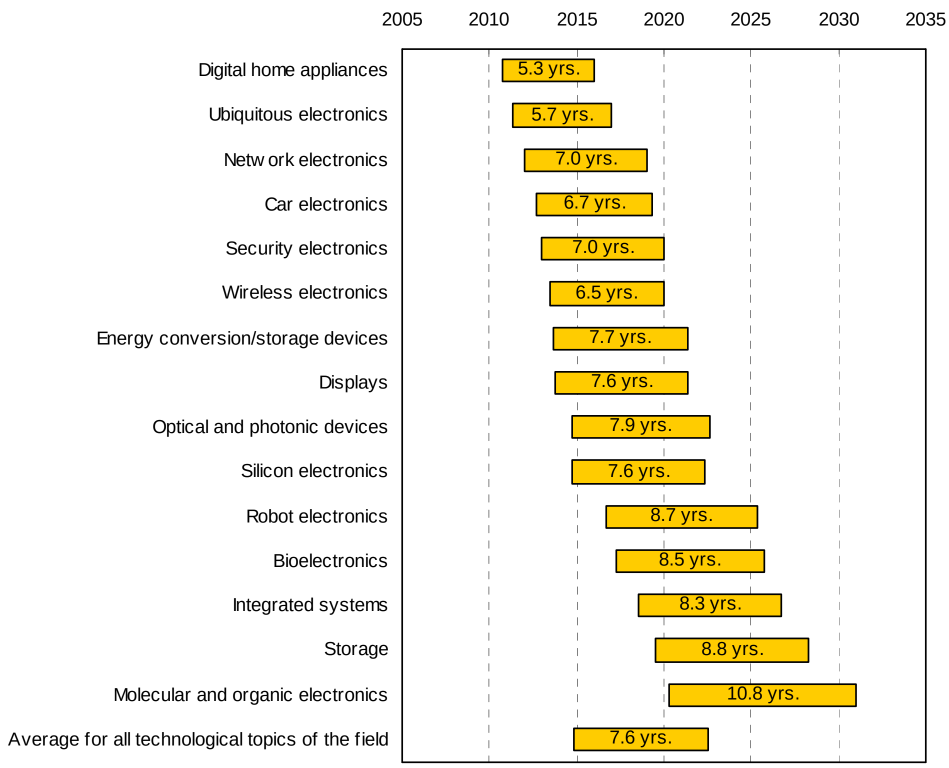
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

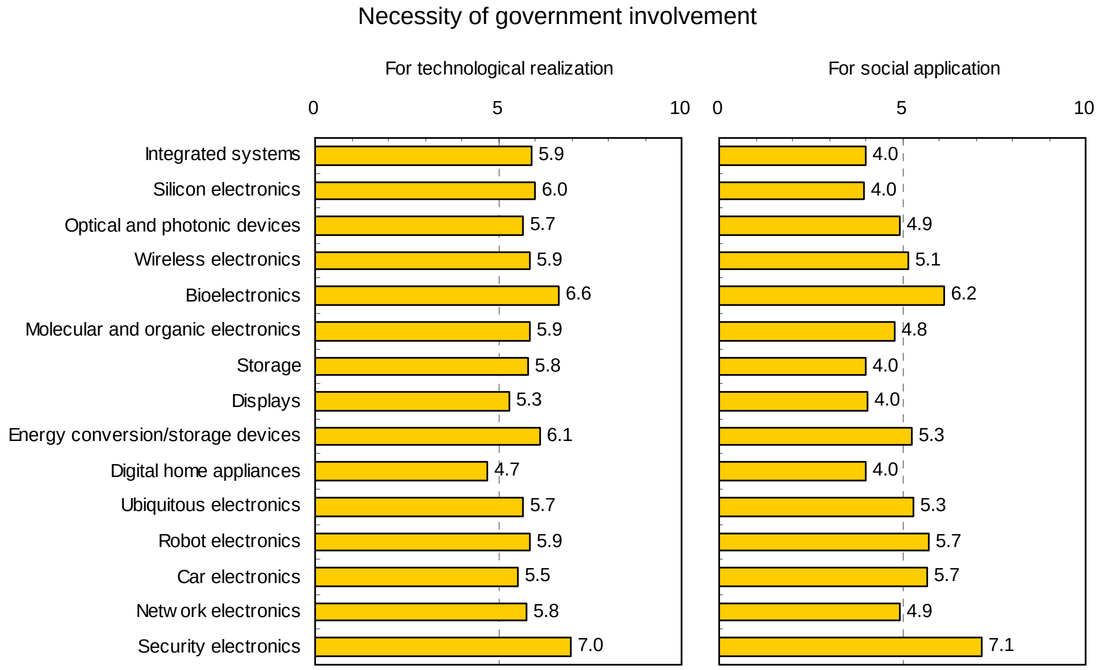
Topic	Year T*	Period*	Area
34: A logic/memory LSI that uses a single molecule as the basic switching element.	2022	11	Molecular and organic electronics
35: Five-sense sensors with a sensitivity equivalent to humans.	2021	11	Molecular and organic electronics
36: An LSI containing carbon nanotube transistors.	2018	11	Molecular and organic electronics
22: Secure optical quantum communications system.	2018	10	Optical and photonic devices
24: Large-capacity optical buffer memory.	2018	10	Optical and photonic devices

Topic	Year T*	Period*	Area
32: A micromachine-based health care device that can be implanted in the human body.	2015	10	Bioelectronics
33: Device fabrication technology and genetic engineering technology based on single-atom/-molecule manipulation.	2020	10	Molecular and organic electronics
59: A system that automatically drives a car to the specified destination.	2016	10	Car electronics

Topic	Year T*	Period*	Area
49: LSI that enables comprehensive media processing on a chip not simply by storing, communicating or signal-processing, but also by providing understanding and retrieval functions of audiovisual content.	2011	4	Digital home appliances
15: Widespread home use of 10-Gbps access networks.	2012	5	Optical and photonic devices
41: A flat-panel display larger than A3 size and with a resolution equivalent to high quality print images (600 dpi or higher).	2011	5	Displays
52: Fully wireless office and home environments that obviate the need for the physical connection.	2009	5	Digital home appliances
53: A one-chip ubiquitous computer with which information can be exchanged anytime, anywhere, and with anyone.	2012	5	Ubiquitous electronics
54: RF tags for attaching to most everyday items to help to track their location and state.	2008	5	Ubiquitous electronics
60: An automotive system in which a car is equipped with sensors for predicting and diagnosing failures and accidents.	2011	5	Car electronics
61: Technology to allow 100-Mbps or faster communications between cars or between a car and a base station.	2011	5	Car electronics
69: Widespread use of tracing systems (for food, recycled goods, etc.) in which the information stored in the electronic tags attached to food and other merchandise is linked to logistics, POS systems, and home-delivery services.	2009	5	Security electronics

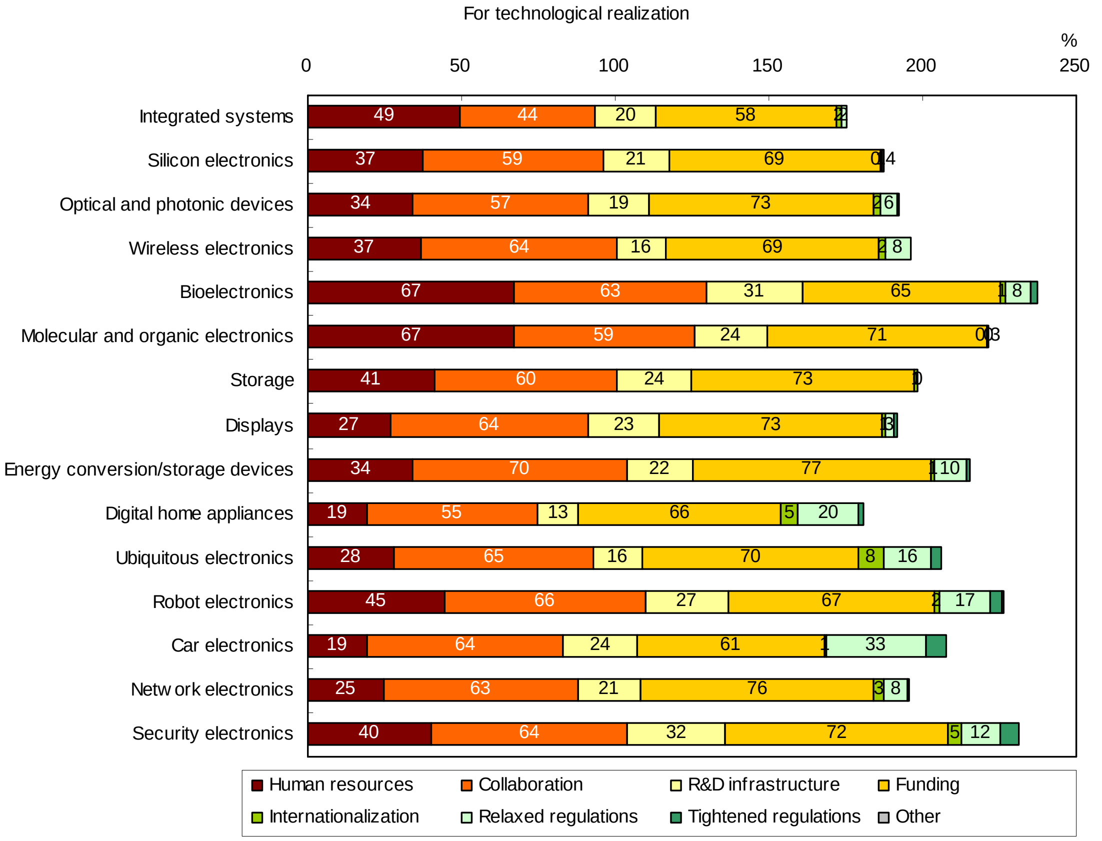
*Year T: Time of technological realization Period: Period until social application (years)

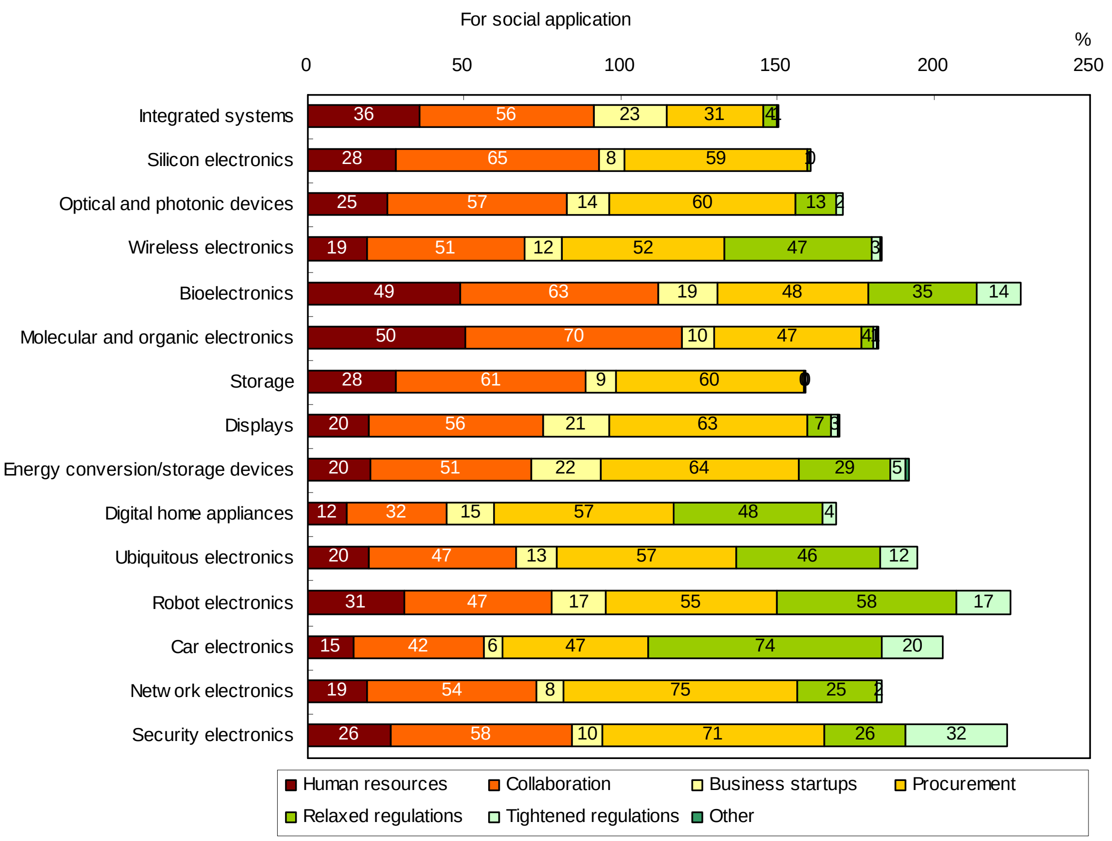
E. Effective measures that should taken by government



*Responses were indexed on a 10-point scale

Effective measures





F. Time-line of topics

Technological realization

year	topic
2008	54: RF tags for attaching to most everyday items to help to track their location and state.
	52: Fully wireless office and home environments that obviate the need for the physical connection.
	69: Widespread use of tracing systems (for food, recycled goods, etc.) in which the information stored in the electronic tags attached to food and other merchandise is linked to logistics, POS systems, and home-delivery services.
2011	41: A flat-panel display larger than A3 size and with a resolution equivalent to high quality print images (600 dpi or higher).
	49: LSI that enables comprehensive media processing on a chip not simply by storing, communicating or signal-processing, but also by providing understanding and retrieval functions of audiovisual content.
	50: A high-resolution video distribution system that allows searching through and distribution of TV, film, and music archives of the past few years.
	60: An automotive system in which a car is equipped with sensors for predicting and diagnosing failures and accidents.
	61: Technology to allow 100-Mbps or faster communications between cars or between a car and a base station.
	63: Technology for time division transmission at 100 Gbps or faster.
2012	11: An LSI operating based on nonvolatile logic.
	15: Widespread home use of 10-Gbps access networks.
	17: Almost all indoor lighting is replaced by semiconductor light sources.
	28: A wireless system in which terminals mutually communicate to form a network (a wireless system in which remote terminals are linked through multiple intermediate terminals, rather than through communications between the terminal and the access point, such as the base station, as in mobile telephone networks and wireless LANs).
	46: The batteries of most mobile equipment (PCs, mobile phones, PDAs, etc.) are replaced by fuel cells.
	51: Wall-mounted panels and furnishings with communications, sensing, displaying, lighting and other capabilities.
	53: A one-chip ubiquitous computer with which information can be exchanged anytime, anywhere, and with anyone.
	62: Technology with which HDTV video (about 1.5 Gbps) can be transmitted to any remote place without delays due to compression and other processing.
2013	04: A wearable automatic translation device with voice input and output capability.
	06: A 100M-gate LSI whose logical function changes in real time.
	13: A small-scale semiconductor fabrication plant that supports high-mix, low-volume production and allows a two orders of magnitude reduction in capital investment from the current levels.
	14: Organic material devices (e.g. lasers and switches).
	19: Ultraviolet/deep-ultraviolet laser diodes.
	20: Optical multiplex communications equipments capable of transmitting multiplexed signals at 100 Tbps over a single optical fiber.
	26: A card-size software radio whose specifications, including center frequency, bandwidth, modulation method, and error correction method, can be changed in software.
	27: A wireless terminal that can autonomously operate whenever necessary, using natural energy (e.g. many dispersed sensors (wireless terminals) autonomously send alarms to the central system depending on their sensed values, without the need for an external power supply).
	31: A miniature chemical analysis system for checking food or environmental safety on the spot.
	48: A miniature electric generator that uses thermal or vibration energy and may be embedded in IC tags.
	64: Large-scale (about 1000x1000) optical cross-connect equipment
	67: Non-contact detectors for drugs, toxic gases, biological weapons, etc.
2014	05: A microprocessor LSI with a clock frequency of 50 GHz or higher.
	10: An LSI with on-chip optical interconnect
	12: A fault-tolerant logic LSI with self-repair capability.
	18: Photonic sensing technology using an unused radio frequency range of 1-10 THz.

year	topic
	21: Ultralow-loss (e.g. 0.1 dB/km or lower) holey fibers (photonic crystal fibers).
	42: A 3D video display that may be viewed without wearing special glasses and shows undistorted images even when the viewer makes certain natural movements such as shifting the body.
	43: An organic emissive display that is so large as to cover an entire wall.
	55: A system that provides information services most suited for the users and their situation without instructions from them.
	65: A biometric authentication system capable of non-contact, high-accuracy identification of individuals from a distance of about 10 m (with an authentication performance equivalent to the current fingerprint authentication systems and for potential applications such as quick access control without slowing the flow of people walking along the passage).
	66: Widespread use of portable authentication technologies that can quickly authenticate individuals based on their DNA.
2015	03: An artificial intelligence chip capable of understanding human feelings from facial expressions.
	07: An LSI containing transistors with a gate length of 3 nm.
	08: An LSI chip with a storage capacity of 256 gigabits or larger.
	23: Photonic-crystal-based potonic integrated circuits.
	32: A micromachine-based health care device that can be implanted in the human body.
	44: A display device that allows people to enjoy movies anywhere, anytime by directly projecting images on their retinas.
	45: A folding display that is equivalent to newspaper in size, thickness, and resolution.
	56: It becomes popular that every family has a household helper robot capable of doing the washing, cleaning,, and other household chores.
	68: A crustal movement sensor that enables prediction of an earthquake a few minutes before it occurs.
2016	25: A broadband solid-state amplifier operating in a DC to 1000 GHz range.
	47: A new material that offers a higher energy conversion efficiency than silicon or GaAs solar cells.
	59: A system that automatically drives a car to the specified destination.
2017	38: A magnetic hard disk drive that has a storage density of 10 terabits per square inch (an increase of more than two orders of magnitude from current technology).
	39: An optical memory that has a storage density of 1 terabit or more per square inch (including the near field).
	58: Surgery performed by remotely controlling a micromachine equipped with sensors and manipulators.
2018	22: Secure optical quantum communications system.
	24: Large-capacity optical buffer memory.
	36: An LSI containing carbon nanotube transistors.
	57: A microrobot that contains sensors, controllers, and actuators tightly packed using micromachine technology and can be sent into the human body for medical examination.
2019	29: Electronics technology with new capabilities achieved through fusion between electronics and biomechanisms at the single-cell/-molecule level (e.g. devices for diagnosis and drug development).
2020	16: Soft X-ray laser at a few tens of angstroms of wavelength.
	33: Device fabrication technology and genetic engineering technology based on single-atom/-molecule manipulation.
2021	35: Five-sense sensors with a sensitivity equivalent to humans.
	40: A large-scale probe array memory with a storage density of 10 terabits or more per square inch.
2022	02: An information device that uses the spintronics principle to achieve three orders of magnitude greater processing power than the CMOS logic circuit in specific applications.
	30: Technology for fabricating nano-scale integrated circuits as designed, using self-organization and other bottom-up methods.
	34: A logic/memory LSI that uses a single molecule as the basic switching element.
2023	09: An LSI using high-temperature superconductivity material for wiring.
	37: A storage system that stores a bit of data by using a single atom/molecule.
2024	01: An information device that uses the quantum computing principle to achieve three orders of magnitude greater processing power than the CMOS logic circuit in specific applications.

Social application

year	topic
2013	54: RF tags for attaching to most everyday items to help to track their location and state.
2014	52: Fully wireless office and home environments that obviate the need for the physical connection.
	69: Widespread use of tracing systems (for food, recycled goods, etc.) in which the information stored in the electronic tags attached to food and other merchandise is linked to logistics, POS systems, and home-delivery services.
2015	49: LSI that enables comprehensive media processing on a chip not simply by storing, communicating or signal-processing, but also by providing understanding and retrieval functions of audiovisual content.
2016	41: A flat-panel display larger than A3 size and with a resolution equivalent to high quality print images (600 dpi or higher).
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	62: Technology with which HDTV video (about 1.5 Gbps) can be transmitted to any remote place without delays due to compression and other processing.
2020	04: A wearable automatic translation device with voice input and output capability.
	64: Large-scale (about 1000x1000) optical cross-connect equipment
	65: A biometric authentication system capable of non-contact, high-accuracy identification of individuals from a distance of about 10 m (with an authentication performance equivalent to the current fingerprint authentication systems and for potential applications such as quick access control without slowing the flow of people walking along the passage).
	67: Non-contact detectors for drugs, toxic gases, biological weapons, etc.
2021	05: A microprocessor LSI with a clock frequency of 50 GHz or higher.
	06: A 100M-gate LSI whose logical function changes in real time.
	14: Organic material devices (e.g. lasers and switches).
	19: Ultraviolet/deep-ultraviolet laser diodes.
	20: Optical multiplex communications equipments capable of transmitting multiplexed signals at 100 Tbps over a single optical fiber.
	48: A miniature electric generator that uses thermal or vibration energy and may be embedded in IC tags.
	55: A system that provides information services most suited for the users and their situation without instructions from them.

year	topic
2022	08: An LSI chip with a storage capacity of 256 gigabits or larger.
	12: A fault-tolerant logic LSI with self-repair capability.
	18: Photonic sensing technology using an unused radio frequency range of 1-10 THz.
	21: Ultralow-loss (e.g. 0.1 dB/km or lower) holey fibers (photonic crystal fibers).
	42: A 3D video display that may be viewed without wearing special glasses and shows undistorted images even when the viewer makes certain natural movements such as shifting the body.
	43: An organic emissive display that is so large as to cover an entire wall.
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2024	25: A broadband solid-state amplifier operating in a DC to 1000 GHz range.
	44: A display device that allows people to enjoy movies anywhere, anytime by directly projecting images on their retinas.
2025	32: A micromachine-based health care device that can be implanted in the human body.
	47: A new material that offers a higher energy conversion efficiency than silicon or GaAs solar cells.
2026	38: A magnetic hard disk drive that has a storage density of 10 terabits per square inch (an increase of more than two orders of magnitude from current technology).
	39: An optical memory that has a storage density of 1 terabit or more per square inch (including the near field).
	58: Surgery performed by remotely controlling a micromachine equipped with sensors and manipulators.
	59: A system that automatically drives a car to the specified destination.
2027	57: A microrobot that contains sensors, controllers, and actuators tightly packed using micromachine technology and can be sent into the human body for medical examination.
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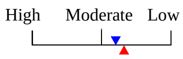
	30: Technology for fabricating nano-scale integrated circuits as designed, using self-organization and other bottom-up methods.
2032	09: An LSI using high-temperature superconductivity material for wiring.
	35: Five-sense sensors with a sensitivity equivalent to humans.
	37: A storage system that stores a bit of data by using a single atom/molecule.
2033	01: An information device that uses the quantum computing principle to achieve three orders of magnitude greater processing power than the CMOS logic circuit in specific applications.
	34: A logic/memory LSI that uses a single molecule as the basic switching element.

Appendix: Results of R1 and R2

I. Integrated systems

1. Questions ragarding the relevant area

1) Degree of expertise in the area

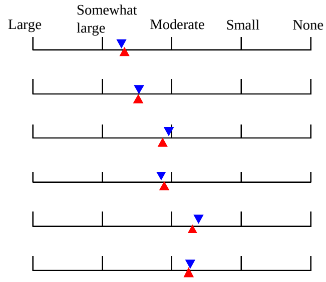


2) Cunrrent impacts

[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

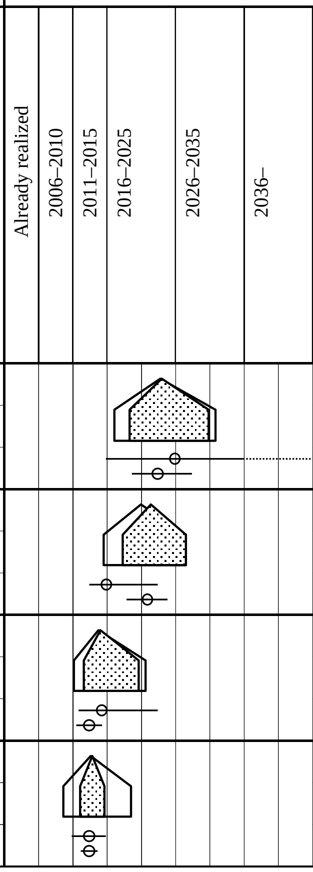
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

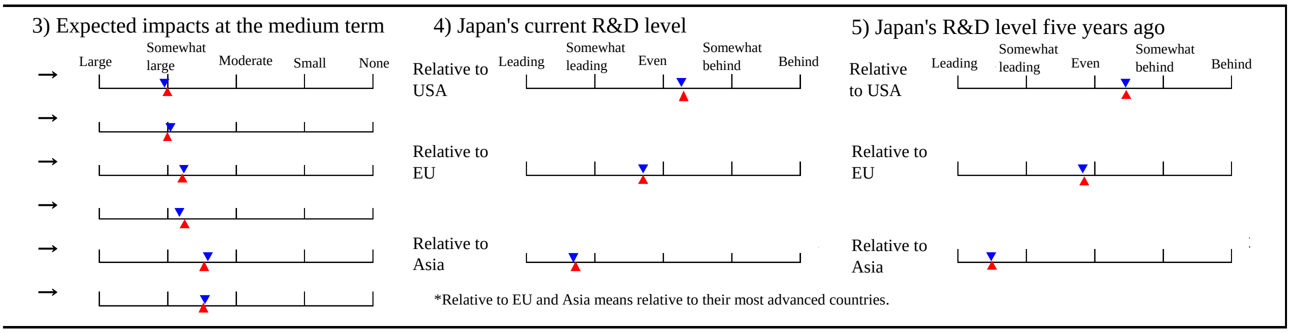
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



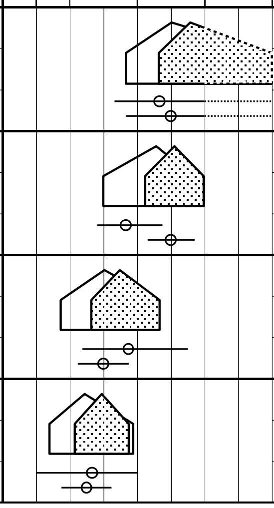
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
1	An information device that uses the quantum computing principle to achieve three orders of magnitude greater processing power than the CMOS logic circuit in specific applications.	1	144	8	42	50	-	71	47	46	7	0		9	9
		2	137	9	28	63	-	68	39	54	7	0		7	6
		E	12	100	0	0	-	88	75	25	0	0		18	0
2	An information device that uses the spintronics principle to achieve three orders of magnitude greater processing power than the CMOS logic circuit in specific applications.	1	133	8	34	58	-	66	37	55	8	0		11	12
		2	128	5	29	66	-	58	22	67	11	0		8	9
		E	7	100	0	0	-	68	43	43	14	0		0	0
3	An artificial intelligence chip capable of understanding human feelings from facial expressions.	1	137	8	33	59	-	57	29	43	27	1		4	7
		2	128	5	19	76	-	49	10	67	23	0		2	0
		E	6	100	0	0	-	54	17	66	17	0		0	0
4	A wearable automatic translation device with voice input and output capability.	1	145	6	30	64	-	73	52	38	10	0		1	2
		2	129	2	16	82	-	74	51	43	6	0		0	0
		E	3	100	0	0	-	50	0	100	0	0		0	0





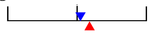
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application					(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
18	76	6	0	0	39	34	20	7	57	39	43	52	17	4	0	0						10	13	19	29	32	20	43	47	24	39	8	3	1
2	98	0	0	0	33	51	12	4	75	21	27	59	1	2	0	0						8	11	4	33	48	15	54	55	10	33	2	1	0
8	92	0	0	0	42	50	0	8	64	36	18	82	9	0	0	0						8	8	17	33	42	8	64	55	0	45	9	0	0
29	69	2	0	0	31	46	16	7	49	46	40	53	13	3	0	0						12	15	11	40	32	17	40	49	25	41	8	0	2
16	83	1	0	0	18	62	14	6	67	26	28	61	0	2	0	0						11	11	3	34	46	17	46	56	11	36	1	0	0
29	71	0	0	0	43	14	29	14	67	0	33	50	0	0	0	0						0	0	0	29	29	42	50	25	0	75	0	0	0
30	68	2	0	0	16	36	38	10	34	57	28	49	6	5	1	1						1	10	10	29	37	24	26	42	39	31	18	6	1
13	85	1	1	0	4	41	46	9	30	64	13	58	0	3	0	0						2	2	2	22	59	17	20	53	35	26	7	2	0
20	80	0	0	0	0	34	33	33	25	25	25	100	0	0	0	0						0	0	0	0	67	33	25	25	50	25	25	0	0
56	39	4	1	0	20	39	33	8	25	62	22	49	13	8	1	1						1	4	10	32	31	27	22	47	41	34	16	1	1
77	21	2	0	0	10	51	33	6	25	66	13	56	6	2	0	0						0	1	1	35	47	17	22	58	38	29	8	0	0
67	33	0	0	0	0	0	67	33	50	50	0	50	0	0	0	0						0	0	0	0	67	33	100	50	50	50	0	0	0



II. Silicon electronics

1. Questions ragarding the relevant area

1) Degree of expertise in the area

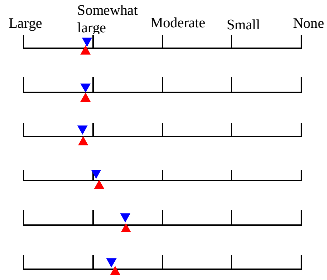


2) Current impacts

[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

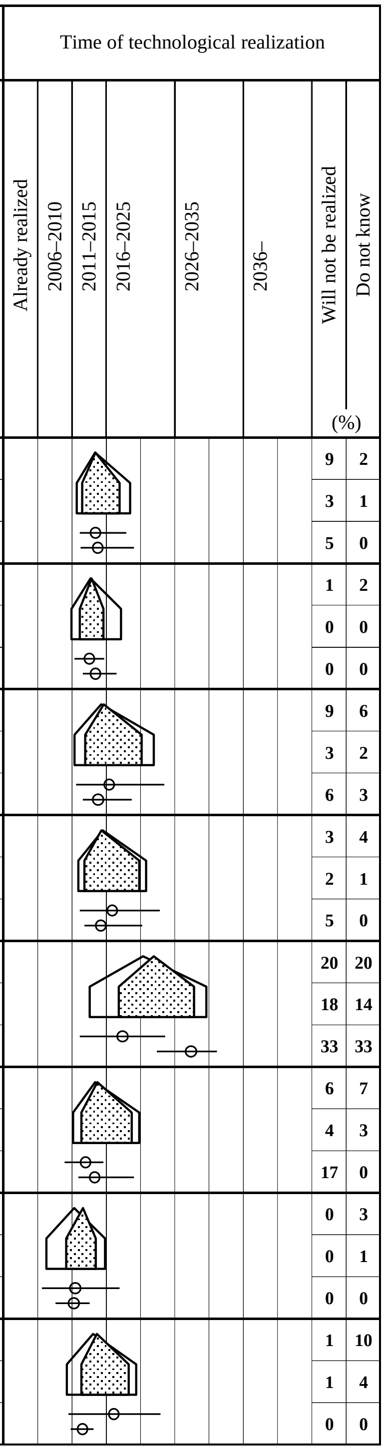
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

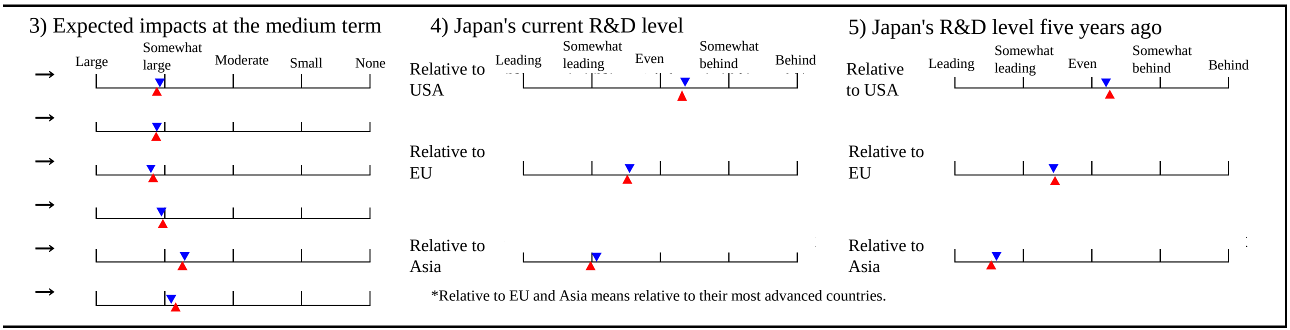


2. Questions regarding topics

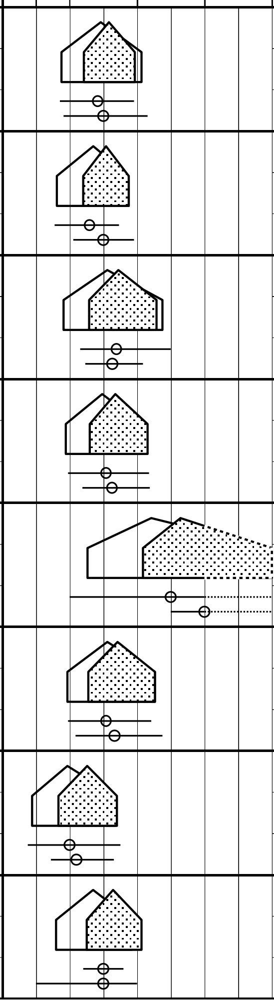
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Will not be realized (%)	Do not know (%)
5	A microprocessor LSI with a clock frequency of 50 GHz or higher.	1	139	21	39	40	-	76	56	37	6	1	9	2
		2	128	15	35	50	-	85	71	27	2	0	3	1
		E	19	100	0	0	-	82	63	37	0	0	5	0
6	A 100M-gate LSI whose logical function changes in real time.	1	126	17	44	39	-	78	58	40	2	0	1	2
		2	120	8	44	48	-	86	73	25	2	0	0	0
		E	10	100	0	0	-	90	80	20	0	0	0	0
7	An LSI containing transistors with a gate length of 3 nm.	1	141	26	39	35	-	77	57	38	4	1	9	6
		2	129	26	33	41	-	84	69	29	2	0	3	2
		E	34	100	0	0	-	87	74	26	0	0	6	3
8	An LSI chip with a storage capacity of 256 gigabits or larger.	1	140	21	43	36	-	75	53	41	5	1	3	4
		2	126	17	42	41	-	83	68	28	4	0	2	1
		E	22	100	0	0	-	93	86	14	0	0	5	0
9	An LSI using high-temperature superconductivity material for wiring.	1	126	10	39	51	-	46	13	52	27	8	20	20
		2	125	7	27	66	-	41	4	55	38	3	18	14
		E	9	100	0	0	-	44	11	56	22	11	33	33
10	An LSI with on-chip optical interconnect	1	143	26	40	34	-	67	42	46	9	3	6	7
		2	131	14	45	41	-	65	35	57	7	1	4	3
		E	18	100	0	0	-	69	47	41	6	6	17	0
11	An LSI operating based on nonvolatile logic.	1	116	16	40	44	-	72	48	44	7	1	0	3
		2	110	10	37	53	-	76	53	44	3	0	0	1
		E	11	100	0	0	-	88	80	10	10	0	0	0
12	A fault-tolerant logic LSI with self-repair capability.	1	112	10	29	61	-	66	38	49	12	1	1	10
		2	105	4	26	70	-	59	23	68	8	1	1	4
		E	4	100	0	0	-	75	67	0	33	0	0	0

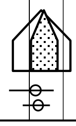
Time of technological realization

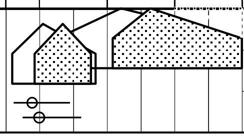




*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
5	95	0	0	0	31	36	17	16	35	52	37	64	8	5	0	0		8	4	19	26	25	30	37	53	19	55	9	2	0
0	100	0	0	0	20	58	16	6	39	59	25	68	2	0	0	0		4	2	4	36	33	27	31	65	7	60	0	0	0
0	100	0	0	0	26	47	16	11	41	53	18	59	6	0	0	0		11	0	5	32	26	37	25	83	17	50	0	0	0
20	78	2	0	0	21	49	18	12	36	51	36	66	5	5	1	0		0	3	15	33	25	27	35	53	21	55	8	0	0
3	96	0	1	0	14	68	13	5	35	58	21	72	1	0	0	0		1	1	3	40	35	22	29	64	9	60	0	0	0
0	100	0	0	0	40	40	20	0	50	20	20	70	0	0	0	0		10	0	0	30	40	30	43	43	29	71	0	0	0
36	62	1	1	0	29	40	21	10	30	52	42	64	5	2	0	0		9	7	18	26	30	26	37	50	18	51	8	0	1
19	81	0	0	0	18	64	13	5	35	69	24	68	0	0	0	0		6	3	4	33	41	22	29	62	7	58	0	0	0
22	78	0	0	0	24	49	18	9	45	61	23	61	0	0	0	0		9	0	6	33	43	18	38	46	4	62	0	0	0
25	36	2	37	0	23	42	24	11	27	47	37	62	6	3	0	0		3	6	15	28	27	30	35	51	20	51	7	1	1
20	38	0	42	0	15	60	19	6	26	60	22	72	1	0	0	0		2	2	3	35	39	23	23	59	3	64	1	1	0
19	14	0	67	0	27	50	14	9	40	55	25	75	0	0	0	0		5	0	5	32	36	27	38	63	0	63	6	0	0
43	50	4	0	3	13	37	28	22	35	49	35	43	7	3	0	1		26	28	8	27	28	37	41	58	22	39	9	0	0
31	69	0	0	0	3	53	30	14	37	60	24	55	0	0	0	0		25	18	2	23	42	33	35	74	6	45	0	0	0
62	38	0	0	0	22	11	22	45	80	20	20	60	0	0	0	0		44	33	0	22	45	33	33	50	0	67	0	0	0
44	53	2	0	1	26	41	22	11	34	55	41	54	4	2	0	0		9	12	17	28	23	32	39	57	21	44	7	0	1
39	61	0	0	0	13	65	14	8	34	70	26	67	0	0	0	0		7	5	4	44	29	23	27	77	8	53	0	0	0
47	53	0	0	0	27	28	17	28	54	54	23	62	0	0	0	0		22	0	0	33	39	28	38	62	8	46	0	0	0
28	70	2	0	0	21	39	24	16	39	37	28	66	5	4	0	0		0	3	14	28	33	25	32	45	37	41	10	0	0
9	91	0	0	0	9	56	27	8	45	41	13	74	0	0	0	1		0	2	4	26	46	24	26	62	11	60	0	0	0
10	90	0	0	0	27	18	46	9	60	40	30	50	0	0	0	0		0	0	9	27	37	27	25	50	13	63	0	0	0
13	84	3	0	0	17	45	29	9	44	42	28	58	5	5	1	0		2	12	9	33	38	20	35	47	30	42	9	1	0
2	98	0	0	0	6	61	26	7	55	48	9	71	0	0	0	0		1	5	1	25	51	23	33	64	10	50	0	0	0
0	100	0	0	0	25	25	25	25	67	33	0	33	0	0	0	0		0	0	0	25	50	25	67	67	33	33	0	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
				(%)					(%)										(%)	
13	A small-scale semiconductor fabrication plant that supports high-mix, low-volume production and allows a two orders of magnitude reduction in capital investment from the current levels.	1	**136**	**14**	**32**	**54**	**-**	**77**	**60**	**32**	**7**	**1**							**7**	**10**
		2	**122**	**10**	**20**	**70**	**-**	**88**	**76**	**21**	**3**	**0**							**4**	**4**
		E	**12**	**100**	**0**	**0**	**-**	**95**	**91**	**9**	**0**	**0**							**17**	**0**

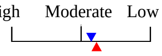
Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application							Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
64	**24**	**3**	**6**	**3**	**26**	**40**	**22**	**12**	**29**	**50**	**37**	**61**	**8**	**13**	**0**	**0**						**6**	**11**	**25**	**35**	**27**	**13**	**25**	**48**	**29**	**58**	**19**	**4**	**0**
90	**8**	**0**	**2**	**0**	**17**	**68**	**10**	**5**	**30**	**67**	**25**	**72**	**2**	**4**	**0**	**0**						**6**	**5**	**8**	**57**	**18**	**17**	**19**	**57**	**14**	**77**	**7**	**1**	**0**
92	**0**	**0**	**8**	**0**	**25**	**67**	**0**	**8**	**27**	**55**	**18**	**55**	**9**	**9**	**0**	**0**						**17**	**0**	**17**	**58**	**17**	**8**	**27**	**45**	**0**	**73**	**9**	**0**	**0**

III. Optical and photonic devices

1. Questions ragarding the relevant area

1) Degree of expertise in the area

High Moderate Low



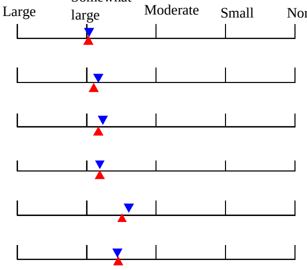
2) Current impacts

Large / Somewhat large / Moderate / Small / None

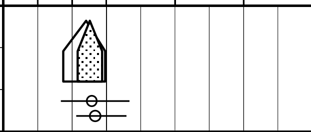
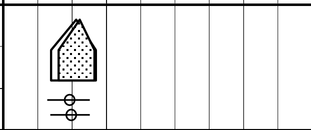
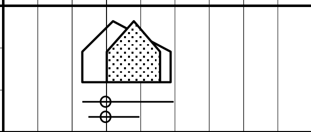
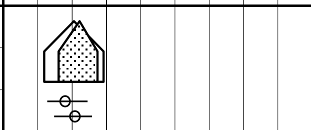
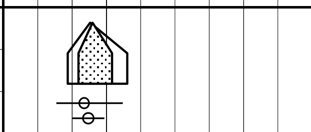
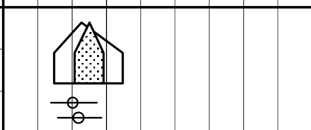
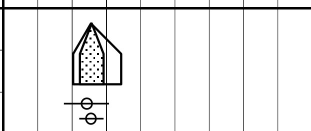
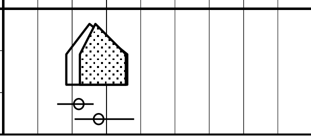
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

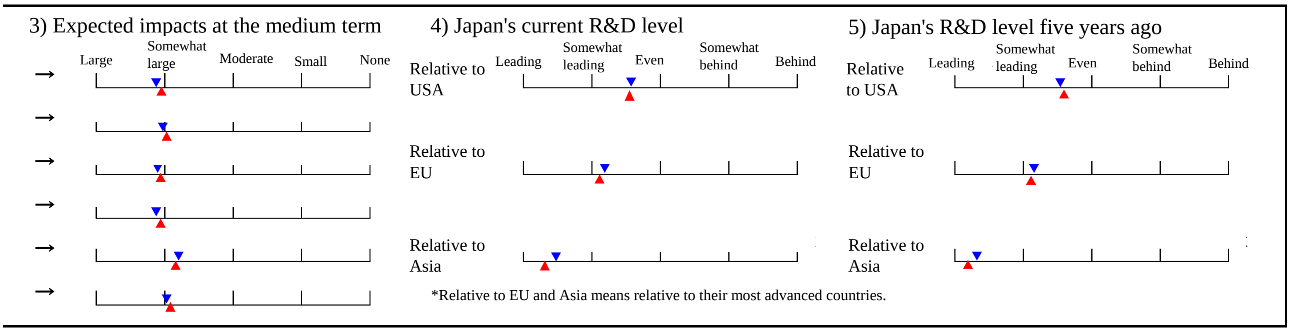
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

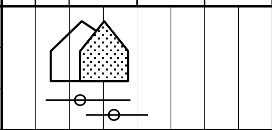
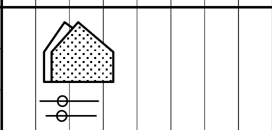
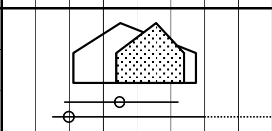
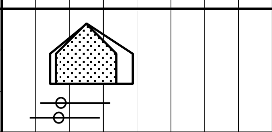
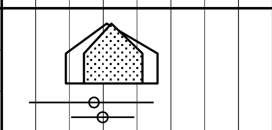
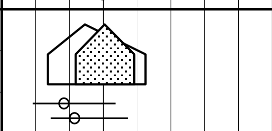
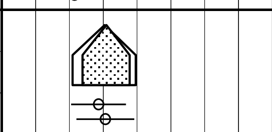
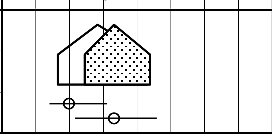
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

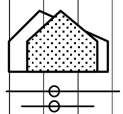
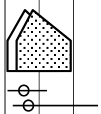
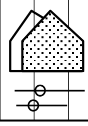


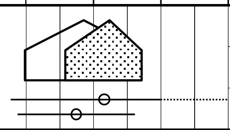
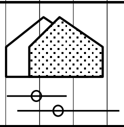
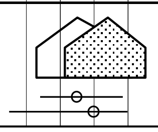
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
14	Organic material devices (e.g. lasers and switches).	1	132	14	38	48	-	60	26	61	13	0		0	5
		2	127	9	34	57	-	57	19	74	7	0		0	2
		E	11	100	0	0	-	55	18	64	18	0		0	0
15	Widespread home use of 10-Gbps access networks.	1	145	26	32	42	-	75	55	36	8	1		1	3
		2	128	19	35	46	-	85	73	23	3	1		0	0
		E	24	100	0	0	-	88	79	17	4	0		0	0
16	Soft X-ray laser at a few tens of angstroms of wavelength.	1	93	9	33	58	-	46	11	54	31	4		0	14
		2	97	2	18	80	-	44	2	70	28	0		0	8
		E	2	100	0	0	-	25	0	0	100	0		0	0
17	Almost all indoor lighting is replaced by semiconductor light sources.	1	150	21	37	42	-	74	54	36	9	1		5	1
		2	135	14	34	52	-	86	74	23	3	0		2	0
		E	19	100	0	0	-	87	78	11	11	0		5	0
18	Photonic sensing technology using an unused radio frequency range of 1-10 THz.	1	115	11	42	47	-	55	21	62	14	3		2	4
		2	112	12	29	59	-	52	9	79	12	0		1	1
		E	13	100	0	0	-	63	31	61	8	0		0	0
19	Ultraviolet/deep-ultraviolet laser diodes.	1	119	24	33	43	-	64	35	51	14	0		0	4
		2	115	17	24	59	-	57	20	70	10	0		0	3
		E	20	100	0	0	-	76	57	32	11	0		0	5
20	Optical multiplex communications equipments capable of transmitting multiplexed signals at 100 Tbps over a single optical fiber.	1	120	24	38	38	-	72	49	42	8	1		3	8
		2	115	22	29	49	-	79	60	34	5	1		3	1
		E	25	100	0	0	-	75	56	32	12	0		4	0
21	Ultralow-loss (e.g. 0.1 dB/km or lower) holey fibers (photonic crystal fibers).	1	107	18	40	42	-	56	24	55	19	2		4	4
		2	104	14	25	61	-	53	15	68	16	1		3	2
		E	15	100	0	0	-	60	33	40	27	0		7	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
39	52	8	0	1	17	47	27	9	37	56	31	59	4	4	0	0		2	7	12	35	28	25	34	53	32	39	7	1	0
32	67	1	0	0	4	69	20	7	41	61	21	67	0	0	0	0		0	4	1	47	31	21	33	66	14	50	0	0	0
18	73	9	0	0	0	73	9	18	67	44	44	67	0	0	0	0		0	0	0	70	10	20	63	88	25	38	0	0	0
71	26	1	2	0	21	37	26	16	19	43	29	47	11	32	3	0		3	6	30	37	20	13	12	27	25	54	49	3	1
94	6	0	0	0	10	59	22	9	19	54	16	65	2	33	0	1		1	2	22	48	21	9	13	28	14	70	56	1	0
100	0	0	0	0	21	49	17	13	24	38	24	52	0	48	0	0		4	0	26	52	9	13	20	35	10	65	65	0	0
24	64	9	0	3	11	52	26	11	33	33	34	56	6	9	1	1		2	20	11	37	39	13	34	49	24	30	14	7	3
3	95	1	0	1	2	64	25	9	37	43	27	76	1	2	0	0		0	10	2	40	45	13	35	71	6	42	8	0	0
0	100	0	0	0	0	0	50	50	100	100	0	0	0	0	0	0		0	0	0	0	50	50	100	100	0	0	0	0	0
93	6	1	0	0	16	33	31	20	16	49	22	59	7	19	3	0		10	3	21	35	24	20	12	32	25	65	27	10	2
99	1	0	0	0	9	57	27	7	13	58	8	73	5	14	2	0		2	2	7	54	28	11	12	39	16	72	23	5	0
100	0	0	0	0	16	47	21	16	13	63	13	63	13	19	13	0		5	5	17	55	17	11	13	63	13	69	13	13	0
29	60	9	0	2	15	51	24	10	35	49	35	61	5	9	2	1		2	8	14	41	31	14	30	44	33	37	16	12	2
9	85	5	0	1	8	69	17	6	40	66	25	71	1	5	1	0		1	2	5	54	30	11	31	63	17	50	14	4	0
31	61	8	0	0	31	46	15	8	42	67	42	58	0	0	0	0		0	0	15	47	23	15	18	64	18	64	9	18	0
73	25	0	0	2	17	41	26	16	28	47	33	67	5	5	0	0		1	9	14	32	30	24	30	52	34	48	10	2	1
89	9	1	0	1	5	69	20	6	32	64	14	76	1	2	0	0		0	3	2	50	32	16	29	73	13	52	7	1	0
100	0	0	0	0	15	55	10	20	50	69	19	75	0	6	0	0		0	5	11	42	26	21	47	80	13	47	7	7	0
70	29	1	0	0	21	43	26	10	29	42	36	61	7	14	1	0		6	8	21	41	19	19	20	48	19	61	23	4	1
91	9	0	0	0	11	56	28	5	22	57	26	77	3	5	0	0		4	2	11	57	23	9	17	49	12	73	20	0	0
100	0	0	0	0	12	48	36	4	29	50	33	79	0	4	0	0		8	4	16	48	28	8	26	43	22	74	17	0	0
56	35	8	0	1	13	38	33	16	27	48	24	64	6	2	1	1		4	11	12	29	33	26	23	47	20	47	7	0	4
83	15	2	0	0	5	53	30	12	27	61	16	76	3	1	0	0		3	5	5	41	40	14	18	64	12	67	4	0	0
100	0	0	0	0	7	46	20	27	18	64	9	64	0	0	0	0		7	0	7	33	33	27	18	55	18	55	0	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan					Time of technological realization							
				High	Moderate	Low	None	Index	High (%)	Moderate (%)	Low (%)	None (%)	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
22	Secure optical quantum communications system.	1	**118**	**11**	**31**	**58**	**-**	**67**	**42**	**41**	**16**	**1**							**4**	**4**
		2	**114**	**6**	**21**	**73**	**-**	**70**	**43**	**51**	**5**	**1**							**2**	**4**
		E	**7**	**100**	**0**	**0**	**-**	**82**	**72**	**14**	**14**	**0**							**0**	**0**
23	Photonic-crystal-based potonic integrated circuits.	1	**131**	**21**	**44**	**35**	**-**	**62**	**32**	**52**	**16**	**0**							**3**	**9**
		2	**118**	**14**	**31**	**55**	**-**	**58**	**21**	**68**	**11**	**0**							**3**	**3**
		E	**17**	**100**	**0**	**0**	**-**	**66**	**41**	**41**	**18**	**0**							**0**	**0**
24	Large-capacity optical buffer memory.	1	**108**	**15**	**35**	**50**	**-**	**63**	**36**	**47**	**14**	**3**							**7**	**9**
		2	**103**	**6**	**27**	**67**	**-**	**61**	**29**	**56**	**14**	**1**							**4**	**6**
		E	**6**	**100**	**0**	**0**	**-**	**63**	**33**	**50**	**17**	**0**							**0**	**0**

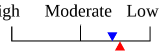
Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
28	**61**	**10**	**0**	**1**	**28**	**39**	**23**	**10**	**40**	**41**	**40**	**57**	**13**	**8**	**1**	**0**						**8**	**6**	**29**	**35**	**24**	**12**	**29**	**41**	**20**	**49**	**16**	**20**	**4**
9	**85**	**6**	**0**	**0**	**15**	**69**	**10**	**6**	**58**	**52**	**28**	**75**	**2**	**0**	**0**	**0**						**4**	**6**	**13**	**60**	**20**	**7**	**29**	**57**	**10**	**67**	**6**	**13**	**0**
33	**17**	**50**	**0**	**0**	**29**	**57**	**0**	**14**	**83**	**50**	**33**	**100**	**0**	**0**	**0**	**0**						**0**	**0**	**14**	**43**	**29**	**14**	**67**	**67**	**0**	**67**	**0**	**17**	**0**
60	**38**	**2**	**0**	**0**	**22**	**40**	**27**	**11**	**41**	**48**	**32**	**67**	**4**	**4**	**0**	**0**						**6**	**10**	**15**	**28**	**35**	**22**	**31**	**46**	**40**	**44**	**4**	**1**	**1**
83	**15**	**2**	**0**	**0**	**8**	**67**	**16**	**9**	**48**	**61**	**17**	**77**	**2**	**1**	**1**	**0**						**5**	**5**	**2**	**36**	**47**	**15**	**30**	**62**	**23**	**53**	**2**	**1**	**0**
94	**0**	**6**	**0**	**0**	**18**	**52**	**6**	**24**	**54**	**54**	**15**	**85**	**0**	**0**	**0**	**0**						**0**	**0**	**0**	**41**	**41**	**18**	**50**	**64**	**14**	**50**	**0**	**0**	**0**
44	**54**	**0**	**0**	**2**	**22**	**38**	**29**	**11**	**35**	**46**	**32**	**60**	**7**	**3**	**0**	**0**						**7**	**10**	**15**	**24**	**34**	**27**	**36**	**49**	**33**	**45**	**4**	**1**	**1**
26	**73**	**1**	**0**	**0**	**10**	**54**	**25**	**11**	**37**	**53**	**16**	**77**	**2**	**0**	**0**	**0**						**4**	**6**	**3**	**34**	**48**	**15**	**30**	**62**	**14**	**59**	**1**	**0**	**0**
40	**60**	**0**	**0**	**0**	**17**	**50**	**0**	**33**	**50**	**75**	**25**	**75**	**0**	**0**	**0**	**0**						**0**	**0**	**17**	**33**	**33**	**17**	**80**	**60**	**40**	**60**	**0**	**0**	**0**

IV. Wireless electronics

1. Questions ragarding the relevant area

1) Degree of expertise in the area

High Moderate Low



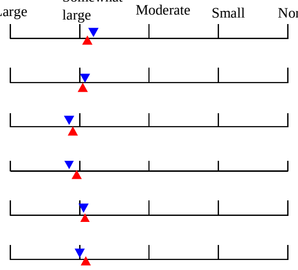
2) Current impacts

Large / Somewhat large / Moderate / Small / None

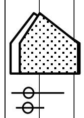
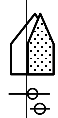
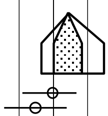
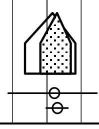
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

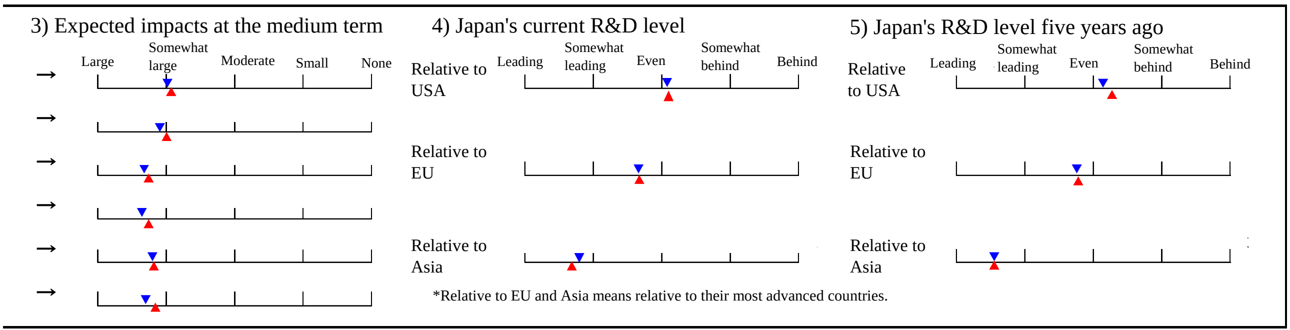
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

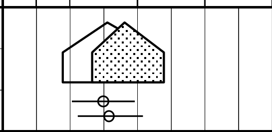
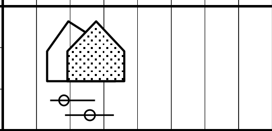
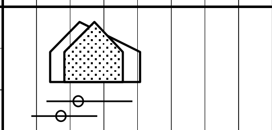
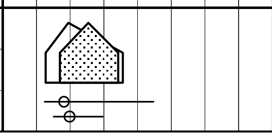
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
25	A broadband solid-state amplifier operating in a DC to 1000 GHz range.	1	101	15	27	58	-	53	18	57	25	0		7	9
		2	94	13	16	71	-	49	6	77	17	0		3	6
		E	12	100	0	0	-	54	17	66	17	0		0	8
26	A card-size software radio whose specifications, including center frequency, bandwidth, modulation method, and error correction method, can be changed in software.	1	107	9	36	55	-	67	40	50	10	0		0	3
		2	99	7	22	71	-	60	24	68	8	0		0	0
		E	7	100	0	0	-	68	43	43	14	0		0	0
27	A wireless terminal that can autonomously operate whenever necessary, using natural energy (e.g. many dispersed sensors (wireless terminals) autonomously send alarms to the central system depending on their sensed values, without the need for an external power supply).	1	124	11	35	54	-	69	45	43	12	0		0	3
		2	110	6	25	69	-	71	46	47	7	0		0	0
		E	7	100	0	0	-	82	72	14	14	0		0	0
28	A wireless system in which terminals mutually communicate to form a network (a wireless system in which remote terminals are linked through multiple intermediate terminals, rather than through communications between the terminal and the access point, such as the base station, as in mobile telephone networks and wireless LANs).	1	114	6	44	50	-	65	39	45	14	2		1	3
		2	107	4	31	65	-	61	27	61	12	0		1	0
		E	4	100	0	0	-	88	75	25	0	0		0	0

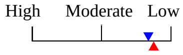


Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
20	77	3	0	0	14	41	33	12	40	37	37	60	6	7	0	0		5	15	11	33	33	23	36	42	28	38	22	1	0
3	95	2	0	0	3	64	28	5	45	49	18	73	0	1	0	0		4	7	1	43	34	22	24	63	8	56	8	0	0
18	82	0	0	0	8	67	17	8	45	64	27	82	0	0	0	0		0	8	0	50	25	25	11	56	22	44	11	0	0
19	75	6	0	0	23	41	26	10	36	50	31	63	12	26	2	0		1	6	22	36	26	16	29	38	22	38	50	9	1
4	95	1	0	0	6	66	25	3	35	65	10	71	4	12	0	0		1	1	3	61	22	14	17	42	10	43	63	1	1
0	83	17	0	0	0	86	0	14	17	50	0	67	17	33	0	0		0	0	0	86	0	14	0	67	33	0	50	17	17
34	59	6	0	1	23	44	24	9	41	50	37	59	8	22	4	0		0	7	22	43	23	12	27	41	26	45	51	14	0
20	80	0	0	0	7	71	18	4	35	68	18	69	2	5	0	0		0	1	5	66	21	8	16	53	18	59	53	3	0
33	67	0	0	0	0	72	14	14	33	67	0	67	0	0	0	0		0	0	0	71	0	29	0	80	60	20	20	0	0
20	75	5	0	0	19	41	25	15	38	53	34	52	15	30	5	0		2	5	27	32	25	16	26	35	22	35	58	18	0
8	92	0	0	0	8	71	18	3	31	73	19	65	2	15	0	0		2	2	10	61	20	9	18	45	10	50	66	6	0
0	100	0	0	0	25	50	25	0	50	50	25	75	0	25	0	0		0	0	25	50	25	0	25	50	50	25	25	0	0

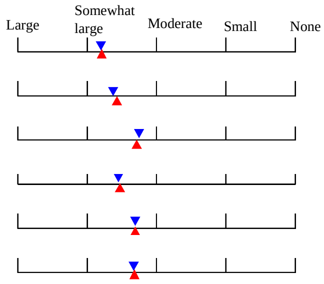
V. Bioelectronics

1. Questions ragarding the relevant area

1) Degree of expertise in the area

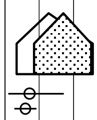
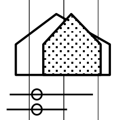
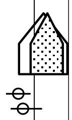
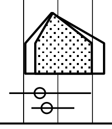


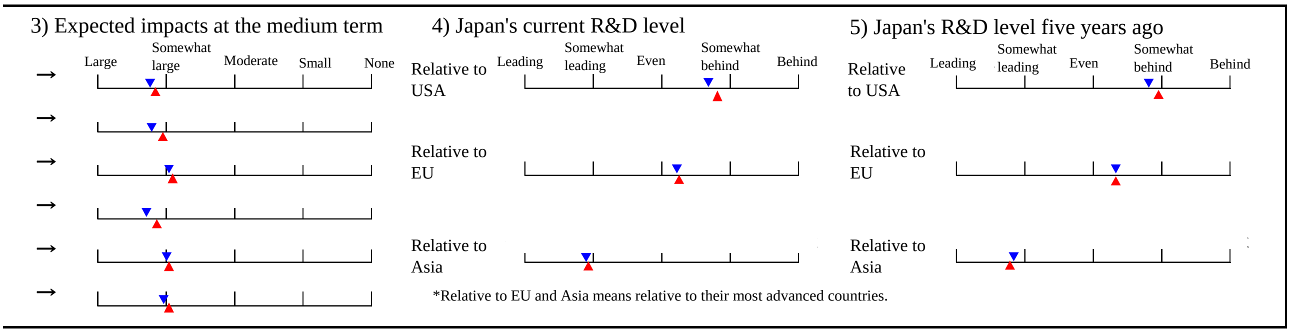
2) Current impacts



[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
29	Electronics technology with new capabilities achieved through fusion between electronics and biomechanisms at the single-cell/-molecule level (e.g. devices for diagnosis and drug development).	1	89	11	20	69	-	63	31	58	10	1		2	11
		2	83	6	8	86	-	62	26	72	2	0		1	6
		E	5	100	0	0	-	100	100	0	0	0		0	0
30	Technology for fabricating nano-scale integrated circuits as designed, using self-organization and other bottom-up methods.	1	118	11	25	64	-	56	25	53	19	3		14	12
		2	100	8	12	80	-	54	15	71	13	1		9	8
		E	8	100	0	0	-	75	50	50	0	0		0	13
31	A miniature chemical analysis system for checking food or environmental safety on the spot.	1	99	10	23	67	-	66	37	55	7	1		2	4
		2	97	7	15	78	-	62	26	72	2	0		0	3
		E	7	100	0	0	-	100	100	0	0	0		0	0
32	A micromachine-based health care device that can be implanted in the human body.	1	115	16	27	57	-	68	40	51	9	0		0	3
		2	110	8	18	74	-	62	27	68	5	0		0	3
		E	9	100	0	0	-	94	89	11	0	0		0	0

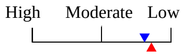


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
1	94	4	0	1	28	55	11	6	58	46	48	59	10	16	5	1						5	11	18	57	13	12	42	53	34	37	32	16	1
0	100	0	0	0	20	68	8	4	79	53	40	65	4	8	1	0						1	9	10	69	15	6	56	64	21	43	29	11	0
0	100	0	0	0	75	25	0	0	50	50	50	50	0	25	0	0						0	0	80	20	0	0	60	40	20	60	40	0	0
18	76	5	0	1	25	38	21	16	57	51	48	59	6	4	0	0						14	13	12	35	27	26	45	60	27	42	10	1	1
4	96	0	0	0	15	61	18	6	71	52	33	64	0	1	0	0						9	8	6	53	28	13	55	63	18	46	6	1	1
29	71	0	0	0	62	38	0	0	63	50	38	63	0	0	0	0						0	13	37	38	25	0	63	50	13	38	13	0	0
29	64	6	0	1	28	48	16	8	45	57	35	52	7	21	13	0						3	6	26	45	20	9	35	44	33	44	36	28	1
23	77	0	0	0	22	65	8	5	55	74	22	66	1	8	4	0						0	4	18	64	15	3	42	64	17	60	39	22	0
57	43	0	0	0	71	29	0	0	71	71	14	43	0	29	0	0						0	0	71	29	0	0	57	29	14	86	71	29	0
19	72	7	1	1	33	50	12	5	49	55	41	59	9	31	7	1						3	8	38	38	18	6	33	49	32	39	48	32	1
5	95	0	0	0	19	70	6	5	63	71	29	63	1	16	3	0						1	2	23	63	11	3	41	62	19	44	63	22	0
33	67	0	0	0	67	33	0	0	78	67	33	44	0	22	0	0						0	0	78	22	0	0	44	33	11	56	78	11	0

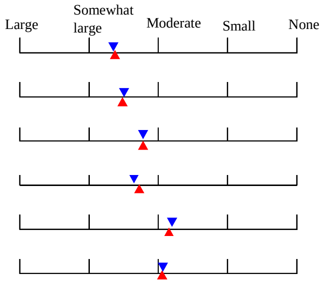
VI. Molecular and organic electronics

1. Questions ragarding the relevant area

1) Degree of expertise in the area



2) Current impacts

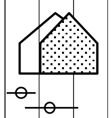
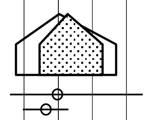
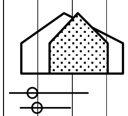
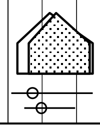


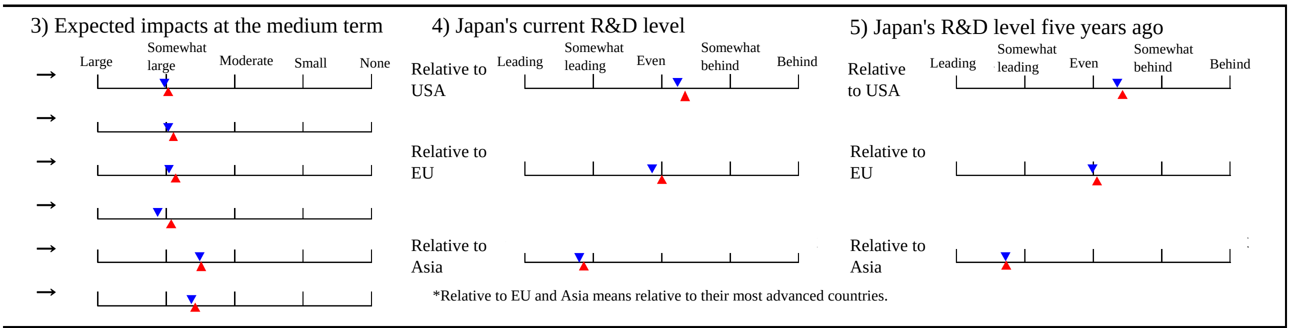
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
33	Device fabrication technology and genetic engineering technology based on single-atom/-molecule manipulation.	1	105	5	38	57	-	59	27	56	16	1		2	12
		2	101	5	23	72	-	56	16	74	10	0		0	6
		E	5	100	0	0	-	90	80	20	0	0		0	0
34	A logic/memory LSI that uses a single molecule as the basic switching element.	1	116	5	36	59	-	55	23	51	24	2		9	12
		2	104	5	21	74	-	49	8	73	18	1		9	9
		E	5	100	0	0	-	65	40	40	20	0		20	0
35	Five-sense sensors with a sensitivity equivalent to humans.	1	94	13	34	53	-	61	30	54	16	0		5	3
		2	100	2	23	75	-	55	19	64	17	0		5	2
		E	2	100	0	0	-	100	100	0	0	0		0	0
36	An LSI containing carbon nanotube transistors.	1	125	6	40	54	-	55	24	50	24	2		6	10
		2	118	3	32	65	-	50	9	71	20	0		3	3
		E	4	100	0	0	-	69	50	25	25	0		0	0



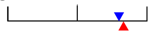
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application					(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
15	81	2	0	2	27	41	23	9	63	45	44	55	8	3	1	0						5	12	16	36	34	14	43	54	24	39	12	9	1
1	99	0	0	0	15	63	14	8	80	48	34	75	0	0	0	0						2	9	7	54	27	12	60	73	11	42	5	2	1
0	100	0	0	0	80	20	0	0	60	40	40	80	0	0	0	0						0	0	40	60	0	0	40	60	0	40	0	0	0
11	83	4	0	2	24	39	26	11	55	51	35	51	6	1	0	0						9	17	14	26	34	26	46	50	24	38	4	0	1
2	98	0	0	0	9	64	20	7	74	59	21	71	0	0	0	0						14	13	5	38	41	16	55	71	8	41	1	0	1
0	100	0	0	0	20	60	20	0	60	60	40	60	0	0	0	0						20	0	20	60	0	20	50	50	0	50	0	0	0
26	64	9	0	1	20	47	23	10	54	51	45	59	7	2	0	0						8	4	12	41	29	18	44	53	30	48	7	4	1
13	86	1	0	0	8	65	19	8	71	60	20	68	1	0	0	0						4	5	5	55	29	11	50	64	11	53	8	2	0
0	100	0	0	0	100	0	0	0	100	50	0	50	0	0	0	0						0	0	50	50	0	0	100	50	0	50	0	0	0
43	55	2	0	0	17	44	28	11	42	54	36	59	6	2	0	0						10	12	11	30	31	28	36	60	29	42	5	1	1
33	67	0	0	0	7	63	24	6	43	68	20	72	0	0	0	1						5	5	3	43	39	15	36	71	11	52	1	0	0
0	100	0	0	0	0	25	50	25	67	0	0	33	0	0	0	0						25	0	0	25	0	75	0	100	0	0	0	0	0

VII. Storage

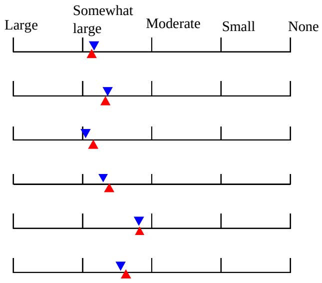
1. Questions ragarding the relevant area

1) Degree of expertise in the area

High Moderate Low



2) Current impacts

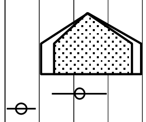
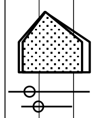
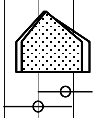
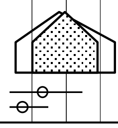


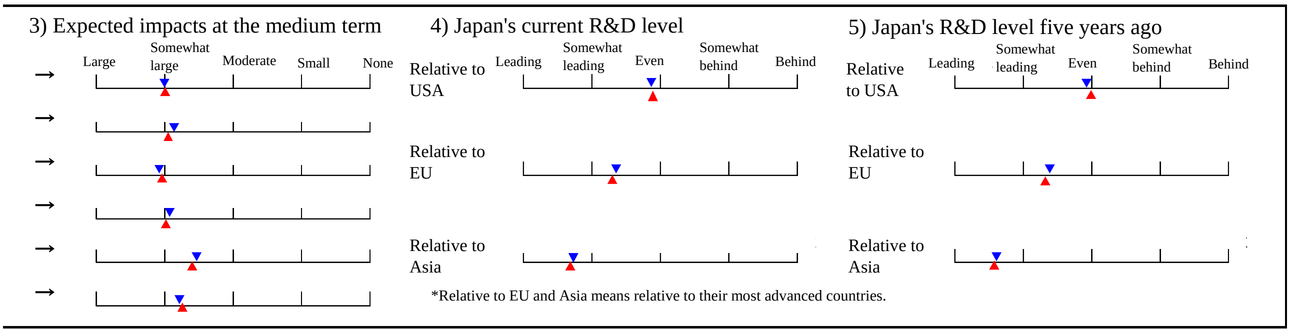
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

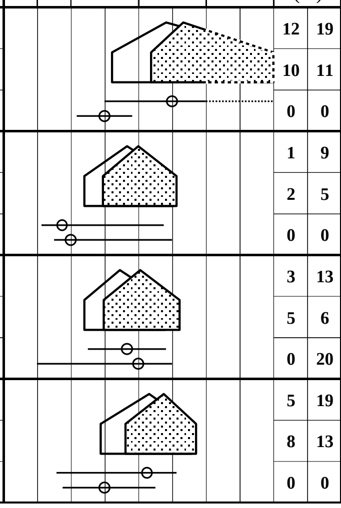
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
37	A storage system that stores a bit of data by using a single atom/molecule.	1	107	9	34	57	-	60	28	57	13	2		10	12
		2	103	5	18	77	-	54	14	74	12	0		9	5
		E	5	100	0	0	-	75	60	20	20	0		0	0
38	A magnetic hard disk drive that has a storage density of 10 terabits per square inch (an increase of more than two orders of magnitude from current technology).	1	112	4	28	68	-	74	52	41	6	1		5	9
		2	105	2	18	80	-	78	58	40	2	0		1	5
		E	2	100	0	0	-	75	50	50	0	0		0	0
39	An optical memory that has a storage density of 1 terabit or more per square inch (including the near field).	1	117	8	32	60	-	68	41	47	11	1		5	7
		2	100	5	29	66	-	63	31	62	6	1		3	4
		E	5	100	0	0	-	70	40	60	0	0		0	20
40	A large-scale probe array memory with a storage density of 10 terabits or more per square inch.	1	96	7	28	65	-	58	25	57	17	1		5	12
		2	91	3	24	73	-	51	11	71	18	0		3	7
		E	3	100	0	0	-	83	67	33	0	0		0	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
16	80	3	0	1	19	47	21	13	44	45	45	60	7	3	0	0	12	19	10	27	36	27	36	44	27	51	5	0	1
3	97	0	0	0	6	68	21	5	56	47	32	69	1	0	0	0	10	11	5	31	50	14	37	58	8	55	1	0	0
33	67	0	0	0	40	20	20	20	75	25	50	75	0	0	0	0	0	0	20	40	0	40	33	33	0	67	0	0	0
56	43	0	0	1	23	43	21	13	35	48	34	66	3	5	0	0	1	9	12	25	38	25	28	46	26	51	6	1	3
82	18	0	0	0	11	63	21	5	32	61	24	79	1	0	0	0	2	5	1	30	51	18	20	59	8	62	0	0	1
100	0	0	0	0	0	50	0	50	0	100	0	100	0	0	0	0	0	0	0	0	50	50	0	100	0	0	0	0	0
73	25	0	0	2	20	49	21	10	38	50	36	71	4	3	0	0	3	13	9	34	33	24	30	49	29	54	5	0	2
93	7	0	0	0	7	70	17	6	36	66	24	80	0	0	0	0	5	6	0	41	42	17	25	64	12	64	0	0	0
100	0	0	0	0	0	80	0	20	0	75	0	75	0	0	0	0	0	20	0	20	40	40	0	67	0	100	0	0	0
31	61	6	0	2	16	47	26	11	40	50	43	66	5	4	0	0	5	19	6	31	42	21	31	49	24	55	6	1	3
16	81	3	0	0	6	59	29	6	40	65	14	65	1	0	0	0	8	13	1	30	53	16	31	61	9	60	0	0	0
50	0	50	0	0	0	67	0	33	50	100	0	50	0	0	0	0	0	0	0	33	0	67	0	100	100	100	0	0	0

Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–

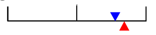


VIII. Displays

1. Questions ragarding the relevant area

1) Degree of expertise in the area

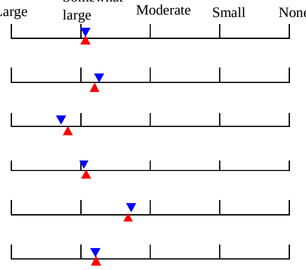
High / Moderate / Low



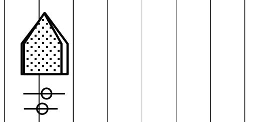
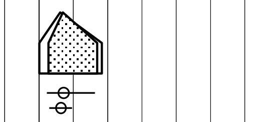
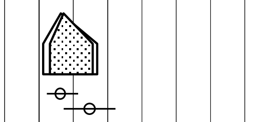
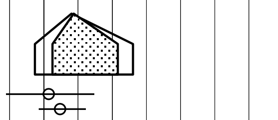
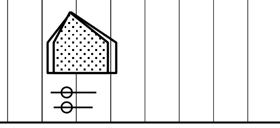
2) Current impacts

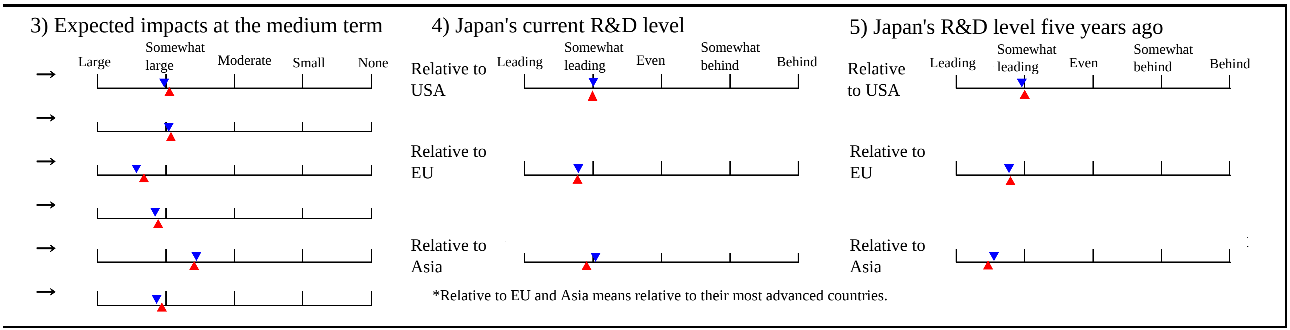
Large / Somewhat large / Moderate / Small / None

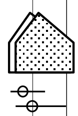
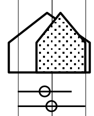
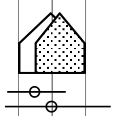
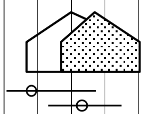
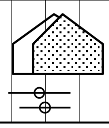
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
41	A flat-panel display larger than A3 size and with a resolution equivalent to high quality print images (600 dpi or higher).	1	123	11	32	57	-	70	45	46	7	2		2	0
		2	117	6	28	66	-	71	43	53	4	0		0	0
		E	7	100	0	0	-	71	43	57	0	0		0	0
42	A 3D video display that may be viewed without wearing special glasses and shows undistorted images even when the viewer makes certain natural movements such as shifting the body.	1	124	7	27	66	-	60	30	49	21	0		4	5
		2	114	4	21	75	-	55	17	71	12	0		3	4
		E	5	100	0	0	-	70	40	60	0	0		0	0
43	An organic emissive display that is so large as to cover an entire wall.	1	130	8	32	60	-	67	43	40	17	0		1	2
		2	119	5	19	76	-	69	41	52	7	0		0	0
		E	6	100	0	0	-	83	67	33	0	0		0	0
44	A display device that allows people to enjoy movies anywhere, anytime by directly projecting images on their retinas.	1	110	10	28	62	-	49	21	39	35	5		9	5
		2	110	6	17	77	-	45	7	59	32	2		6	5
		E	7	100	0	0	-	50	14	57	29	0		0	0
45	A folding display that is equivalent to newspaper in size, thickness, and resolution.	1	127	9	31	60	-	70	45	47	8	0		2	2
		2	119	5	19	76	-	69	40	57	3	0		1	0
		E	6	100	0	0	-	83	67	33	0	0		0	0

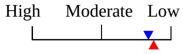


Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
86	7	0	7	0	20	36	28	16	29	49	35	68	10	6	1	0		2	5	12	29	31	28	30	48	29	54	8	1	1
98	0	1	1	0	3	59	31	7	22	58	23	79	2	3	1	0		0	1	3	32	44	21	18	52	11	72	3	0	0
100	0	0	0	0	0	14	43	43	33	67	33	67	0	0	0	0		0	0	0	17	33	50	33	67	33	67	0	0	0
66	29	3	0	2	11	36	38	15	37	47	32	63	9	5	2	1		4	7	7	26	40	27	34	47	41	45	12	5	1
84	14	2	0	0	5	50	36	9	33	62	21	72	3	0	1	0		4	5	3	24	58	15	24	55	25	56	1	3	1
100	0	0	0	0	40	0	40	20	0	33	33	100	0	0	0	0		0	0	25	25	25	25	0	33	33	67	0	0	0
80	17	3	0	0	21	37	23	19	29	52	38	77	9	4	0	1		2	3	10	27	32	31	29	46	35	58	13	1	1
96	3	1	0	0	6	60	26	8	22	65	24	78	1	1	0	0		0	1	2	30	50	18	16	55	18	71	5	0	0
80	20	0	0	0	17	49	17	17	25	75	25	75	0	0	0	0		0	0	20	40	20	20	25	100	25	75	25	0	0
31	64	3	0	2	11	41	33	15	29	50	34	56	8	15	13	1		9	10	8	38	33	21	29	41	35	36	21	19	4
10	90	0	0	0	2	57	30	11	33	67	21	61	0	10	3	0		6	6	2	41	39	18	22	52	30	50	23	9	0
0	100	0	0	0	0	29	42	29	0	50	0	50	0	25	0	0		0	0	17	17	33	33	0	25	50	75	50	0	0
64	30	6	0	0	17	48	19	16	31	58	40	72	7	6	1	0		2	3	8	36	29	27	25	52	34	56	13	2	1
84	15	1	0	0	8	65	20	7	26	68	26	73	0	1	0	0		0	1	6	39	36	19	19	64	21	67	3	0	0
80	20	0	0	0	0	66	17	17	40	80	20	80	0	20	0	0		0	0	17	33	17	33	50	75	25	75	25	0	0

IX. Energy conversion/storage devices

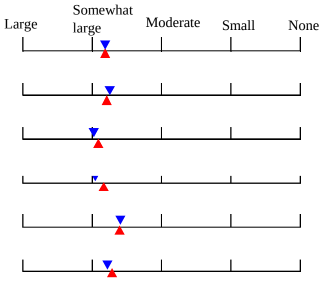
1. Questions ragarding the relevant area

1) Degree of expertise in the area

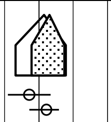
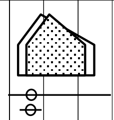
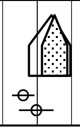


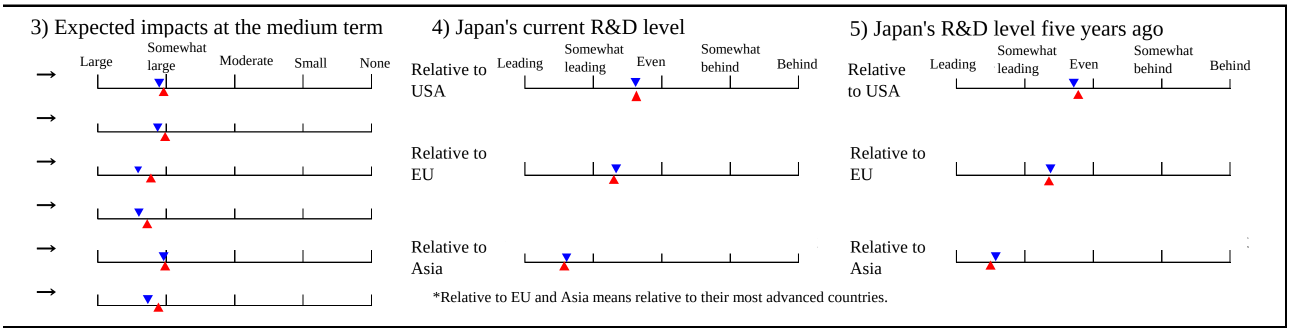
2) Current impacts

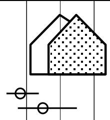
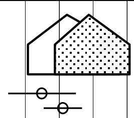
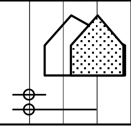
Category	Impact	
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
46	The batteries of most mobile equipment (PCs, mobile phones, PDAs, etc.) are replaced by fuel cells.	1	**127**	**6**	**28**	**66**	**-**	**78**	**58**	**37**	**4**	**1**		**2**	**1**
		2	**114**	**4**	**18**	**78**	**-**	**83**	**69**	**27**	**4**	**0**		**1**	**2**
		E	**4**	**100**	**0**	**0**	**-**	**69**	**50**	**25**	**25**	**0**		**0**	**25**
47	A new material that offers a higher energy conversion efficiency than silicon or GaAs solar cells.	1	**113**	**8**	**35**	**57**	**-**	**75**	**53**	**41**	**6**	**0**		**4**	**17**
		2	**108**	**8**	**24**	**68**	**-**	**82**	**65**	**30**	**5**	**0**		**4**	**3**
		E	**9**	**100**	**0**	**0**	**-**	**83**	**67**	**33**	**0**	**0**		**0**	**0**
48	A miniature electric generator that uses thermal or vibration energy and may be embedded in IC tags.	1	**117**	**5**	**35**	**60**	**-**	**67**	**39**	**51**	**9**	**1**		**2**	**5**
		2	**110**	**4**	**17**	**79**	**-**	**64**	**31**	**62**	**7**	**0**		**0**	**2**
		E	**4**	**100**	**0**	**0**	**-**	**69**	**50**	**25**	**25**	**0**		**0**	**0**

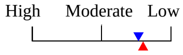


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application			Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
70	26	4	0	0	25	42	22	11	28	50	34	61	8	30	6	0		2	5	25	40	20	15	20	40	31	48	50	16	1
91	9	0	0	0	8	72	15	5	23	71	22	76	4	23	1	0		2	3	7	54	29	10	17	42	17	58	56	4	1
100	0	0	0	0	25	50	0	25	0	100	33	100	0	33	0	0		0	25	25	25	25	25	0	33	33	33	100	0	0
54	40	5	0	1	27	44	23	6	32	53	36	61	7	8	2	0		3	21	21	39	24	16	21	50	23	57	21	12	2
77	23	0	0	0	12	71	11	6	37	70	23	80	0	3	0	0		5	4	7	63	20	10	23	55	18	72	15	6	1
62	38	0	0	0	22	67	0	11	63	63	25	88	0	38	0	0		0	0	11	67	11	11	38	50	38	88	38	25	0
51	46	3	0	0	20	46	27	7	41	52	38	62	6	9	1	0		3	8	15	37	32	16	28	47	36	48	22	9	1
62	37	1	0	0	10	66	18	6	43	68	20	75	0	5	2	0		0	3	6	48	33	13	21	57	32	61	16	4	1
100	0	0	0	0	50	25	0	25	67	67	0	100	0	0	0	0		0	0	25	50	0	25	0	67	67	100	33	0	0

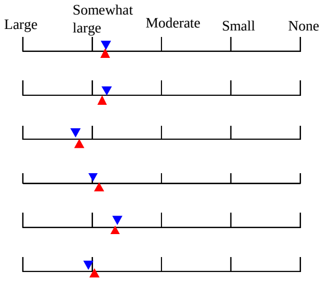
X. Digital home appliances

1. Questions ragarding the relevant area

1) Degree of expertise in the area

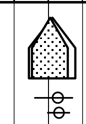
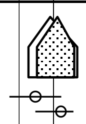
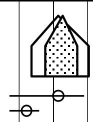
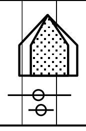


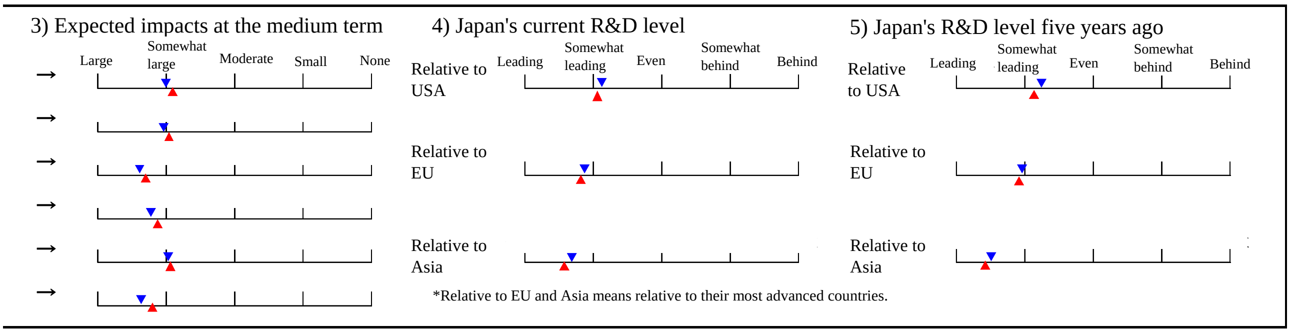
2) Current impacts

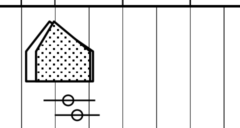
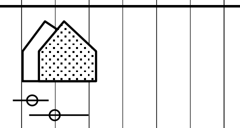
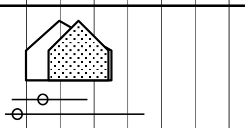
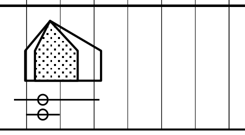


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
49	LSI that enables comprehensive media processing on a chip not simply by storing, communicating or signal-processing, but also by providing understanding and retrieval functions of audiovisual content.	1	116	9	45	46	-	68	41	49	9	1		0	3
		2	112	5	32	63	-	60	23	72	4	1		2	1
		E	6	100	0	0	-	54	33	33	17	17		20	0
50	A high-resolution video distribution system that allows searching through and distribution of TV, film, and music archives of the past few years.	1	117	6	36	58	-	57	30	39	30	1		1	3
		2	109	6	17	77	-	48	9	65	26	0		0	1
		E	6	100	0	0	-	54	17	66	17	0		0	0
51	Wall-mounted panels and furnishings with communications, sensing, displaying, lighting and other capabilities.	1	124	7	31	62	-	55	24	50	24	2		1	1
		2	112	4	18	78	-	50	11	68	21	0		0	1
		E	4	100	0	0	-	58	34	33	33	0		0	0
52	Fully wireless office and home environments that obviate the need for the physical connection.	1	135	13	37	50	-	61	31	53	14	2		4	2
		2	116	9	23	68	-	55	16	73	11	0		3	0
		E	11	100	0	0	-	64	36	46	18	0		10	0



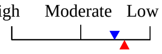
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
58	40	1	1	0	13	33	32	22	26	45	32	67	9	11	2	0		0	4	8	28	31	33	21	31	28	54	30	7	0
81	19	0	0	0	5	47	35	13	21	63	15	74	5	3	1	0		1	2	3	26	45	26	14	37	17	68	21	0	0
100	0	0	0	0	0	20	60	20	50	25	0	25	0	0	0	0		0	0	0	25	50	25	33	33	33	0	0	0	0
58	39	0	3	0	16	30	30	24	18	43	25	48	14	34	10	0		1	4	15	29	31	25	14	29	31	39	54	16	0
87	13	0	0	0	5	44	41	10	19	55	9	58	6	28	2	0		0	3	4	36	44	16	12	27	17	48	65	3	0
100	0	0	0	0	0	17	66	17	20	40	20	40	20	40	0	0		0	0	0	50	33	17	20	20	20	0	60	0	0
78	19	3	0	0	12	29	33	26	26	47	35	56	5	17	5	0		3	4	9	26	34	31	22	37	27	45	33	10	0
97	2	1	0	0	2	36	48	14	20	55	17	73	2	6	0	0		0	3	1	29	50	20	13	39	20	71	24	3	0
100	0	0	0	0	0	25	50	25	33	33	33	67	0	0	0	0		0	0	25	25	0	50	50	0	0	50	50	0	0
43	55	2	0	0	19	35	30	16	23	39	18	42	18	42	10	2		5	4	20	30	32	18	17	26	17	32	62	17	1
34	66	0	0	0	3	55	32	10	18	49	13	60	7	43	4	0		3	2	5	37	48	10	11	24	9	42	81	10	0
45	55	0	0	0	9	46	27	18	22	44	11	44	22	67	0	0		20	0	18	46	18	18	11	22	11	44	78	0	0

XI. Ubiquitous electronics

1. Questions ragarding the relevant area

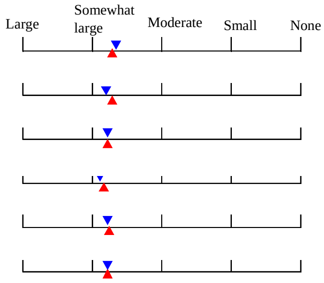
1) Degree of expertise in the area

High Moderate Low



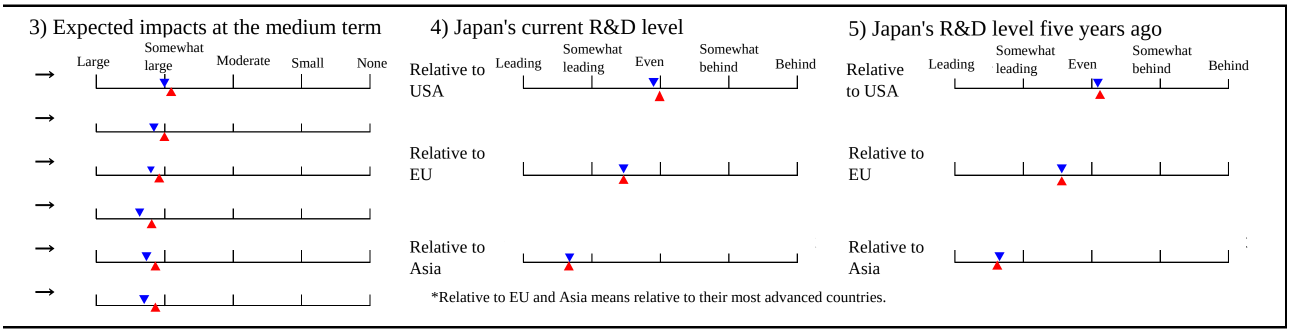
2) Current impacts

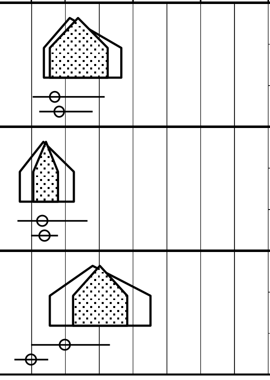
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
53	A one-chip ubiquitous computer with which information can be exchanged anytime, anywhere, and with anyone.	1	130	11	33	56	-	72	48	43	8	1							2	1
		2	115	7	24	69	-	77	58	36	6	0							1	0
		E	8	100	0	0	-	84	74	13	13	0							0	0
54	RF tags for attaching to most everyday items to help to track their location and state.	1	146	9	39	52	-	74	53	40	6	1							1	0
		2	129	7	29	64	-	80	63	32	5	0							1	0
		E	9	100	0	0	-	94	89	11	0	0							0	0
55	A system that provides information services most suited for the users and their situation without instructions from them.	1	117	7	28	65	-	58	29	47	21	3							3	3
		2	104	2	18	80	-	54	15	71	14	0							3	2
		E	2	100	0	0	-	75	50	50	0	0							0	0

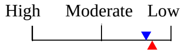


Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
33	65	1	0	1	28	39	20	13	38	55	32	76	19	15	5	1						3	3	21	30	31	18	32	46	31	44	37	14	1
15	83	2	0	0	12	61	18	9	36	73	23	72	3	5	1	0						0	2	5	51	33	11	25	58	11	61	35	2	0
43	57	0	0	0	14	43	14	29	0	100	20	80	0	20	20	0						0	0	0	42	29	29	0	60	20	40	40	20	0
62	37	1	0	0	29	39	19	13	26	47	30	52	35	37	18	2						1	1	31	38	21	10	23	38	26	43	61	32	2
88	12	0	0	0	17	56	19	8	21	59	15	63	19	33	8	0						0	1	15	57	22	6	16	37	12	51	68	21	0
75	25	0	0	0	37	38	25	0	0	88	13	50	0	50	13	0						0	0	13	62	25	0	0	50	25	38	63	25	0
29	68	1	0	2	16	39	27	18	31	49	29	54	15	17	11	0						2	4	17	34	30	19	26	37	33	40	40	25	0
10	90	0	0	0	6	53	31	10	27	63	10	75	3	9	0	0						1	3	4	47	41	8	18	47	16	60	36	13	0
100	0	0	0	0	0	50	50	0	0	50	50	100	0	0	0	0						0	0	50	0	50	0	0	50	50	100	50	50	0

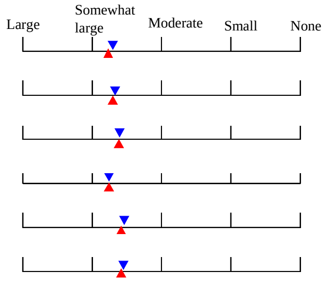
XII. Robot electronics

1. Questions ragarding the relevant area

1) Degree of expertise in the area

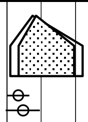
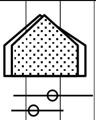
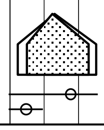


2) Current impacts

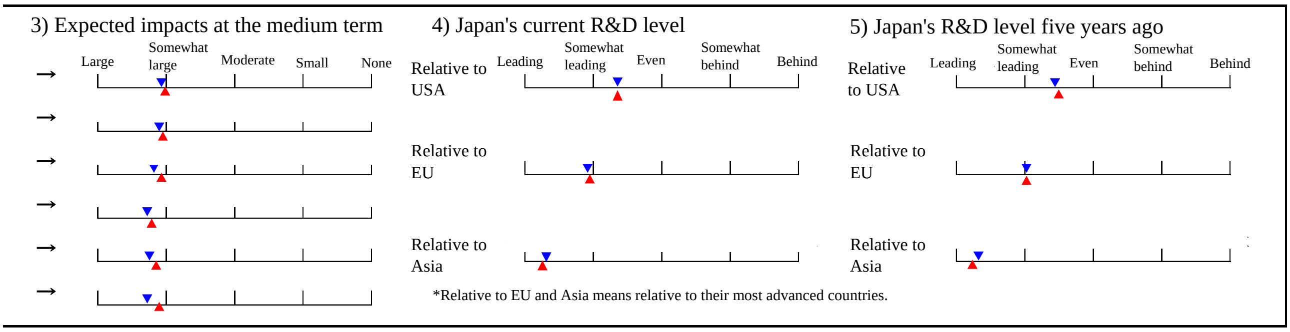


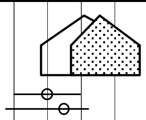
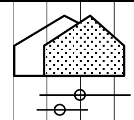
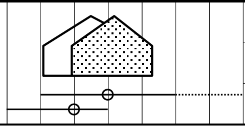
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
56	It becomes popular that every family has a household helper robot capable of doing the washing, cleaning,, and other household chores.	1	122	7	18	75	-	57	26	51	20	3		3	4
		2	117	3	14	83	-	53	14	70	16	0		1	3
		E	4	100	0	0	-	38	0	50	50	0		0	0
57	A microrobot that contains sensors, controllers, and actuators tightly packed using micromachine technology and can be sent into the human body for medical examination.	1	122	10	27	63	-	67	38	53	9	0		2	7
		2	116	6	16	78	-	61	23	72	5	0		2	2
		E	7	100	0	0	-	75	57	29	14	0		0	0
58	Surgery performed by remotely controlling a micromachine equipped with sensors and manipulators.	1	110	7	25	68	-	63	36	46	16	2		3	6
		2	110	4	15	81	-	59	23	68	9	0		2	1
		E	4	100	0	0	-	81	75	0	25	0		0	0

Time of technological realization columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–

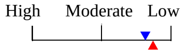


Countries at the leading edge					Regarding technological realization												Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't											Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
85	14	0	0	1	16	31	31	22	34	56	29	54	8	17	6	1		4	4	11	34	31	24	27	38	31	43	33	20	1
97	3	0	0	0	5	49	37	9	32	63	19	59	4	7	1	1		3	4	4	45	36	15	20	36	18	63	36	14	0
100	0	0	0	0	0	25	50	25	0	33	33	67	0	0	0	0		25	0	0	0	50	50	0	50	50	50	0	0	0
33	63	4	0	0	32	43	14	11	46	53	50	65	7	26	6	0		1	8	27	44	18	11	36	41	25	42	53	29	1
12	88	0	0	0	17	63	15	5	52	65	34	72	1	21	6	0		0	4	14	65	16	5	36	50	20	51	69	19	0
17	83	0	0	0	43	43	0	14	83	83	67	83	0	0	0	0		0	0	43	43	0	14	83	83	67	67	50	17	0
30	66	3	0	1	30	44	16	10	46	55	43	65	8	26	11	1		1	7	33	40	17	10	36	44	20	39	56	31	1
14	85	1	0	0	13	65	17	5	49	68	27	70	0	23	5	0		1	3	16	62	16	6	37	55	14	49	69	18	0
33	67	0	0	0	50	25	0	25	67	67	33	67	0	33	0	0		0	0	50	25	0	25	67	67	33	67	67	0	0

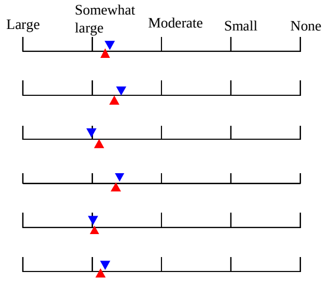
XIII. Car electronics

1. Questions ragarding the relevant area

1) Degree of expertise in the area



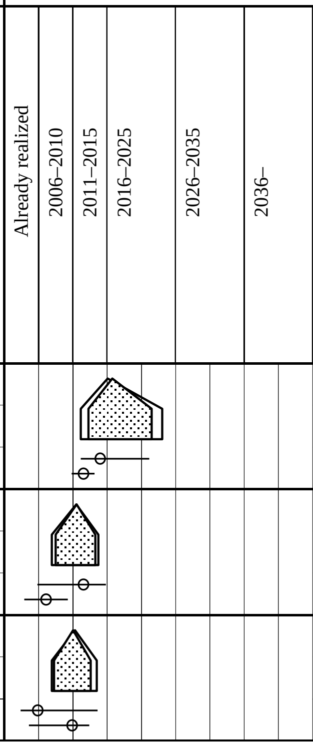
2) Current impacts

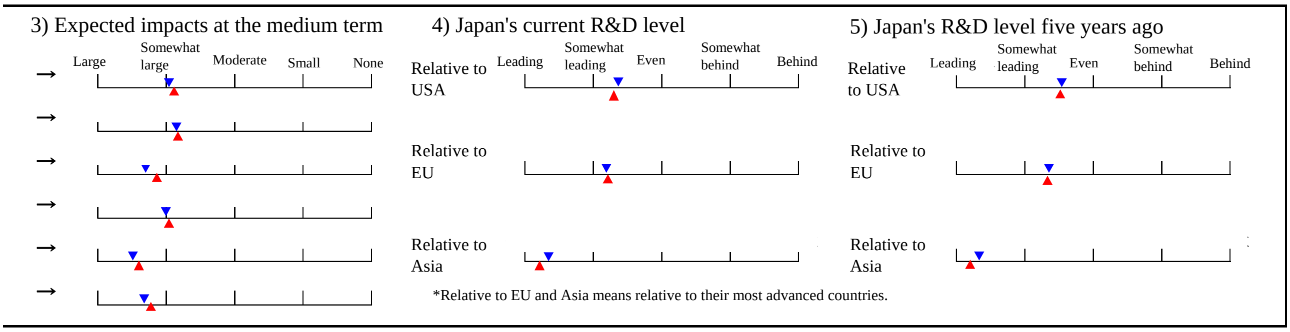


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

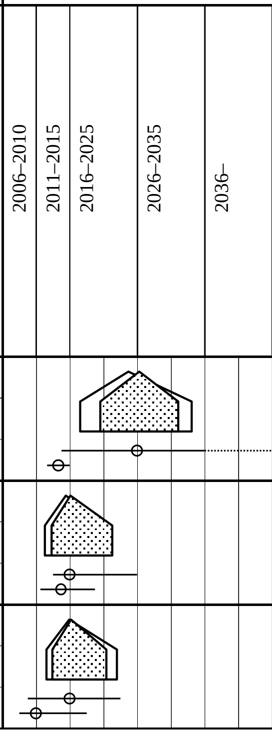
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
59	A system that automatically drives a car to the specified destination.	1	108	6	28	66	-	59	32	42	23	3		5	6
		2	111	4	14	82	-	52	14	68	18	0		5	2
		E	4	100	0	0	-	63	25	75	0	0		0	0
60	An automotive system in which a car is equipped with sensors for predicting and diagnosing failures and accidents.	1	120	7	34	59	-	73	47	49	4	0		1	2
		2	114	4	22	74	-	70	43	51	6	0		0	1
		E	5	100	0	0	-	65	40	40	20	0		0	0
61	Technology to allow 100-Mbps or faster communications between cars or between a car and a base station.	1	113	5	42	53	-	59	29	48	23	0		0	3
		2	113	5	27	68	-	56	16	76	8	0		0	0
		E	6	100	0	0	-	79	66	17	17	0		0	0





Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)							
61	35	4	0	0	24	43	21	12	27	51	40	46	11	45	20	1
83	17	0	0	0	5	64	23	8	22	64	31	58	1	43	9	0
33	67	0	0	0	0	75	25	0	50	50	50	50	0	75	25	0
76	18	6	0	0	20	42	28	10	24	49	38	55	13	27	9	1
92	7	1	0	0	4	60	25	11	19	68	20	63	1	24	5	0
50	50	0	0	0	20	20	40	20	25	100	25	50	0	50	0	0
55	41	4	0	0	17	41	29	13	20	43	32	53	14	39	16	0
78	21	1	0	0	6	68	22	4	17	60	21	62	0	31	5	0
40	40	20	0	0	33	50	0	17	40	60	60	60	0	40	0	0

Time of social application

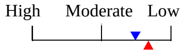


Time of social application		Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)		(%)				(%)						
9	9	34	35	17	14	25	36	16	34	59	40	2
6	7	20	53	21	6	16	38	7	43	77	34	0
0	0	0	50	25	25	33	67	33	67	100	33	0
0	4	21	39	26	14	19	43	17	46	50	23	0
0	2	6	56	28	10	15	45	5	56	70	17	0
0	0	20	20	20	40	33	100	33	67	100	67	0
0	3	20	39	26	15	14	37	14	38	60	23	1
0	1	7	58	29	6	13	42	6	42	76	9	0
0	0	17	66	0	17	40	60	40	80	60	20	0

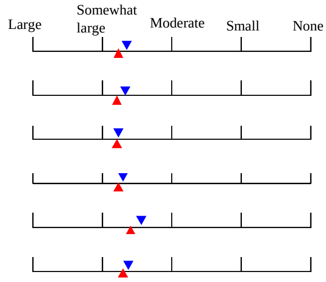
XIV. Network electronics

1. Questions ragarding the relevant area

1) Degree of expertise in the area



2) Current impacts



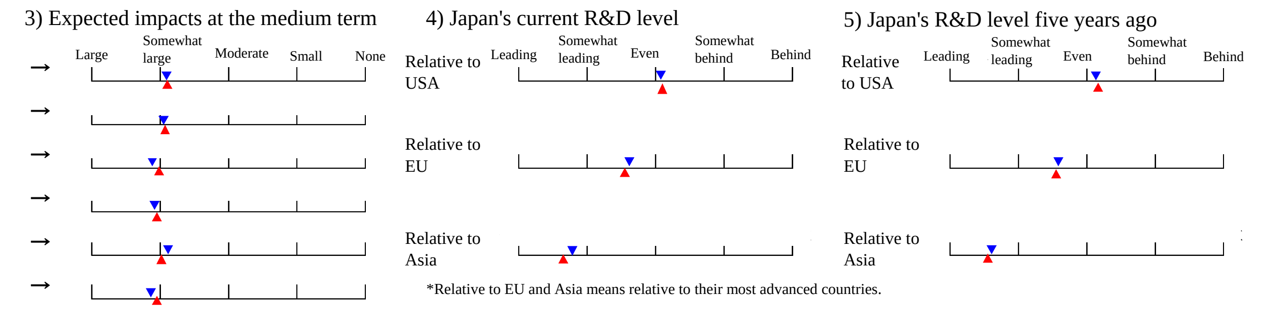
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

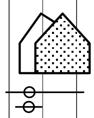
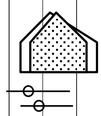
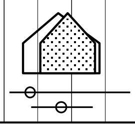
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
62	Technology with which HDTV video (about 1.5 Gbps) can be transmitted to any remote place without delays due to compression and other processing.	1	102	12	31	57	-	59	25	65	8	2							1	2
		2	106	8	23	69	-	54	12	82	6	0							1	1
		E	8	100	0	0	-	59	25	62	13	0							0	0
63	Technology for time division transmission at 100 Gbps or faster.	1	99	16	37	47	-	64	34	55	10	1							1	2
		2	100	12	23	65	-	55	13	81	6	0							1	1
		E	12	100	0	0	-	69	42	50	8	0							0	0
64	Large-scale (about 1000x1000) optical cross-connect equipment	1	100	19	35	46	-	65	35	56	8	1							1	4
		2	97	13	28	59	-	56	16	76	8	0							0	3
		E	13	100	0	0	-	71	46	46	8	0							0	0

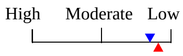


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
58	42	0	0	0	19	36	27	18	28	51	32	57	10	16	1	0		3	4	13	36	35	16	22	40	21	49	40	10	0
73	27	0	0	0	3	67	24	6	21	61	21	70	6	13	1	0		1	1	2	51	37	10	16	48	10	66	50	3	0
100	0	0	0	0	0	37	38	25	17	50	33	50	17	0	0	0		0	0	0	13	62	25	17	17	17	67	33	0	0
62	36	2	0	0	22	39	21	18	32	50	33	68	6	6	0	0		0	5	11	39	31	19	22	46	17	65	19	4	0
82	18	0	0	0	5	70	20	5	27	63	18	78	2	7	0	0		0	3	3	59	29	9	18	55	8	78	14	1	0
91	9	0	0	0	8	76	8	8	36	64	27	91	0	9	0	0		0	8	0	67	25	8	18	64	18	91	18	0	0
38	60	1	0	1	25	38	24	13	31	49	37	69	8	6	0	0		0	5	15	35	32	18	27	46	22	55	18	1	0
19	80	0	1	0	7	68	19	6	27	65	22	79	1	3	0	0		0	4	4	49	33	14	22	59	7	80	12	1	0
33	67	0	0	0	31	53	8	8	25	75	25	92	0	0	0	0		0	0	17	50	25	8	9	64	9	82	9	0	0

XV. Security electronics

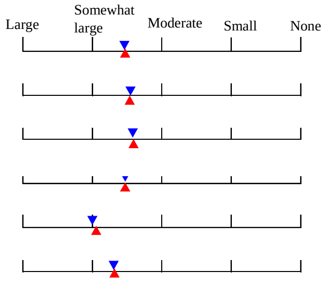
1. Questions ragarding the relevant area

1) Degree of expertise in the area



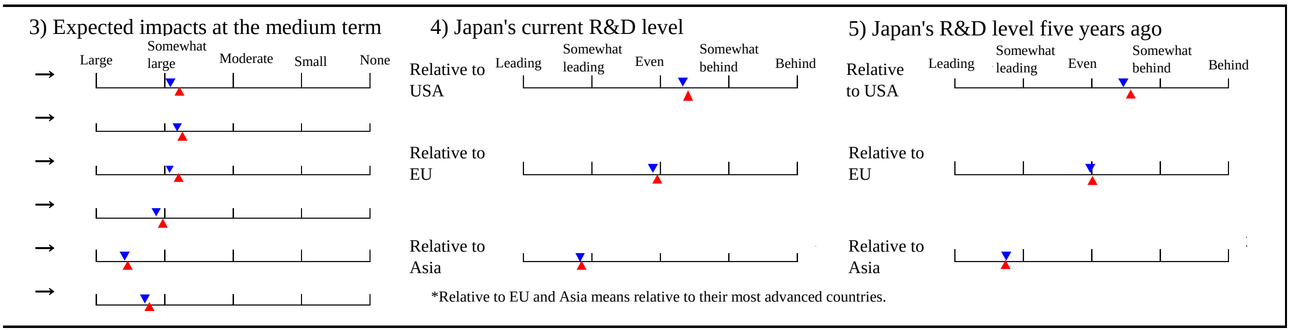
2) Current impacts

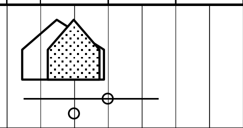
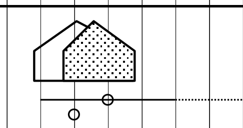
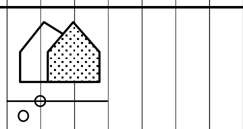
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
65	A biometric authentication system capable of non-contact, high-accuracy identification of individuals from a distance of about 10 m (with an authentication performance equivalent to the current fingerprint authentication systems and for potential applications such as quick access control without slowing the flow of people walking along the passage).	1	98	7	30	63	-	56	26	52	19	3							1	5
		2	95	1	15	84	-	55	13	80	7	0							0	1
		E	1	100	0	0	-	100	100	0	0	0							0	0
66	Widespread use of portable authentication technologies that can quickly authenticate individuals based on their DNA.	1	87	6	25	69	-	57	28	47	21	4							2	11
		2	94	1	11	88	-	52	10	79	11	0							2	2
		E	1	100	0	0	-	50	0	100	0	0							0	0
67	Non-contact detectors for drugs, toxic gases, biological weapons, etc.	1	86	5	30	65	-	67	41	46	11	2							2	12
		2	91	1	14	85	-	62	28	65	6	1							1	7
		E	1	100	0	0	-	100	100	0	0	0							0	0
68	A crustal movement sensor that enables prediction of an earthquake a few minutes before it occurs.	1	86	3	26	71	-	86	75	22	1	2							6	18
		2	90	0	12	88	-	93	86	13	1	0							8	7
		E																		
69	Widespread use of tracing systems (for food, recycled goods, etc.) in which the information stored in the electronic tags attached to food and other merchandise is linked to logistics, POS systems, and home-delivery services.	1	113	7	31	62	-	69	42	49	8	1							0	2
		2	109	2	13	85	-	63	28	68	4	0							0	0
		E	2	100	0	0	-	63	50	0	50	0							0	0



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
16	80	1	1	2	18	52	17	13	32	44	38	53	16	19	12	0		2	5	23	41	25	11	22	34	20	48	33	40	1
4	96	0	0	0	5	76	15	4	37	62	31	73	3	15	4	0		0	2	11	65	19	5	21	51	13	68	30	37	0
100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0		0	0	100	0	0	0	0	0	0	100	0	0	0
1	96	3	0	0	28	40	18	14	46	46	37	59	10	21	18	0		2	12	28	30	27	15	24	36	18	44	36	36	2
0	100	0	0	0	8	76	12	4	51	69	22	74	3	15	8	0		1	8	21	61	14	4	23	46	8	67	39	47	0
0	100	0	0	0	100	0	0	0	0	100	0	0	0	100	100	0		0	0	100	0	0	0	0	0	0	100	100	100	0
4	96	0	0	0	39	40	13	8	36	45	41	69	15	12	12	0		1	11	40	33	17	10	30	45	16	48	17	25	1
1	99	0	0	0	31	55	9	5	38	61	31	80	6	8	7	0		0	5	41	41	13	5	30	60	7	78	14	23	0
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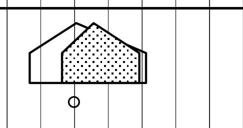
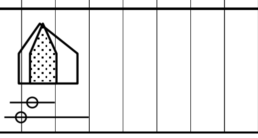
85	12	0	0	3	64	25	5	6	45	47	58	55	7	4	1	0		5	21	61	22	9	8	38	49	21	55	8	8	3
98	2	0	0	0	84	10	3	3	52	58	58	76	1	4	0	0		7	7	78	17	0	5	42	73	7	77	6	6	0
53	43	4	0	0	30	43	15	12	28	55	31	48	18	25	19	0		0	5	35	36	18	11	20	41	24	42	38	43	1
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100	0	0	0	0	0	50	0	50	0	0	0	0	100	0	0	0		0	0	0	50	0	50	0	0	0	0	0	100	0

3. Life science field

3.1. Overview

(1) Current conditions in life science

A. Perspective as a science

As exemplified by the genome research of the 1990s, the life science field has displayed rapid development over the past 10 years. Reproductive science utilizing embryos, bioinstrumentation technology capable of imaging single molecules, bioinformatics such as systems biology, nanobiology, and other interdisciplinary areas previously unknown in life science have advanced particularly rapidly. This has dramatically deepened human understanding of life, but, as we will discuss below, society has its own demands, and research related to applications such as SNP analysis for lifestyle-related diseases has become notably active.

B. Perspective of society

The questionnaire results clearly show that as life science develops, expectations for its contributions to society are high. The aim is to extend healthy life expectancy, as exemplified by aging healthily. As society ages, however, illnesses that require constant care, such as Alzheimer's disease and Parkinson's disease are expected to become social problems, but in the search for cures, even basic understanding of their mechanisms is insufficient. Brain science research and so on must be further strengthened. In addition, expectations for solutions from life science are high not only for medical care and drug discovery, but also for food and population issues, as well as for food safety, environmental safety, and other issues related to peace of mind. Policy perspectives such as mere industrial and economic vitalization are insufficient, and these issues increasingly must be handled as global problems that extend beyond any single country. In the 21st century, the role of the life science field will be extremely large.

(2) Selection of areas for forecasting

Areas for which significant development in the future is expected were selected by experts, always bearing in mind society's expectations for life science and with the subcommittee fully recognizing the importance of basic research as the foundation for meeting those expectations. The committee thereby selected the important areas by considering a span from molecules and cells to individuals and populations, as well as healthcare, medical science, foods, the environment, and so on. In addition, continuity with the previous survey was also considered in the selection of overall areas.

(3) Overview of survey results

The survey was a Delphi analysis with questionnaires sent to experts. About 226 people responded, centered on researchers in life science fields. This includes respondents in the corporate sector. We examined the survey results based on these responses.

The results are first, regarding predictions for society 30 years from now, an overwhelming number of responses indicated that while there will be no major change in average longevity, healthy life expectancy will be greatly extended. This demonstrates the high expectations for life science regarding medical care, health, and environmental problems. On the other hand, expectations for obtaining intellectual property rights are high for drug discovery research, technology for measuring biological substances, and so on. Demand for life science is strong not only for national health, but also as a foundation for industrial vitalization. Expectations are high for the development of new integrated areas such as nanobiology, regenerative medicine, and monitoring and sensor technology for biological substances and for the creation of new industries based on them. The survey also showed strong long-term expectations for the development of untapped areas such as the environmental and ecological biology, the brain research, and so on. In addition, the separate degree of importance survey showed a consciousness that topics related to conquering illnesses such as cancer, Alzheimer's disease, and allergic disease are particularly important. However, even though consciousness of the importance of curing brain diseases such as Alzheimer's disease and schizophrenia is high, brain science as a whole is extremely advanced and untapped. Therefore, although it is recognized as frontier work, in the questionnaire it was not necessarily recognized as having a high degree of importance at present.

Regarding Japan's research level related to these social or academic expectations, the survey results show that Japan is seen as trailing Europe and the United States somewhat, with the surrounding nations of Asia rapidly making up ground behind Japan. Comparing levels by country, the survey showed a belief that the USA has an overwhelming lead in the life science field as a whole, followed by Japan and then Europe. Japan is seen as having a lead in nanobiology, and monitoring and sensor technology for biological substances. In addition, overall Japan is seen as leading in chemical and technological aspects of life science. Government involvement to activate or support life science areas in response to growing social demands is strongly desired. Expectations are particularly high for active government involvement on overcoming disease, solving food problems, and so on. Social application of most technologies is predicted to require 20 to 25 years, but those related to brain science are expected to require an additional 5 years beyond that. Life science requires government support that takes a long-term outlook.

(4) Comments on the survey results

This Delphi analysis is a survey of experts, with responses from people who have a certain amount of understanding of the background, so the results should put to sufficient use. In fact, if we look at the results of the previous two surveys, we can see that they obtained a sufficiently high percentage of correct forecasts. We must point out, however, that the results provide overall average values and do not easily express the views of people with great insight into a particular area or with unique ways of thinking. This may be covered in part by the separate scenario survey. Below are some of the comprehensive analyses from expert perspectives of the subcommittee members.

- ◆ Progress in genomic analysis has increased speed and precision in the field of drug discovery, bringing some success in molecular-targeted cancer drugs, but deeper understanding of generation, cell cycles, apoptosis, and so on is required in order to develop more basic and universal drugs. Further completion and development of genome network analysis and other basic research are necessary.
- ◆ Japan lags behind in translation research and other clinical research, so prompt response is needed.
- ◆ With society aging, development of treatment methods and therapeutic medications for illnesses such as Alzheimer's disease and Parkinson's disease is an urgent task. Looking ahead 30 years, strong government support for research into molecular mechanisms and so on is needed right now.

- Embryonic stem cells are important not only to medical science and healthcare, but to industrial applications as well. Regenerative medical science requires interdisciplinary initiatives in pharmaceutical science, materials engineering, nanotechnology, bioimaging, and so on.
- Japan is strong in technologies such as single-molecule measurement and sugar engineering, and in the future practical measurement in healthcare and function measurement in medical science and biology will also become important.
- Immunology will play an important role in addressing infectious disease, cancer, and allergies, and understanding natural immunity is an urgent task.
- In information biology and bioinformatics, human resources development is an urgent task.
- Expectations are high for the application of life science to environmental issues, improved basic research for the development of key technologies and national understanding are needed.
- Currently, Japan's level in nanobiology is high, leading the world, but developing systems to link this to industrial application will require large costs. There are limits to what individual corporations and research institutions can do, so national support is necessary.

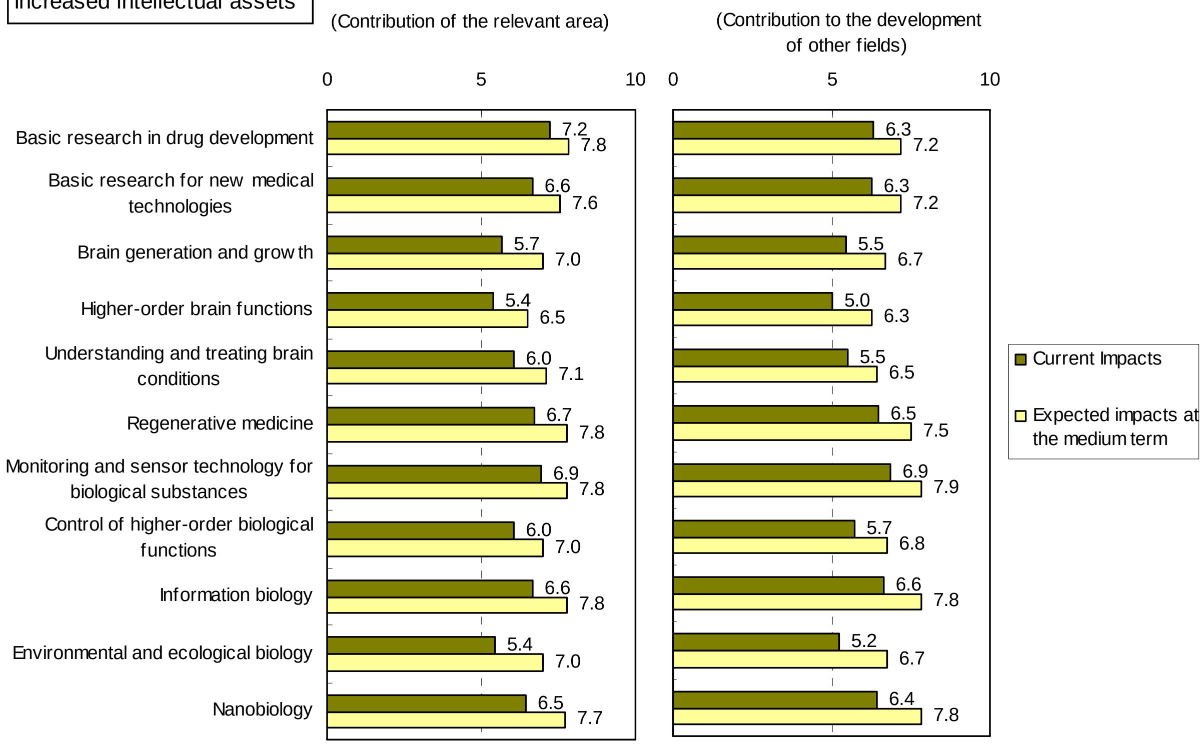
Because the survey as a whole emphasized social contributions, it may not fully reflect the importance of basic research. As seen in the above opinions of working group members on trends in the field, life science research requires much time before its fruits can be realized or contribute to society. We wish to emphasize once again the necessity of a support system for basic research that gives this point due consideration.

(SAKAKI Yoshiyuki)

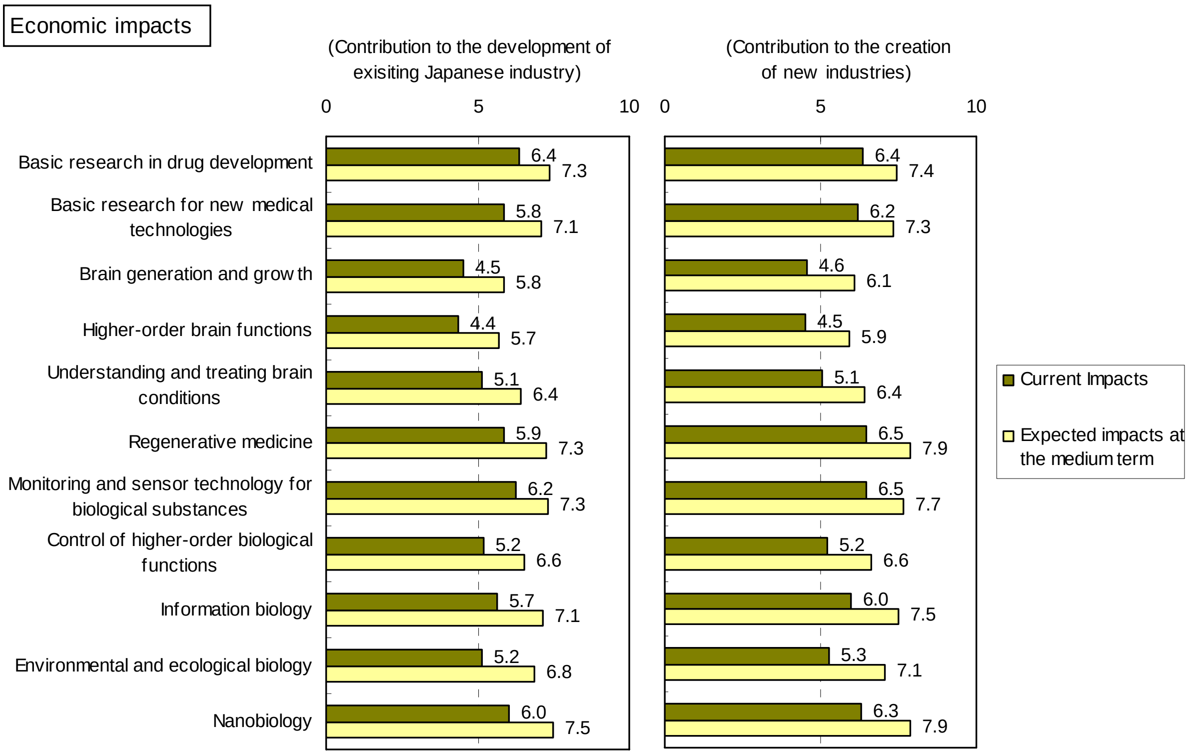
3.2. Main results

A. Impacts

Increased intellectual assets

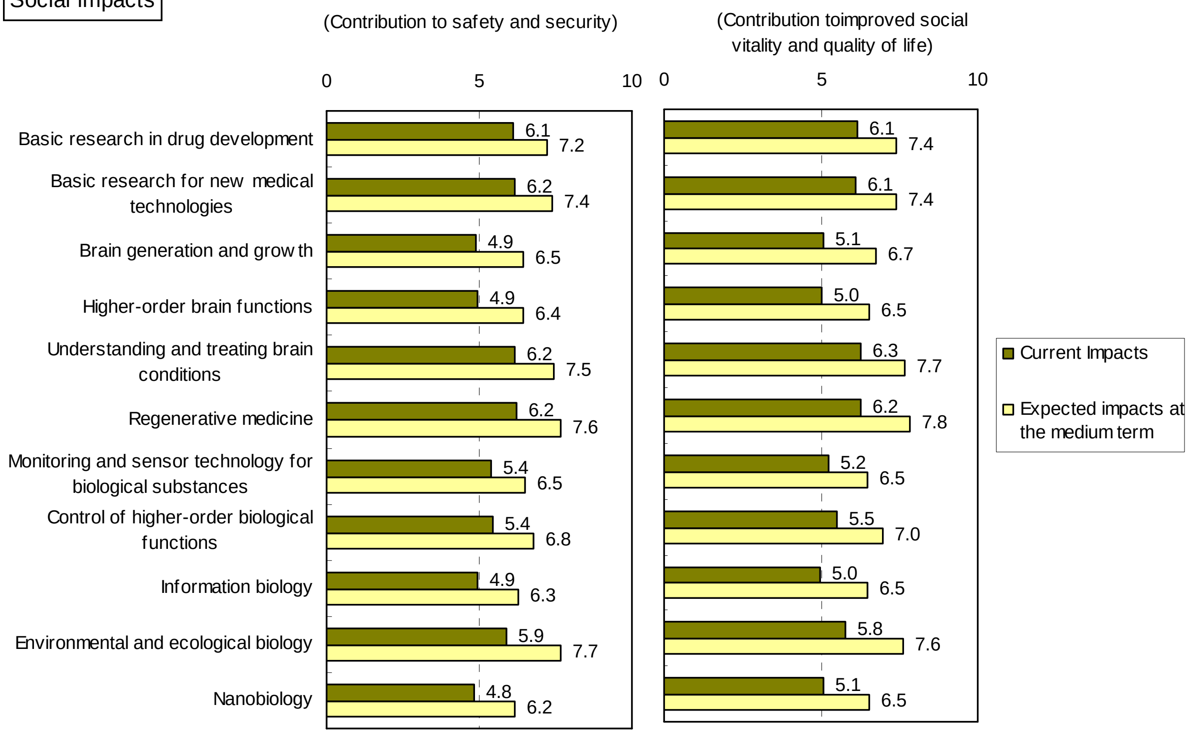


Economic impacts



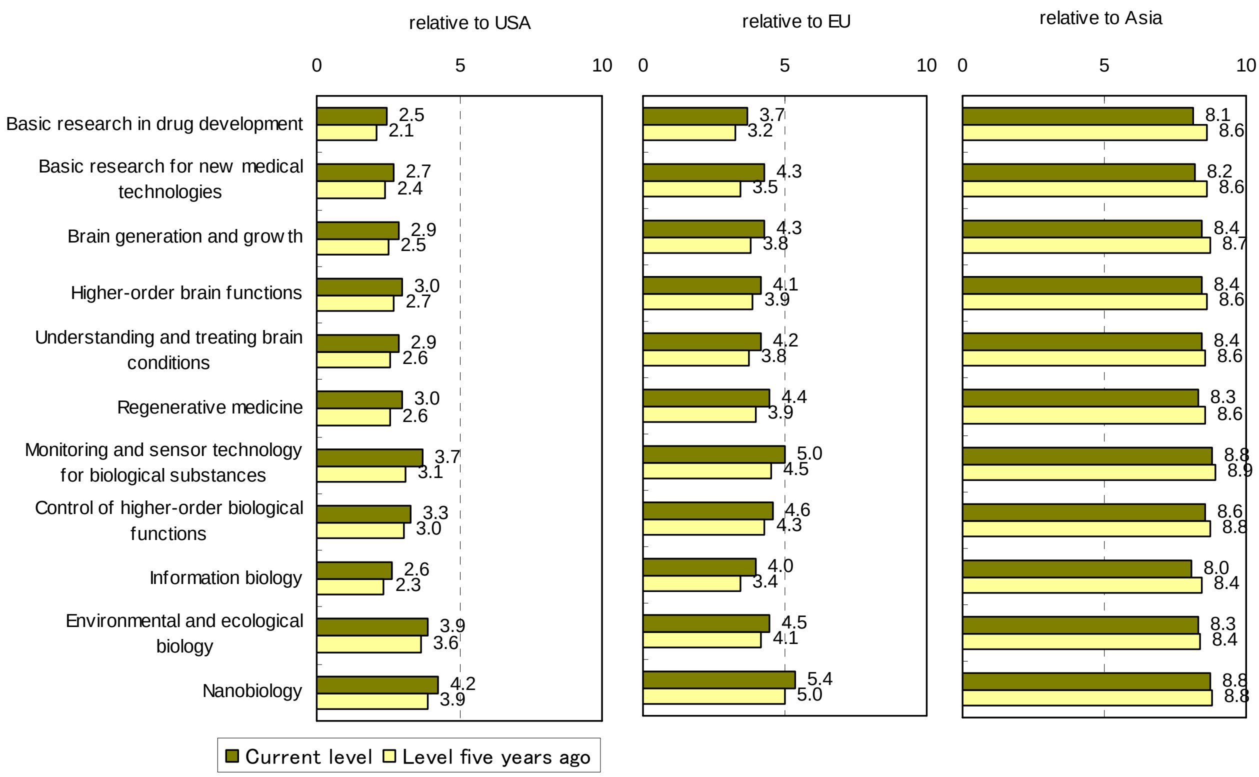
*Responses are indexed on a 10-point scale.

Social impacts



*Responses are indexed on a 10-point scale.

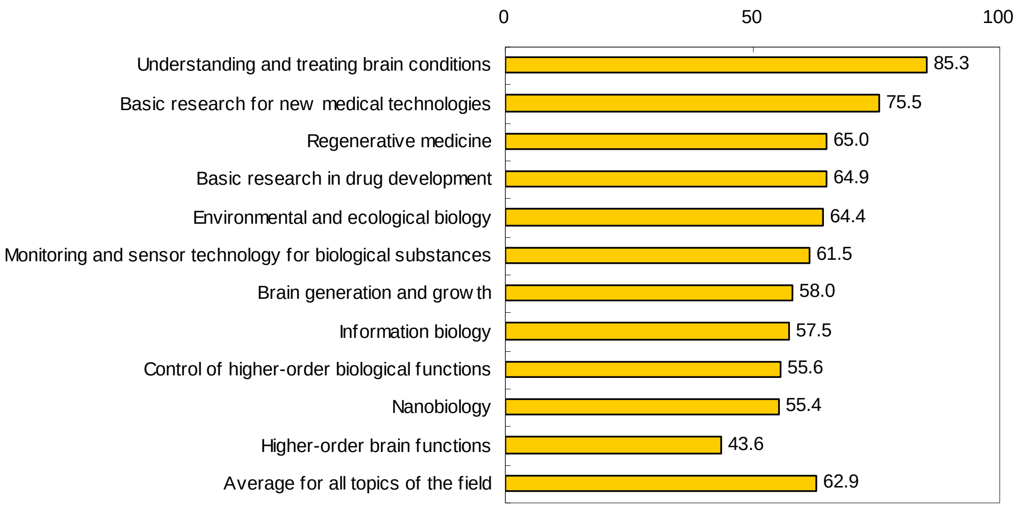
B. Japan’s R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan

Average importance index by area



The most important 10 topics

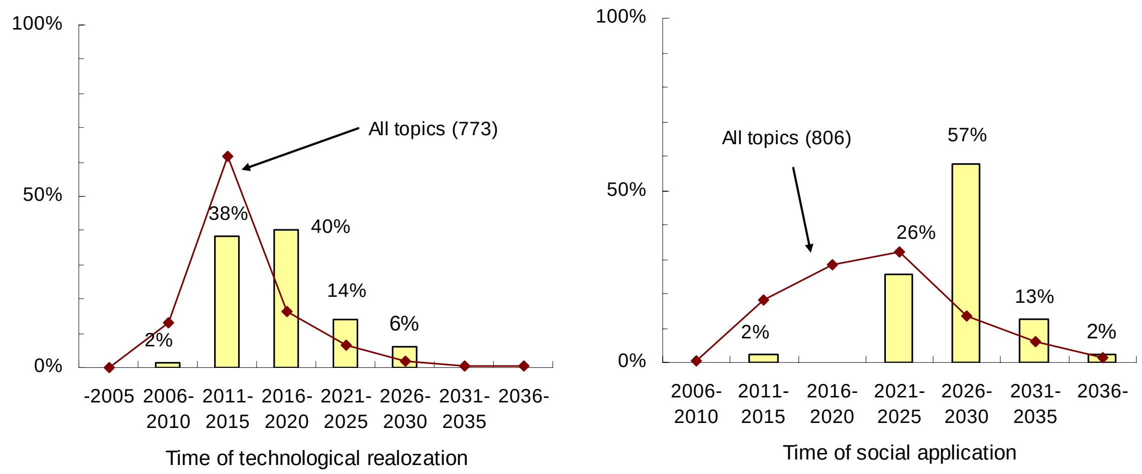
	Topic	Index	Year T*	Year S*
1	12: Effective technology to prevent cancer metastasis.	89	2020	2030
2	10: Technology for immediate, complete control of allergies based on elucidation of the immunoregulatory mechanisms and environmental factors that lead to hay fever, atopic dermatitis, and other allergies.	88	2015	2027
3	22: Treatment for preventing the progression of Alzheimer's disease.	88	2019	2030
4	23: Elucidation of the etiology of manic-dpressive psychosis at the molecular level.	84	2020	-
5	33: Technology to detect a cancerous tissue of the diameter smaller than 1 mm presenting anywhere in the body.	84	2014	2023
6	24: Elucidation of the etiology of schizophrenia at the molecular level.	84	2022	-
7	04: Technologies for drug development to predict bioactivities of proteins such as interactions between protein and protein, between proteins and DNA or RNA, and between proteins and synthetic compounds from their higher order structure.	83	2015	2026
8	57: Mass production technology for fuels and bioplastics utilizing plants and microorganisms.	81	2014	2024
9	29: Technology to manipulate stem cell differentiation and growth for induction of functional cells to use for therapy.	79	2016	2029
10	14: Effective cancer prevention measures can be implemented by clarifying the relationships among multiple environmental risk factors associated with cancer.	79	2020	2030

Year T: Time of technological realization Year S: Time of social application

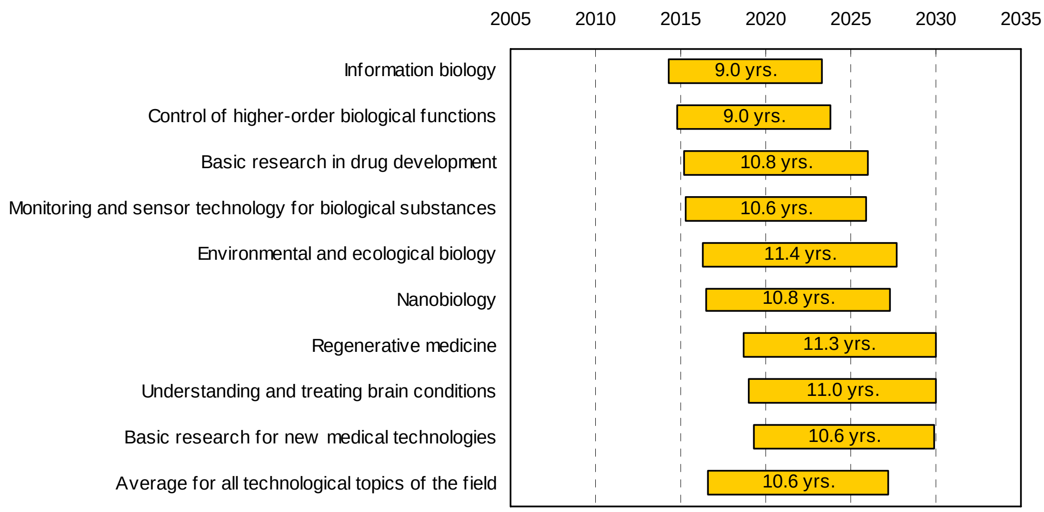
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

Topic	Year T*	Period*	Area
28: Reprograming technology to create stem cells from differentiated somatic cells.	2015	14	Regenerative medicine
29: Technology to manipulate stem cell differentiation and growth for induction of functional cells to use for therapy.	2016	13	Regenerative medicine
02: Technology to freely cause to survive or remove specialized cells in vivo, based on elucidation of the molecular mechanism of apoptosis, in vivo (for application to therapeutic agents for cancer and illnesses based on inability to maintain homeostasis).	2019	12	Basic research in drug development
05: For drug development, technology to directly control gene expression at the individual level by utilizing siRNA, etc.	2014	12	Basic research in drug development
10: Technology for immediate, complete control of allergies based on elucidation of the immunoregulatory mechanisms and environmental factors that lead to hay fever, atopic dermatitis, and other allergies.	2015	12	Basic research for new medical technologies

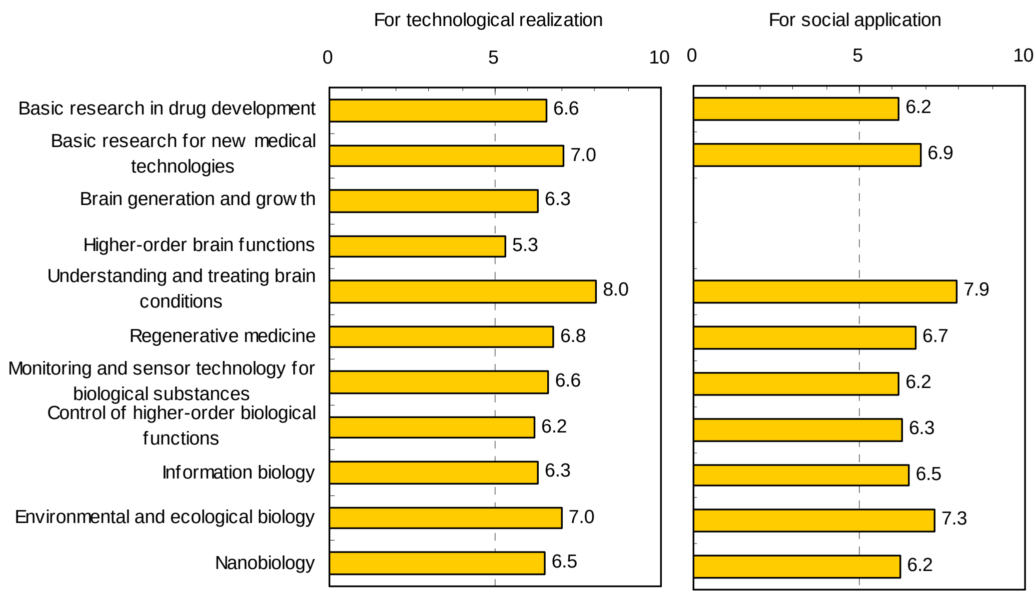
Topic	Year T*	Period*	Area
35: Technology to observe the interactions among various substances inside and outside of cells, to simultaneously identify those substances, and to monitor their distribution.	2016	12	Monitoring and sensor technology for biological substances
54: Technology to create practical plants resistant to cold and drought through elucidation of the molecular mechanisms of signal transductions in plants, from perception of low temperatures and other outside data to phenotypic expression.	2015	12	Environmental and ecological biology
55: Genetically-engineered plants and microorganisms that can remove NOx and other pollutants.	2015	12	Environmental and ecological biology
56: Plants with radically improvement in functions such as atmospheric nitrogen fixing and soil phosphate utilization through plant genome technology.	2015	12	Environmental and ecological biology
60: Technology to form cells with the minimum genetic set needed to produce substances.	2019	12	Environmental and ecological biology
62: Highly efficient energy conversion technology that utilizes motor proteins (molecular motors) that convert chemical energy to mechanical energy.	2018	12	Nanobiology

Topic	Year T*	Period*	Area
41: Technology to select cells (clones) to produce specific useful antibodies.	2010	5	Control of higher-order biological functions
52: Methods to predict various genome functions from DNA sequencing data.	2014	8	Information biology
08: Effective therapeutic agents for protozoan disease (malaria, trypanosomiasis, leishmaniasis, filariasis, etc.).	2013	9	Basic research in drug development
33: Technology to detect a cancerous tissue of the diameter smaller than 1 mm presenting anywhere in the body.	2014	9	Monitoring and sensor technology for biological substances
47: Through bioinformatics, the integration and sharing of vast amounts of data is made possible, and the data may be used for the implementation of life science research carried out over networks of virtual laboratories.	2014	9	Information biology
48: Remote technology systems applying advanced virtual reality technology.	2013	9	Information biology
49: Bioinformatics that can predict the risk of cancer and lifestyle diseases based on genetic. background, etc.	2014	9	Information biology
64: Nanochamber arrays that enable simultaneous detection of many biological reactions by concentrating thousands or tens of thousands of receptors on a single semiconductor chip.	2014	9	Nanobiology

*Year T: Time of technological realization　Period: Period until social application (years)

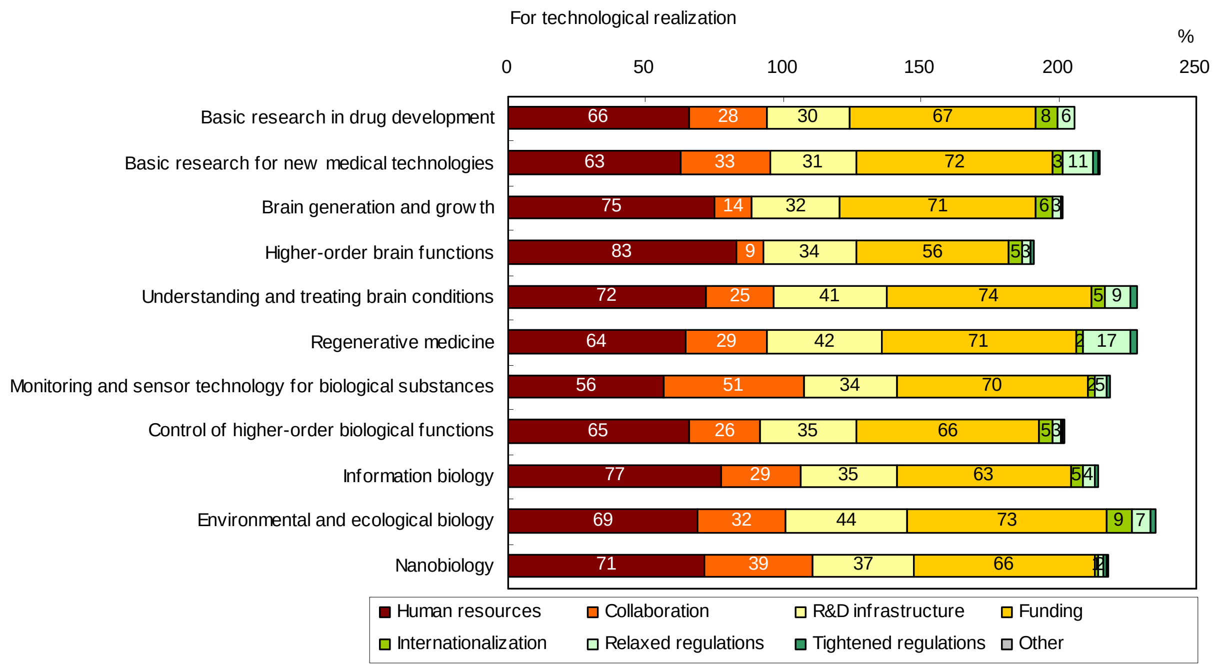
E. Effective measures that should taken by government

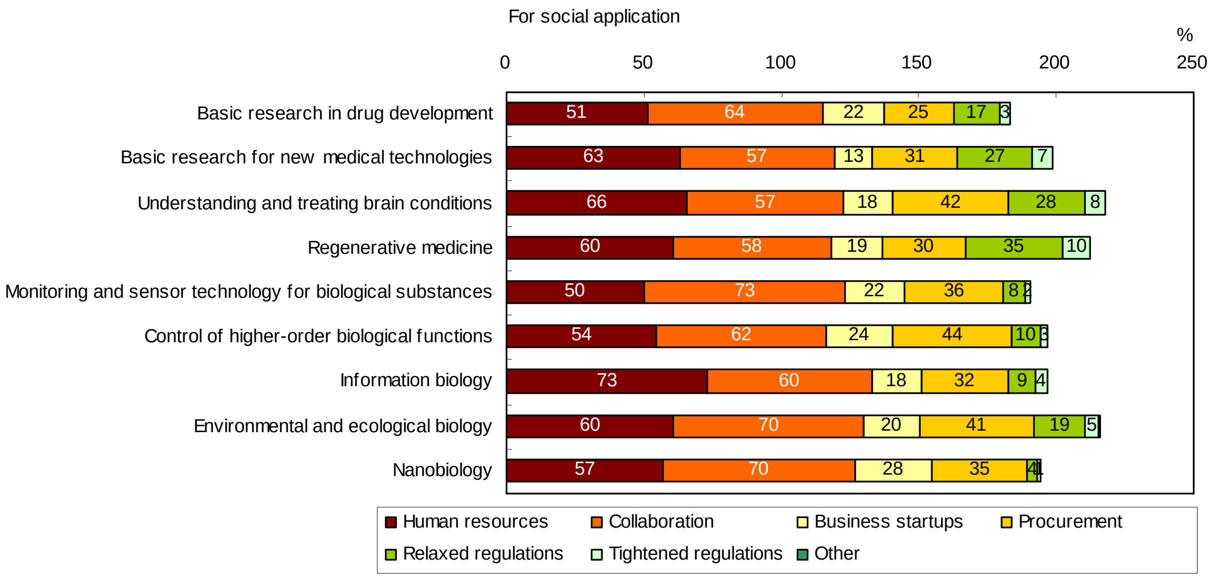
Necessity of government involvement



*Responses were indexed on a 10-point scale

Effective measures





F. Time-line of topics

Technological realization

year	topic
2010	41: Technology to select cells (clones) to produce specific useful antibodies.
2013	08: Effective therapeutic agents for protozoan disease (malaria, trypanosomiasis, leishmaniasis, filariasis, etc.).
	48: Remote technology systems applying advanced virtual reality technology.
2014	05: For drug development, technology to directly control gene expression at the individual level by utilizing siRNA, etc.
	06: Artificial antibody manufacturing technology based on elucidation of the antigen-recognition mechanism of antibodies.
	30: Long-term organ cultivation and preservation technology for organ transplants.
	33: Technology to detect a cancerous tissue of the diameter smaller than 1 mm presenting anywhere in the body.
	40: Elucidation of the molecular mechanism of floral differentiation in higher-order plants.
	47: Through bioinformatics, the integration and sharing of vast amounts of data is made possible, and the data may be used for the implementation of life science research carried out over networks of virtual laboratories.
	49: Bioinformatics that can predict the risk of cancer and lifestyle diseases based on genetic. background, etc.
	52: Methods to predict various genome functions from DNA sequencing data.
	57: Mass production technology for fuels and bioplastics utilizing plants and microorganisms.
	64: Nanochamber arrays that enable simultaneous detection of many biological reactions by concentrating thousands or tens of thousands of receptors on a single semiconductor chip.
2015	01: Elucidation of all molecular mechanisms to explain the cell cycle in higher animals (human, mouse; for application to cancer treatment).
	04: Technologies for drug development to predict bioactivities of proteins such as interactions between protein and protein, between proteins and DNA or RNA, and between proteins and synthetic compounds from their higher order structure.
	10: Technology for immediate, complete control of allergies based on elucidation of the immunoregulatory mechanisms and environmental factors that lead to hay fever, atopic dermatitis, and other allergies.
	28: Reprograming technology to create stem cells from differentiated somatic cells.
	34: Technology for molecular imaging in the body with the precision of single molecule detection.
	36: Technology that can sequence the whole human genome in one day.
	37: Equipment that can sample a single cell and measure all kinds of mRNAs with their copy numbers within the cell.
	38: Equipment to automatically analyze the sequences of sugar chains with 20 or more linked sugars with their branching and linkage patterns.

year	topic
	42: Regulation of autoimmune disease such as chronic rheumatoid arthritis based on the elucidation of the mechanisms for self-disposal of mutant cell components.
	54: Technology to create practical plants resistant to cold and drought through elucidation of the molecular mechanisms of signal transductions in plants, from perception of low temperatures and other outside data to phenotypic expression.
	55: Genetically-engineered plants and microorganisms that can remove NOx and other pollutants.
	56: Plants with radically improvement in functions such as atmospheric nitrogen fixing and soil phosphate utilization through plant genome technology.
	63: Chemical sensor technology that mimics the ion selection function of the ion channels that exist in cell membranes.
2016	07: Technology for the in-silico development of pharmaceuticals through technology to simulate drug disposition and effects on targets.
	13: Tailor-made treatment based on elucidation of major single nucleotide polymorphisms (SNPs) that bring risk of lifestyle disease.
	29: Technology to manipulate stem cell differentiation and growth for induction of functional cells to use for therapy.
	35: Technology to observe the interactions among various substances inside and outside of cells, to simultaneously identify those substances, and to monitor their distribution.
2017	32: Self-propelled micromachines for diagnosis and treatment inside the body (organ lumina).
	44: Elucidation of the mechanisms regulating the balance between immune system activation and suppression.
	53: Technology to radically improve photosynthesis function in order to increase food production and protect the environment.
	59: Elucidation of the basic genetic networks that control growth and development of plants such as shape, size, and bloom period.
2018	39: Technology to voluntarily control prostheses by using computers to convert movement-related brain activity to signals and transmit them via the spinal cord and peripheral nerves.
	43: Elucidation of immune system repair and regeneration mechanisms.
	62: Highly efficient energy conversion technology that utilizes motor proteins (molecular motors) that convert chemical energy to mechanical energy.
2019	02: Technology to freely cause to survive or remove specialized cells in vivo, based on elucidation of the molecular mechanism of apoptosis, in vivo (for application to therapeutic agents for cancer and illnesses based on inability to maintain homeostasis).
	09: Transplant technology free of side effects through clarification of most of the immune function molecules that contribute to transplant rejection.
	22: Treatment for preventing the progression of Alzheimer's disease.
	27: Technology to utilize animals as a bioreactor to produce organs and tissues to transplant into humans.
	46: Protein design methods with voluntary molecular recognition mechanisms through the application of bioinformatics.
	58: Technology to prevent eutrophication in marine and fresh water by measuring microorganism populations in natural environments and controlling their group compositions.
	60: Technology to form cells with the minimum genetic set needed to produce substances.
	61: Based on genome sequence research in many species, elucidation of the diversity and evolution of environmental response mechanisms in organisms, such as metabolic capacity and ability to respond to stress.
	65: Biofuel cells that reconstruct the reactions of enzyme molecules in bodies on a nano scale.
2020	03: Technology for integrated analysis of the gene expression cascade and signaling cascade of molecular processes in higher animals such as mice from zygote to adult.
	12: Effective technology to prevent cancer metastasis.
	14: Effective cancer prevention measures can be implemented by clarifying the relationships among multiple environmental risk factors associated with cancer.
	23: Elucidation of the etiology of manic-dpressive psychosis at the molecular level.
	31: Artificial retinas to give sight to the visually impaired.
	50: Verification testing to elucidate the evolutionary mechanisms of organisms.
2021	26: Artificial organs (pancreases, kidneys, livers, etc.) incorporating human cells and tissue.
	51: Based on compete gene function data for unicellular organisms, technology to simulate all cell functions such as multiplication and environmental response.

year	topic
2022	11: Treatment methods that normalize cancerous cells by controlling signaling and leading cancer cells towards proper differentiation.
	24: Elucidation of the etiology of schizophrenia at the molecular level.
	45: Elucidation of the influence of weightlessness on generation and the endocrine and immune systems.
2023	15: Technology to repair at the individual level abnormal genes that cause hereditary disease, etc.
2024	18: Elucidation of the cellular and molecular mechanisms whereby the juvenile brain has much greater plasticity and ability to compensate for organic damages than the adult brain.
	21: Elucidation of the mechanisms for generating the functional asymmetry of the left and right cerebral hemispheres.
2025	20: Elucidation of the regulatory mechanisms for expression of emotional behavior such as anger and aggression.
2026	17: Elucidation of the relationship between memory and synaptic plasticity.
	25: Synthetic technology for artificial cells to replace functions such as cell membrane transport and conversion of matter and energy. Synthetic technlogy for artificial cells with functions such as cell membrane transport, material transfer, and energy conversion.
2028	16: Nearly complete elucidation of the molecular mechanisms for neural network formation.
	19: Elucidation of neural mechanisms of dreaming.

Social application

year	topic
2015	41: Technology to select cells (clones) to produce specific useful antibodies.
2022	08: Effective therapeutic agents for protozoan disease (malaria, trypanosomiasis, leishmaniasis, filariasis, etc.).
	48: Remote technology systems applying advanced virtual reality technology.
	52: Methods to predict various genome functions from DNA sequencing data.
2023	33: Technology to detect a cancerous tissue of the diameter smaller than 1 mm presenting anywhere in the body.
	47: Through bioinformatics, the integration and sharing of vast amounts of data is made possible, and the data may be used for the implementation of life science research carried out over networks of virtual laboratories.
	49: Bioinformatics that can predict the risk of cancer and lifestyle diseases based on genetic. background, etc.
	64: Nanochamber arrays that enable simultaneous detection of many biological reactions by concentrating thousands or tens of thousands of receptors on a single semiconductor chip.
2024	06: Artificial antibody manufacturing technology based on elucidation of the antigen-recognition mechanism of antibodies.
	30: Long-term organ cultivation and preservation technology for organ transplants.
	57: Mass production technology for fuels and bioplastics utilizing plants and microorganisms.
2025	34: Technology for molecular imaging in the body with the precision of single molecule detection.
	38: Equipment to automatically analyze the sequences of sugar chains with 20 or more linked sugars with their branching and linkage patterns.
2026	04: Technologies for drug development to predict bioactivities of proteins such as interactions between protein and protein, between proteins and DNA or RNA, and between proteins and synthetic compounds from their higher order structure.
	05: For drug development, technology to directly control gene expression at the individual level by utilizing siRNA, etc.
	36: Technology that can sequence the whole human genome in one day.
	37: Equipment that can sample a single cell and measure all kinds of mRNAs with their copy numbers within the cell.
	42: Regulation of autoimmune disease such as chronic rheumatoid arthritis based on the elucidation of the mechanisms for self-disposal of mutant cell components.
	63: Chemical sensor technology that mimics the ion selection function of the ion channels that exist in cell membranes.
2027	07: Technology for the in-silico development of pharmaceuticals through technology to simulate drug disposition and effects on targets.
	10: Technology for immediate, complete control of allergies based on elucidation of the immunoregulatory mechanisms and environmental factors that lead to hay fever, atopic dermatitis, and other allergies.

year	topic
	13: Tailor-made treatment based on elucidation of major single nucleotide polymorphisms (SNPs) that bring risk of lifestyle disease.
	54: Technology to create practical plants resistant to cold and drought through elucidation of the molecular mechanisms of signal transductions in plants, from perception of low temperatures and other outside data to phenotypic expression.
	55: Genetically-engineered plants and microorganisms that can remove NOx and other pollutants.
	56: Plants with radically improvement in functions such as atmospheric nitrogen fixing and soil phosphate utilization through plant genome technology.
2028	32: Self-propelled micromachines for diagnosis and treatment inside the body (organ lumina).
	35: Technology to observe the interactions among various substances inside and outside of cells, to simultaneously identify those substances, and to monitor their distribution.
	53: Technology to radically improve photosynthesis function in order to increase food production and protect the environment.
2029	28: Reprograming technology to create stem cells from differentiated somatic cells.
	29: Technology to manipulate stem cell differentiation and growth for induction of functional cells to use for therapy.
	39: Technology to voluntarily control prostheses by using computers to convert movement-related brain activity to signals and transmit them via the spinal cord and peripheral nerves.
	46: Protein design methods with voluntary molecular recognition mechanisms through the application of bioinformatics.
2030	09: Transplant technology free of side effects through clarification of most of the immune function molecules that contribute to transplant rejection.
	12: Effective technology to prevent cancer metastasis.
	14: Effective cancer prevention measures can be implemented by clarifying the relationships among multiple environmental risk factors associated with cancer.
	22: Treatment for preventing the progression of Alzheimer's disease.
	27: Technology to utilize animals as a bioreactor to produce organs and tissues to transplant into humans.
	58: Technology to prevent eutrophication in marine and fresh water by measuring microorganism populations in natural environments and controlling their group compositions.
	62: Highly efficient energy conversion technology that utilizes motor proteins (molecular motors) that convert chemical energy to mechanical energy.
	65: Biofuel cells that reconstruct the reactions of enzyme molecules in bodies on a nano scale.
2031	02: Technology to freely cause to survive or remove specialized cells in vivo, based on elucidation of the molecular mechanism of apoptosis, in vivo (for application to therapeutic agents for cancer and illnesses based on inability to maintain homeostasis).
	26: Artificial organs (pancreases, kidneys, livers, etc.) incorporating human cells and tissue.
	31: Artificial retinas to give sight to the visually impaired.
	60: Technology to form cells with the minimum genetic set needed to produce substances.
2032	11: Treatment methods that normalize cancerous cells by controlling signaling and leading cancer cells towards proper differentiation.
2033	15: Technology to repair at the individual level abnormal genes that cause hereditary disease, etc.
2036	25: Synthetic technology for artificial cells to replace functions such as cell membrane transport and conversion of matter and energy. Synthetic technlogy for artificial cells with functions such as cell membrane transport, material transfer, and energy conversion.

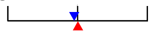
Appendix: Results of R1 and R2

I. Basic research in drug development

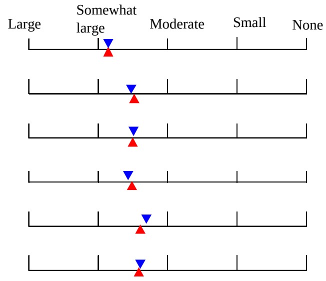
1. Questions regarding the relevant area

1) Degree of expertise in the area

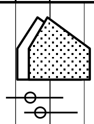
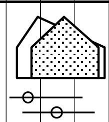
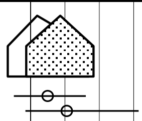
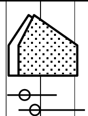
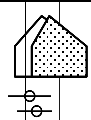
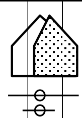
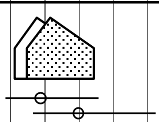
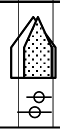
High Moderate Low



2) Current impacts

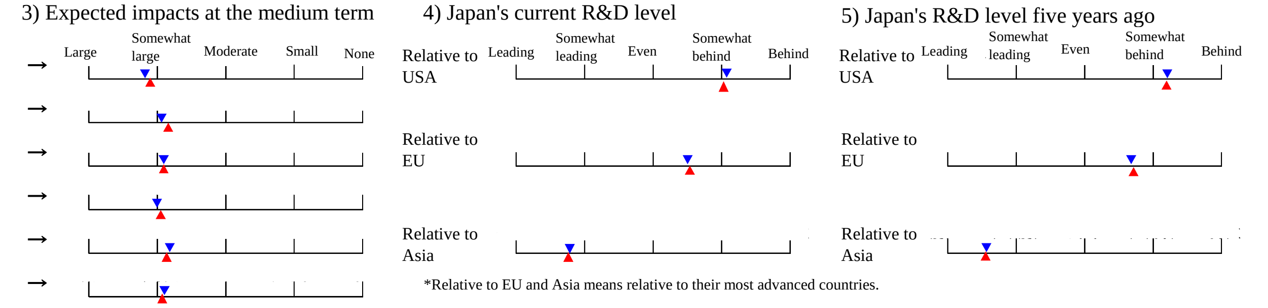
		Large / Somewhat large / Moderate / Small / None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
1	Elucidation of all molecular mechanisms to explain the cell cycle in higher animals (human, mouse; for application to cancer treatment).	1	**222**	**14**	**40**	**46**	**-**	**68**	**43**	**46**	**10**	**1**		**3**	**6**
		2	**177**	**13**	**40**	**47**	**-**	**64**	**31**	**64**	**4**	**1**		**2**	**3**
		E	**23**	**100**	**0**	**0**	**-**	**80**	**66**	**30**	**0**	**4**		**4**	**0**
2	Technology to freely cause to survive or remove specialized cells in vivo, based on elucidation of the molecular mechanism of apoptosis, in vivo (for application to therapeutic agents for cancer and illnesses based on inability to maintain homeostasis).	1	**222**	**13**	**42**	**45**	**-**	**69**	**43**	**47**	**10**	**0**		**5**	**5**
		2	**176**	**10**	**42**	**48**	**-**	**64**	**31**	**64**	**5**	**0**		**1**	**2**
		E	**18**	**100**	**0**	**0**	**-**	**86**	**78**	**11**	**11**	**0**		**0**	**0**
3	Technology for integrated analysis of the gene expression cascade and signaling cascade of molecular processes in higher animals such as mice from zygote to adult.	1	**215**	**21**	**30**	**49**	**-**	**67**	**39**	**51**	**10**	**0**		**2**	**4**
		2	**173**	**17**	**34**	**49**	**-**	**58**	**20**	**71**	**8**	**1**		**1**	**2**
		E	**29**	**100**	**0**	**0**	**-**	**66**	**38**	**52**	**7**	**3**		**0**	**0**
4	Technologies for drug development to predict bioactivities of proteins such as interactions between protein and protein, between proteins and DNA or RNA, and between proteins and synthetic compounds from their higher order structure.	1	**244**	**29**	**39**	**32**	**-**	**79**	**61**	**36**	**3**	**0**		**0**	**2**
		2	**202**	**19**	**44**	**37**	**-**	**83**	**66**	**31**	**3**	**0**		**0**	**2**
		E	**39**	**100**	**0**	**0**	**-**	**96**	**92**	**5**	**3**	**0**		**0**	**0**
5	For drug development, technology to directly control gene expression at the individual level by utilizing siRNA, etc.	1	**228**	**21**	**31**	**48**	**-**	**73**	**49**	**45**	**6**	**0**		**3**	**5**
		2	**185**	**17**	**31**	**52**	**-**	**72**	**47**	**48**	**5**	**0**		**1**	**3**
		E	**32**	**100**	**0**	**0**	**-**	**88**	**75**	**25**	**0**	**0**		**0**	**0**
6	Artificial antibody manufacturing technology based on elucidation of the antigen-recognition mechanism of antibodies.	1	**211**	**17**	**37**	**46**	**-**	**65**	**41**	**40**	**19**	**0**		**0**	**5**
		2	**182**	**12**	**35**	**53**	**-**	**63**	**32**	**57**	**11**	**0**		**0**	**4**
		E	**21**	**100**	**0**	**0**	**-**	**77**	**57**	**38**	**5**	**0**		**0**	**0**
7	Technology for the in-silico development of pharmaceuticals through technology to simulate drug disposition and effects on targets.	1	**193**	**11**	**28**	**61**	**-**	**68**	**43**	**41**	**15**	**1**		**3**	**6**
		2	**163**	**7**	**28**	**65**	**-**	**69**	**43**	**47**	**10**	**0**		**1**	**2**
		E	**11**	**100**	**0**	**0**	**-**	**93**	**91**	**0**	**9**	**0**		**0**	**0**
8	Effective therapeutic agents for protozoan disease (malaria, trypanosomiasis, leishmaniasis, filariasis, etc.).	1	**155**	**8**	**32**	**60**	**-**	**50**	**21**	**38**	**38**	**3**		**1**	**11**
		2	**154**	**3**	**25**	**72**	**-**	**45**	**13**	**44**	**42**	**1**		**0**	**3**
		E	**4**	**100**	**0**	**0**	**-**	**63**	**25**	**75**	**0**	**0**		**0**	**0**

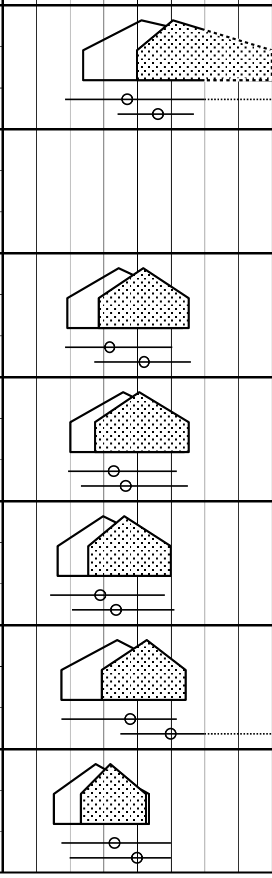
Time of technological realization columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–

3) Expected impacts at the medium term   4) Japan's current R&D level   5) Japan's R&D level five years ago



*Relative to EU and Asia means relative to their most advanced countries.

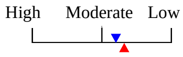
Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
3	95	1	0	1	32	40	23	5	50	30	37	57	12	14	0	0														
1	98	1	0	0	17	64	17	2	69	19	27	73	6	8	0	0														
0	100	0	0	0	44	43	4	9	81	29	33	81	14	10	0	0														
9	88	2	0	1	30	44	22	4	50	33	37	56	13	14	1	0		4	11	28	46	19	7	39	46	23	32	27	11	1
1	99	0	0	0	13	73	13	1	66	20	24	76	6	8	0	0		1	8	11	69	18	2	50	63	16	22	25	6	0
6	94	0	0	0	49	39	6	6	82	35	41	76	18	6	0	0		0	6	11	72	17	0	61	50	28	33	22	0	0
3	93	3	0	1	34	43	18	5	49	21	46	62	14	13	0	0														
1	99	0	0	0	16	68	15	1	70	14	40	70	7	7	1	0														
3	97	0	0	0	34	52	14	0	69	17	48	83	17	10	3	0														
7	87	5	0	1	37	46	15	2	56	41	48	62	10	9	0	0		0	5	26	44	23	7	44	54	36	34	15	3	0
3	97	0	0	0	27	61	11	1	70	30	43	70	3	5	0	0		0	3	12	68	18	2	49	69	25	24	12	3	0
5	95	0	0	0	62	35	3	0	81	41	54	68	8	5	0	0		0	0	26	58	16	0	61	66	29	32	11	0	0
7	90	2	0	1	25	47	24	4	43	43	34	54	10	16	6	0		4	9	25	46	23	6	38	46	33	34	28	13	0
2	98	0	0	0	15	69	15	1	59	36	28	73	6	7	0	0		1	5	12	71	16	1	46	62	22	23	27	4	0
6	94	0	0	0	38	59	3	0	53	44	34	75	16	16	0	0		0	0	25	69	6	0	31	56	41	28	44	3	0
7	87	5	0	1	21	42	29	8	46	45	31	51	10	13	2	1		2	7	16	42	34	8	34	52	42	33	21	5	1
2	96	2	0	0	12	62	24	2	55	41	23	64	5	6	0	0		1	3	9	63	26	2	42	66	29	22	18	2	0
5	90	5	0	0	45	40	10	5	58	42	47	68	11	0	0	0		0	0	24	66	10	0	43	62	43	43	14	0	0
1	95	3	0	1	26	42	26	6	56	48	34	47	10	7	1	1		3	8	22	35	30	13	49	56	38	29	17	5	1
0	99	1	0	0	17	60	21	2	75	45	28	56	4	3	0	1		1	3	14	56	27	3	59	67	29	24	10	3	0
0	100	0	0	0	46	36	9	9	70	60	40	70	10	0	0	0		0	0	20	60	10	10	67	78	44	11	0	0	0
6	80	9	2	3	22	42	33	3	48	25	31	41	32	9	1	1		2	10	20	39	29	12	51	40	19	39	15	2	1
3	87	5	5	0	20	49	29	2	62	23	26	59	29	4	0	0		1	3	19	49	28	4	61	56	13	38	10	2	0
25	75	0	0	0	75	25	0	0	75	50	25	75	25	0	0	0		0	0	67	33	0	0	33	100	33	33	0	0	0



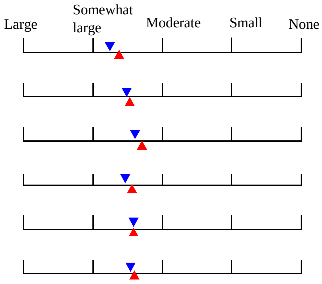
II. Basic research for new medical technologies

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

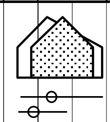
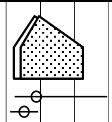
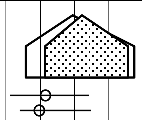
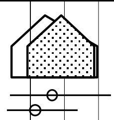
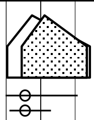
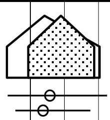
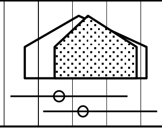


[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

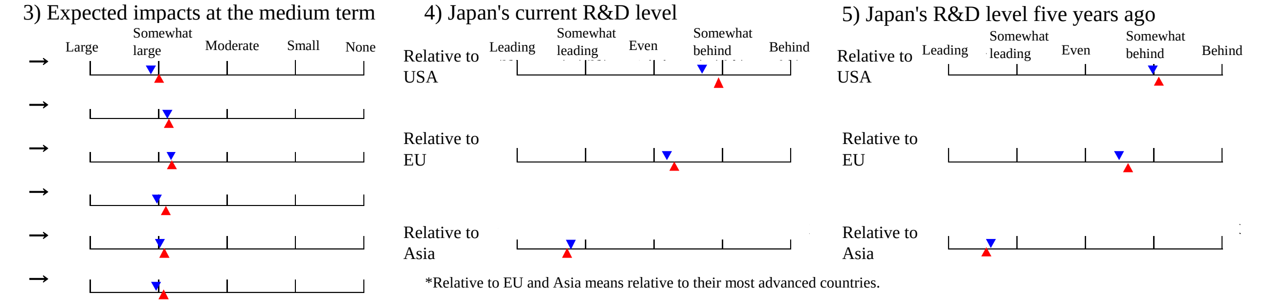
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
9	Transplant technology free of side effects through clarification of most of the immune function molecules that contribute to transplant rejection.	1	180	12	38	50	-	68	42	46	11	1		8	6
		2	161	6	34	60	-	64	32	62	6	0		4	3
		E	9	100	0	0	-	78	56	44	0	0		0	0
10	Technology for immediate, complete control of allergies based on elucidation of the immunoregulatory mechanisms and environmental factors that lead to hay fever, atopic dermatitis, and other allergies.	1	181	16	31	53	-	81	65	29	6	0		3	4
		2	170	8	31	61	-	88	78	20	2	0		1	2
		E	14	100	0	0	-	96	93	7	0	0		0	7
11	Treatment methods that normalize cancerous cells by controlling signaling and leading cancer cells towards proper differentiation.	1	206	18	33	49	-	75	56	33	9	2		10	8
		2	174	12	31	57	-	78	60	35	4	1		5	4
		E	21	100	0	0	-	88	81	14	0	5		14	0
12	Effective technology to prevent cancer metastasis.	1	189	15	33	52	-	83	67	31	2	0		1	7
		2	173	9	27	64	-	89	80	18	2	0		1	5
		E	16	100	0	0	-	100	100	0	0	0		6	0
13	Tailor-made treatment based on elucidation of major single nucleotide polymorphisms (SNPs) that bring risk of lifestyle disease.	1	227	22	32	46	-	73	51	40	8	1		2	7
		2	185	12	38	50	-	71	45	48	6	1		2	5
		E	22	100	0	0	-	84	68	32	0	0		0	0
14	Effective cancer prevention measures can be implemented by clarifying the relationships among multiple environmental risk factors associated with cancer.	1	181	19	29	52	-	74	54	35	11	0		4	7
		2	164	9	24	67	-	79	60	35	4	1		3	4
		E	14	100	0	0	-	96	93	7	0	0		0	0
15	Technology to repair at the individual level abnormal genes that cause hereditary disease, etc.	1	202	23	30	47	-	62	34	48	16	2		11	13
		2	177	18	31	51	-	59	24	65	10	1		8	5
		E	31	100	0	0	-	68	42	52	0	6		3	3

3) Expected impacts at the medium term

4) Japan's current R&D level

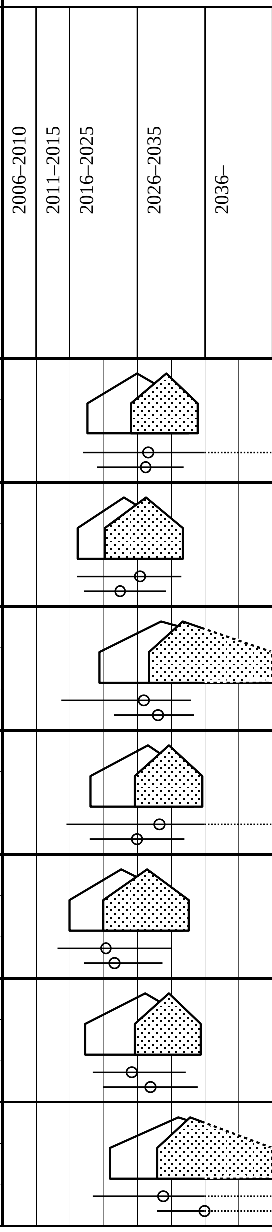
5) Japan's R&D level five years ago



*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge: Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: Will not be applied	Do not know	Regarding social application — Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)								(%)		(%)				(%)						
5	91	3	1	0	30	48	19	3	49	31	36	53	10	27	5	2	7	10	35	41	20	4	48	42	15	31	45	11	1
1	99	0	0	0	16	69	13	2	64	23	34	67	5	16	1	0	4	4	17	65	15	3	60	55	12	22	50	5	0
0	100	0	0	0	33	56	11	0	100	22	67	78	0	33	0	0	0	0	33	56	11	0	100	67	11	56	67	0	0
19	75	5	0	1	32	46	17	5	48	45	34	62	9	8	1	1	3	5	28	45	21	6	51	49	21	40	19	2	1
15	84	1	0	0	27	61	11	1	61	42	28	76	2	5	1	0	1	3	20	70	7	3	62	63	18	40	16	2	0
36	64	0	0	0	57	29	14	0	93	50	36	79	14	14	0	0	0	7	50	50	0	0	100	64	14	36	36	0	0
3	95	1	0	1	32	46	16	6	47	38	34	67	9	13	2	1	9	12	26	44	21	9	54	49	19	35	23	3	2
1	97	1	1	0	20	69	8	3	63	26	30	80	3	6	1	0	5	6	15	70	11	4	65	57	10	36	19	2	0
10	85	5	0	0	65	25	5	5	79	37	47	95	21	11	0	0	15	0	55	40	0	5	63	63	21	32	26	0	0
3	94	2	0	1	38	47	12	3	49	42	40	66	9	13	1	1	2	9	31	48	17	4	48	54	20	36	24	3	0
2	98	0	0	0	28	63	8	1	62	33	31	78	2	7	0	0	2	6	19	69	11	1	63	62	14	28	23	3	0
19	81	0	0	0	62	38	0	0	75	63	69	75	13	19	0	0	7	0	47	53	0	0	53	67	47	33	53	0	0
18	81	1	0	0	42	41	14	3	46	47	35	57	12	25	11	0	3	7	42	40	13	5	45	49	25	32	35	24	1
13	87	0	0	0	37	50	12	1	58	51	30	63	5	18	4	1	2	6	37	48	13	2	58	62	16	26	26	11	0
27	73	0	0	0	57	38	5	0	67	48	38	76	0	19	5	0	0	0	59	36	5	0	59	50	18	36	27	9	0
8	85	7	0	0	38	43	15	4	51	35	43	52	10	14	5	1	6	6	39	37	18	6	51	46	18	36	20	12	3
6	91	3	0	0	29	61	9	1	64	31	30	68	3	5	1	0	3	4	31	55	13	1	67	53	14	37	14	8	0
21	79	0	0	0	62	38	0	0	85	31	54	77	8	15	0	0	0	0	64	36	0	0	71	50	29	36	21	21	0
3	93	4	0	0	32	44	20	4	47	32	42	54	14	29	13	2	9	20	36	41	19	4	46	34	20	34	38	29	2
1	98	1	0	0	18	65	14	3	66	23	32	69	5	21	6	1	9	9	24	60	12	4	66	44	10	30	41	19	1
6	94	0	0	0	35	53	6	6	66	17	45	83	7	28	7	0	7	3	52	35	10	3	70	37	17	33	47	23	0

Time of social application

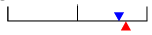


III. Brain generation and growth

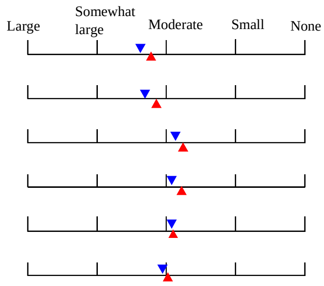
1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



2) Current impacts

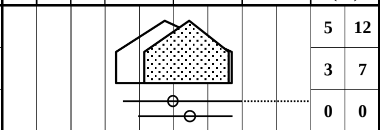
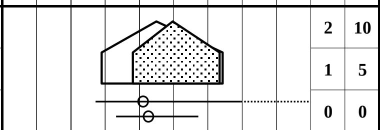
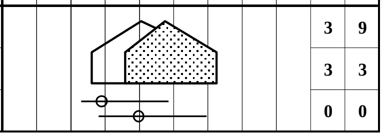


[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

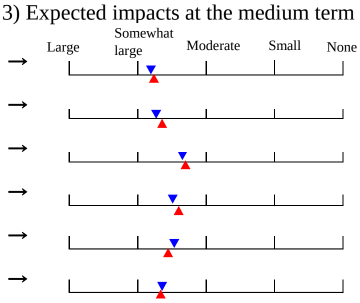
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

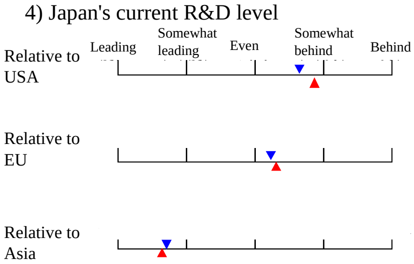
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
16	Nearly complete elucidation of the molecular mechanisms for neural network formation.	1	**163**	**18**	**22**	**60**	-	**67**	**42**	**42**	**15**	**1**		**5**	**12**
		2	**152**	**7**	**21**	**72**	-	**61**	**29**	**57**	**14**	**0**		**3**	**7**
		E	**10**	**100**	**0**	**0**	-	**85**	**70**	**30**	**0**	**0**		**0**	**0**
17	Elucidation of the relationship between memory and synaptic plasticity.	1	**159**	**15**	**23**	**62**	-	**66**	**39**	**46**	**14**	**1**		**2**	**10**
		2	**150**	**9**	**21**	**70**	-	**55**	**17**	**71**	**12**	**0**		**1**	**5**
		E	**14**	**100**	**0**	**0**	-	**81**	**62**	**38**	**0**	**0**		**0**	**0**
18	Elucidation of the cellular and molecular mechanisms whereby the juvenile brain has much greater plasticity and ability to compensate for organic damages than the adult brain.	1	**150**	**12**	**30**	**58**	-	**66**	**40**	**43**	**17**	**0**		**3**	**9**
		2	**144**	**7**	**16**	**77**	-	**57**	**23**	**60**	**17**	**0**		**3**	**3**
		E	**10**	**100**	**0**	**0**	-	**85**	**70**	**30**	**0**	**0**		**0**	**0**

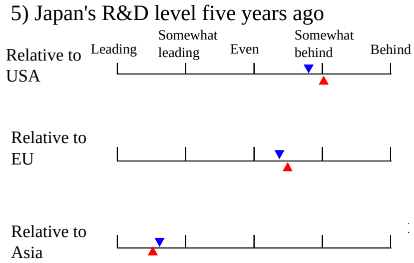
3) Expected impacts at the medium term



4) Japan's current R&D level



5) Japan's R&D level five years ago



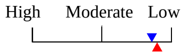
*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application						(%)	Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
1	98	1	0	0	29	45	20	6	61	19	43	63	14	6	1	1																		
1	99	0	0	0	14	65	18	3	74	13	31	71	6	3	1	0																		
0	100	0	0	0	20	60	20	0	50	10	50	100	10	0	0	0																		
3	93	4	0	0	26	46	20	8	57	21	39	59	14	6	1	1																		
1	98	1	0	0	9	71	18	2	76	15	30	69	8	3	1	0																		
0	100	0	0	0	23	69	8	0	46	31	46	85	15	0	0	0																		
4	92	4	0	0	30	43	20	7	57	17	45	60	13	9	1	1																		
1	99	0	0	0	12	66	21	1	74	14	34	73	5	4	1	0																		
0	100	0	0	0	50	40	10	0	40	30	40	100	10	0	0	0																		

IV. Higher-order brain functions

1. Questions regarding the relevant area

1) Degree of expertise in the area

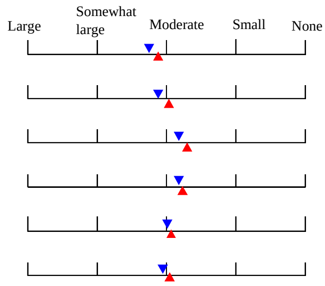


2) Current impacts

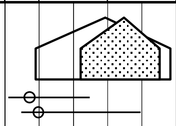
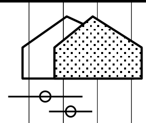
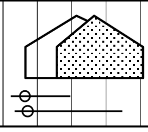
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

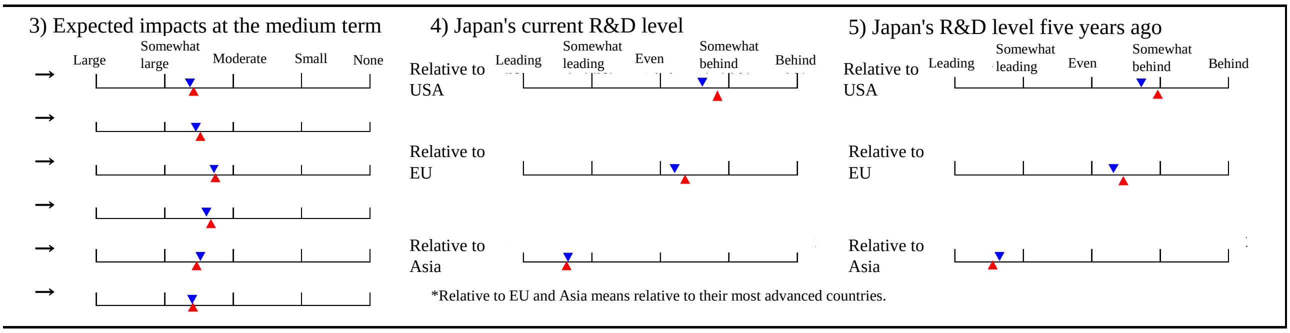
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
19	Elucidation of neural mechanisms of dreaming.	1	106	6	24	70	-	40	9	41	43	7		5	19
		2	122	2	7	91	-	34	2	33	63	2		2	6
		E	2	100	0	0	-	50	0	100	0	0		0	0
20	Elucidation of the regulatory mechanisms for expression of emotional behavior such as anger and aggression.	1	117	11	24	65	-	63	36	44	20	0		2	9
		2	126	4	13	83	-	56	23	56	21	0		1	6
		E	5	100	0	0	-	90	80	20	0	0		0	0
21	Elucidation of the mechanisms for generating the functional asymmetry of the left and right cerebral hemispheres.	1	119	8	22	70	-	47	17	43	35	5		2	12
		2	128	2	10	88	-	41	2	58	38	2		1	6
		E	3	100	0	0	-	50	0	100	0	0		0	0



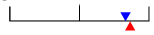
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (%)							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
2	94	4	0	0	12	34	41	13	60	10	36	45	12	6	1	2																		
1	96	3	0	0	4	37	51	8	84	8	31	50	5	4	1	0																		
0	100	0	0	0	0	50	50	0	100	0	0	0	0	0	0	0																		
3	90	7	0	0	27	36	32	5	64	12	41	57	14	7	6	2																		
2	94	4	0	0	17	50	31	2	83	12	39	60	6	3	1	0																		
20	60	20	0	0	60	40	0	0	20	40	40	100	0	0	0	0																		
7	87	5	0	1	12	37	41	10	57	10	35	54	12	7	2	2																		
2	96	2	0	0	6	49	42	3	81	8	31	58	3	3	1	0																		
0	100	0	0	0	0	67	33	0	0	0	0	100	33	0	0	0																		

V. Understanding and treating brain conditions

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

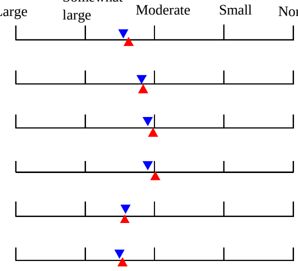


2) Current impacts

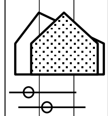
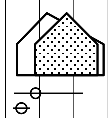
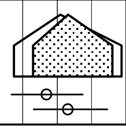
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

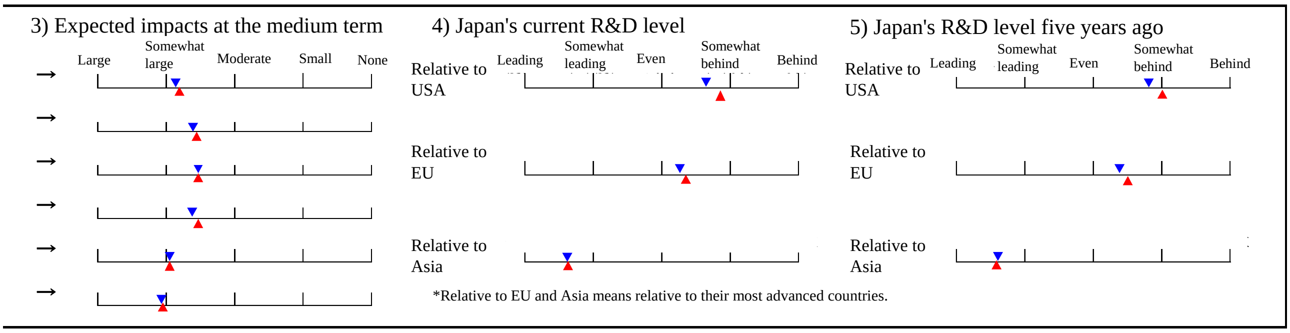
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

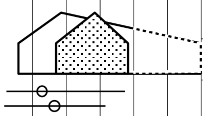
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
22	Treatment for preventing the progression of Alzheimer's disease.	1	169	12	27	61	-	81	63	33	4	0		1	5
		2	154	6	19	75	-	88	77	21	2	0		0	3
		E	9	100	0	0	-	94	89	11	0	0		0	0
23	Elucidation of the etiology of manic-dpressive psychosis at the molecular level.	1	136	11	26	63	-	80	63	30	7	0		2	5
		2	143	3	14	83	-	84	71	23	6	0		1	2
		E	5	100	0	0	-	90	80	20	0	0		0	0
24	Elucidation of the etiology of schizophrenia at the molecular level.	1	132	12	20	68	-	79	61	30	9	0		2	9
		2	141	4	13	83	-	84	71	24	5	0		1	3
		E	6	100	0	0	-	100	100	0	0	0		0	0



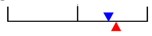
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
4	94	1	0	1	47	39	13	1	52	34	42	71	14	14	3	0						1	8	43	42	12	3	48	54	22	42	29	14	1
1	99	0	0	0	53	42	5	0	70	26	39	76	6	10	1	0						1	5	46	45	8	1	66	57	18	42	28	8	0
0	100	0	0	0	78	22	0	0	44	33	33	100	0	44	0	0						0	0	67	22	11	0	56	56	22	44	67	0	0
1	95	4	0	0	43	38	17	2	52	32	46	65	14	15	5	2																		
1	98	1	0	0	45	46	9	0	71	23	43	74	5	9	2	0																		
0	100	0	0	0	80	20	0	0	60	80	60	100	20	20	0	0																		
1	95	4	0	0	42	44	12	2	53	31	46	62	13	17	6	2																		
1	98	1	0	0	45	47	8	0	74	24	42	71	5	9	2	0																		
17	83	0	0	0	100	0	0	0	67	50	67	67	17	17	0	0																		

VI. Regenerative medicine

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



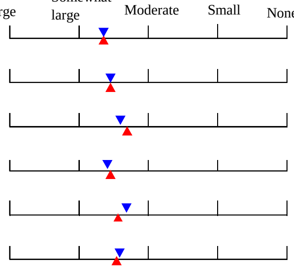
2) Current impacts

Large | Somewhat large | Moderate | Small | None

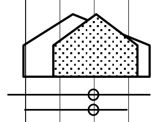
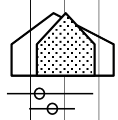
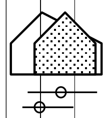
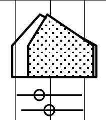
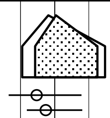
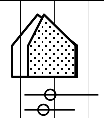
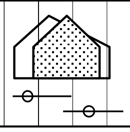
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

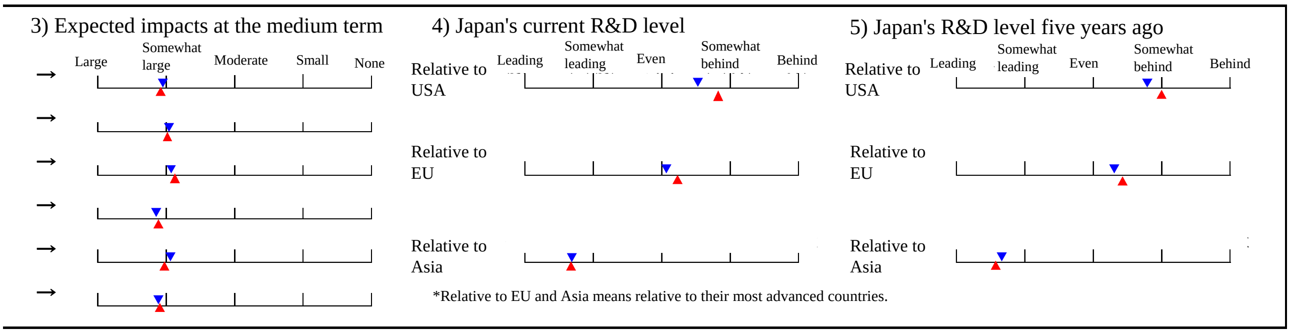
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

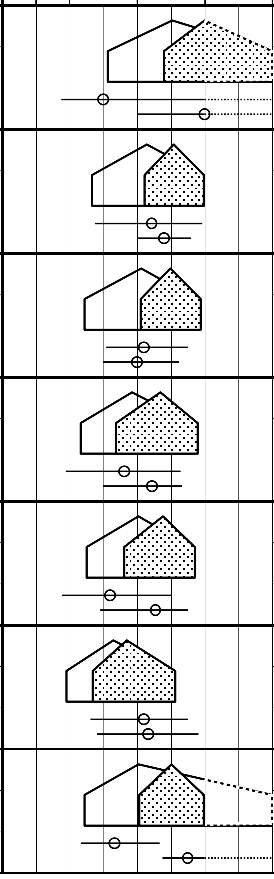


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
25	Synthetic technology for artificial cells to replace functions such as cell membrane transport and conversion of matter and energy. Synthetic technlogy for artificial cells with functions such as cell membrane transport, material transfer, and energy	1	150	8	30	62	-	57	27	48	22	3		5	14
		2	152	3	22	75	-	47	9	66	23	2		7	5
		E	4	100	0	0	-	63	25	75	0	0		0	0
26	Artificial organs (pancreases, kidneys, livers, etc.) incorporating human cells and tissue.	1	163	14	22	64	-	71	45	49	6	0		1	9
		2	153	5	22	73	-	68	38	57	4	1		1	4
		E	8	100	0	0	-	88	75	25	0	0		0	0
27	Technology to utilize animals as a bioreactor to produce organs and tissues to transplant into humans.	1	161	12	26	62	-	64	39	42	15	4		8	9
		2	150	7	19	74	-	57	23	63	12	2		5	3
		E	11	100	0	0	-	68	46	45	0	9		9	0
28	Reprograming technology to create stem cells from differentiated somatic cells.	1	176	19	25	56	-	71	46	45	8	1		1	8
		2	160	11	18	71	-	70	44	50	6	0		0	6
		E	17	100	0	0	-	90	80	20	0	0		0	0
29	Technology to manipulate stem cell differentiation and growth for induction of functional cells to use for therapy.	1	180	20	29	51	-	77	57	37	5	1		1	6
		2	162	15	19	66	-	79	61	35	4	0		1	3
		E	25	100	0	0	-	93	88	8	4	0		0	0
30	Long-term organ cultivation and preservation technology for organ transplants.	1	151	10	29	61	-	68	42	47	10	1		1	10
		2	148	7	16	77	-	63	31	60	8	1		1	3
		E	11	100	0	0	-	73	55	27	18	0		0	0
31	Artificial retinas to give sight to the visually impaired.	1	128	9	26	65	-	70	46	42	10	2		2	12
		2	136	2	18	80	-	70	44	50	5	1		1	6
		E	3	100	0	0	-	100	100	0	0	0		0	0



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
4	93	2	0	1	22	41	27	10	56	31	45	58	9	14	4	2						9	16	22	43	24	11	53	46	20	34	24	7	2
1	98	1	0	0	9	64	22	5	67	24	35	69	2	4	1	0						8	10	8	63	23	6	69	52	20	26	16	2	0
0	100	0	0	0	50	50	0	0	50	0	25	50	0	0	0	0						0	0	25	75	0	0	50	25	50	0	0	0	0
5	93	2	0	0	37	47	13	3	52	46	50	67	9	29	8	0						3	11	39	45	13	3	47	50	30	37	40	14	1
3	97	0	0	0	21	72	6	1	61	34	46	74	4	19	1	0						2	3	17	71	10	2	56	61	22	31	40	6	0
13	87	0	0	0	62	38	0	0	75	38	63	100	0	63	0	0						0	0	62	38	0	0	75	63	50	63	75	0	0
2	91	7	0	0	31	43	20	6	48	37	50	58	11	35	13	0						10	16	37	41	14	8	41	44	25	37	43	22	0
1	98	1	0	0	16	65	15	4	64	25	43	67	2	22	3	0						7	3	17	68	11	4	59	58	15	24	47	13	0
9	91	0	0	0	36	55	0	9	90	40	70	90	0	40	0	0						9	0	36	55	0	9	80	70	50	60	80	10	0
9	83	7	0	1	36	48	14	2	52	37	45	61	10	31	12	1						2	11	36	47	13	4	45	40	24	38	37	24	1
6	93	1	0	0	23	67	9	1	63	30	41	71	2	20	3	0						1	8	21	68	10	1	63	55	16	29	39	16	0
33	67	0	0	0	60	40	0	0	73	60	60	93	0	40	7	0						0	0	56	38	6	0	69	56	31	38	81	13	0
9	86	5	0	0	41	45	12	2	54	43	46	67	11	33	12	1						2	7	40	46	10	4	46	48	29	40	45	23	0
5	94	1	0	0	28	64	7	1	64	30	43	75	3	24	3	0						1	3	28	64	7	1	60	58	22	32	46	15	0
17	83	0	0	0	67	33	0	0	75	50	58	83	13	46	13	0						0	0	72	28	0	0	68	68	44	52	76	28	0
3	95	1	0	1	35	41	19	5	45	38	44	59	11	29	11	0						3	8	37	39	18	6	43	41	30	41	33	20	0
1	98	0	0	1	20	67	11	2	63	30	42	65	2	18	4	0						1	3	20	66	11	3	60	55	19	34	30	11	0
0	100	0	0	0	64	27	9	0	73	36	45	64	9	45	27	0						0	10	46	45	9	0	82	45	36	45	36	45	0
9	88	3	0	0	33	48	18	1	53	38	43	58	7	23	6	0						2	11	32	45	21	2	41	52	28	43	29	14	1
7	93	0	0	0	16	74	7	3	69	32	45	73	2	12	2	0						2	7	16	71	12	1	55	64	20	38	27	7	0
33	67	0	0	0	67	33	0	0	67	67	0	33	0	0	0	0						0	0	50	50	0	0	50	50	0	0	0	0	0

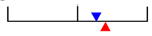


VII. Monitoring and sensor technology for biological substances

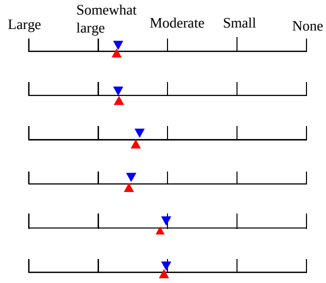
1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



2) Current impacts

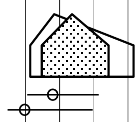
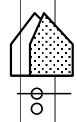
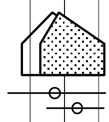
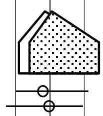
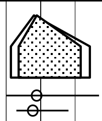
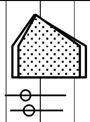
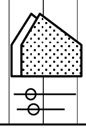


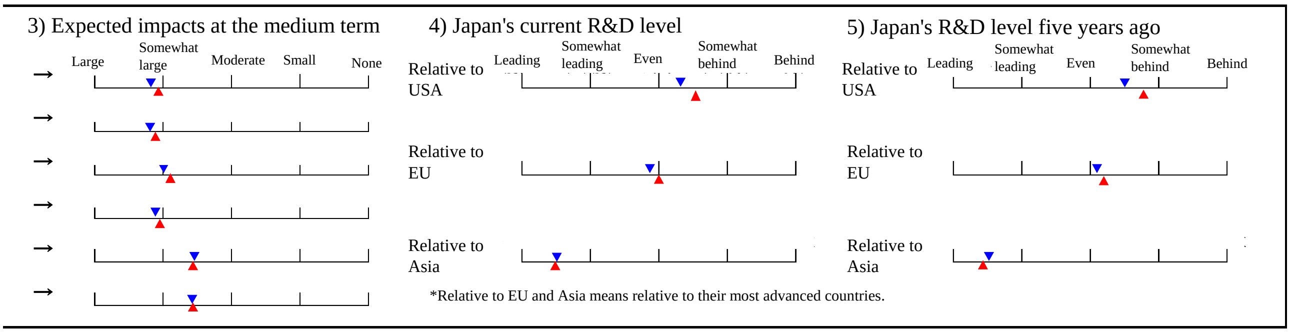
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
32	Self-propelled micromachines for diagnosis and treatment inside the body (organ lumina).	1	116	8	18	74	-	65	38	47	15	0		2	8
		2	138	3	9	88	-	62	28	64	8	0		0	5
		E	4	100	0	0	-	88	75	25	0	0		0	0
33	Technology to detect a cancerous tissue of the diameter smaller than 1 mm presenting anywhere in the body.	1	129	9	26	65	-	76	55	37	7	1		0	5
		2	148	1	15	84	-	84	69	30	1	0		0	3
		E	1	100	0	0	-	100	100	0	0	0		0	0
34	Technology for molecular imaging in the body with the precision of single molecule detection.	1	181	17	36	47	-	63	34	50	15	1		2	7
		2	173	5	39	56	-	56	18	73	8	1		1	3
		E	8	100	0	0	-	61	29	57	14	0		0	0
35	Technology to observe the interactions among various substances inside and outside of cells, to simultaneously identify those substances, and to monitor their distribution.	1	182	21	31	48	-	63	35	49	15	1		2	7
		2	165	4	37	59	-	58	20	71	9	0		1	3
		E	6	100	0	0	-	92	83	17	0	0		0	0
36	Technology that can sequence the whole human genome in one day.	1	203	23	36	41	-	61	35	42	19	4		6	7
		2	182	14	40	46	-	61	30	55	13	2		2	3
		E	26	100	0	0	-	72	46	50	4	0		0	4
37	Equipment that can sample a single cell and measure all kinds of mRNAs with their copy numbers within the cell.	1	196	23	38	39	-	63	36	46	16	2		4	8
		2	182	13	37	50	-	57	22	61	17	0		2	2
		E	24	100	0	0	-	64	38	41	21	0		4	4
38	Equipment to automatically analyze the sequences of sugar chains with 20 or more linked sugars with their branching and linkage patterns.	1	148	16	30	54	-	60	30	51	18	1		1	9
		2	147	5	24	71	-	53	14	70	15	1		1	3
		E	8	100	0	0	-	69	38	62	0	0		0	0

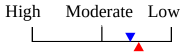


Countries at the leading edge: Japan	USA	EU	Asia	Other (%)	Regarding technological realization – Necessity of gov't involvement: High	Moderate	Low	None (%)	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other (%)	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know (%)	Regarding social application – Necessity of gov't involvement: High	Moderate	Low	None (%)	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other (%)
30	67	2	0	1	27	48	21	4	40	58	35	55	9	13	3	1		3	12	27	38	29	6	40	52	38	29	25	8	1
30	67	2	0	1	17	68	14	1	52	60	29	66	2	9	2	0		0	4	15	66	18	1	49	72	25	33	17	2	0
50	25	0	0	25	50	50	0	0	25	50	0	25	0	25	0	0		0	0	25	75	0	0	25	50	0	0	25	0	0
22	77	1	0	0	33	48	16	3	45	54	46	62	7	15	2	0		1	5	29	43	21	7	40	51	39	40	25	6	0
17	82	0	1	0	23	66	10	1	51	62	36	68	2	6	1	0		0	3	17	68	14	1	46	74	23	45	12	1	0
0	100	0	0	0	100	0	0	0	100	0	100	100	0	0	0	0		0	0	0	100	0	0	0	100	0	100	0	0	0
42	53	4	0	1	25	46	26	3	53	42	37	63	9	5	1	1		3	12	18	44	29	9	48	51	29	38	9	3	3
51	48	1	0	0	14	71	13	2	64	44	31	74	2	3	1	0		3	4	12	64	21	3	56	71	20	34	5	1	0
87	13	0	0	0	25	62	13	0	75	38	25	50	13	0	0	0		0	0	13	87	0	0	50	88	13	13	13	13	0
14	83	3	0	0	28	47	22	3	50	41	37	68	10	3	1	1		2	12	20	40	29	11	47	48	31	40	6	4	2
6	94	0	0	0	13	72	13	2	64	41	29	76	1	3	1	0		2	4	10	65	20	5	59	73	20	37	5	1	0
33	67	0	0	0	17	83	0	0	50	67	0	83	0	0	0	0		0	0	0	100	0	0	50	83	0	50	0	0	0
9	88	2	0	1	28	41	22	9	41	52	42	59	11	6	2	1		5	13	23	38	27	12	39	54	34	39	11	12	1
6	92	1	1	0	16	68	14	2	47	57	36	69	2	4	2	0		4	3	17	60	20	3	40	73	22	36	8	5	0
8	92	0	0	0	35	53	12	0	50	81	42	58	4	0	0	0		0	8	27	61	12	0	38	85	23	35	4	0	0
10	87	2	0	1	27	47	21	5	44	47	47	63	8	7	2	1		3	13	19	45	25	11	41	53	29	39	8	9	1
4	96	0	0	0	14	67	17	2	52	53	34	70	1	3	1	0		4	3	12	62	22	4	43	75	17	33	6	2	0
17	83	0	0	0	29	54	17	0	35	74	48	61	4	4	0	0		8	4	25	54	21	0	30	87	9	35	4	0	0
34	62	4	0	0	24	46	25	5	48	43	50	65	7	4	1	1		1	12	22	36	31	11	40	60	36	43	8	5	1
37	63	0	0	0	12	63	24	1	63	42	42	64	4	4	1	1		1	5	8	60	26	6	57	73	24	35	3	1	0
62	38	0	0	0	49	38	13	0	88	50	75	88	38	13	13	13		0	0	49	38	13	0	75	75	50	75	13	13	0

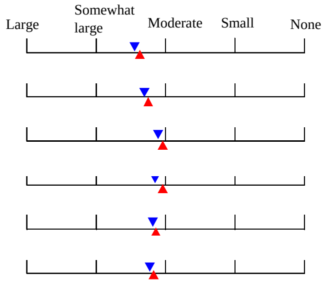
VIII. Control of higher-order biological functions

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

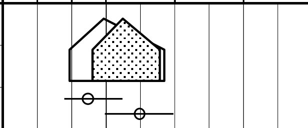
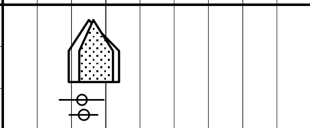
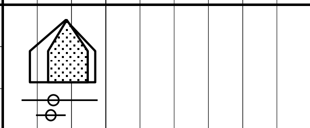
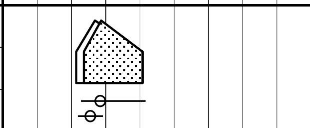
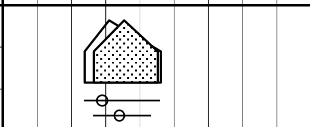
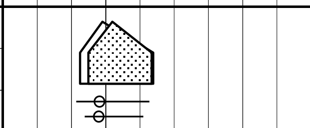
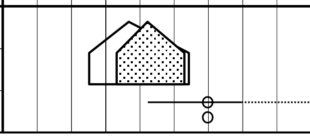


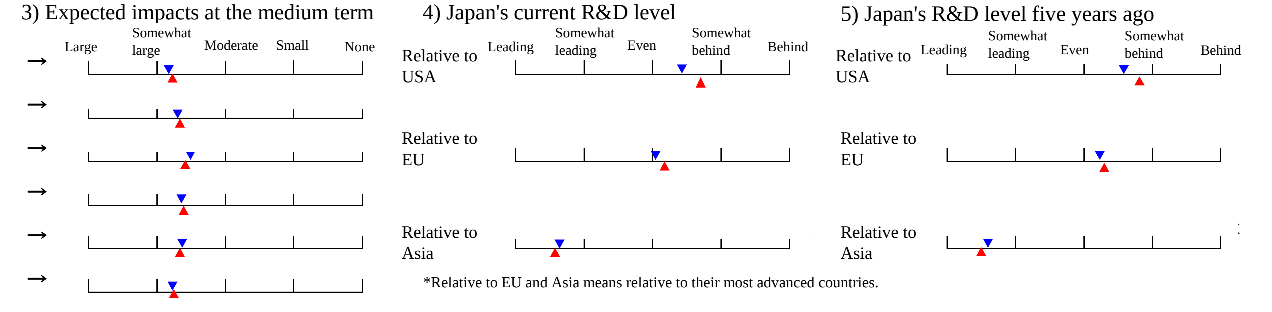
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

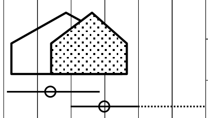
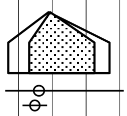
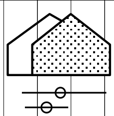
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate	Low	None	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know
39	Technology to voluntarily control prostheses by using computers to convert movement-related brain activity to signals and transmit them via the spinal cord and peripheral nerves.	1	112	12	21	67	-	65	40	43	15	2		2	13
		2	132	3	14	83	-	59	23	67	9	1		1	3
		E	4	100	0	0	-	75	50	50	0	0		0	0
40	Elucidation of the molecular mechanism of floral differentiation in higher-order plants.	1	105	15	26	59	-	47	16	44	35	5		0	12
		2	129	12	10	78	-	42	7	53	35	5		1	5
		E	15	100	0	0	-	60	20	80	0	0		0	0
41	Technology to select cells (clones) to produce specific useful antibodies.	1	165	18	33	49	-	59	32	46	20	2		0	2
		2	163	7	35	58	-	55	17	71	11	1		1	1
		E	12	100	0	0	-	58	25	58	17	0		0	0
42	Regulation of autoimmune disease such as chronic rheumatoid arthritis based on the elucidation of the mechanisms for self-disposal of mutant cell components.	1	155	18	34	48	-	73	48	46	6	0		0	7
		2	150	6	31	63	-	73	48	48	4	0		0	2
		E	9	100	0	0	-	75	56	33	11	0		0	0
43	Elucidation of immune system repair and regeneration mechanisms.	1	159	19	31	50	-	67	41	44	15	0		1	6
		2	153	8	29	63	-	63	31	61	7	1		1	3
		E	13	100	0	0	-	79	61	31	8	0		0	0
44	Elucidation of the mechanisms regulating the balance between immune system activation and suppression.	1	160	18	33	49	-	68	44	43	13	0		0	5
		2	155	10	27	63	-	65	33	61	5	1		0	3
		E	15	100	0	0	-	83	67	33	0	0		0	0
45	Elucidation of the influence of weightlessness on generation and the endocrine and immune systems.	1	109	5	25	70	-	35	9	25	53	13		3	13
		2	122	2	13	85	-	32	4	23	65	8		2	12
		E	2	100	0	0	-	50	50	0	0	50		0	50

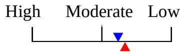


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application					(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
17	83	0	0	0	34	41	22	3	49	49	55	56	8	7	2	2						2	11	35	44	18	3	45	48	39	49	25	12	2
9	91	0	0	0	18	70	11	1	66	45	45	65	2	3	1	0						2	2	17	67	14	2	63	58	26	45	14	4	0
0	100	0	0	0	50	50	0	0	50	50	25	50	0	0	0	0						0	0	75	25	0	0	50	25	25	25	25	25	0
16	74	9	0	1	16	46	31	7	48	17	38	61	4	5	1	3																		
7	93	0	0	0	7	62	26	5	77	11	28	70	2	2	0	2																		
14	86	0	0	0	20	67	13	0	100	14	36	86	7	0	0	0																		
10	84	5	0	1	14	39	36	11	38	37	38	56	7	9	1	2						1	3	19	33	34	14	38	51	36	40	18	7	3
3	96	1	0	0	8	59	29	4	55	34	28	68	1	6	2	0						1	1	9	52	34	5	43	63	27	39	9	2	0
17	83	0	0	0	17	41	17	25	44	33	44	100	0	0	0	0						0	0	8	58	17	17	30	70	30	50	20	0	0
11	87	1	0	1	30	48	19	3	47	34	47	64	9	6	1	1						1	8	28	49	19	4	42	55	28	44	15	5	2
5	93	1	1	0	20	70	10	0	66	28	33	75	2	3	2	0						0	2	19	68	12	1	57	66	19	47	8	2	0
33	67	0	0	0	33	56	11	0	78	44	56	78	0	0	0	0						0	0	45	33	22	0	89	67	33	67	11	0	0
5	92	3	0	0	27	44	26	3	51	28	45	65	12	8	1	1																		
1	97	1	1	0	15	71	13	1	70	21	38	71	1	2	1	0																		
8	92	0	0	0	38	47	15	0	92	31	62	85	0	0	0	0																		
9	89	2	0	0	26	46	26	2	49	28	45	63	12	5	1	1																		
3	96	1	0	0	15	72	12	1	66	22	33	73	2	3	1	0																		
13	87	0	0	0	46	47	7	0	87	20	47	93	0	7	0	0																		
2	97	0	0	1	17	35	32	16	36	29	42	37	28	3	1	5																		
1	99	0	0	0	9	42	37	12	58	19	43	43	22	2	1	1																		
0	100	0	0	0	50	0	0	50	100	0	100	100	0	0	0	0																		

IX. Information biology

1. Questions regarding the relevant area

1) Degree of expertise in the area

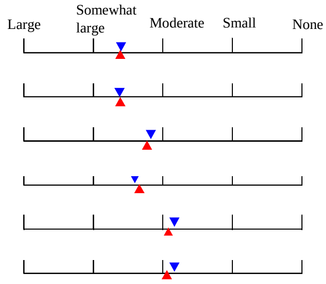


2) Current impacts

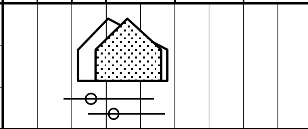
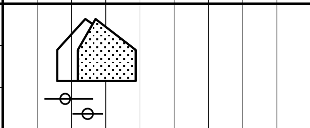
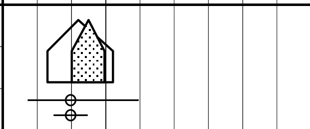
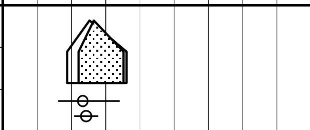
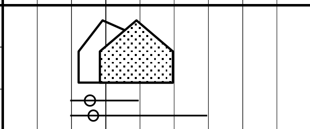
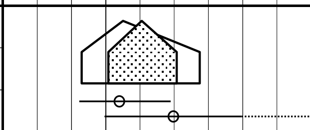
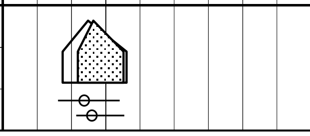
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

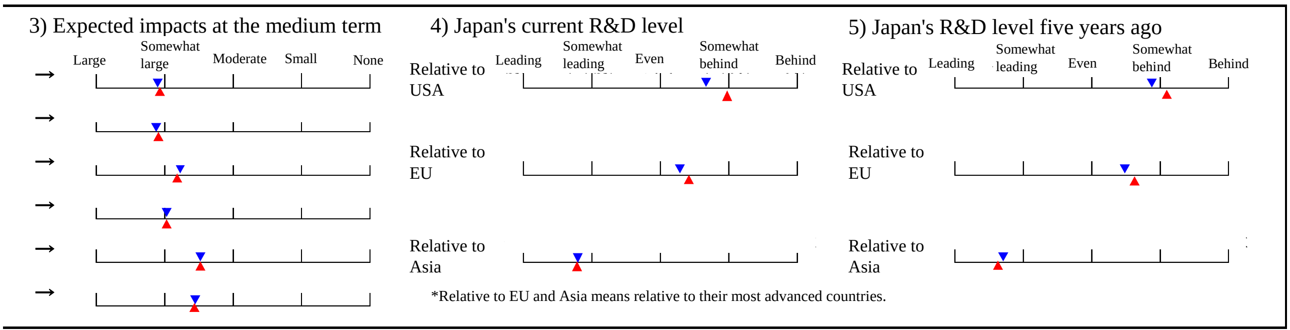
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

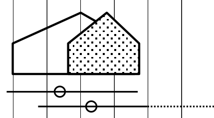
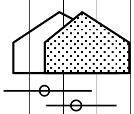
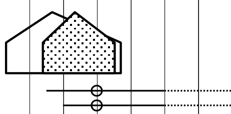
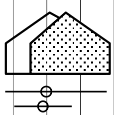
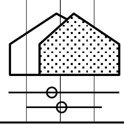
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
46	Protein design methods with voluntary molecular recognition mechanisms through the application of bioinformatics.	1	187	22	30	48	-	66	39	50	10	1		3	9
		2	175	14	26	60	-	61	27	63	10	0		2	2
		E	24	100	0	0	-	87	74	26	0	0		0	0
47	Through bioinformatics, the integration and sharing of vast amounts of data is made possible, and the data may be used for the implementation of life science research carried out over networks of virtual laboratories.	1	189	18	37	45	-	60	32	47	19	2		2	10
		2	170	11	25	64	-	55	19	64	16	1		1	2
		E	18	100	0	0	-	75	50	50	0	0		0	0
48	Remote technology systems applying advanced virtual reality technology.	1	117	6	23	71	-	60	32	46	20	2		2	9
		2	131	2	8	90	-	55	18	69	12	1		0	2
		E	2	100	0	0	-	100	100	0	0	0		0	0
49	Bioinformatics that can predict the risk of cancer and lifestyle diseases based on genetic. background, etc.	1	201	21	33	46	-	74	53	37	10	0		0	5
		2	174	10	29	61	-	77	60	30	10	0		0	1
		E	17	100	0	0	-	94	88	12	0	0		0	0
50	Verification testing to elucidate the evolutionary mechanisms of organisms.	1	168	11	31	58	-	42	12	35	49	4		13	22
		2	163	6	24	70	-	37	4	37	56	3		6	6
		E	10	100	0	0	-	63	30	60	10	0		0	20
51	Based on compete gene function data for unicellular organisms, technology to simulate all cell functions such as multiplication and environmental response.	1	187	12	33	55	-	51	20	47	29	4		5	12
		2	175	5	28	67	-	46	8	61	30	1		5	2
		E	9	100	0	0	-	72	44	56	0	0		0	11
52	Methods to predict various genome functions from DNA sequencing data.	1	220	28	38	34	-	69	45	44	10	1		3	9
		2	188	24	36	40	-	71	47	44	9	0		1	2
		E	45	100	0	0	-	92	85	13	2	0		0	2



Countries at the leading edge (%)					Regarding technological realization													Time of social application							Regarding social application										
					Necessity of gov't involvement (%)				Effective measures that should be taken by gov't (%)														(%)		Necessity of gov't involvement (%)				Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
6	92	1	0	1	27	47	23	3	61	44	42	57	5	3	2	2						3	10	23	42	29	6	57	53	28	38	8	4	2
1	98	1	0	0	12	71	16	1	77	34	33	64	1	2	1	0						2	5	10	67	21	2	71	62	18	30	5	1	0
4	96	0	0	0	38	49	13	0	96	33	46	79	0	0	0	0						0	0	21	66	13	0	83	63	33	46	0	0	0
5	93	1	0	1	23	46	26	5	59	40	47	58	14	5	2	1						3	12	19	44	29	8	57	52	25	37	10	4	1
1	98	0	1	0	11	71	17	1	78	31	41	63	6	2	1	0						1	4	8	74	16	2	79	59	22	27	4	1	0
0	100	0	0	0	39	55	6	0	78	39	44	67	22	0	0	0						0	0	18	70	12	0	81	50	25	19	0	0	0
9	88	2	0	1	26	47	22	5	52	48	44	56	13	13	6	2						4	10	26	42	26	6	54	56	20	42	29	12	2
7	93	0	0	0	13	72	13	2	73	48	37	54	2	9	3	0						1	4	13	73	12	2	71	64	15	32	16	6	0
0	100	0	0	0	100	0	0	0	100	0	50	50	0	0	0	0						0	0	50	50	0	0	100	0	0	0	0	0	0
9	88	2	0	1	40	45	14	1	56	41	46	56	11	17	8	2						1	6	37	43	18	2	50	48	23	35	24	21	1
4	96	0	0	0	34	56	9	1	76	40	38	65	5	8	1	0						1	2	26	59	14	1	72	57	16	37	17	11	0
12	88	0	0	0	65	35	0	0	94	53	29	71	12	6	0	0						0	0	47	53	0	0	76	53	6	18	24	0	0
12	73	12	0	3	12	26	48	14	51	17	39	52	11	5	2	3																		
6	90	4	0	0	6	36	53	5	74	9	28	64	7	3	1	1																		
11	78	11	0	0	20	50	30	0	80	10	40	60	0	0	0	0																		
15	80	2	0	3	19	37	34	10	59	25	41	57	8	4	2	2																		
8	91	1	0	0	6	54	36	4	79	13	31	64	4	1	1	1																		
22	78	0	0	0	33	56	11	0	78	22	44	67	22	0	0	0																		
5	92	2	0	1	33	41	21	5	62	36	44	59	16	5	1	1						3	12	26	38	29	7	53	50	30	40	10	8	1
2	96	2	0	0	24	64	11	1	84	28	36	68	6	3	1	0						1	3	19	60	19	2	74	57	19	34	5	3	0
2	96	2	0	0	53	45	2	0	90	29	43	74	12	5	0	0						2	5	40	42	16	2	80	59	20	36	0	5	0

X. Environmental and ecological biology

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

2) Current impacts

Large / Somewhat large / Moderate / Small / None

[Increased intellectual assets] Contribution of the relevant area itself to increased intellectual assets

Contribution to the development of other fields

[Economic impacts] Contribution to the development of existing Japanese industry

Contribution to the creation of new industries or businesses

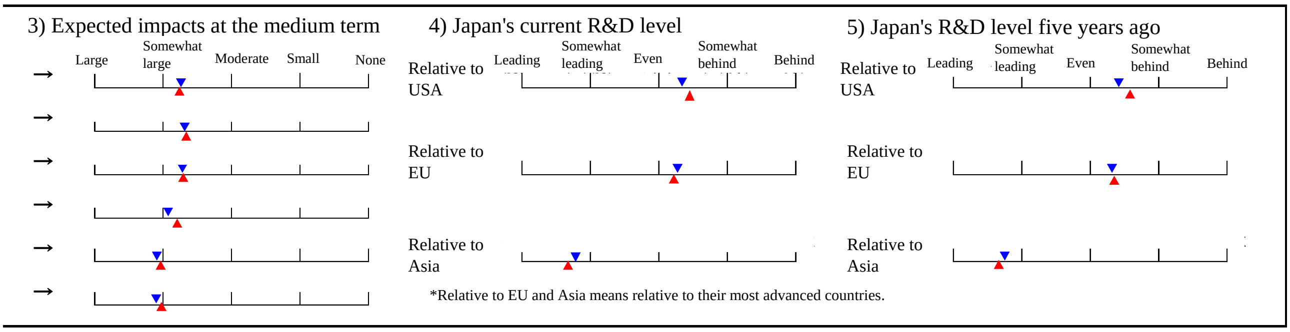
[Social impacts] Contribution to safety and security

Contribution to improved social vitality and quality of life

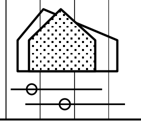
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
53	Technology to radically improve photosynthesis function in order to increase food production and protect the environment.	1	112	18	22	60	-	69	49	32	16	3		6	15
		2	135	11	7	82	-	76	59	33	7	1		5	4
		E	15	100	0	0	-	95	93	0	7	0		7	0
54	Technology to create practical plants resistant to cold and drought through elucidation of the molecular mechanisms of signal transductions in plants, from perception of low temperatures and other outside data to phenotypic expression.	1	110	19	26	55	-	67	41	44	14	1		2	6
		2	129	13	9	78	-	65	35	55	9	1		2	2
		E	17	100	0	0	-	82	65	35	0	0		0	0
55	Genetically-engineered plants and microorganisms that can remove NOx and other pollutants.	1	114	21	20	59	-	66	41	42	15	2		2	8
		2	132	11	13	76	-	67	41	48	9	2		2	1
		E	14	100	0	0	-	79	57	43	0	0		0	0
56	Plants with radically improvement in functions such as atmospheric nitrogen fixing and soil phosphate utilization through plant genome technology.	1	109	19	25	56	-	66	42	39	18	1		1	8
		2	128	11	8	81	-	69	45	43	10	2		4	2
		E	14	100	0	0	-	93	86	14	0	0		14	7
57	Mass production technology for fuels and bioplastics utilizing plants and microorganisms.	1	109	10	27	63	-	76	57	34	9	0		1	5
		2	129	7	11	82	-	81	66	29	5	0		0	2
		E	9	100	0	0	-	94	89	11	0	0		0	0
58	Technology to prevent eutrophication in marine and fresh water by measuring microorganism populations in natural environments and controlling their group compositions.	1	95	12	22	66	-	66	44	40	13	3		9	4
		2	120	5	11	84	-	69	45	43	11	1		2	3
		E	6	100	0	0	-	83	67	33	0	0		0	17
59	Elucidation of the basic genetic networks that control growth and development of plants such as shape, size, and bloom period.	1	116	20	24	56	-	58	30	44	25	1		0	4
		2	129	15	8	77	-	50	12	67	20	1		1	3
		E	19	100	0	0	-	76	53	47	0	0		0	0
60	Technology to form cells with the minimum genetic set needed to produce substances.	1	128	8	34	58	-	52	23	44	28	5		4	11
		2	138	4	16	80	-	50	12	66	20	2		4	7
		E	6	100	0	0	-	67	33	67	0	0		0	17

Time of technological realization columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
23	71	5	1	0	41	35	18	6	45	39	56	66	18	13	3	0		4	21	41	38	15	6	43	56	26	39	29	13	2
17	82	0	1	0	40	50	7	3	65	35	48	73	15	8	2	0		4	6	41	49	7	3	69	73	18	42	23	4	1
29	71	0	0	0	53	40	7	0	73	33	80	93	40	13	7	0		7	0	73	20	7	0	87	67	20	53	53	7	7
26	69	5	0	0	34	47	18	1	51	34	50	69	15	14	5	1		1	9	35	44	19	2	40	51	27	40	33	9	5
22	78	0	0	0	27	63	9	1	67	33	44	78	13	10	2	0		2	3	28	62	9	1	63	73	19	40	23	4	1
41	59	0	0	0	53	41	6	0	65	35	76	88	35	12	6	0		0	0	59	35	6	0	65	71	24	53	53	6	6
24	73	2	0	1	36	43	17	4	48	44	50	66	12	19	4	0		4	15	36	46	14	4	39	58	31	48	33	10	2
15	84	1	0	0	32	59	8	1	64	38	46	76	9	12	5	0		2	2	37	54	7	2	59	71	22	45	26	6	1
21	72	7	0	0	57	43	0	0	71	43	71	93	29	14	7	0		7	0	64	36	0	0	71	64	29	57	50	7	7
18	77	3	1	1	35	43	21	1	45	40	45	63	12	16	6	0		3	11	36	45	17	2	42	56	31	41	29	14	1
9	88	2	1	0	25	65	9	1	68	32	44	71	10	9	2	0		2	3	32	57	9	2	61	69	19	40	24	6	1
21	72	7	0	0	43	57	0	0	79	21	64	79	29	14	7	0		8	8	57	43	0	0	64	57	21	50	50	7	7
26	67	7	0	0	41	43	12	4	47	55	46	67	13	12	4	0		1	9	43	42	12	3	37	58	43	49	25	11	2
22	77	1	0	0	43	48	8	1	59	51	43	75	9	7	2	0		0	3	45	45	9	1	48	70	29	45	18	4	2
22	78	0	0	0	67	33	0	0	56	56	44	89	22	22	0	0		0	0	67	33	0	0	44	67	67	56	33	11	11
16	73	6	0	5	36	45	16	3	48	44	45	61	16	9	4	2		10	12	36	42	15	7	44	49	30	49	14	13	1
15	83	2	0	0	26	64	8	2	66	38	48	72	13	5	1	0		3	7	30	62	6	2	57	68	21	46	11	5	0
17	83	0	0	0	67	33	0	0	83	50	33	100	67	33	0	0		0	17	67	33	0	0	50	67	33	67	67	33	0
17	79	3	0	1	30	38	28	4	51	26	43	64	13	8	3	1														
6	94	0	0	0	11	68	20	1	75	25	38	70	6	5	0	0														
6	94	0	0	0	50	50	0	0	83	28	61	89	28	6	0	0														
6	91	2	0	1	19	43	32	6	48	31	48	65	7	5	2	1		7	13	17	44	29	10	45	56	25	35	14	9	2
1	99	0	0	0	7	73	19	1	74	20	42	67	4	4	2	0		6	12	7	67	24	2	66	64	15	31	7	3	0
17	83	0	0	0	17	66	17	0	83	33	50	67	0	0	0	0		0	17	33	50	17	0	67	50	17	17	17	17	0

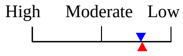
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan (%)					Time of technological realization						(%)	
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
61	Based on genome sequence research in many species, elucidation of the diversity and evolution of environmental response mechanisms in organisms, such as metabolic capacity and ability to respond to stress.	1	**156**	**13**	**27**	**60**	**-**	**56**	**26**	**46**	**25**	**3**							**3**	**10**
		2	**148**	**8**	**16**	**76**	**-**	**51**	**12**	**69**	**18**	**1**							**0**	**5**
		E	**12**	**100**	**0**	**0**	**-**	**79**	**58**	**42**	**0**	**0**							**0**	**8**

Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
		(%)				(%)						(%)										(%)			(%)						(%)			
9	**86**	**4**	**0**	**1**	**22**	**43**	**30**	**5**	**52**	**26**	**43**	**60**	**13**	**4**	**3**	**1**																		
3	**96**	**0**	**1**	**0**	**11**	**67**	**21**	**1**	**78**	**21**	**41**	**71**	**4**	**3**	**0**	**0**																		
17	**83**	**0**	**0**	**0**	**82**	**18**	**0**	**0**	**100**	**27**	**82**	**91**	**27**	**9**	**0**	**0**																		

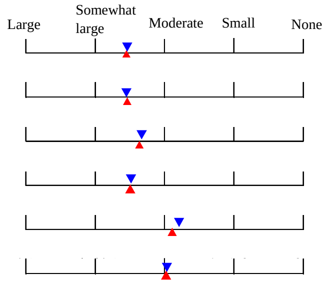
XI. Nanobiology

1. Questions regarding the relevant area

1) Degree of expertise in the area

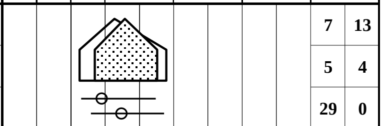
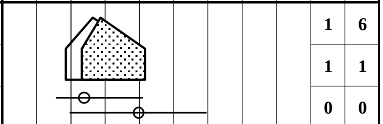
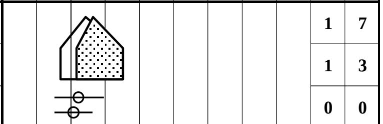
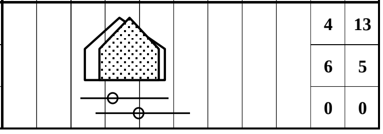


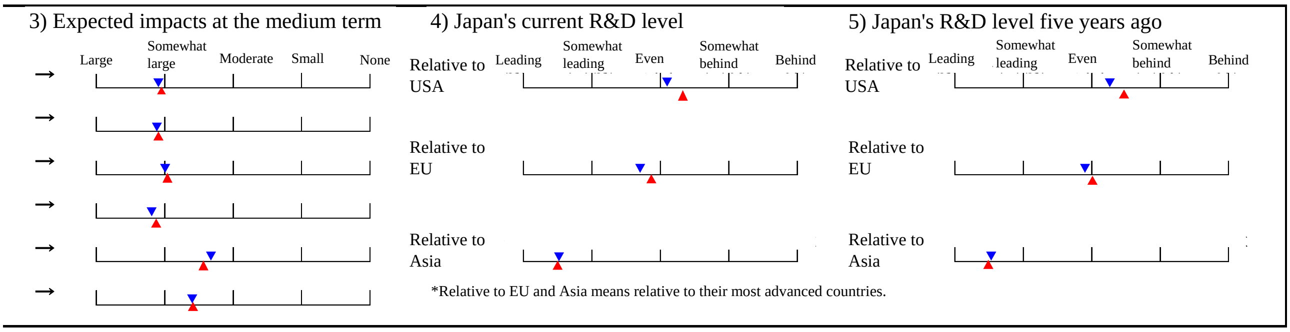
2) Current impacts

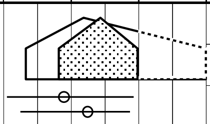
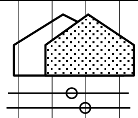
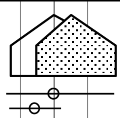
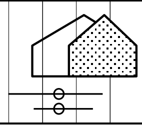


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
62	Highly efficient energy conversion technology that utilizes motor proteins (molecular motors) that convert chemical energy to mechanical energy.	1	127	15	35	50	-	62	37	43	17	3		7	13
		2	137	5	23	72	-	56	20	67	12	1		5	4
		E	7	100	0	0	-	57	29	42	29	0		29	0
63	Chemical sensor technology that mimics the ion selection function of the ion channels that exist in cell membranes.	1	141	16	33	51	-	58	27	50	22	1		1	6
		2	150	5	25	70	-	54	15	73	11	1		1	1
		E	8	100	0	0	-	79	57	43	0	0		0	0
64	Nanochamber arrays that enable simultaneous detection of many biological reactions by concentrating thousands or tens of thousands of receptors on a single semiconductor chip.	1	137	18	29	53	-	64	37	47	16	0		1	7
		2	149	7	23	70	-	58	22	67	10	1		1	3
		E	11	100	0	0	-	70	40	60	0	0		0	0
65	Biofuel cells that reconstruct the reactions of enzyme molecules in bodies on a nano scale.	1	116	11	27	62	-	61	32	50	15	3		4	13
		2	133	2	14	84	-	53	14	73	11	2		6	5
		E	3	100	0	0	-	67	33	67	0	0		0	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
45	50	3	0	2	32	43	21	4	59	37	49	68	11	5	1	2						7	12	26	41	24	9	47	56	36	41	7	3	2
47	52	1	0	0	19	65	14	2	77	28	38	67	2	2	1	1						5	6	13	66	17	4	64	64	27	32	3	1	0
86	14	0	0	0	50	17	33	0	67	33	33	67	0	0	0	0						29	0	14	29	43	14	50	67	17	17	0	0	0
21	72	5	0	2	23	51	23	3	53	44	39	66	6	4	2	1						1	11	16	50	28	6	42	57	37	42	6	2	2
18	82	0	0	0	12	71	16	1	68	37	32	68	1	2	1	1						1	3	9	70	18	3	57	68	24	34	3	1	0
50	50	0	0	0	38	62	0	0	38	38	25	88	0	0	0	0						0	0	36	38	13	13	43	43	29	43	14	14	0
21	76	2	0	1	32	43	23	2	52	51	48	62	9	6	1	1						1	9	24	42	29	5	46	59	44	41	6	2	2
12	88	0	0	0	15	68	16	1	68	46	40	65	1	2	1	1						2	3	8	73	16	3	52	74	34	35	4	1	0
36	64	0	0	0	36	55	9	0	64	36	27	91	0	0	0	0						0	0	9	73	9	9	40	70	50	30	10	0	0
18	80	0	0	2	31	51	14	4	53	49	46	63	11	5	1	2						5	14	25	50	19	6	42	58	39	45	5	3	2
9	91	0	0	0	12	71	15	2	71	46	37	63	1	2	1	1						5	5	8	73	14	5	55	73	26	38	4	2	0
33	67	0	0	0	33	67	0	0	33	33	0	100	0	0	0	0						0	0	0	34	33	33	50	50	50	50	0	0	0

4. Health, medical care, and welfare field

4.1. Overview

With the completion of the sequencing of the human genome, basic and clinical research in the field of the health, medical care, and welfare is placed in a transitional phase and is developing in new directions. For the past several years, the field of health, medical care, and welfare has been emphasizing prevention and treatment of lifestyle-related diseases such as cancer, diabetes, hypertension, and hyperlipidemia. This accounted for a major portion of research clinically and socially in the field. Furthermore, with the rapid progress in aging of society and the declining birthrate, increasing number of patients with impaired cognition such as Arzheimer’s disease and those with Parkinson’s disease are becoming serious, and additional efforts have been applied to brain science research. Emphasis has also been placed on healthcare support for the elderly with a view towards improving their quality of life. Such areas certainly form an important part of the field of health, medical care, and welfare. On the other hand, along with understandings of the role of genes as a cause of disease, genetic diagnosis and treatment are becoming more important in healthcare. At the same time, expectations are high for medical transplantation, artificial organs, and regenerative medicine. Genetic treatment and regenerative medicine will likely become the center of healthcare. In addition to the above, in any age, measures against emerging and reemerging infections cannot be neglected. Firm action must be taken today against AIDS, viral hepatitis, SARS, avian influenza, in-hospital infectious disease, and so on. Such issues in the field of health, medical care, and welfare require manpower and financial support from the national government.

For this survey, areas were selected under sufficient consideration of the new developments in the field of health, medical care, and welfare described above. Over the past few years, the extreme importance of genetic factors in cancer, the core of this field, has become clear, and along with illnesses such as diabetes, obesity, and hyperlipidemia that are rapidly increasing in Japan it has been taken up as personalized medicine. "Elucidation of biological defense mechanisms and therapeutic application," which is closely related to personalized medicine and important in the onset and progress of diseases, was considered as the topic next in importance. "Recovery of biological functions focusing on QOL and support for it," which seeks to improve healthcare for the elderly and healthcare in general and "Application of IT to medicine", which necessitates collaboration with other fields, were also considered very important issues. In addition, "Human-centered medicine and construction of healthcare support systems" must not be forgotten in the future of the field of health, medical care, and welfare.

In addition to the above, prevention of disease, in other words, preventive medicine, will be particularly important in healthcare from now on. The achievement of early detection and treatment of disease through the development of efficient examination systems is also extremely important. Collaboration with other areas on this point is necessary.

"Measures against emerging and reemerging infectious diseases" has also once again become an area of emphasis. Causes for such emergence and reemergence are rooted in society. They include rapid changes in living environments and lifestyles, annual increases in the number of elderly with poor immune systems, increasing opportunities for contact between humans and animals, and urbanization through the destruction of natural areas. Although some of their aspects cannot be solved simply through medicine and nursing, they are important topics in the field of health, medical care, and welfare.

Medicine and welfare for an aging society are considered as an increasingly important area for the future of the field of health, medical care, and welfare in Japan, and policies to address it from a wide variety of angles are needed.

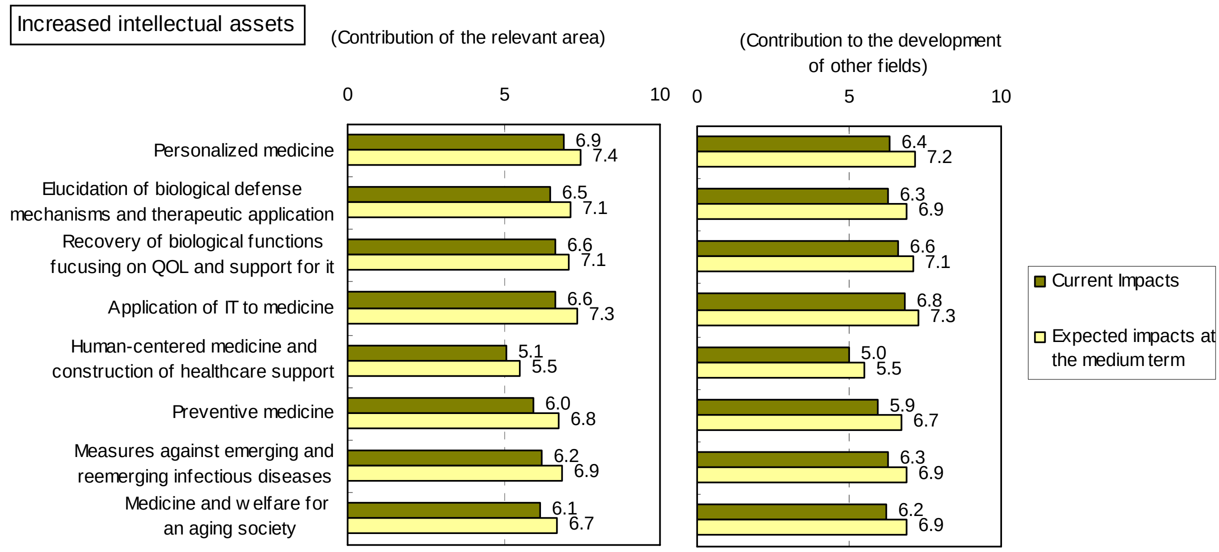
In the 8 areas covered, the allocation of questions for areas was related to their degree of importance, and the number of questions was appropriate.

(SARUTA Takao)

4.2. Main results

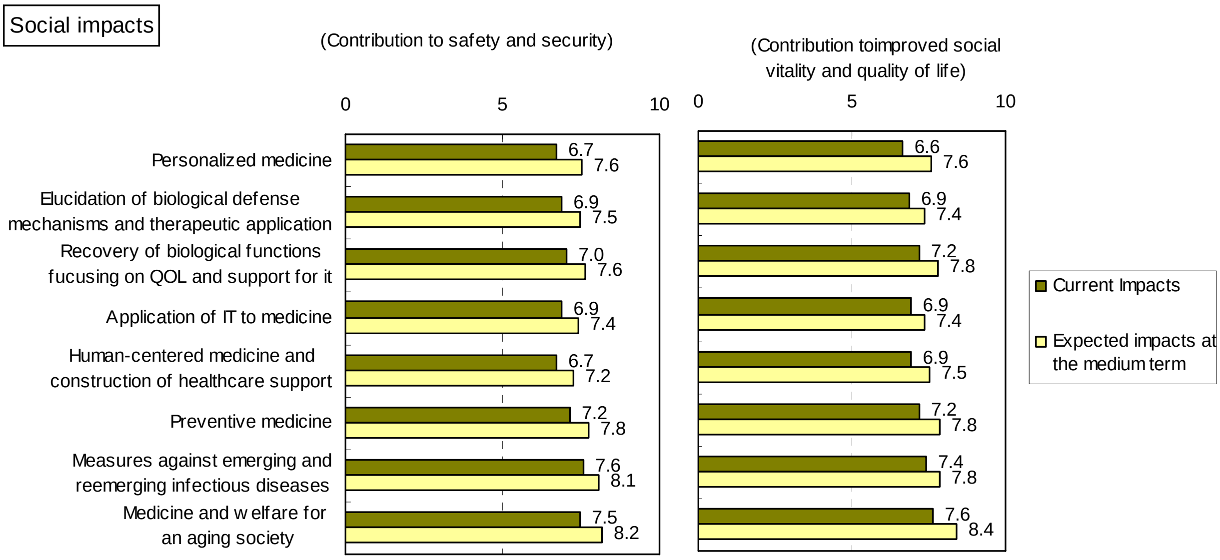
A. Impacts

Increased intellectual assets



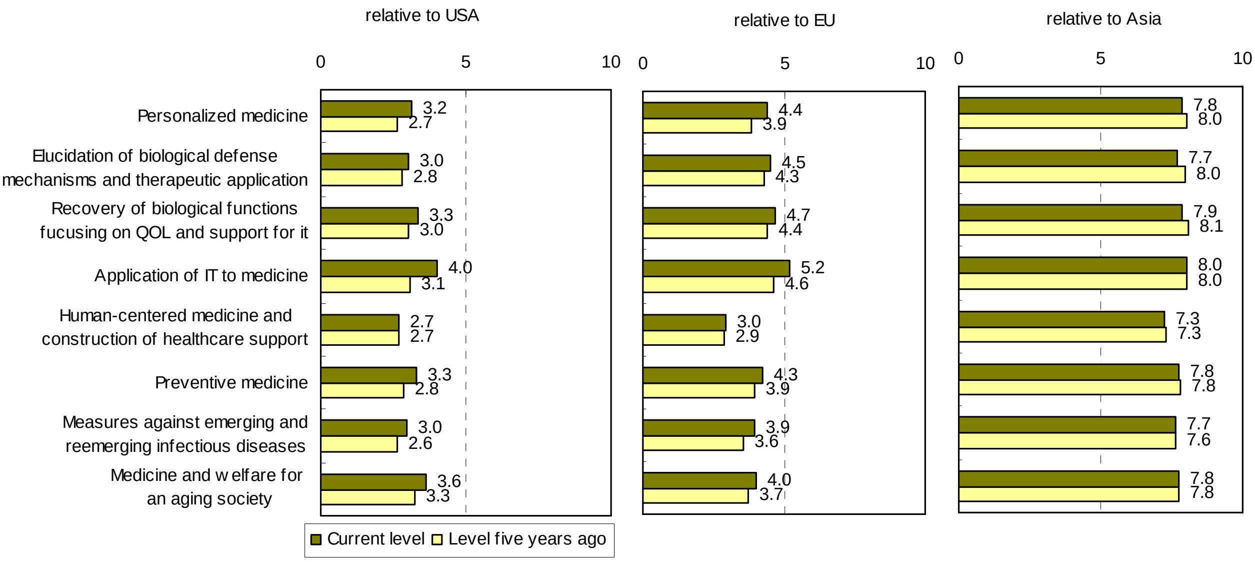
Economic impacts

Social impacts



*Responses are indexed on a 10-point scale.

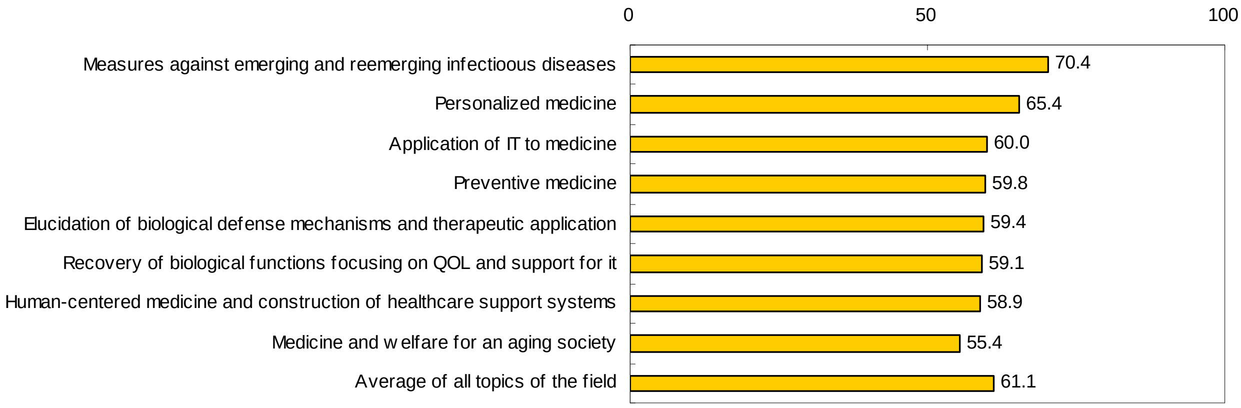
B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan

Average importance index by area



The most important 10 topics

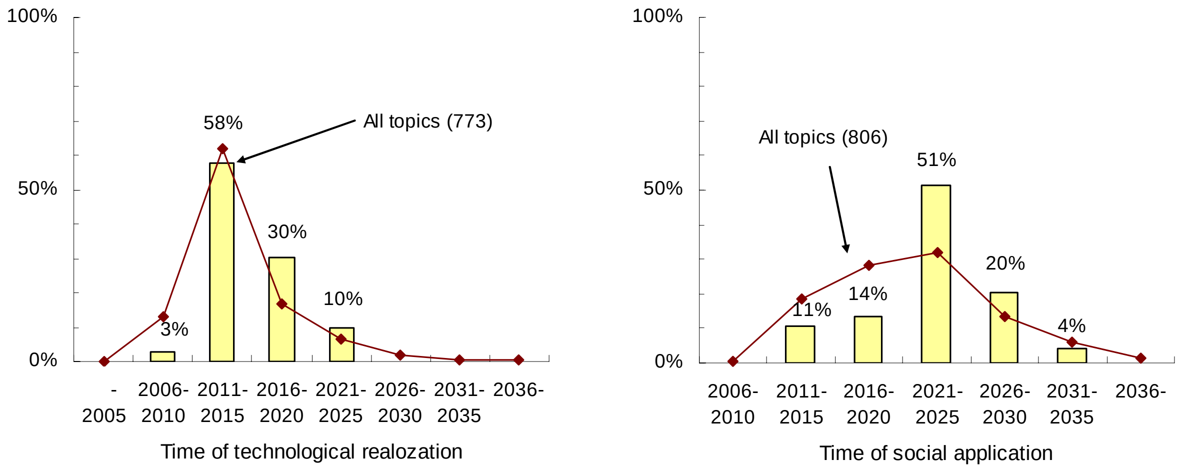
	Topic	Index	Year T*	Year S*
1	03: Elucidation of the pathogenesis of atherosclerosis.	92	2015	-
2	02: Therapeutic application of the achievements on the pathophysiology of cancerization	89	2021	2028
3	01: Elucidation of the pathophysiology of cancer metastasis.	86	2018	-
4	30: Prophylactic technologies to overcome hospital-acquired infection.	85	2011	2018
5	71: Methods to overcome drug resistance in infections.	83	2014	2022
6	77: Drugs to cure Alzheimer's disease.	82	2019	2029
7	16: Tailored cancer treatments.	80	2014	2023
8	69: Systems to almost perfectly detect infected people and carriers of imported pathogens at airports and seaports.	79	2014	2022
9	70: Methods to prevent and treat human infection with highly pathogenic avian influenza found in poultry.	78	2013	2020
10	04: Early-phase diagnosis of almost all types of cancer by blood testing.	77	2018	2026

Year T: Time of technological realization Year S: Time of social application

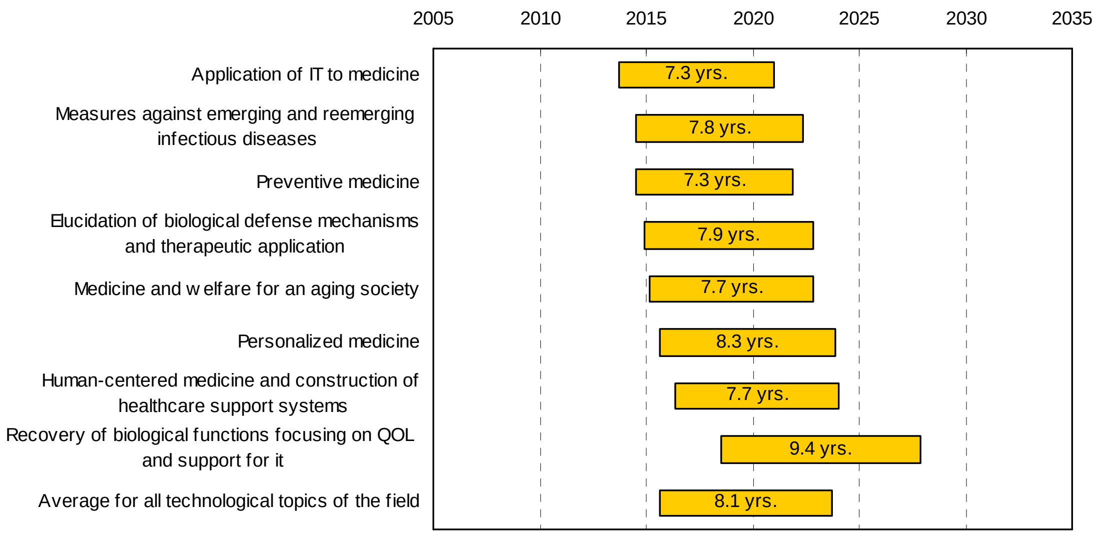
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

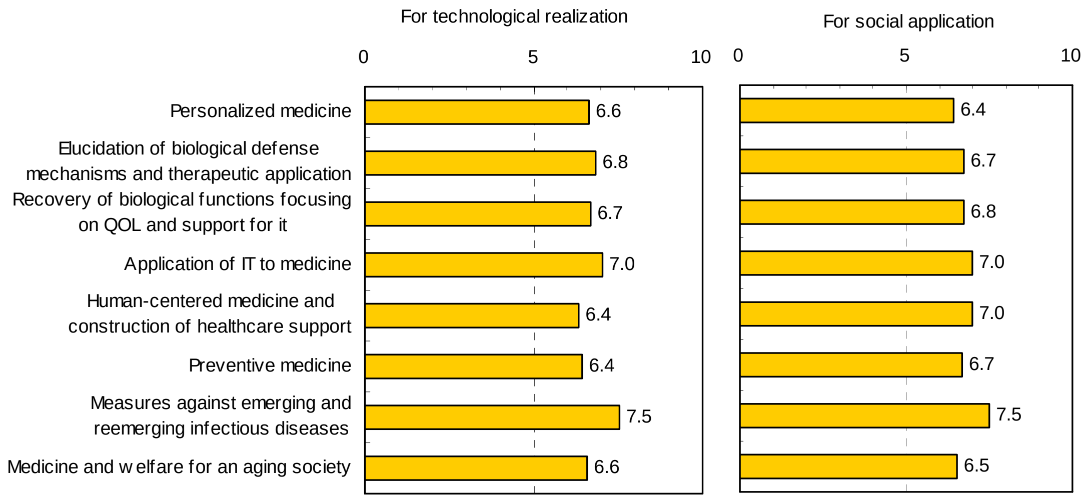
Topic	Year T*	Period*	Area
10: Gene therapy of cancer.	2018	11	Personalized medicine
32: Completely implanted artificial kidney technology.	2021	11	Recovery of biological functions focusing on QOL and support for it
31: Treatment methods that promote recovery from motor paralysis through transplantation of nerve stem cells.	2020	10	Recovery of biological functions focusing on QOL and support for it
37: Completely implanted artificial hearts and lungs.	2022	10	Recovery of biological functions focusing on QOL and support for it
39: Artificial limbs with sensation.	2021	10	Recovery of biological functions focusing on QOL and support for it
57: Systems to prevent the onset of serious genetic disease.	2020	10	Preventive medicine
76: Methods to prevent the occurrence of neurogenerative diseases.	2020	10	Medicine and welfare for an aging society
77: Drugs to cure Alzheimer's disease.	2019	10	Medicine and welfare for an aging society

Topic	Time*	Periods*	Area
42: Systems for the collection and use of all of a patient's medical data, including test results, case history, and medications, on a single card.	2009	4	Application of IT to medicine
80: Automatic Systems for programming fitness for the elderly.	2010	5	Medicine and welfare for an aging society
55: Methods to prevent senile osteoporosis.	2013	6	Preventive medicine
56: Prevention and treatment methods for dental caries and periodontitis.	2011	6	Preventive medicine
60: Blood tests (evaluation of nutrition intake, etc.) and urine tests (evaluation of cancer risk through urinary metabolites, etc.) that accurately reflect risk of lifestyle disease.	2013	6	Preventive medicine
74: Systems for family management of health and emergency.	2012	6	Medicine and welfare for an aging society

*Year T: Time of technological realization   Period: Period until social application (years)

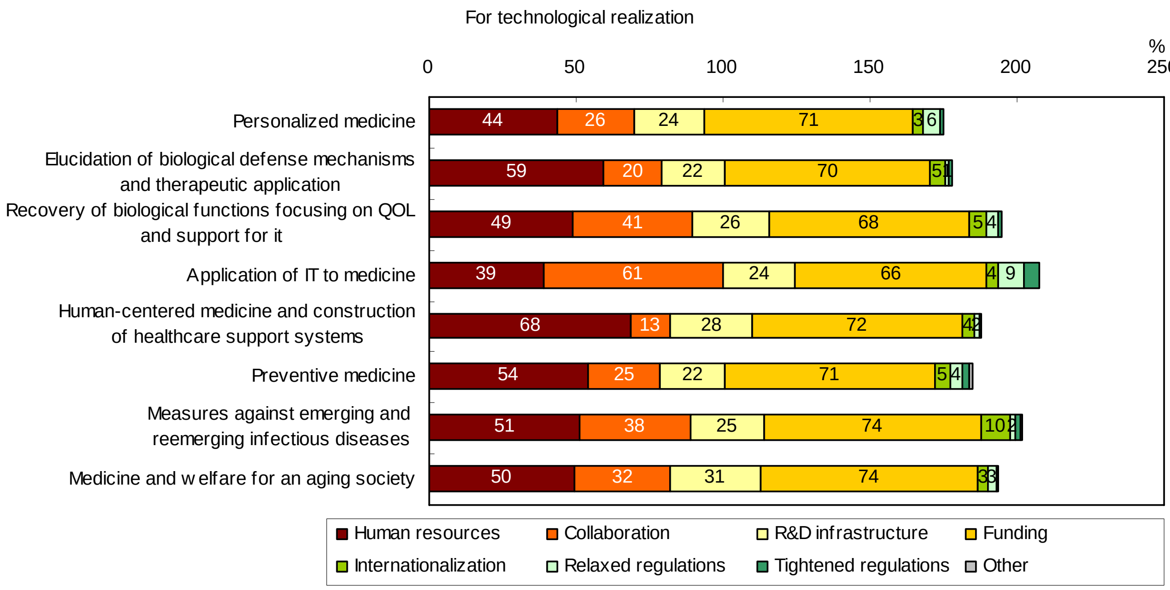
E. Effective measures that should taken by government

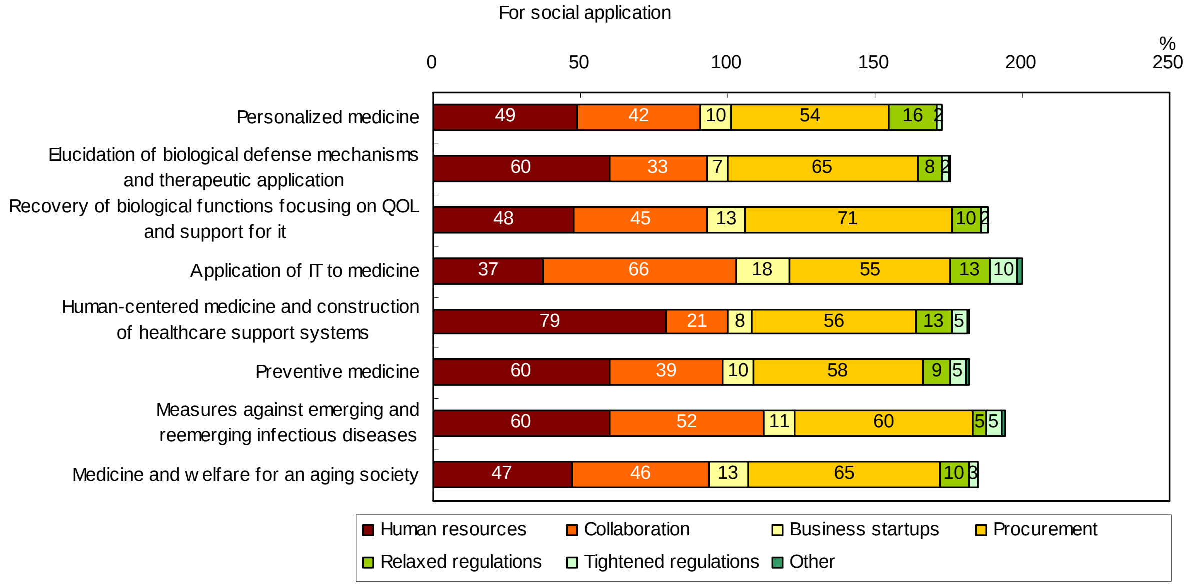
Necessity of government involvement



*Responses were indexed on a 10-point scale

Effective measures





F. Time-line of topics

Technological realization

Year	Topic
2009	42: Systems for the collection and use of all of a patient's medical data, including test results, case history, and medications, on a single card.
2010	80: Automatic Systems for programming fitness for the elderly.
2011	30: Prophylactic technologies to overcome hospital-acquired infection.
	56: Prevention and treatment methods for dental caries and periodontitis.
2012	63: Therapeutic agents for addictions such as nicotine addiction.
	74: Systems for family management of health and emergency.
2013	13: Assays of drug resistance of cancers.
2013	14: Effective radiological therapy and intensifying drugs for cancer treatment.
	15: Drug delivery systems (DDS).
	55: Methods to prevent senile osteoporosis.
	58: Technology to prevent premature birth.
	60: Blood tests (evaluation of nutrition intake, etc.) and urine tests (evaluation of cancer risk through urinary metabolites, etc.) that accurately reflect risk of lifestyle disease.
	68: Automatic devices to identify pathogens and evaluate their drug susceptibility within 1 hour.
	70: Methods to prevent and treat human infection with highly pathogenic avian influenza found in poultry.
2014	07: Oral administation of insulin
	11: Hemocatharsis devices that selectively remove target substances from the blood.
	16: Tailored cancer treatments.
	18: Immunological therapy with high specificity and long effects against target infections.
	21: Early detection methods for rejection of organ and tissue transplants.
	22: Drugs to cure viral liver disease.
	29: Technology to control rejection following transplantation of hematopoietic stem cells.
	43: Treatment technologies utilizing micromachines for the entire digestive tract.
	46: Technology to quantify psychological stress.
	61: Genome-based methods to diagnose changes in the risk of illnesses.
	64: Drugs that are effective for improving obesity.
	66: Treatment that completely cure HIV infection.

Year	Topic
	69: Systems to almost perfectly detect infected people and carriers of imported pathogens at airports and seaports.
	71: Methods to overcome drug resistance in infections.
	72: Methods to quantitatively evaluate biological age.
	73: Completely implanted urination-cotrolling apparatuses.
2015	03: Elucidation of the pathogenesis of atherosclerosis.
	09: Immunological therapy effective for cancer
	12: Gene therapy that allows for localized treatment of atheroclerotic lesions.
	17: Hypothermic treatment of cancer (an innovative treatment aiming at slowing cancer development and lengthening the time spent for coexistence with cancer).
	23: Treatment methods that completely cure atopic dermatitis and other allergic disease.
	24: Anti-cancer agents and immunosuppressive drugs that drastically reduce iatrogenic opportunistic infections and do not interfere with phylaxis.
	27: Treatment methods for hematological disease through regulation of the growth and differentiation of hematopoietic stem cells.
	28: Methods to prevent the onset of aplastic anemia, myelodysplastic syndromes, and other idiopathic hematopoietic disorders.
	33: Autogenous tissue storage, growth, and transplantation.
	35: Caregiver robots for the severely disabled (mentally or physically).
	40: Artificial blood.
	41: Evaluation and treatment methods for people with impairments of higher cortical functions
	54: Communication systems for people with cognitive or language disabilities.
	79: Robots for monitoring the safty in childcare.
2016	08: Gene therapy of familial hypercholesterolemia.
	26: Elucidation of the influence of endocrine-disrupting substances, and measures based thereon.
	44: Visualization technology for in vivo functions such as signal transmission and metabolism.
	45: Imaging systems that can detect almost all disease anywhere in the body.
	78: Elimination of infertility.
2017	19: Methods to prevent the onset of autoimmune disease.
	49: Elucidation of the causes of attention deficit hyperactivity disorder (ADHD).
2018	01: Elucidation of the pathophysiology of cancer metastasis.
	04: Early-phase diagnosis of almost all types of cancer by blood testing.
	06: Gene therapy of diabetes mellitus
	10: Gene therapy of cancer.
	20: Treatment methods that cure autoimmune disease.
2019	05: Diagnostic methods to help select appropriate treatment of kidney disorders without performing a renal biopsy.
	67: Treatment for prion diseases.
	77: Drugs to cure Alzheimer's disease.
2020	31: Treatment methods that promote recovery from motor paralysis through transplantation of nerve stem cells.
	34: Treatment technologies for the regeneration of damaged organs by using embryonic stem cells.
	36: Regenerative muscle treatment methods for muscular dystrophy.
	38: Completely implanted endocrine organs.
	48: Treatment that fully cures schizophrenia.
	57: Systems to prevent the onset of serious genetic disease.
	76: Methods to prevent the occurrence of neurogenerative diseases.
2021	02: Therapeutic application of the achievements on the pathophysiology of cancerization
	32: Completely implanted artificial kidney technology.
	39: Artificial limbs with sensation.
	62: Effective chemopreventive drugs for cancer.

Year	Topic
2022	75: Elucidation of individual aging mechanisms.
	25: Elucidation of the mechanisms of change in organisms in space environments.
	37: Completely implanted artificial hearts and lungs.

Social application

Year	Topic
2011	53: Development of outpatient clinic for second opinion and its searching system.
2012	52: Development of hospital staff like a hotel concierge or a butler who can answer patients' queries and demands.
2013	42: Systems for the collection and use of all of a patient's medical data, including test results, case history, and medications, on a single card.
2014	47: Preparation of terminal-care environments, facilities, and technology in which patients can end their lives comfortably and peacefully.
	59: Standardization and spread of evaluation of medical economics.
2015	50: Development of evaluation and training programs to improve ADL (activities of daily living) of disabled people.
	51: Preparation of social infrastructures to improve lives of disabled people markedly.
	80: Automatic Systems for programming fitness for the elderly.
2017	56: Prevention and treatment methods for dental caries and periodontitis.
2018	30: Prophylactic technologies to overcome hospital-acquired infection.
	74: Systems for family management of health and emergency.
2019	55: Methods to prevent senile osteoporosis.
	60: Blood tests (evaluation of nutrition intake, etc.) and urine tests (evaluation of cancer risk through urinary metabolites, etc.) that accurately reflect risk of lifestyle disease.
2019	63: Therapeutic agents for addictions such as nicotine addiction.
2020	15: Drug delivery systems (DDS).
	58: Technology to prevent premature birth.
	65: Expansion and improvement of health information systems for the general public in order to promote personalized medicine through genome data.
	70: Methods to prevent and treat human infection with highly pathogenic avian influenza found in poultry.
2021	07: Oral administation of insulin
	13: Assays of drug resistance of cancers.
	14: Effective radiological therapy and intensifying drugs for cancer treatment.
	21: Early detection methods for rejection of organ and tissue transplants.
	46: Technology to quantify psychological stress.
	64: Drugs that are effective for improving obesity.
	66: Treatment that completely cure HIV infection.
	68: Automatic devices to identify pathogens and evaluate their drug susceptibility within 1 hour.
2022	11: Hemocatharsis devices that selectively remove target substances from the blood.
	18: Immunological therapy with high specificity and long effects against target infections.
	22: Drugs to cure viral liver disease.
	43: Treatment technologies utilizing micromachines for the entire digestive tract.
	61: Genome-based methods to diagnose changes in the risk of illnesses.
	69: Systems to almost perfectly detect infected people and carriers of imported pathogens at airports and seaports.
	71: Methods to overcome drug resistance in infections.
	73: Completely implanted urination-cotrolling apparatuses.
2023	09: Immunological therapy effective for cancer
	16: Tailored cancer treatments.
	23: Treatment methods that completely cure atopic dermatitis and other allergic disease.
	27: Treatment methods for hematological disease through regulation of the growth and differentiation of hematopoietic stem cells.

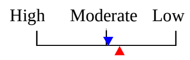
Year	Topic
2024	29: Technology to control rejection following transplantation of hematopoietic stem cells.
	33: Autogenous tissue storage, growth, and transplantation.
	54: Communication systems for people with cognitive or language disabilities.
	78: Elimination of infertility.
	79: Robots for monitoring the safty in childcare.
	08: Gene therapy of familial hypercholesterolemia.
	12: Gene therapy that allows for localized treatment of atheroclerotic lesions.
	17: Hypothermic treatment of cancer (an innovative treatment aiming at slowing cancer development and lengthening the time spent for coexistence with cancer).
	19: Methods to prevent the onset of autoimmune disease.
	24: Anti-cancer agents and immunosuppressive drugs that drastically reduce iatrogenic opportunistic infections and do not interfere with phylaxis.
	26: Elucidation of the influence of endocrine-disrupting substances, and measures based thereon.
	28: Methods to prevent the onset of aplastic anemia, myelodysplastic syndromes, and other idiopathic hematopoietic disorders.
	35: Caregiver robots for the severely disabled (mentally or physically).
	40: Artificial blood.
	41: Evaluation and treatment methods for people with impairments of higher cortical functions
	45: Imaging systems that can detect almost all disease anywhere in the body.
2025	20: Treatment methods that cure autoimmune disease.
	44: Visualization technology for in vivo functions such as signal transmission and metabolism.
2026	04: Early-phase diagnosis of almost all types of cancer by blood testing.
2027	05: Diagnostic methods to help select appropriate treatment of kidney disorders without performing a renal biopsy.
	06: Gene therapy of diabetes mellitus
2028	02: Therapeutic application of the achievements on the pathophysiology of cancerization
2028	48: Treatment that fully cures schizophrenia.
	67: Treatment for prion diseases.
2029	10: Gene therapy of cancer.
	34: Treatment technologies for the regeneration of damaged organs by using embryonic stem cells.
	36: Regenerative muscle treatment methods for muscular dystrophy.
	38: Completely implanted endocrine organs.
	77: Drugs to cure Alzheimer's disease.
2030	31: Treatment methods that promote recovery from motor paralysis through transplantation of nerve stem cells.
	57: Systems to prevent the onset of serious genetic disease.
	62: Effective chemopreventive drugs for cancer.
	76: Methods to prevent the occurrence of neurogenerative diseases.
2031	39: Artificial limbs with sensation.
2032	32: Completely implanted artificial kidney technology.
	37: Completely implanted artificial hearts and lungs.

Appendix: Results of R1 and R2

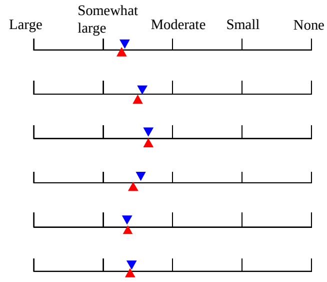
I. Personalized medicine

1. Questions regarding the area

1) Degree of expertise in the area



2) Current impacts

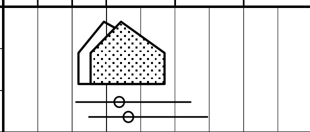
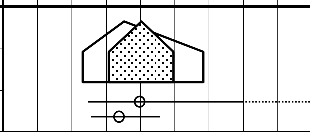
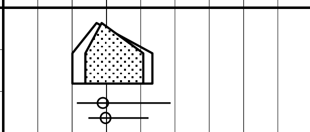
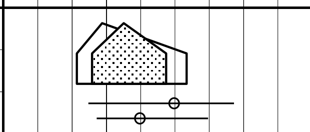
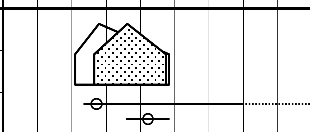
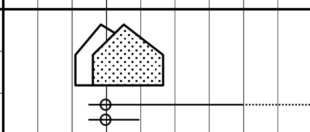
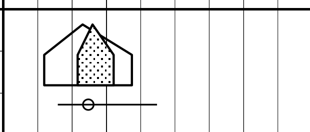
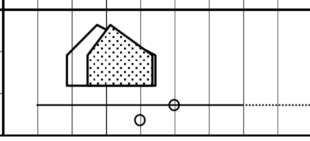


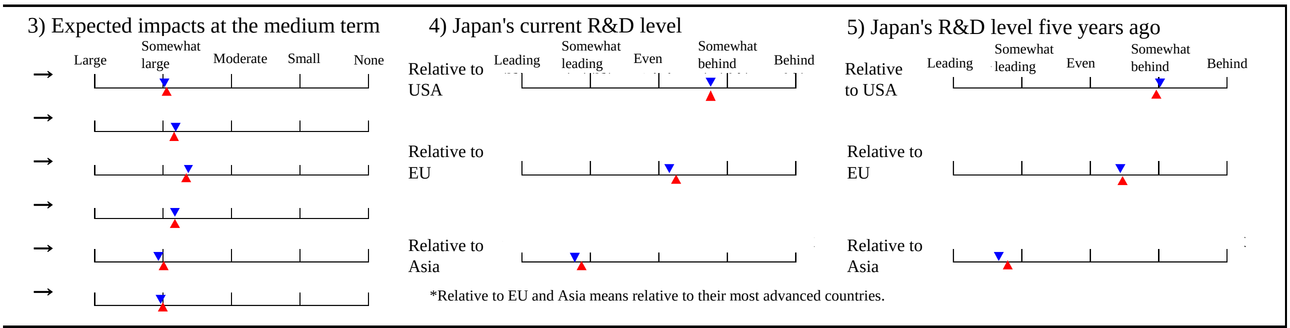
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

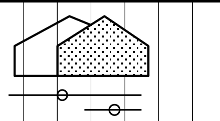
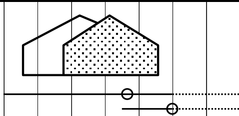
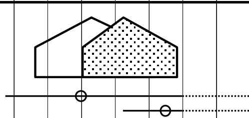
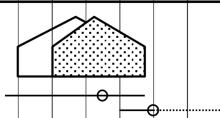
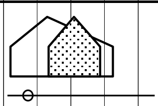
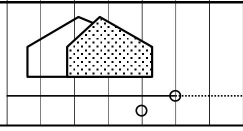
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

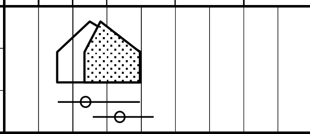
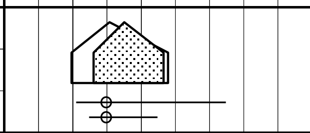
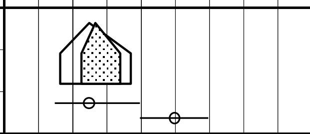
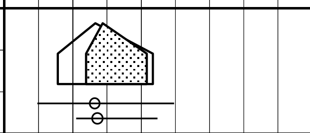
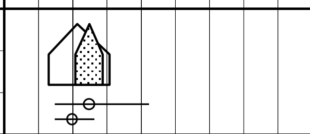
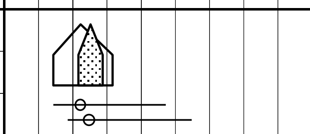
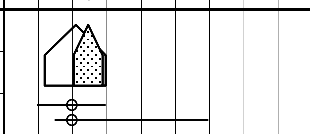
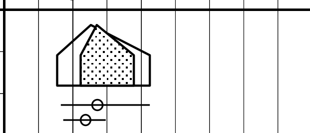
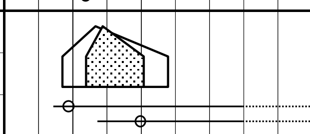
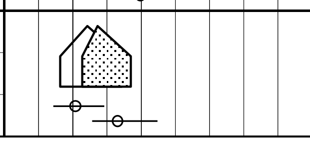
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
1	Elucidation of the pathophysiology of cancer metastasis.	1	101	19	24	57	-	79	61	34	4	1		3	11
		2	82	12	24	64	-	86	72	27	1	0		1	7
		E	10	100	0	0	-	100	100	0	0	0		0	0
2	Therapeutic application of the achievements on the pathophysiology of cancerization	1	103	22	26	52	-	83	68	29	2	1		3	12
		2	80	15	24	61	-	89	80	19	1	0		1	9
		E	12	100	0	0	-	96	92	8	0	0		0	0
3	Elucidation of the pathogenesis of atherosclerosis.	1	105	21	30	49	-	82	65	33	1	1		0	11
		2	91	13	24	63	-	92	85	14	0	1		2	7
		E	12	100	0	0	-	100	100	0	0	0		8	8
4	Early-phase diagnosis of almost all types of cancer by blood testing.	1	105	14	31	55	-	71	48	41	11	0		9	15
		2	84	8	27	65	-	77	58	36	5	1		2	13
		E	7	100	0	0	-	100	100	0	0	0		14	0
5	Diagnostic methods to help select appropriate treatment of kidney disorders without performing a renal biopsy.	1	76	7	26	67	-	57	25	53	22	0		3	15
		2	72	7	14	79	-	51	14	62	24	0		0	13
		E	5	100	0	0	-	80	60	40	0	0		0	0
6	Gene therapy of diabetes mellitus	1	88	7	27	66	-	72	45	52	2	1		2	17
		2	77	3	19	78	-	66	36	58	3	3		5	12
		E	2	100	0	0	-	100	100	0	0	0		0	0
7	Oral administation of insulin	1	84	6	23	71	-	69	45	43	12	0		4	17
		2	81	0	19	81	-	67	37	57	6	0		2	16
		E													
8	Gene therapy of familial hypercholesterolemia.	1	81	5	26	69	-	47	17	43	36	4		0	20
		2	68	3	22	75	-	42	7	50	40	3		4	15
		E	2	100	0	0	-	50	0	100	0	0		0	50

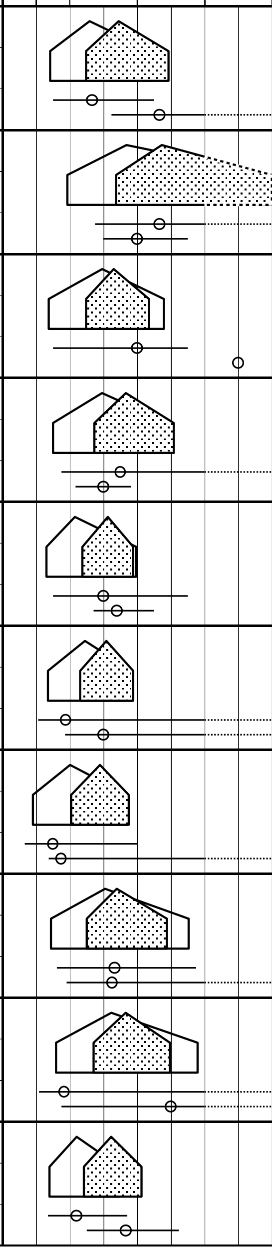


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application			Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
3	96	1	0	0	47	35	16	2	52	33	35	66	19	8	0	0														
1	99	0	0	0	52	41	6	1	65	15	18	74	4	5	1	0														
10	90	0	0	0	90	10	0	0	70	20	20	80	10	20	10	0														
1	99	0	0	0	51	36	13	0	52	41	38	67	17	10	1	0		5	13	47	34	17	2	53	44	24	41	31	10	1
0	100	0	0	0	63	32	4	1	66	24	22	74	1	8	1	0		0	10	57	36	4	3	73	41	11	38	23	3	0
0	100	0	0	0	75	25	0	0	83	33	17	83	0	17	8	0		0	8	75	25	0	0	92	42	25	58	25	8	0
11	87	2	0	0	43	47	10	0	46	35	39	72	13	9	0	1														
2	97	1	0	0	31	64	4	1	54	20	31	74	2	6	0	0														
0	92	8	0	0	33	67	0	0	25	17	17	92	0	8	0	0														
15	83	2	0	0	28	49	16	7	40	35	41	60	16	8	3	0		4	23	29	40	22	9	42	35	26	45	25	9	0
5	95	0	0	0	14	71	13	2	46	28	26	71	4	5	1	0		2	13	14	72	9	5	52	36	19	49	16	4	0
0	100	0	0	0	29	57	14	0	43	43	14	71	14	29	14	0		14	0	33	50	0	17	60	60	20	60	20	20	0
15	80	4	0	1	22	40	33	5	46	34	32	62	16	3	0	0		6	18	16	42	33	9	48	34	14	47	20	2	0
9	90	0	1	0	7	71	21	1	53	16	16	66	3	1	0	0		0	13	7	69	24	0	56	28	7	44	12	0	1
20	60	0	20	0	0	60	40	0	80	20	20	80	0	0	0	0		0	0	20	80	0	0	60	40	20	40	40	0	0
5	93	2	0	0	34	51	15	0	43	35	40	66	12	13	1	0		1	22	27	47	22	4	41	38	19	47	26	12	3
1	98	0	0	1	20	69	8	3	53	26	26	73	3	8	1	0		5	11	15	74	8	3	57	38	14	57	19	1	0
0	100	0	0	0	0	100	0	0	50	0	50	100	0	0	0	0		0	0	0	100	0	0	100	100	0	0	0	0	0
7	89	4	0	0	18	40	33	9	28	38	35	60	11	15	0	0		4	20	14	38	38	10	38	35	21	45	23	1	0
4	95	1	0	0	10	68	22	0	27	37	20	67	3	3	0	0		1	15	10	61	28	1	34	46	7	62	13	0	0
4	95	1	0	0	11	47	39	3	30	27	37	63	11	14	3	0		0	21	11	38	38	13	39	34	18	42	29	10	2
0	100	0	0	0	6	54	36	4	34	13	22	69	3	6	0	2		5	12	5	54	35	6	34	33	5	59	23	0	0
0	100	0	0	0	0	50	50	0	100	50	50	50	0	0	0	0		0	50	0	50	50	0	100	50	0	50	100	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
9	Immunological therapy effective for cancer	1	**96**	**21**	**25**	**54**	**-**	**70**	**47**	**43**	**9**	**1**		**3**	**14**
		2	**78**	**13**	**29**	**58**	**-**	**76**	**52**	**47**	**1**	**0**		**0**	**12**
		E	**10**	**100**	**0**	**0**	**-**	**85**	**70**	**30**	**0**	**0**		**0**	**0**
10	Gene therapy of cancer.	1	**94**	**18**	**23**	**59**	**-**	**65**	**40**	**46**	**10**	**4**		**6**	**14**
		2	**78**	**10**	**22**	**68**	**-**	**61**	**31**	**54**	**12**	**3**		**4**	**17**
		E	**8**	**100**	**0**	**0**	**-**	**78**	**62**	**25**	**13**	**0**		**13**	**13**
11	Hemocatharsis devices that selectively remove target substances from the blood.	1	**80**	**8**	**30**	**62**	**-**	**53**	**17**	**61**	**21**	**1**		**0**	**10**
		2	**76**	**5**	**18**	**77**	**-**	**48**	**4**	**78**	**18**	**0**		**0**	**13**
		E	**4**	**100**	**0**	**0**	**-**	**83**	**67**	**33**	**0**	**0**		**0**	**33**
12	Gene therapy that allows for localized treatment of atheroclerotic lesions.	1	**79**	**11**	**34**	**55**	**-**	**60**	**30**	**54**	**12**	**4**		**5**	**13**
		2	**72**	**10**	**14**	**76**	**-**	**52**	**13**	**74**	**10**	**3**		**7**	**10**
		E	**7**	**100**	**0**	**0**	**-**	**64**	**29**	**71**	**0**	**0**		**0**	**29**
13	Assays of drug resistance of cancers.	1	**86**	**16**	**29**	**55**	**-**	**68**	**44**	**41**	**15**	**0**		**1**	**11**
		2	**73**	**11**	**21**	**68**	**-**	**64**	**35**	**51**	**14**	**0**		**0**	**7**
		E	**8**	**100**	**0**	**0**	**-**	**78**	**62**	**25**	**13**	**0**		**0**	**0**
14	Effective radiological therapy and intensifying drugs for cancer treatment.	1	**81**	**16**	**27**	**57**	**-**	**61**	**34**	**43**	**23**	**0**		**0**	**13**
		2	**71**	**11**	**18**	**71**	**-**	**56**	**21**	**62**	**17**	**0**		**0**	**11**
		E	**8**	**100**	**0**	**0**	**-**	**75**	**50**	**50**	**0**	**0**		**0**	**13**
15	Drug delivery systems (DDS).	1	**85**	**9**	**28**	**63**	**-**	**61**	**30**	**54**	**16**	**0**		**0**	**11**
		2	**73**	**10**	**19**	**71**	**-**	**53**	**10**	**82**	**8**	**0**		**0**	**10**
		E	**7**	**100**	**0**	**0**	**-**	**64**	**29**	**71**	**0**	**0**		**0**	**14**
16	Tailored cancer treatments.	1	**88**	**26**	**24**	**50**	**-**	**74**	**54**	**35**	**10**	**1**		**0**	**13**
		2	**80**	**15**	**19**	**66**	**-**	**80**	**64**	**30**	**6**	**0**		**0**	**8**
		E	**12**	**100**	**0**	**0**	**-**	**92**	**83**	**17**	**0**	**0**		**0**	**0**
17	Hypothermic treatment of cancer (an innovative treatment aiming at slowing cancer development and lengthening the time spent for coexistence with cancer).	1	**73**	**12**	**22**	**66**	**-**	**59**	**33**	**41**	**22**	**4**		**1**	**17**
		2	**66**	**5**	**8**	**87**	**-**	**55**	**21**	**57**	**20**	**2**		**5**	**14**
		E	**3**	**100**	**0**	**0**	**-**	**83**	**67**	**33**	**0**	**0**		**0**	**0**
18	Immunological therapy with high specificity and long effects against target infections.	1	**80**	**23**	**25**	**52**	**-**	**68**	**41**	**49**	**9**	**1**		**1**	**14**
		2	**72**	**10**	**24**	**66**	**-**	**61**	**26**	**66**	**8**	**0**		**1**	**6**
		E	**7**	**100**	**0**	**0**	**-**	**79**	**57**	**43**	**0**	**0**		**0**	**0**

Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application		Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)								(%)		(%)				(%)						
14	83	3	0	0	26	44	27	3	40	27	41	70	14	13	0	0	2	15	24	42	26	8	47	38	20	48	30	1	1
6	94	0	0	0	19	70	11	0	47	13	31	81	5	7	1	0	0	13	17	73	9	1	56	32	11	63	19	3	0
10	90	0	0	0	50	50	0	0	50	30	30	100	30	20	10	0	0	0	40	60	0	0	70	20	20	70	40	10	0
4	95	1	0	0	23	56	20	1	40	29	43	65	20	15	6	0	5	18	24	53	19	4	48	34	19	45	34	13	0
0	100	0	0	0	12	74	11	3	47	12	28	72	5	7	1	1	4	18	15	72	9	4	58	26	9	54	30	3	1
0	100	0	0	0	25	62	13	0	88	13	25	63	13	13	13	13	13	13	38	49	13	0	63	38	13	63	25	13	13
36	61	3	0	0	16	47	33	4	28	44	31	63	8	7	1	0	0	14	14	46	32	8	33	55	24	42	20	3	0
29	71	0	0	0	4	68	28	0	24	41	16	65	1	3	0	1	1	14	5	63	32	0	24	60	14	47	13	1	0
33	67	0	0	0	33	67	0	0	100	33	33	33	0	0	0	0	33	33	33	67	0	0	33	33	33	100	33	0	0
10	90	0	0	0	12	62	23	3	29	30	37	69	11	14	6	0	4	14	16	56	24	4	38	32	15	48	32	11	0
3	97	0	0	0	8	73	13	6	31	28	25	72	3	12	3	0	7	9	9	72	13	6	41	33	8	70	19	3	0
0	100	0	0	0	29	57	14	0	57	29	29	57	0	0	14	0	0	29	17	83	0	0	17	33	0	83	17	17	0
10	90	0	0	0	20	40	35	5	31	41	40	63	18	12	0	0	2	13	22	44	28	6	43	42	24	39	19	4	0
7	93	0	0	0	13	62	24	1	24	39	24	70	4	6	1	0	1	7	14	57	25	4	49	54	10	48	12	3	0
0	100	0	0	0	13	49	38	0	25	25	25	88	13	13	13	0	13	0	37	25	25	13	71	29	43	57	14	14	0
7	88	5	0	0	21	44	31	4	31	36	39	59	16	15	4	0	0	13	19	49	26	6	42	49	17	42	20	4	0
1	99	0	0	0	14	62	23	1	30	36	35	64	3	4	1	0	0	13	13	63	20	4	46	63	12	45	6	2	0
0	100	0	0	0	25	50	25	0	50	38	38	75	25	13	13	0	0	13	25	37	25	13	57	43	43	57	14	14	0
15	81	4	0	0	16	47	35	2	26	46	27	54	12	14	3	1	0	14	21	46	29	4	28	46	20	35	27	8	0
7	92	1	0	0	7	74	18	1	20	65	15	62	4	8	1	0	0	10	10	69	20	1	19	70	12	46	17	1	0
29	71	0	0	0	28	29	29	14	33	83	17	67	33	17	17	0	0	14	29	43	14	14	17	50	33	33	67	17	0
7	91	2	0	0	30	44	24	2	46	34	43	61	18	14	0	0	1	14	30	37	28	5	54	39	18	46	30	4	0
3	96	1	0	0	29	52	18	1	56	23	29	72	4	8	3	0	0	9	27	55	17	1	61	32	15	61	17	3	0
8	92	0	0	0	33	59	8	0	67	17	8	75	17	8	0	0	0	8	33	50	17	0	50	8	8	75	0	0	0
8	87	3	0	2	16	49	29	6	38	28	32	55	15	9	2	0	4	15	16	43	31	10	51	38	13	39	15	2	0
3	97	0	0	0	13	66	16	5	56	17	17	78	3	3	2	2	3	16	14	64	17	5	68	37	7	52	7	2	0
0	100	0	0	0	67	33	0	0	100	67	33	67	33	33	33	0	0	0	33	67	0	0	100	67	33	67	33	33	0
7	92	1	0	0	32	50	17	1	44	31	43	68	15	11	1	0	0	18	31	44	22	3	49	42	12	53	22	8	0
4	95	0	1	0	16	74	10	0	54	13	28	77	4	4	0	0	0	8	14	73	13	0	52	43	7	65	10	0	0
14	86	0	0	0	33	67	0	0	50	17	50	100	17	0	0	0	0	0	33	67	0	0	33	33	17	100	17	0	0

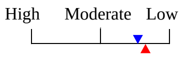
Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–



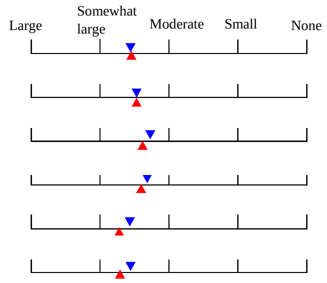
II. Elucidation of biological defense mechanisms and therapeutic application

1. Questions regarding the area

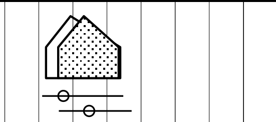
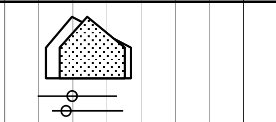
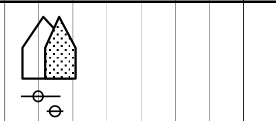
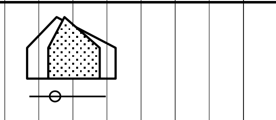
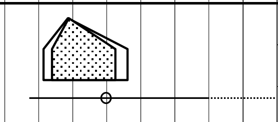
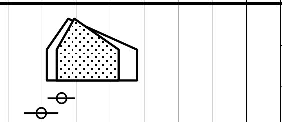
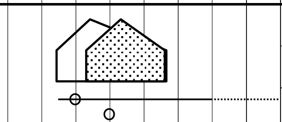
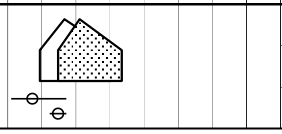
1) Degree of expertise in the area

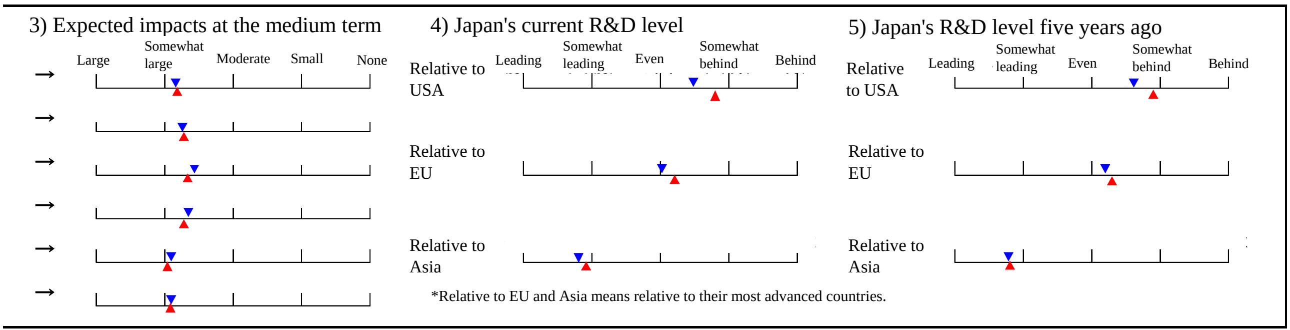


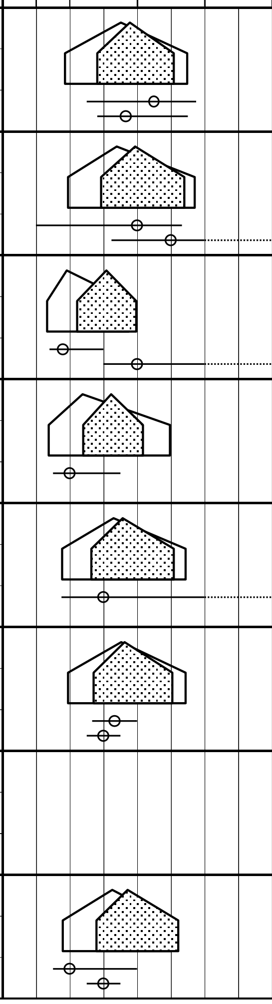
2) Current impacts

[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

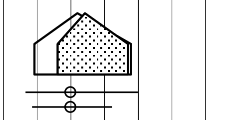
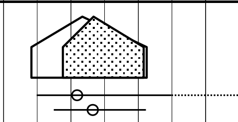
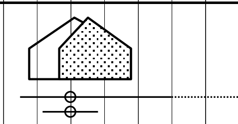
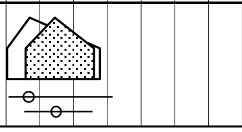
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
19	Methods to prevent the onset of autoimmune disease.	1	75	11	36	53	-	60	28	58	14	0		4	22
		2	72	8	22	70	-	53	11	81	8	0		0	17
		E	6	100	0	0	-	58	17	83	0	0		0	17
20	Treatment methods that cure autoimmune disease.	1	78	12	31	57	-	64	36	50	14	0		3	21
		2	71	8	27	65	-	56	17	73	10	0		0	18
		E	6	100	0	0	-	75	50	50	0	0		0	17
21	Early detection methods for rejection of organ and tissue transplants.	1	80	10	30	60	-	62	34	46	20	0		0	9
		2	73	3	29	68	-	56	16	74	10	0		0	8
		E	2	100	0	0	-	38	0	50	50	0		0	0
22	Drugs to cure viral liver disease.	1	72	8	26	66	-	69	46	36	18	0		0	14
		2	70	0	17	83	-	76	56	37	7	0		0	10
		E													
23	Treatment methods that completely cure atopic dermatitis and other allergic disease.	1	74	4	23	73	-	66	42	39	19	0		1	17
		2	71	0	21	79	-	72	49	43	7	1		0	14
		E													
24	Anti-cancer agents and immunosuppressive drugs that drastically reduce iatrogenic opportunistic infections and do not interfere with phylaxis.	1	80	11	38	51	-	68	44	40	16	0		0	16
		2	74	3	27	70	-	65	36	53	10	1		1	14
		E	2	100	0	0	-	100	100	0	0	0		0	0
25	Elucidation of the mechanisms of change in organisms in space environments.	1	46	4	15	81	-	44	14	37	44	5		2	23
		2	52	2	4	94	-	33	2	29	67	2		0	18
		E	1	100	0	0	-	100	100	0	0	0		0	0
26	Elucidation of the influence of endocrine-disrupting substances, and measures based thereon.	1	78	6	19	75	-	62	33	50	17	0		0	20
		2	66	3	9	88	-	56	20	66	14	0		0	8
		E	2	100	0	0	-	75	50	50	0	0		0	0





Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
6	92	2	0	0	19	52	28	1	53	24	34	73	11	6	0	0						3	22	20	42	29	9	47	33	14	52	19	6	0
1	99	0	0	0	10	77	13	0	58	13	24	72	6	3	0	0						0	19	8	74	17	1	57	21	7	74	11	0	0
0	100	0	0	0	17	83	0	0	67	50	50	83	0	17	0	0						0	17	17	66	0	17	60	40	20	100	0	0	0
1	99	0	0	0	23	49	27	1	48	29	32	77	14	14	0	0						1	21	23	39	32	6	48	36	13	54	16	3	0
1	99	0	0	0	13	74	13	0	60	12	21	74	7	0	0	0						0	18	10	72	17	1	60	28	10	74	10	0	0
17	83	0	0	0	20	80	0	0	80	20	20	60	20	0	0	0						0	17	17	83	0	0	67	50	0	83	17	0	0
1	98	0	1	0	16	55	25	4	47	35	29	58	14	15	4	0						0	9	19	44	32	5	41	31	18	53	16	9	0
0	100	0	0	0	11	76	13	0	54	20	17	70	4	4	0	0						0	7	13	69	18	0	56	23	11	67	13	3	0
0	100	0	0	0	0	50	50	0	50	50	100	0	0	0	0	0						0	0	50	0	50	0	100	0	50	100	0	0	0
22	78	0	0	0	32	46	21	1	45	34	27	67	13	10	1	0						0	16	32	35	30	3	46	38	11	46	20	3	0
14	86	0	0	0	32	55	11	2	62	23	15	72	3	0	0	0						0	12	32	51	17	0	54	42	6	69	11	0	0
5	87	6	2	0	25	44	30	1	41	37	30	70	10	4	0	0						0	21	24	35	37	4	46	39	12	49	18	1	0
1	97	0	1	1	24	60	16	0	51	18	18	72	1	0	1	0						0	13	21	54	24	1	51	39	6	66	6	0	0
6	92	1	1	0	27	47	26	0	45	42	38	69	20	9	0	0						0	18	26	39	32	3	46	48	27	51	17	0	1
1	99	0	0	0	15	71	14	0	56	27	17	68	3	0	0	0						1	14	11	73	15	1	54	37	10	64	7	1	0
0	100	0	0	0	50	50	0	0	50	50	0	100	0	0	0	0						0	0	50	50	0	0	100	50	0	50	0	0	0
0	96	2	0	2	26	41	28	5	46	32	44	44	34	2	0	0																		
0	98	0	2	0	16	48	32	4	60	19	36	45	19	0	0	0																		
0	100	0	0	0	100	0	0	0	100	0	0	100	100	0	0	0																		
9	79	12	0	0	30	51	19	0	48	41	37	58	12	7	11	0						1	18	34	44	19	3	57	45	18	39	10	18	0
3	92	3	2	0	21	66	13	0	61	27	23	73	6	0	3	0						0	6	17	73	10	0	67	40	3	49	5	11	0
0	100	0	0	0	50	50	0	0	50	0	0	100	50	0	0	0						0	0	50	50	0	0	50	50	0	50	0	0	0

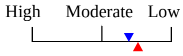
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Degree of expertise (%) Moderate	Degree of expertise (%) Low	Degree of expertise (%) None	Importance to Japan Index	Importance to Japan (%) High	Importance to Japan (%) Moderate	Importance to Japan (%) Low	Importance to Japan (%) None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
27	Treatment methods for hematological disease through regulation of the growth and differentiation of hematopoietic stem cells.	1	**75**	**16**	**23**	**61**	**-**	**62**	**36**	**41**	**23**	**0**							**0**	**10**
		2	**69**	**10**	**14**	**76**	**-**	**57**	**19**	**69**	**12**	**0**							**0**	**6**
		E	**7**	**100**	**0**	**0**	**-**	**93**	**86**	**14**	**0**	**0**							**0**	**0**
28	Methods to prevent the onset of aplastic anemia, myelodysplastic syndromes, and other idiopathic hematopoietic disorders.	1	**67**	**18**	**21**	**61**	**-**	**56**	**29**	**37**	**34**	**0**							**0**	**14**
		2	**60**	**12**	**10**	**78**	**-**	**50**	**12**	**63**	**25**	**0**							**0**	**13**
		E	**7**	**100**	**0**	**0**	**-**	**71**	**43**	**57**	**0**	**0**							**0**	**0**
29	Technology to control rejection following transplantation of hematopoietic stem cells.	1	**69**	**13**	**25**	**62**	**-**	**62**	**34**	**48**	**18**	**0**							**0**	**13**
		2	**68**	**7**	**18**	**75**	**-**	**54**	**13**	**75**	**12**	**0**							**0**	**6**
		E	**5**	**100**	**0**	**0**	**-**	**90**	**80**	**20**	**0**	**0**							**0**	**0**
30	Prophylactic technologies to overcome hospital-acquired infection.	1	**99**	**19**	**26**	**55**	**-**	**74**	**54**	**37**	**9**	**0**							**0**	**14**
		2	**84**	**15**	**21**	**64**	**-**	**85**	**72**	**22**	**6**	**0**							**0**	**6**
		E	**13**	**100**	**0**	**0**	**-**	**88**	**77**	**23**	**0**	**0**							**0**	**0**

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
6	94	0	0	0	25	49	25	1	50	32	39	71	14	14	1	0						0	10	18	50	28	4	45	44	14	56	18	2	0
4	96	0	0	0	16	74	10	0	60	18	24	76	3	6	0	0						0	4	12	78	10	0	58	45	6	66	9	0	0
14	86	0	0	0	86	14	0	0	57	43	43	100	14	14	0	0						0	0	43	57	0	0	43	57	14	71	43	0	0
7	93	0	0	0	22	44	32	2	47	30	34	69	14	9	0	0						0	15	19	44	34	3	49	38	15	56	15	2	0
2	98	0	0	0	14	74	12	0	53	14	19	81	3	0	0	0						0	10	12	72	16	0	55	31	3	67	5	0	2
17	83	0	0	0	43	57	0	0	71	29	29	100	14	0	0	0						0	0	29	71	0	0	57	57	29	71	29	0	0
5	95	0	0	0	24	48	27	1	45	35	38	71	12	8	0	0						0	15	18	45	32	5	50	38	20	53	13	2	0
3	97	0	0	0	13	77	10	0	55	18	22	75	3	0	0	0						0	6	11	72	17	0	61	29	6	64	6	0	2
0	100	0	0	0	100	0	0	0	80	60	40	100	20	0	0	0						0	0	40	60	0	0	60	80	40	60	40	0	0
5	93	2	0	0	42	39	16	3	62	39	41	48	11	9	12	1						0	14	45	31	23	1	62	41	18	43	14	19	2
2	97	1	0	0	50	43	7	0	82	27	24	60	4	1	8	0						0	7	59	33	8	0	84	34	4	54	7	10	0
8	92	0	0	0	62	38	0	0	85	15	15	77	0	0	8	0						0	0	69	31	0	0	92	31	0	46	8	15	0

III. Recovery of biological functions fucusing on QOL and support for it

1. Questions regarding the area

1) Degree of expertise in the area

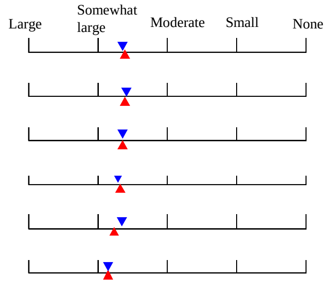


2) Current impacts

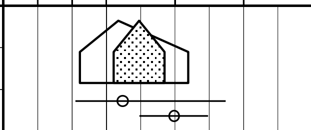
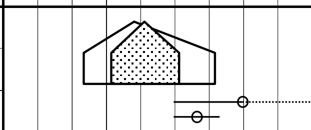
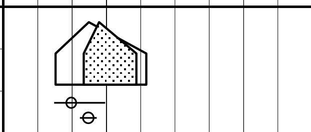
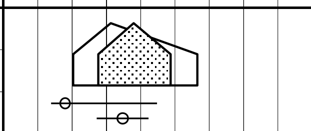
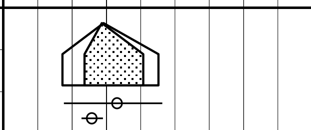
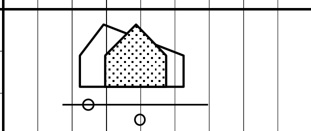
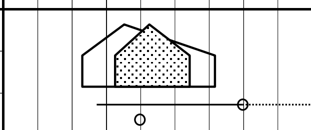
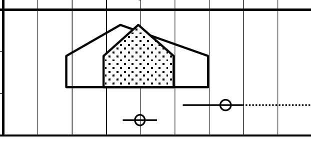
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

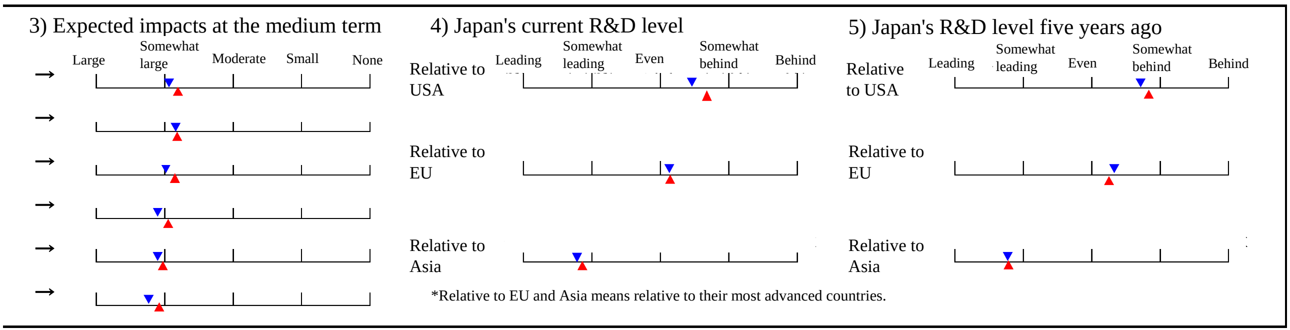
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



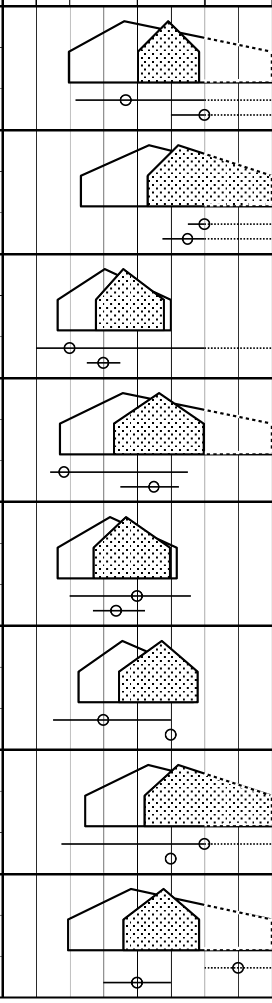
2. Questions regarding topics

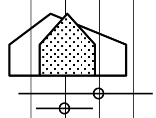
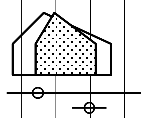
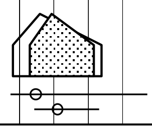
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
31	Treatment methods that promote recovery from motor paralysis through transplantation of nerve stem cells.	1	72	15	29	56	-	69	43	48	8	1		0	15
		2	76	4	14	82	-	63	32	59	8	1		1	11
		E	3	100	0	0	-	50	34	33	0	33		33	0
32	Completely implanted artificial kidney technology.	1	53	8	26	66	-	64	35	52	13	0		2	20
		2	56	7	14	79	-	61	25	68	7	0		2	9
		E	4	100	0	0	-	75	50	50	0	0		0	0
33	Autogenous tissue storage, growth, and transplantation.	1	67	6	27	67	-	67	43	42	15	0		0	12
		2	63	5	17	78	-	67	37	57	6	0		0	6
		E	3	100	0	0	-	100	100	0	0	0		0	0
34	Treatment technologies for the regeneration of damaged organs by using embryonic stem cells.	1	73	8	30	62	-	68	42	47	11	0		1	15
		2	66	5	17	78	-	64	31	65	2	2		2	8
		E	3	100	0	0	-	83	67	33	0	0		0	0
35	Caregiver robots for the severely disabled (mentally or physically).	1	77	22	26	52	-	65	34	57	9	0		1	7
		2	69	16	23	61	-	59	22	72	6	0		0	4
		E	11	100	0	0	-	64	27	73	0	0		0	0
36	Regenerative muscle treatment methods for muscular dystrophy.	1	65	9	25	66	-	52	20	47	33	0		2	17
		2	64	3	17	80	-	50	8	76	16	0		0	10
		E	2	100	0	0	-	50	0	100	0	0		0	50
37	Completely implanted artificial hearts and lungs.	1	55	5	33	62	-	61	32	47	21	0		2	15
		2	56	2	16	82	-	56	18	69	13	0		4	13
		E	1	100	0	0	-	100	100	0	0	0		0	0
38	Completely implanted endocrine organs.	1	58	9	22	69	-	58	30	41	29	0		9	16
		2	57	4	12	84	-	51	9	77	14	0		2	11
		E	2	100	0	0	-	100	100	0	0	0		0	0

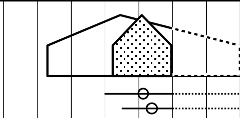
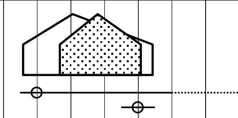
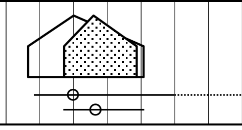
Time of technological realization columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
17	79	1	0	3	28	50	22	0	49	29	49	78	22	16	10	0		0	16	30	49	20	1	47	37	24	50	26	16	0
4	96	0	0	0	15	76	8	1	62	21	30	69	6	7	1	0		1	11	16	75	8	1	57	28	8	74	14	1	0
33	67	0	0	0	34	33	0	33	0	0	0	0	0	100	0	0		33	0	34	33	0	33	0	0	0	0	100	0	0
13	87	0	0	0	24	56	20	0	47	43	39	57	18	6	2	0		4	22	24	54	20	2	45	47	35	45	6	4	0
11	89	0	0	0	17	74	9	0	52	35	24	67	11	4	0	0		2	11	11	80	9	0	45	53	15	65	5	2	0
50	50	0	0	0	25	75	0	0	75	50	25	75	0	0	0	0		0	25	25	75	0	0	75	50	50	75	0	25	0
3	91	6	0	0	32	46	19	3	48	43	45	58	17	22	7	0		0	13	24	54	17	5	50	40	28	48	27	7	0
2	98	0	0	0	15	77	8	0	52	41	31	66	5	3	0	0		0	5	13	77	10	0	58	45	13	69	13	2	0
0	100	0	0	0	33	67	0	0	67	33	33	67	0	33	0	0		0	0	33	67	0	0	67	33	0	67	67	0	0
6	90	3	0	1	39	42	19	0	44	36	51	71	14	26	16	1		1	17	32	46	19	3	44	41	32	52	29	18	0
0	100	0	0	0	16	79	3	2	54	25	33	70	3	11	5	0		2	6	19	74	5	2	53	37	8	71	24	3	2
0	100	0	0	0	0	100	0	0	33	33	33	67	0	33	0	0		0	0	0	100	0	0	67	33	0	33	67	0	0
45	47	5	0	3	29	54	16	1	38	64	40	64	18	15	4	0		0	9	35	46	19	0	36	57	41	51	24	13	0
59	41	0	0	0	15	79	6	0	37	69	27	66	7	3	1	0		0	3	25	69	6	0	35	62	22	69	18	4	0
64	36	0	0	0	27	73	0	0	36	64	27	64	0	0	9	0		0	0	27	64	9	0	18	45	27	45	0	9	0
11	83	3	0	3	13	56	31	0	39	26	42	74	18	6	5	0		2	19	16	52	27	5	38	28	20	60	18	10	0
5	90	2	3	0	5	88	7	0	41	16	38	75	3	2	2	0		0	7	10	80	10	0	44	30	7	82	5	2	0
0	100	0	0	0	0	100	0	0	0	0	100	50	0	0	0	0		0	50	0	100	0	0	0	0	0	100	0	0	0
0	98	2	0	0	26	48	26	0	40	46	37	58	13	4	6	0		2	15	28	44	26	2	37	31	37	50	17	12	0
0	100	0	0	0	15	70	13	2	43	54	15	72	6	4	2	0		4	13	13	72	15	0	42	47	15	72	8	2	0
0	100	0	0	0	100	0	0	0	100	0	0	0	0	0	0	0		0	0	100	0	0	0	100	0	0	0	0	0	0
2	96	2	0	0	22	41	35	2	38	43	40	60	8	9	4	2		9	15	20	43	33	4	37	37	37	54	13	6	2
2	98	0	0	0	9	71	18	2	42	49	18	67	9	4	0	0		4	11	9	71	18	2	45	40	13	75	7	2	0
0	100	0	0	0	50	50	0	0	100	50	0	0	0	0	0	0		0	0	50	50	0	0	50	50	0	0	0	0	0



No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan (%)					Time of technological realization						(%)	
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
39	Artificial limbs with sensation.	1	**73**	**23**	**27**	**50**	**-**	**60**	**31**	**51**	**17**	**1**							**3**	**13**
		2	**65**	**17**	**26**	**57**	**-**	**53**	**11**	**78**	**11**	**0**							**0**	**13**
		E	**11**	**100**	**0**	**0**	**-**	**50**	**9**	**73**	**18**	**0**							**0**	**9**
40	Artificial blood.	1	**64**	**11**	**22**	**67**	**-**	**65**	**41**	**38**	**19**	**2**							**5**	**11**
		2	**61**	**5**	**18**	**77**	**-**	**64**	**34**	**52**	**14**	**0**							**0**	**12**
		E	**3**	**100**	**0**	**0**	**-**	**83**	**67**	**33**	**0**	**0**							**0**	**0**
41	Evaluation and treatment methods for people with impairments of higher cortical functions	1	**90**	**30**	**26**	**44**	**-**	**68**	**43**	**45**	**11**	**1**							**2**	**17**
		2	**71**	**25**	**24**	**51**	**-**	**63**	**29**	**64**	**7**	**0**							**3**	**13**
		E	**18**	**100**	**0**	**0**	**-**	**69**	**45**	**44**	**11**	**0**							**0**	**6**

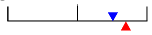
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
20	**67**	**11**	**0**	**2**	**28**	**51**	**21**	**0**	**44**	**54**	**44**	**75**	**11**	**8**	**1**	**0**		**3**	**14**	**33**	**42**	**25**	**0**	**45**	**49**	**38**	**61**	**13**	**6**	**0**
20	**75**	**5**	**0**	**0**	**11**	**79**	**8**	**2**	**39**	**62**	**25**	**69**	**3**	**5**	**0**	**0**		**0**	**13**	**14**	**78**	**6**	**2**	**37**	**65**	**18**	**73**	**6**	**2**	**0**
18	**73**	**9**	**0**	**0**	**20**	**70**	**10**	**0**	**40**	**70**	**10**	**60**	**10**	**10**	**0**	**0**		**0**	**18**	**27**	**73**	**0**	**0**	**36**	**64**	**18**	**73**	**9**	**9**	**0**
21	**79**	**0**	**0**	**0**	**29**	**45**	**24**	**2**	**39**	**52**	**34**	**62**	**13**	**8**	**3**	**2**		**3**	**16**	**27**	**42**	**28**	**3**	**36**	**50**	**41**	**47**	**21**	**7**	**2**
14	**86**	**0**	**0**	**0**	**8**	**75**	**15**	**2**	**37**	**59**	**22**	**66**	**3**	**2**	**0**	**0**		**0**	**10**	**10**	**73**	**17**	**0**	**34**	**68**	**17**	**59**	**5**	**0**	**0**
33	**67**	**0**	**0**	**0**	**67**	**33**	**0**	**0**	**67**	**67**	**33**	**67**	**0**	**0**	**0**	**0**		**0**	**0**	**67**	**33**	**0**	**0**	**67**	**67**	**67**	**67**	**0**	**0**	**0**
8	**87**	**4**	**0**	**1**	**28**	**45**	**26**	**1**	**60**	**30**	**45**	**60**	**15**	**9**	**3**	**2**		**1**	**19**	**28**	**47**	**24**	**1**	**56**	**39**	**15**	**54**	**12**	**6**	**2**
4	**96**	**0**	**0**	**0**	**19**	**68**	**9**	**4**	**77**	**18**	**24**	**62**	**3**	**2**	**2**	**0**		**1**	**16**	**23**	**64**	**9**	**4**	**74**	**21**	**6**	**68**	**3**	**6**	**0**
6	**94**	**0**	**0**	**0**	**12**	**76**	**6**	**6**	**75**	**19**	**31**	**69**	**0**	**0**	**6**	**0**		**0**	**6**	**29**	**59**	**6**	**6**	**69**	**31**	**19**	**75**	**6**	**13**	**0**

IV. Application of IT to medicine

1. Questions regarding the area

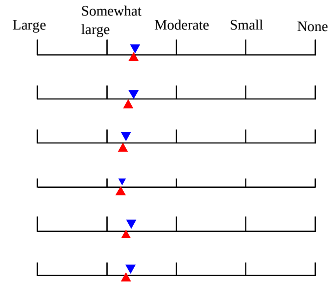
1) Degree of expertise in the area

High Moderate Low

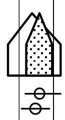
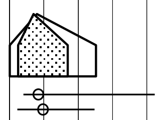
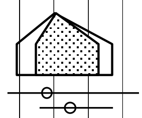
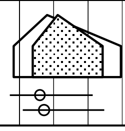


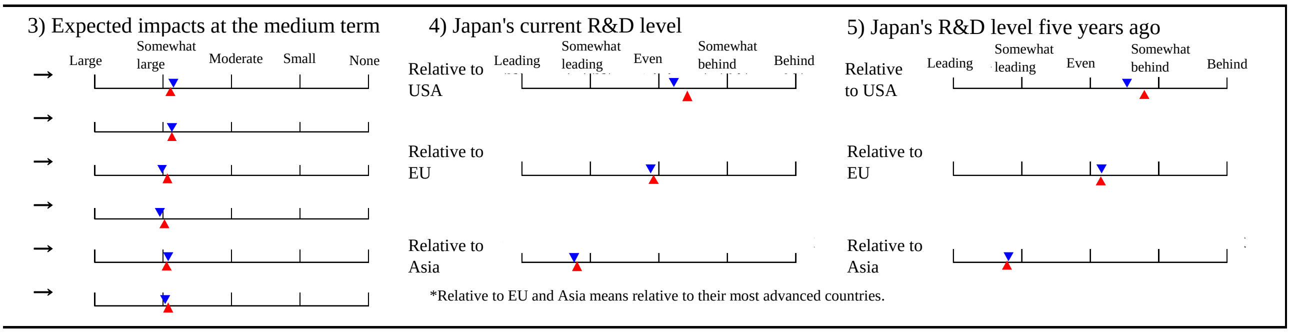
2) Current impacts

		Large / Somewhat large / Moderate / Small / None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

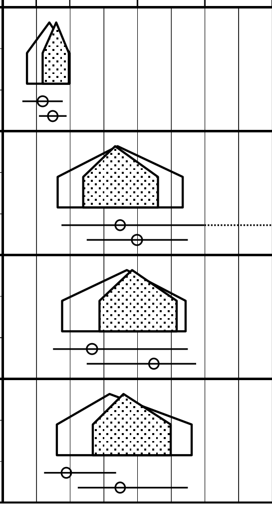


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
42	Systems for the collection and use of all of a patient's medical data, including test results, case history, and medications, on a single card.	1	104	13	35	52	-	72	49	41	9	1		0	6
		2	93	5	19	76	-	75	53	43	4	0		0	3
		E	5	100	0	0	-	90	80	20	0	0		0	0
43	Treatment technologies utilizing micromachines for the entire digestive tract.	1	65	11	28	61	-	58	30	48	17	5		3	10
		2	65	9	14	77	-	53	12	74	14	0		2	8
		E	6	100	0	0	-	67	33	67	0	0		0	0
44	Visualization technology for in vivo functions such as signal transmission and metabolism.	1	78	21	21	58	-	59	29	49	22	0		0	10
		2	71	7	14	79	-	53	13	73	14	0		0	7
		E	5	100	0	0	-	80	60	40	0	0		0	0
45	Imaging systems that can detect almost all disease anywhere in the body.	1	83	20	25	55	-	68	41	51	7	1		6	11
		2	77	8	17	75	-	59	22	72	6	0		3	9
		E	6	100	0	0	-	92	83	17	0	0		17	0



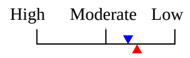
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
31	63	4	1	1	44	34	16	6	30	54	31	46	10	38	27	0						1	8	47	33	16	4	31	48	28	39	37	34	0
23	74	1	0	2	57	33	8	2	24	74	19	50	6	27	17	0						0	6	61	30	8	1	24	69	18	42	35	34	0
20	80	0	0	0	75	25	0	0	25	75	0	50	50	50	0	0						0	0	100	0	0	0	20	80	0	60	40	0	0
31	65	2	0	2	16	47	34	3	43	45	35	60	7	15	0	0						2	11	18	46	33	3	42	47	41	42	14	0	0
28	70	0	0	2	14	68	16	2	45	61	26	69	2	2	0	0						2	8	17	62	19	2	44	71	21	50	5	0	3
50	50	0	0	0	33	67	0	0	67	67	17	33	17	0	0	0						0	0	50	50	0	0	67	67	17	50	0	0	0
7	89	3	0	1	18	43	36	3	39	39	42	69	11	8	1	0						0	13	14	42	41	3	38	43	33	49	15	4	0
1	99	0	0	0	13	71	16	0	47	44	26	77	3	1	1	0						0	7	15	65	19	1	39	55	13	67	3	1	1
0	100	0	0	0	40	60	0	0	60	60	20	60	20	0	0	0						0	0	40	40	20	0	40	60	20	60	0	0	0
15	81	3	0	1	30	41	24	5	42	58	42	70	16	13	3	0						4	15	28	39	27	6	47	56	32	53	19	1	0
15	85	0	0	0	17	71	12	0	39	64	26	66	5	5	1	0						3	11	16	70	14	0	42	68	19	61	9	3	1
33	67	0	0	0	66	17	17	0	50	67	17	50	17	33	0	0						17	0	50	33	17	0	67	67	0	50	50	0	0



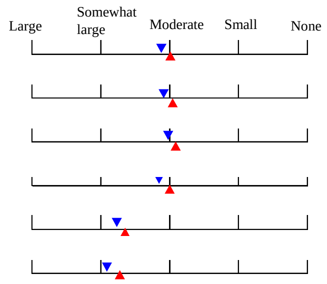
V. Human-centered medicine and construction of healthcare support systems

1. Questions regarding the area

1) Degree of expertise in the area



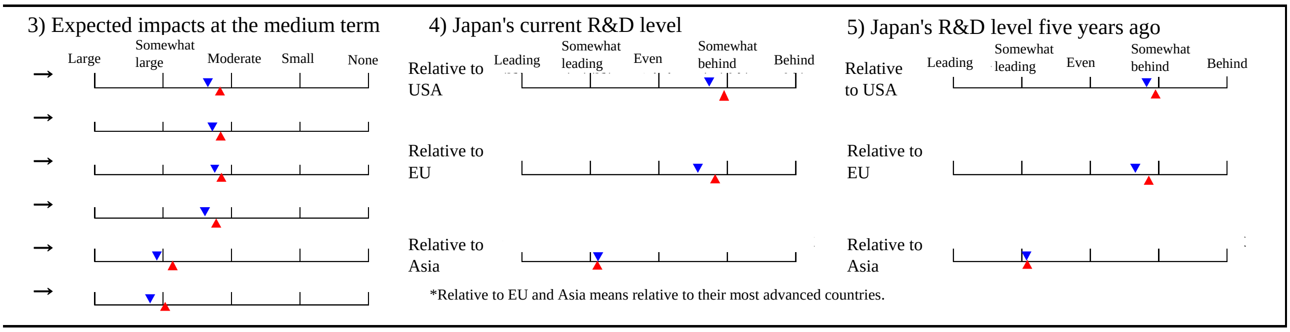
2) Current impacts

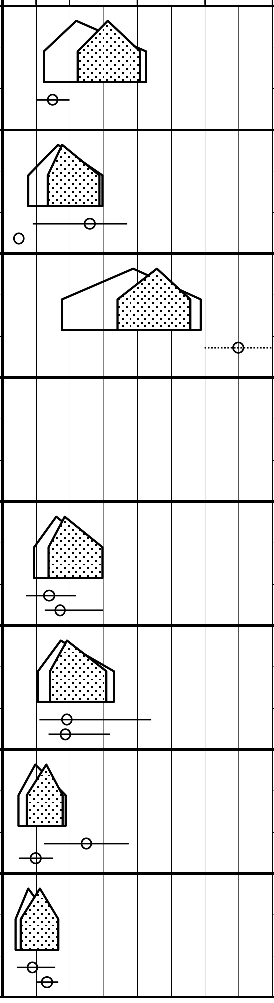


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

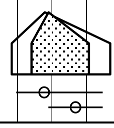
2. Questions regarding topics

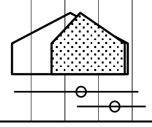
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
46	Technology to quantify psychological stress.	1	**80**	**13**	**26**	**61**	-	**59**	**32**	**43**	**22**	**3**							**1**	**17**
		2	**67**	**0**	**31**	**69**	-	**58**	**23**	**65**	**12**	**0**							**3**	**12**
		E																		
47	Preparation of terminal-care environments, facilities, and technology in which patients can end their lives comfortably and peacefully.	1	**107**	**12**	**33**	**55**	-	**72**	**47**	**45**	**7**	**1**								
		2	**87**	**3**	**31**	**66**	-	**73**	**45**	**55**	**0**	**0**								
		E	**3**	**100**	**0**	**0**	-	**75**	**50**	**50**	**0**	**0**								
48	Treatment that fully cures schizophrenia.	1	**64**	**6**	**20**	**74**	-	**61**	**35**	**39**	**24**	**2**							**5**	**31**
		2	**56**	**2**	**18**	**80**	-	**59**	**22**	**69**	**9**	**0**							**4**	**27**
		E	**1**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**							**0**	**100**
49	Elucidation of the causes of attention deficit hyperactivity disorder (ADHD).	1	**62**	**3**	**24**	**73**	-	**57**	**28**	**47**	**22**	**3**							**2**	**30**
		2	**61**	**0**	**18**	**82**	-	**51**	**10**	**73**	**17**	**0**							**0**	**21**
		E																		
50	Development of evaluation and training programs to improve ADL (activities of daily living) of disabled people.	1	**94**	**31**	**24**	**45**	-	**63**	**37**	**44**	**18**	**1**								
		2	**81**	**26**	**16**	**58**	-	**61**	**26**	**66**	**8**	**0**								
		E	**21**	**100**	**0**	**0**	-	**75**	**52**	**43**	**5**	**0**								
51	Preparation of social infrastructures to improve lives of disabled people markedly.	1	**94**	**28**	**27**	**45**	-	**68**	**42**	**49**	**8**	**1**								
		2	**80**	**20**	**20**	**60**	-	**68**	**39**	**56**	**5**	**0**								
		E	**16**	**100**	**0**	**0**	-	**81**	**62**	**38**	**0**	**0**								
52	Development of hospital staff like a hotel concierge or a butler who can answer patients' queries and demands.	1	**84**	**8**	**24**	**68**	-	**54**	**23**	**48**	**28**	**1**								
		2	**81**	**2**	**25**	**73**	-	**50**	**7**	**78**	**15**	**0**								
		E	**2**	**100**	**0**	**0**	-	**50**	**0**	**100**	**0**	**0**								
53	Development of outpatient clinic for second opinion and its searching system.	1	**107**	**11**	**31**	**58**	-	**62**	**33**	**52**	**14**	**1**								
		2	**91**	**5**	**27**	**68**	-	**57**	**17**	**79**	**4**	**0**								
		E	**5**	**100**	**0**	**0**	-	**90**	**80**	**20**	**0**	**0**								





Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
4	72	23	0	1	14	45	38	3	56	26	41	60	17	10	1	0		1	19	16	44	36	4	56	29	17	43	15	8	1
3	87	10	0	0	7	72	18	3	72	10	21	67	3	2	0	0		2	13	8	67	25	0	83	13	2	57	5	0	2
																		2	14	39	39	21	1	66	30	23	52	28	15	2
																		0	10	40	50	9	1	81	23	7	59	20	5	0
																		0	50	0	0	100	0	100	0	0	0	100	0	0
2	83	10	0	5	26	39	30	5	52	21	40	64	10	7	2	2		5	31	28	31	34	7	55	29	15	49	15	7	2
0	100	0	0	0	13	70	17	0	63	12	29	73	6	0	0	0		2	30	15	60	25	0	73	21	4	65	2	0	0
0	100	0	0	0	0	100	0	0	100	0	100	100	0	0	0	0		0	100	0	0	100	0	100	0	0	100	0	0	0
2	87	9	0	2	29	33	31	7	67	15	36	75	11	5	2	0														
0	100	0	0	0	7	75	16	2	69	4	28	72	4	4	2	0														
																		1	10	37	38	25	0	64	33	15	47	10	16	2
																		0	8	31	59	9	1	86	20	8	63	5	4	1
																		0	5	47	43	10	0	81	29	5	76	0	5	5
																		0	12	58	31	11	0	57	38	24	61	26	22	4
																		0	8	64	33	3	0	78	34	8	71	12	11	0
																		0	0	75	25	0	0	81	50	19	69	6	25	0
																		3	9	14	35	34	17	68	14	18	33	32	18	0
																		1	5	17	56	23	4	82	10	8	29	21	4	0
																		0	0	0	100	0	0	100	0	0	50	0	50	0
																		0	5	22	37	33	8	66	19	13	35	29	16	2
																		0	6	21	64	13	2	76	10	7	35	29	12	0
																		0	20	40	40	20	0	60	0	0	20	40	60	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise High (%)	Moderate	Low	None	Importance to Japan Index (%)	High	Moderate	Low	None	Time of technological realization Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know
54	Communication systems for people with cognitive or language disabilities.	1	80	21	31	48	-	55	22	58	19	1							3	19
		2	75	16	25	59	-	53	12	75	13	0							1	15
		E	12	100	0	0	-	63	25	75	0	0							0	8

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application						(%)	Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
7	**80**	**13**	**0**	**0**	**30**	**43**	**23**	**4**	**56**	**37**	**52**	**75**	**11**	**7**	**4**	**1**						**3**	**21**	**21**	**47**	**29**	**3**	**60**	**48**	**40**	**60**	**15**	**8**	**1**
1	**98**	**0**	**1**	**0**	**16**	**67**	**16**	**1**	**69**	**28**	**35**	**74**	**3**	**3**	**0**	**0**						**1**	**14**	**21**	**59**	**19**	**1**	**72**	**36**	**22**	**65**	**7**	**3**	**1**
8	**92**	**0**	**0**	**0**	**25**	**75**	**0**	**0**	**58**	**33**	**33**	**83**	**0**	**0**	**0**	**0**						**0**	**8**	**33**	**67**	**0**	**0**	**67**	**42**	**33**	**75**	**8**	**0**	**0**

VI. Preventive medicine

1. Questions regarding the area

1) Degree of expertise in the area

High — Moderate — Low

2) Current impacts

Large — Somewhat large — Moderate — Small — None

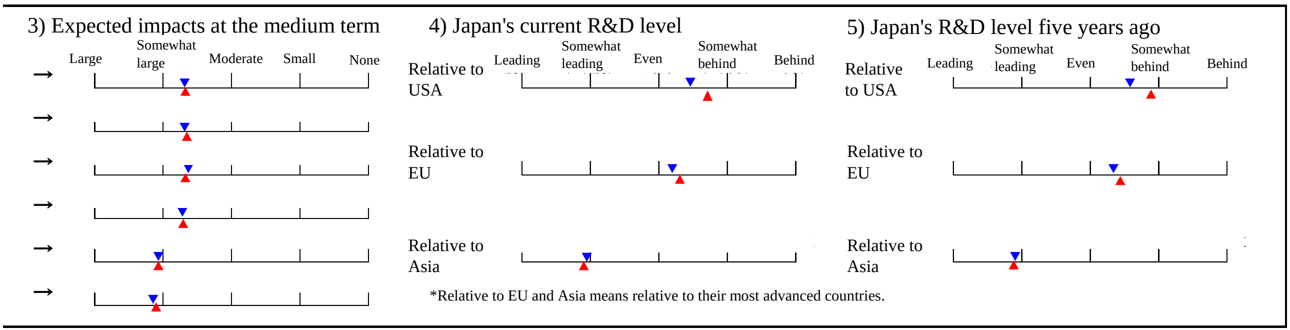
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

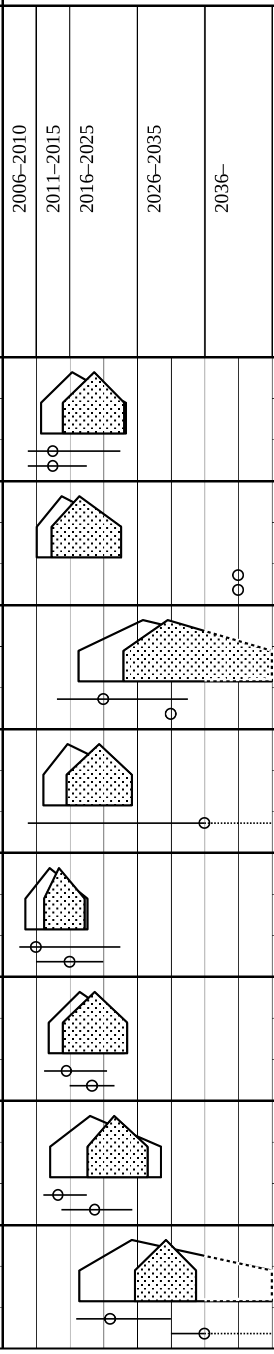
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
55	Methods to prevent senile osteoporosis.	1	95	9	29	62	-	68	42	45	13	0							0	9
		2	82	5	28	67	-	68	38	58	4	0							1	2
		E	4	100	0	0	-	100	100	0	0	0							0	0
56	Prevention and treatment methods for dental caries and periodontitis.	1	58	2	22	76	-	63	38	37	23	2							0	14
		2	58	2	9	89	-	72	46	47	7	0							0	9
		E	1	100	0	0	-	100	100	0	0	0							0	100
57	Systems to prevent the onset of serious genetic disease.	1	70	7	26	67	-	57	28	43	29	0							3	16
		2	68	3	13	84	-	50	10	69	21	0							0	12
		E	2	100	0	0	-	100	100	0	0	0							0	50
58	Technology to prevent premature birth.	1	47	6	28	66	-	57	28	42	30	0							0	17
		2	49	0	14	86	-	49	8	74	18	0							0	8
		E																		
59	Standardization and spread of evaluation of medical economics.	1	88	8	28	64	-	71	47	45	7	1								
		2	73	5	18	77	-	73	47	50	3	0								
		E																		
60	Blood tests (evaluation of nutrition intake, etc.) and urine tests (evaluation of cancer risk through urinary metabolites, etc.) that accurately reflect risk of lifestyle disease.	1	106	14	37	49	-	68	43	46	9	2							3	14
		2	88	10	26	64	-	67	37	58	5	0							1	7
		E	9	100	0	0	-	88	75	25	0	0							0	0
61	Genome-based methods to diagnose changes in the risk of illnesses.	1	89	20	31	49	-	63	36	45	19	0							3	8
		2	77	12	21	67	-	58	21	70	9	0							0	5
		E	9	100	0	0	-	89	78	22	0	0							0	0
62	Effective chemopreventive drugs for cancer.	1	75	13	29	58	-	63	36	49	12	3							4	16
		2	75	3	25	72	-	59	24	65	8	3							4	16
		E	2	100	0	0	-	75	50	50	0	0							0	0



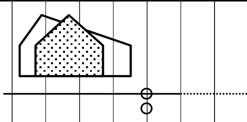
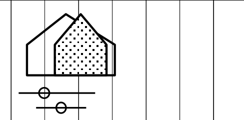
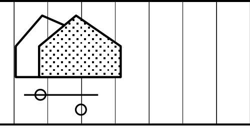
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
16	75	9	0	0	22	41	33	4	38	33	41	68	11	5	1	0
9	90	1	0	0	18	63	19	0	42	29	28	71	3	4	3	1
50	50	0	0	0	50	50	0	0	0	50	25	75	0	0	0	0
19	69	10	0	2	23	32	38	7	46	35	33	58	10	6	0	4
14	86	0	0	0	9	62	27	2	60	24	16	65	2	0	0	2
0	100	0	0	0	100	0	0	0	100	0	0	0	0	0	0	0
3	95	2	0	0	28	41	30	1	53	29	44	58	18	12	11	0
0	100	0	0	0	15	68	15	2	59	5	25	72	8	6	6	0
0	100	0	0	0	100	0	0	0	100	0	0	50	50	0	0	0
17	78	5	0	0	20	36	42	2	56	21	40	63	12	5	5	0
2	98	0	0	0	11	59	28	2	72	9	13	70	2	0	2	0
14	81	3	0	2	27	45	26	2	41	48	36	61	14	8	3	0
3	97	0	0	0	13	74	12	1	48	45	25	78	6	6	1	0
11	89	0	0	0	13	87	0	0	38	38	50	88	13	25	0	0
6	92	1	0	1	36	37	21	6	41	38	39	70	17	22	12	0
0	99	1	0	0	23	64	12	1	55	32	23	75	10	11	5	0
0	100	0	0	0	67	33	0	0	67	22	22	89	33	22	22	0
3	94	0	0	3	28	48	17	7	48	30	31	73	15	10	4	0
0	97	0	0	3	15	72	10	3	57	25	23	74	9	4	3	1
0	100	0	0	0	50	50	0	0	50	50	50	100	50	50	50	0

Time of social application



Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
0	11	22	45	29	4	40	43	24	51	13	6	2
0	6	15	66	18	1	49	47	13	61	8	3	1
0	25	25	75	0	0	50	50	0	50	25	0	0
0	18	25	33	35	7	53	36	21	49	13	2	4
0	7	14	57	27	2	60	31	5	58	0	0	4
0	0	100	0	0	0	100	0	0	0	0	0	0
1	16	29	39	29	3	53	33	20	48	23	24	2
0	12	11	72	15	2	69	19	5	63	9	11	0
0	0	100	0	0	0	100	0	0	50	0	0	0
0	18	23	36	39	2	72	23	21	53	9	5	0
0	8	8	65	25	2	72	15	0	57	0	2	0
0	9	47	39	13	1	55	42	20	39	34	19	1
1	6	62	34	3	1	75	38	7	43	17	10	0
3	13	27	42	28	3	47	46	28	48	22	6	2
0	8	16	71	12	1	58	53	14	64	10	1	0
0	0	13	87	0	0	63	50	13	63	13	13	0
6	7	36	42	16	6	43	48	27	44	33	23	1
0	4	19	69	12	0	49	52	18	60	18	11	0
0	0	67	33	0	0	44	44	22	67	44	33	0
3	14	25	51	20	4	43	41	32	51	19	6	0
3	15	17	72	8	3	54	38	13	74	7	3	1
0	0	50	50	0	0	50	50	50	100	50	50	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan Index	High (%)	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know
63	Therapeutic agents for addictions such as nicotine addiction.	1	**67**	**4**	**25**	**71**	**-**	**57**	**28**	**49**	**20**	**3**							**0**	**11**
		2	**70**	**1**	**11**	**88**	**-**	**53**	**14**	**69**	**16**	**1**							**0**	**13**
		E	**1**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**
64	Drugs that are effective for improving obesity.	1	**77**	**9**	**42**	**49**	**-**	**62**	**34**	**48**	**17**	**1**							**0**	**11**
		2	**74**	**4**	**23**	**73**	**-**	**54**	**14**	**73**	**13**	**0**							**0**	**8**
		E	**3**	**100**	**0**	**0**	**-**	**75**	**50**	**50**	**0**	**0**							**0**	**0**
65	Expansion and improvement of health information systems for the general public in order to promote personalized medicine through genome data.	1	**83**	**13**	**28**	**59**	**-**	**60**	**30**	**50**	**20**	**0**								
		2	**74**	**1**	**22**	**77**	**-**	**54**	**15**	**73**	**12**	**0**								
		E	**1**	**100**	**0**	**0**	**-**	**0**	**100**	**0**	**0**	**0**								

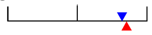
Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding technological realization — Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding social application — Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
3	95	2	0	0	19	49	27	5	40	35	37	55	8	12	12	0		2	11	25	40	30	5	41	39	23	39	15	15	0
0	97	0	0	3	12	68	19	1	50	26	20	65	6	5	2	2		0	13	13	68	18	1	55	52	11	47	8	5	2
0	100	0	0	0	0	100	0	0	100	0	0	100	0	0	0	0		0	0	0	100	0	0	100	100	0	0	0	0	0
0	99	1	0	0	22	49	29	0	41	38	37	71	11	5	1	0		0	8	23	38	36	3	41	42	30	48	17	4	3
0	100	0	0	0	8	76	13	3	43	29	25	71	4	1	0	0		0	6	8	72	17	3	40	46	14	67	7	0	1
0	100	0	0	0	0	67	33	0	33	0	0	100	0	0	0	0		0	0	0	33	67	0	0	67	0	67	0	0	0
																		1	12	36	37	26	1	59	34	22	37	19	22	0
																		0	9	25	64	11	0	76	37	11	42	18	11	1
																		0	0	0	100	0	0	0	0	0	0	100	100	0

VII. Measures against emerging and reemerging infectious diseases

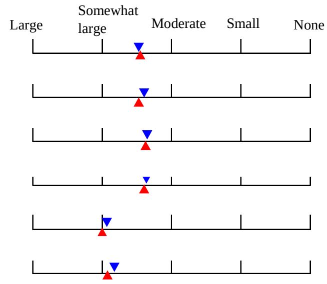
1. Questions regarding the area

1) Degree of expertise in the area

High Moderate Low

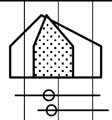
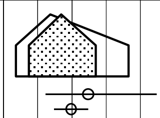
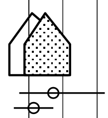
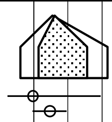
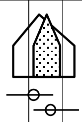
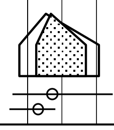


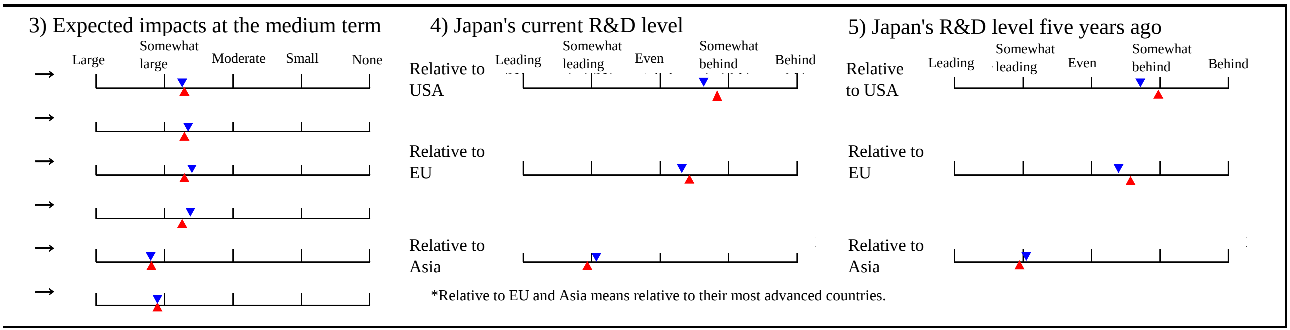
2) Current impacts

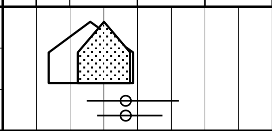
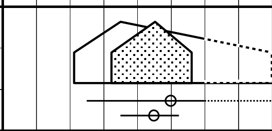
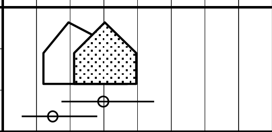
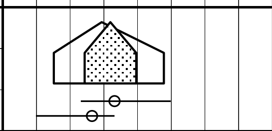
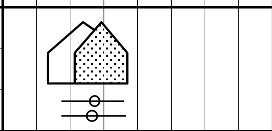
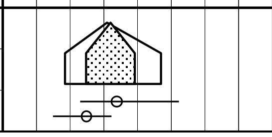


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
66	Treatment that completely cure HIV infection.	1	70	10	20	70	-	62	35	42	23	0		1	14
		2	71	7	17	76	-	67	38	55	7	0		1	10
		E	5	100	0	0	-	85	80	0	20	0		0	0
67	Treatment for prion diseases.	1	59	8	25	67	-	57	30	37	33	0		3	21
		2	63	6	16	78	-	54	19	57	24	0		2	10
		E	4	100	0	0	-	44	25	0	75	0		25	0
68	Automatic devices to identify pathogens and evaluate their drug susceptibility within 1 hour.	1	73	10	32	58	-	64	36	49	15	0		0	11
		2	71	10	23	67	-	61	25	67	8	0		0	7
		E	7	100	0	0	-	82	72	14	14	0		0	0
69	Systems to almost perfectly detect infected people and carriers of imported pathogens at airports and seaports.	1	67	12	31	57	-	73	50	42	8	0		8	12
		2	69	7	13	80	-	79	60	39	1	0		4	9
		E	5	100	0	0	-	100	100	0	0	0		20	0
70	Methods to prevent and treat human infection with highly pathogenic avian influenza found in poultry.	1	59	12	22	66	-	72	49	42	7	2		0	11
		2	67	9	10	81	-	78	57	43	0	0		0	9
		E	6	100	0	0	-	83	67	33	0	0		0	0
71	Methods to overcome drug resistance in infections.	1	71	18	24	58	-	75	55	35	10	0		14	14
		2	76	9	18	73	-	83	69	24	7	0		7	9
		E	7	100	0	0	-	100	100	0	0	0		14	0

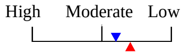


Countries at the leading edge: Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied	Do not know	Regarding social application – Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
0	100	0	0	0	29	49	22	0	43	37	37	69	30	10	7	0		1	14	29	51	20	0	37	43	18	50	18	15	3
0	100	0	0	0	30	60	9	1	56	26	24	85	13	3	0	0		1	12	28	64	7	1	49	51	10	73	9	3	1
0	100	0	0	0	60	20	20	0	40	80	20	100	40	20	0	0		0	0	40	40	20	0	20	80	40	80	40	0	0
12	73	15	0	0	26	42	28	4	54	30	41	63	20	11	2	0		3	21	28	42	26	4	46	41	19	52	20	11	0
3	87	10	0	0	23	61	16	0	55	21	21	74	8	2	2	0		2	11	21	61	18	0	57	32	12	65	5	2	3
25	50	25	0	0	0	25	75	0	25	25	0	50	25	0	0	0		25	0	0	25	75	0	0	33	33	33	33	0	0
12	86	2	0	0	17	52	31	0	36	49	40	57	18	10	0	0		0	11	14	58	25	3	40	57	30	46	20	1	1
13	87	0	0	0	10	74	16	0	34	54	26	76	4	3	0	0		0	6	13	74	12	1	47	63	12	63	6	0	1
29	71	0	0	0	14	72	14	0	29	57	29	86	0	0	0	0		0	0	14	86	0	0	29	71	14	71	14	0	0
4	88	2	4	2	50	35	12	3	44	46	33	48	33	10	14	0		5	12	56	30	11	3	48	47	23	42	15	31	0
3	95	1	1	0	67	29	4	0	55	46	22	67	16	1	6	0		4	7	65	28	7	0	73	54	7	45	6	15	0
0	100	0	0	0	80	20	0	0	80	20	40	80	40	0	0	0		20	0	80	20	0	0	80	60	20	60	20	0	0
9	78	2	9	2	46	36	16	2	49	42	46	58	32	7	7	0		0	10	46	36	16	2	52	52	23	46	9	18	2
4	88	1	7	0	57	38	5	0	61	32	32	68	12	0	3	0		0	8	57	38	5	0	75	48	8	56	2	11	0
0	100	0	0	0	67	33	0	0	50	50	17	67	33	0	0	0		0	0	67	33	0	0	67	50	0	83	0	17	0
10	88	2	0	0	36	41	22	1	45	52	43	64	12	9	4	0		10	15	36	41	19	4	47	61	30	50	8	13	2
8	91	0	1	0	31	58	11	0	46	46	28	72	4	1	1	3		4	9	35	51	11	3	57	67	14	60	3	0	1
43	57	0	0	0	57	43	0	0	43	43	29	86	14	0	0	0		14	0	57	43	0	0	57	86	14	71	0	0	0

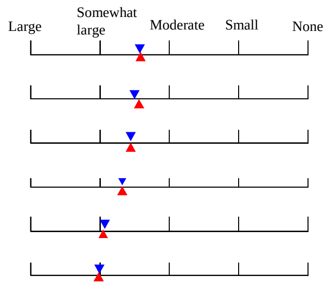
VIII. Medicine and welfare for an aging society

1. Questions regarding the area

1) Degree of expertise in the area



2) Current impacts

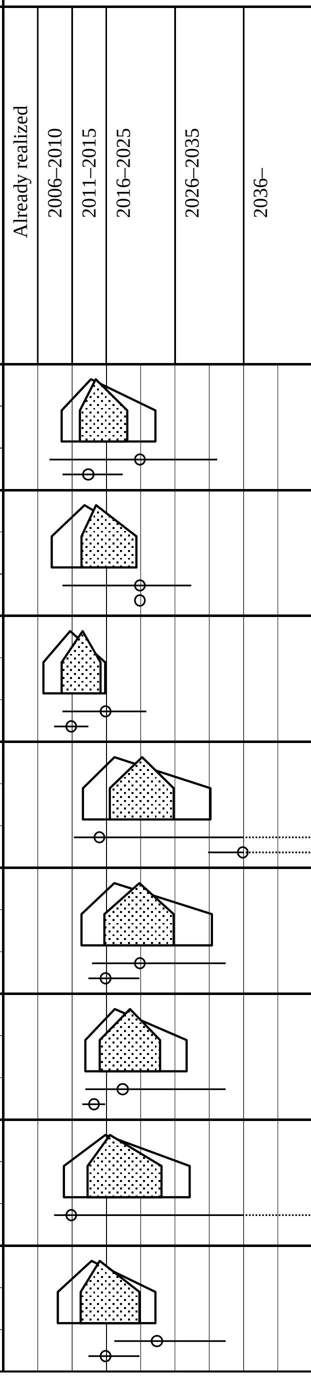


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

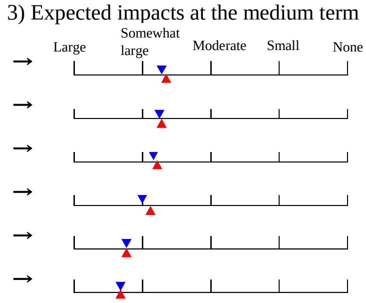
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Will not be realized (%)	Do not know (%)
72	Methods to quantitatively evaluate biological age.	1	79	10	29	61	-	47	14	54	23	9	5	12
		2	73	4	16	80	-	45	4	71	24	1	1	10
		E	3	100	0	0	-	67	33	67	0	0	0	0
73	Completely implanted urination-cotrolling apparatuses.	1	67	10	18	72	-	50	17	50	31	2	0	14
		2	59	2	22	76	-	51	10	75	15	0	0	14
		E	1	100	0	0	-	100	100	0	0	0	0	0
74	Systems for family management of health and emergency.	1	93	14	25	61	-	61	32	49	18	1	0	11
		2	89	4	25	71	-	57	17	77	6	0	0	6
		E	4	100	0	0	-	75	50	50	0	0	0	0
75	Elucidation of individual aging mechanisms.	1	90	11	34	55	-	65	38	48	13	1	2	16
		2	81	2	22	76	-	58	19	75	5	1	0	11
		E	2	100	0	0	-	75	50	50	0	0	0	0
76	Methods to prevent the occurrence of neurogenerative diseases.	1	67	12	22	66	-	61	32	48	20	0	5	23
		2	67	6	24	70	-	55	15	74	11	0	3	14
		E	4	100	0	0	-	63	25	75	0	0	0	0
77	Drugs to cure Alzheimer's disease.	1	77	17	18	65	-	77	59	32	9	0	7	17
		2	68	9	16	75	-	82	68	25	7	0	6	13
		E	6	100	0	0	-	83	67	33	0	0	33	0
78	Elimination of infertility.	1	52	4	31	65	-	56	27	45	24	4	8	24
		2	58	0	10	90	-	52	16	63	19	2	4	12
		E		100	0	0	-	0	100	0	0	0	0	0
79	Robots for monitoring the safty in childcare.	1	52	10	31	59	-	48	16	51	27	6	2	14
		2	59	3	14	83	-	50	8	73	19	0	0	7
		E	2	100	0	0	-	75	50	50	0	0	0	0

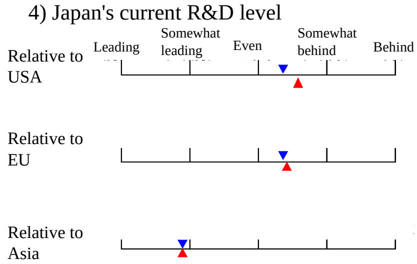
Time of technological realization



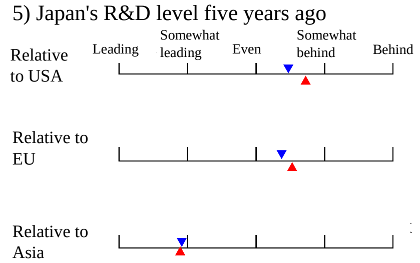
3) Expected impacts at the medium term



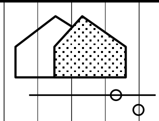
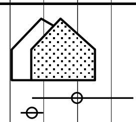
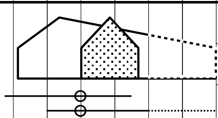
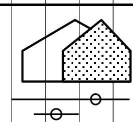
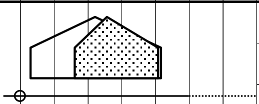
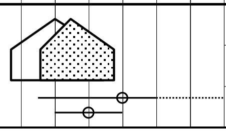
4) Japan's current R&D level

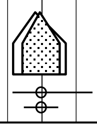


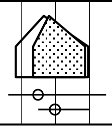
5) Japan's R&D level five years ago



*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
17	76	4	0	3	16	36	40	8	41	24	45	62	15	8	2	2														
6	94	0	0	0	9	57	34	0	47	6	36	76	1	1	0	0														
0	100	0	0	0	67	33	0	0	67	0	0	67	0	0	0	0														
12	78	7	0	3	16	38	43	3	44	49	41	66	8	8	3	0		0	17	19	34	42	5	43	48	30	50	10	7	0
7	93	0	0	0	12	60	28	0	34	43	26	76	2	5	2	0		0	12	14	63	23	0	42	47	18	60	9	4	0
0	100	0	0	0	100	0	0	0	100	0	0	0	0	0	0	0		0	0	100	0	0	0	100	0	0	0	0	0	0
30	58	10	0	2	26	44	28	2	42	51	40	58	10	20	8	0		1	11	28	40	30	2	38	53	35	49	31	12	0
21	77	1	0	1	15	75	9	1	47	56	23	71	5	3	0	0		0	5	16	73	10	1	40	65	19	56	16	3	0
0	100	0	0	0	50	50	0	0	50	50	0	75	25	25	0	0		0	0	50	50	0	0	50	50	0	75	50	0	0
7	89	4	0	0	23	45	29	3	46	29	49	77	11	7	4	0														
0	100	0	0	0	18	70	9	3	56	21	43	82	3	1	0	0														
0	100	0	0	0	50	50	0	0	0	0	50	0	0	50	0	0														
3	92	3	0	2	22	44	31	3	39	31	44	79	18	6	2	0		2	24	23	40	34	3	47	41	31	58	10	2	0
2	96	2	0	0	15	78	5	2	48	20	37	80	3	3	0	0		2	22	13	78	6	3	44	27	11	81	2	0	0
0	100	0	0	0	50	50	0	0	50	25	0	100	0	25	0	0		0	0	50	50	0	0	25	50	0	100	0	0	0
5	94	1	0	0	42	36	21	1	40	37	52	76	21	11	0	1		5	20	40	35	21	4	45	46	35	58	16	6	1
2	98	0	0	0	52	36	9	3	55	26	45	80	6	3	0	0		5	17	48	40	9	3	44	44	19	79	5	0	0
0	100	0	0	0	66	17	0	17	40	20	0	80	0	20	0	0		33	0	49	17	17	17	20	40	0	80	0	0	0
6	84	8	0	2	22	40	34	4	46	31	35	65	10	21	6	2		8	23	24	37	35	4	47	40	17	55	28	4	2
3	97	0	0	0	16	64	18	2	56	11	22	73	7	4	2	0		2	14	16	55	27	2	56	20	4	67	18	7	0
100	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0		0	0	100	0	0	0	0	0	0	0	0	0	0
34	62	2	0	2	14	50	32	4	40	67	46	60	8	6	2	0		4	12	13	56	27	4	39	52	26	52	11	9	2
25	75	0	0	0	9	74	17	0	43	59	22	69	2	2	0	0		0	5	9	73	18	0	42	63	9	58	9	5	0
50	50	0	0	0	50	50	0	0	50	0	0	50	0	0	0	0		0	0	50	50	0	0	50	0	0	0	50	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Degree of expertise: Moderate (%)	Degree of expertise: Low (%)	Degree of expertise: None (%)	Importance to Japan: Index	Importance to Japan: High (%)	Importance to Japan: Moderate (%)	Importance to Japan: Low (%)	Importance to Japan: None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
80	Automatic Systems for programming fitness for the elderly.	1	**77**	**13**	**26**	**61**	**-**	**52**	**22**	**47**	**26**	**5**							**1**	**12**
		2	**75**	**7**	**32**	**61**	**-**	**49**	**10**	**68**	**21**	**1**							**3**	**5**
		E	**5**	**100**	**0**	**0**	**-**	**63**	**25**	**75**	**0**	**0**							**20**	**0**

Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
19	**70**	**10**	**0**	**1**	**14**	**39**	**37**	**10**	**43**	**45**	**46**	**57**	**12**	**9**	**5**	**2**						**3**	**16**	**14**	**41**	**34**	**11**	**48**	**46**	**32**	**49**	**17**	**3**	**0**
11	**86**	**3**	**0**	**0**	**7**	**68**	**21**	**4**	**59**	**50**	**26**	**57**	**3**	**3**	**1**	**0**						**3**	**4**	**5**	**63**	**27**	**5**	**62**	**57**	**14**	**55**	**10**	**3**	**0**
25	**50**	**25**	**0**	**0**	**20**	**60**	**0**	**20**	**50**	**75**	**50**	**75**	**0**	**25**	**0**	**0**						**20**	**0**	**20**	**60**	**0**	**20**	**75**	**100**	**50**	**50**	**25**	**0**	**0**

5. Agriculture, forestry, fisheries, and foods field

5.1. Overview

The world population has increased at a rapid pace and is currently an estimated 6 billion. The countries with the largest populations, such as China and India, however, have slowed their growth rates, and although the United Nations estimates that the world population will reach 9.3 billion by 2050, it also predicts that world population will stabilize for the first time in human history. On the other hand, the number of urban dwellers will only increase, and in 2005 is predicted to account for a majority of the world population for the first time ever.

As the population has rapidly increased, the spread of irrigated agriculture and varietal improvement have increased crop yield, supporting food supplies. Many believe that in the future, however, loss of farmland through urbanization, limitations on irrigation due to pressure on water resources, and other factors will limit the growth of productivity. In addition, gaps between developed and developing countries are widening in terms of both supply and demand, famine, conflict, the connections among poverty, food issues, and environmental degradation, as well as the domestic gap through rapid growth in developing countries causing differences between urban and rural incomes, and so on.

The survey asked respondents for predictions regarding such population dynamics and food supplies 30 years from now (in 2035). There is a shared awareness of the situation, with approximately 70 percent saying that population will hit a ceiling, while demand for agricultural products will increase through advanced consumption such as demand for livestock products. At the same time, regarding food production and technology, 72 percent say there is a concern that environmental issues such as global warming, desertification, and deforestation will cause production to stagnate. In addition, regarding values and standards 30 years from now, 74 percent responded that with global environmental degradation advancing, they expect that the agriculture, forestry, and fisheries will play a role in managing cyclical use of both of the natural and local resources. They expect use of biomass resources and energy and technology for environmentally-friendly agriculture to further advance.

Looking at the history of science and technology, no sooner had the fruits of the 19th century Industrial Revolution period, in other words, the discovery of photosynthesis, Mendelian genetics, Pasteur's principles of biology, Liebig's doctrines on crop nutrition, the mechanization of agriculture that accompanied the development of machinery, and so on, been perfected in the second half of the 20th century as modern agricultural technology, than leaps in science and technology changed our views of the world and of life. Awareness of the scarcity and finiteness of the global ecosystem, the discovery of DNA, the development of electronics and information science and technology, and so on, have created expectations for 21st century innovation in agricultural technology. Fifty years later, the appearance of individual new technologies such as genetic engineering, warnings about the emergence of global environmental problems, and other information is democratized with unprecedented speed, forming opinions faster than ever before. Science and technology have yet to form a prevailing conceptual framework.

This foresight survey reflects this era through the fact that 74 percent of responses on values 30 years from now concentrated in the contributions of agriculture, forestry, and fisheries to natural cycles and conservation of the environment.

For this survey we therefore created an overview by selecting the five areas below based on the twin axes of how far the shift of agriculture, forestry, and fisheries technology that is inseparable from issues such as population and the environment in 21st century technological innovation will advance in the context of science and technology, and how society will form new conceptual frameworks.

- Elucidation of the complex interaction between biodiversity and ecosystems
- Biological solutions to environmental problems and achievement of a sustainable society
- Development of production technology that harmonizes with ecosystems and improves the environment
- Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life
- Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology

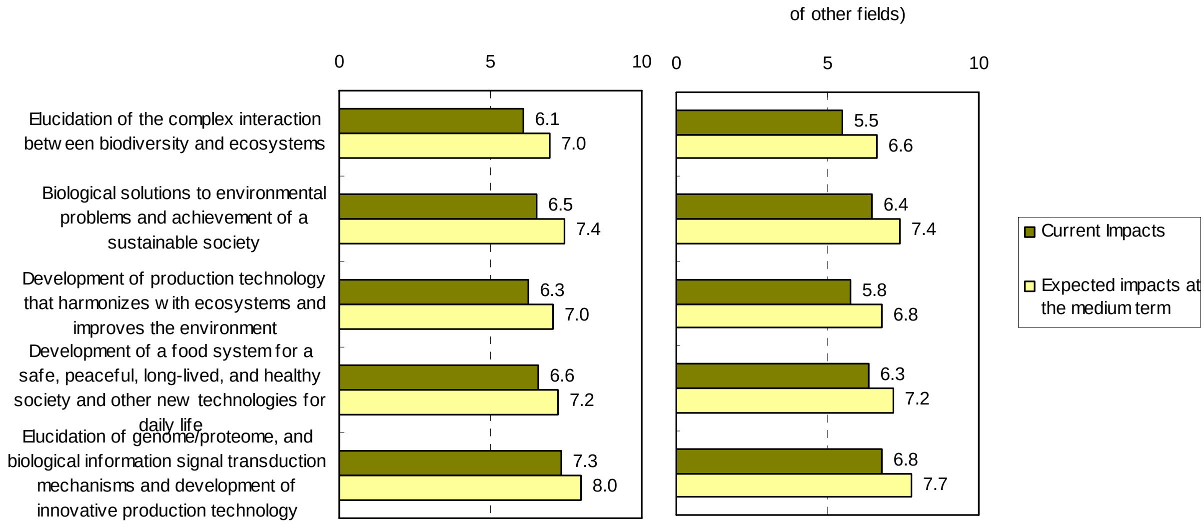
In other words, we set four areas by asking the following in the context of science and technology. How much ecological knowledge related to agriculture, forestry, and fisheries can be obtained (area 1)? How can it be brought into innovation in the technology of agriculture, forestry, and fisheries (area 3)? Once chemical analysis of genes, such as the sequencing of the rice-plant genome, is complete, how far will our understanding of molecular biological phenomena advance (area 5)? How can that be brought into innovation in the technology of agriculture, forestry, and fisheries (area 2)? In addition, regarding the food system that will play a leading role in forming society's conceptual framework on agriculture, forestry, and fisheries technology, in response to the deepening of the aging society and consumer trends on safety and peace of mind, we set new developments as a science of life with all respondents as consumers (area 4). Here we see that science and technology and the environment and production and the environment were antithetical to each other with 20th century technology and the prevailing opinion was that society should rethink science and technology with the environment as a higher priority. Regarding a safe and peaceful life as well, we see the stereotypical concept that science and technology should be rethought in order to avoid new risk. We can see how far science and technology will progress over the coming 30 years in fields in which the persistence of these 20th century ideas influences the direction of development of science and technology. In addition, the influence of the rapid progress of information science and technology in each area is also predicted, and this is reflected in the setting of questions for each area.

(MIWA Eitaro)

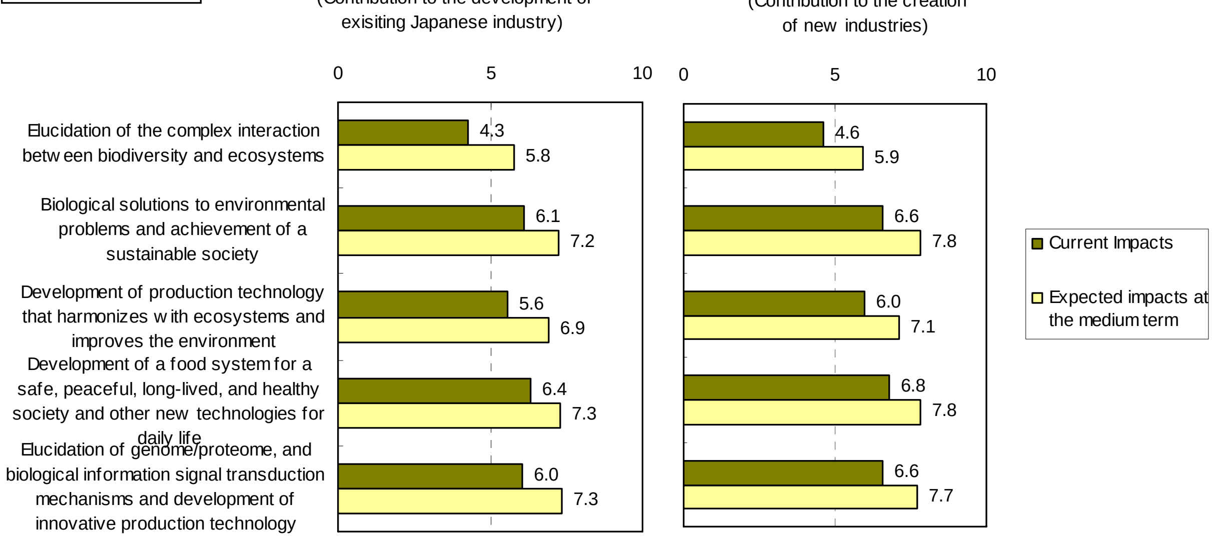
5.2. Main results

A . Impacts

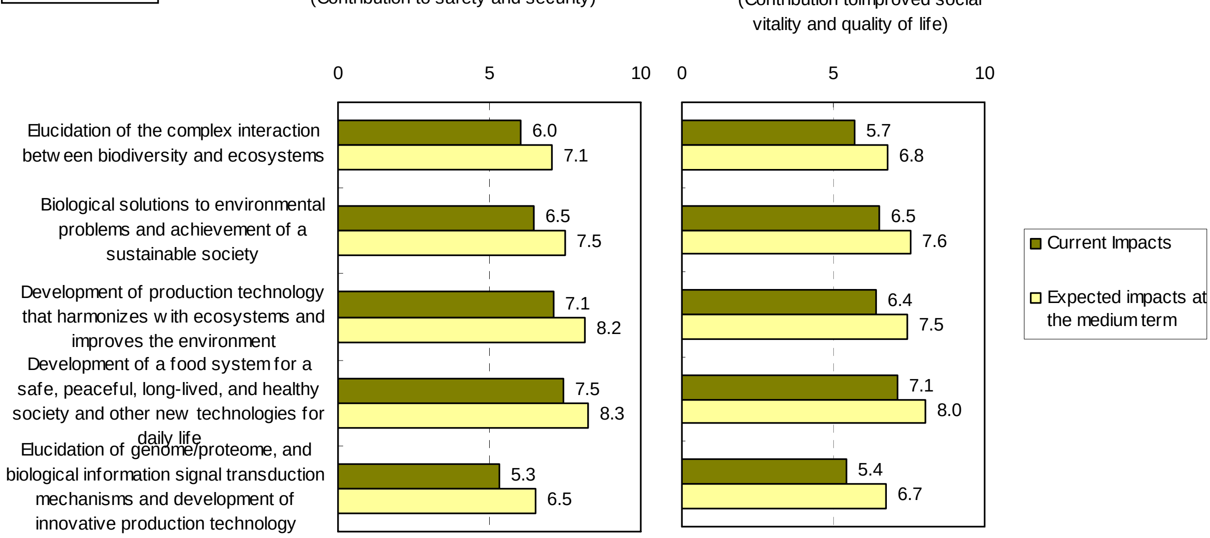
Increased intellectual assets



Economic impacts

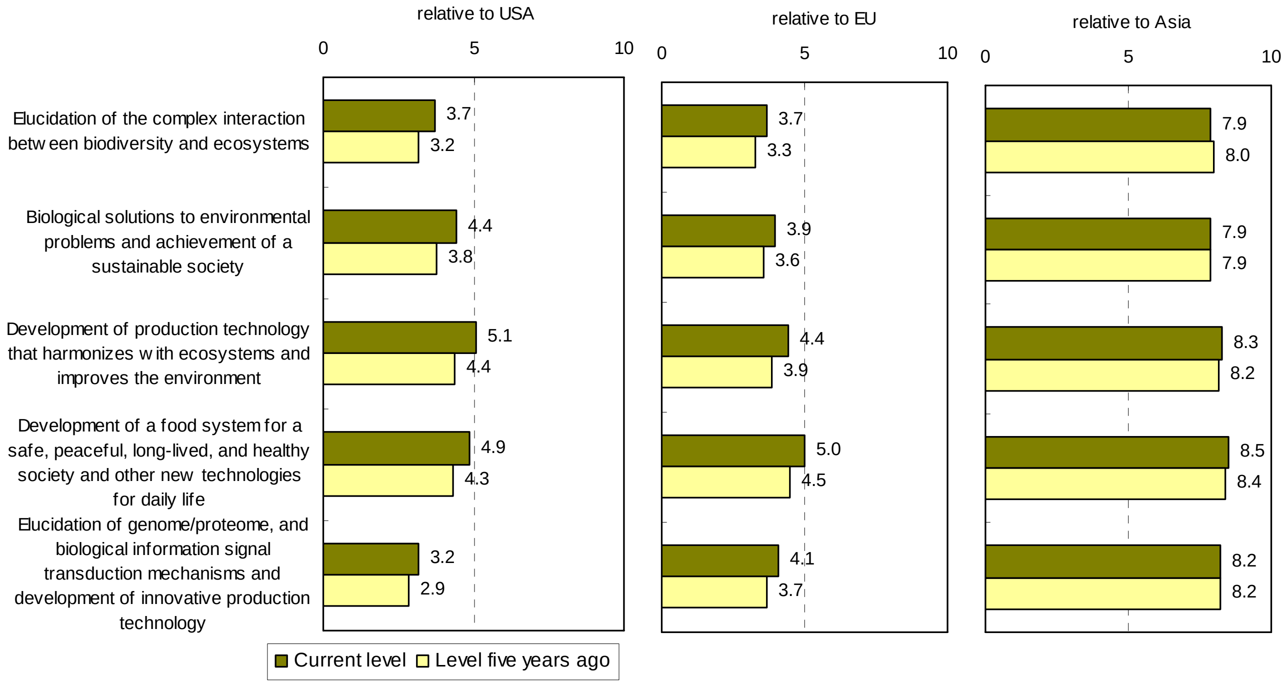


Social impacts



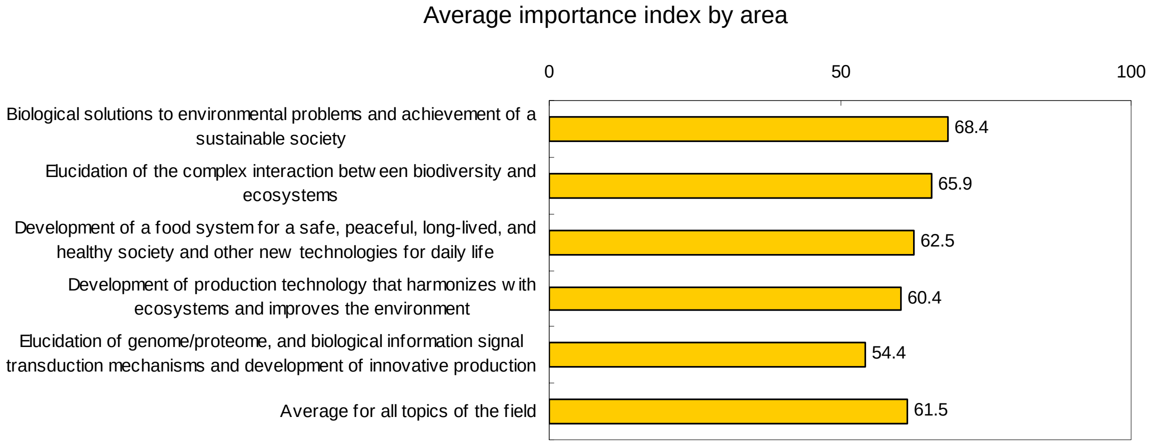
*Responses are indexed on a 10-point scale.

B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan



The most important 10 topics

	Topic	Index	Year T*	Year S*
1	33: Risk management technology for harmful chemicals (endocrine disruptors, heavy metals, etc.) based on elucidation of their long-term impacts on human beings, crops, livestock, and ecosystems.	93	2015	2024
2	34: Formation of positive understanding and consensus on genetically engineered plants and foods.	90		2015
3	32: Prevention, diagnosis, and treatment technology through the complete elucidation of BSE onset.	89	2013	2020
4	15: Achievement of low costs agriculture and forestry and rural communities oriented towards zero emissions by using local agricultural and forestry resources, organic waste, and other sources of biomass energy.	88	2014	2022
5	02: Technology to estimate long-term changes in resource amounts in order to appropriately manage true sardines and other important fisheries resources.	87	2015	2022

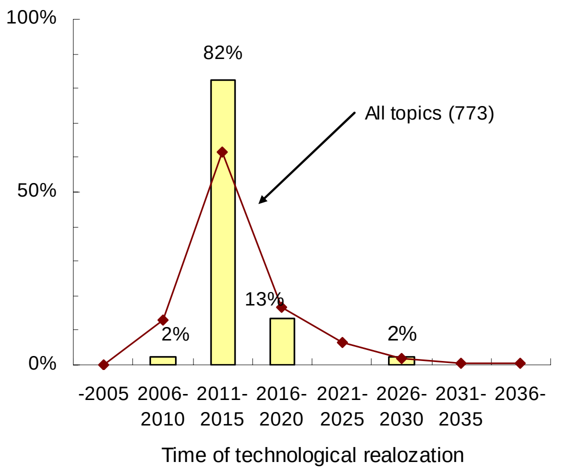
	Topic	Index	Year T*	Year S*
6	18: Technology to restore coastal environments such as marine forests and tidal flats based on elucidation of material cycling systems that connect land, river, and coastal areas.	83	2015	2026
7	01: Technology to assess the impact of global climate change and environmental changes on an ocean-wide scale in particular on changes in the amount of large migratory fish resources such as salmon and tuna.	82	2015	2023
8	14: Technology to effectively remove dioxins and heavy metals from soil by utilizing plants and microorganisms.	80	2014	2022
9	26: Foods and diets especially for the elderly that prevent declines in antioxidant, brain, and mastication functions and that use food to support a healthy aging society.	78	2013	2020
10	46: Genetically engineered plants in which artificially introduced genes do not spread over the environment because of the special timing/site expression of genes.	78	2014	2025

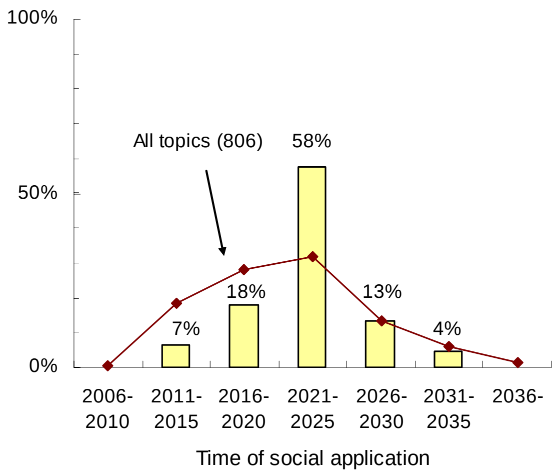
Year T: Time of technological realization Year S: Time of social application

*Responses were indexed on a 100-point scale.

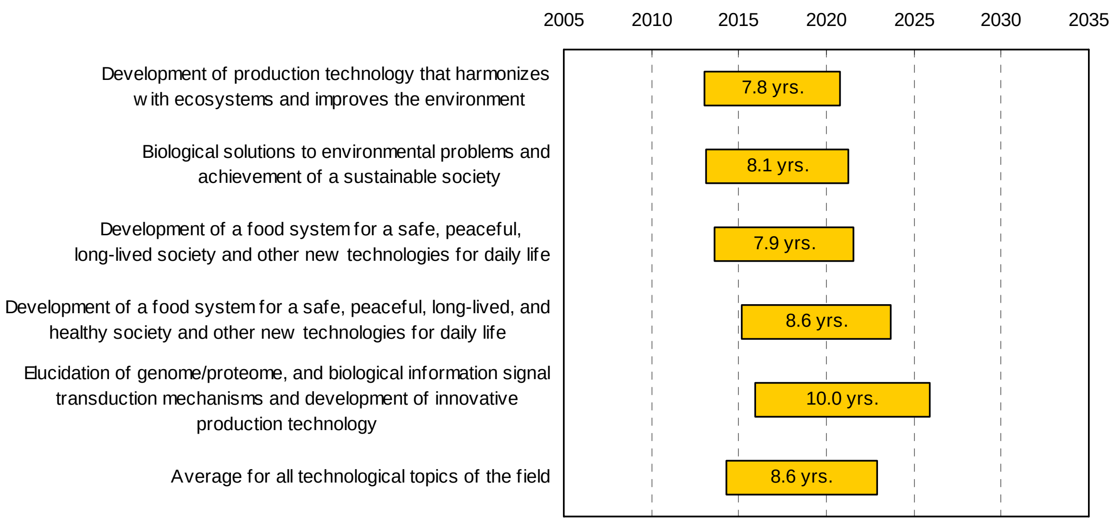
D. Time of realization

Distribution of realization time





Gap between technological realization and social application



Topics with short or long periods until social application

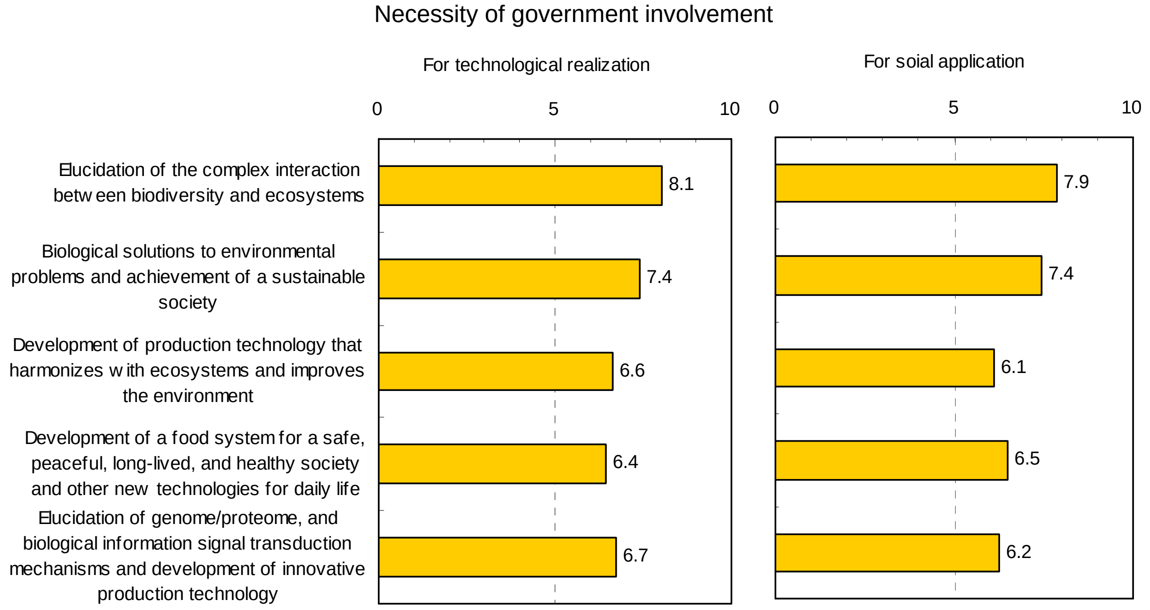
Topic	Year T*	Period*	Area
39: Crop production and greening in the strict environment, such as deserts, by using new plants enhanced/added salt, drought or cold tolerance.	2015	12	Elucidation of genome/ proteome, and biological information signal transduction mechanisms and development of innovative production technology
45: Growth regulation of crop/tree based on the knowledge of the mechanism about biosynthesis, transport, and receptor-mediated signaling by regulators in plants.	2019	12	Elucidation of genome/ proteome, and biological information signal transduction mechanisms and development of innovative production technology
18: Technology to restore coastal environments such as marine forests and tidal flats based on elucidation of material cycling systems that connect land, river, and coastal areas.	2015	11	Development of production technology that harmonizes with ecosystems and improves the environment
40: Modeling of all process about the rice plant growth based on the complete elucidation of gene functions and interaction of transcripts.	2017	11	Elucidation of genome/ proteome, and biological information signal transduction mechanisms and development of innovative production technology
43: Prevention of infection disease based on the knowledge of the immune system and its regulatory factors of fish.	2016	11	Elucidation of genome/ proteome, and biological information signal transduction mechanisms and development of innovative production technology
46: Genetically engineered plants in which artificially introduced genes do not spread over the environment because of the special timing/site expression of genes.	2014	11	Elucidation of genome/ proteome, and biological information signal transduction mechanisms and development of innovative production technology

Topic	Year T*	Period*	Area
23: Systems that utilize wearable computers (ultra-small PCs that can be worn on the body) to enable computer and internet use even during farm work, to serve as automatic input systems for production record data and as navigation systems that advise on use of inputs, pest control, and so on.	2011	4	Development of production technology that harmonizes with ecosystems and improves the environment
09: Widespread use of low-price agriculture, forestry, and fisheries materials (multi-films for outdoor cultivation, fishing tackle, etc.) and containers that use biodegradable materials.	2009	5	Solving environmental problems with biology and achieving a recycling-oriented society
17: Robots that selectively harvest fruit according to quality and ripeness and automatically sort them.	2012	6	Development of production technology that harmonizes with ecosystems and improves the environment
31: Home freshness-sensing devices to detect the freshness of foods.	2012	6	Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life
02: Technology to estimate long-term changes in resource amounts in order to appropriately manage true sardines and other important fisheries resources.	2015	7	Elucidation of the complex interaction between biodiversity and ecosystems
20: Sensor networks that monitor environmental and biological data in fields, barns, ponds, and so on in real time for the early detection of abnormalities in livestock, such as pest outbreaks and avian influenza and other infections.	2013	7	Development of production technology that harmonizes with ecosystems and improves the environment
24: Food manufacturing that avoids causing allergic reactions by using allergen measurement technology.	2014	7	Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life

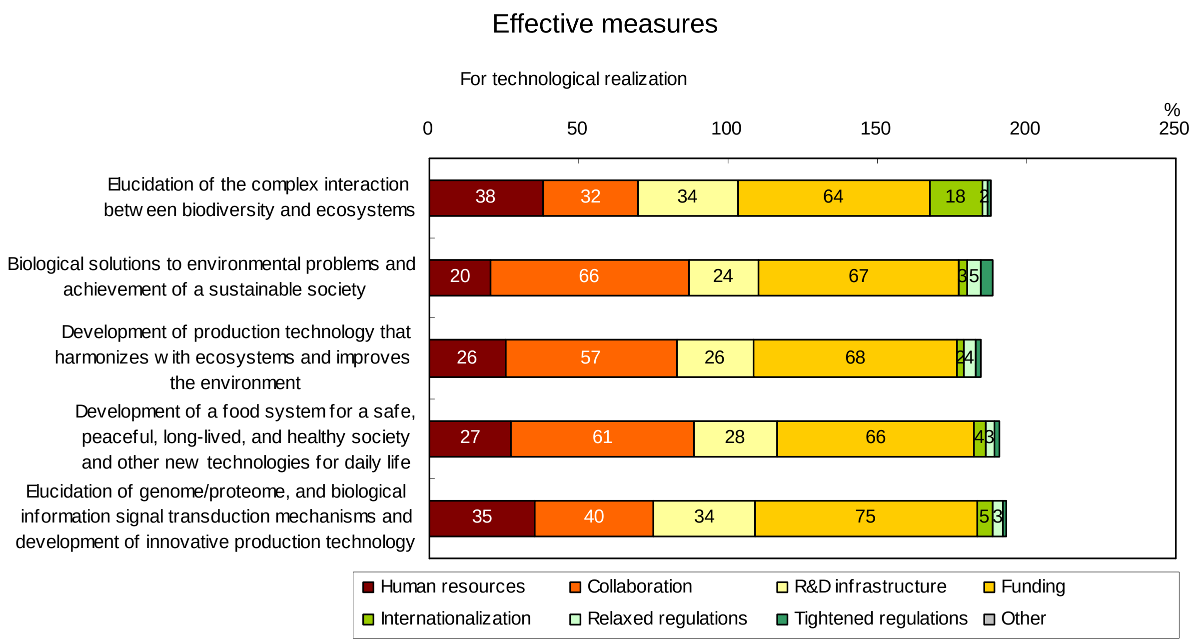
Topic	Year T*	Period*	Area
26: Foods and diets especially for the elderly that prevent declines in antioxidant, brain, and mastication functions and that use food to support a healthy aging society.	2013	7	Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life
30: Forest treatment methods based on physiological elucidation of the comfort-increasing effects of forests and wood.	2013	7	Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life
32: Prevention, diagnosis, and treatment technology through the complete elucidation of BSE onset.	2013	7	Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life

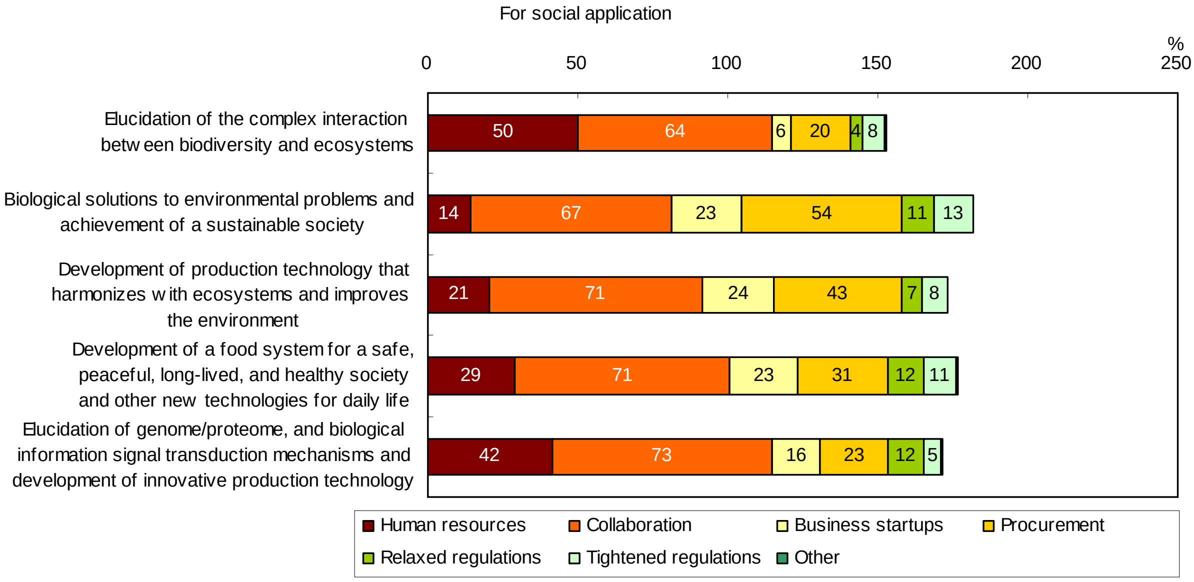
*Year T: Time of technological realization Period: Period until social application (years)

E. Effective measures that should taken by government



*Responses were indexed on a 10-point scale





F. Time-line of topics

Technological realization

Year	Topic
2009	09: Widespread use of low-price agriculture, forestry, and fisheries materials (multi-films for outdoor cultivation, fishing tackle, etc.) and containers that use biodegradable materials.
2011	13: Manufacturing technology for reusable wood compound materials through advances in technology to compound wood and non-wood materials.
	23: Systems that utilize wearable computers (ultra-small PCs that can be worn on the body) to enable computer and internet use even during farm work, to serve as automatic input systems for production record data and as navigation systems that advise on use of inputs, pest control, and so on.
2012	17: Robots that selectively harvest fruit according to quality and ripeness and automatically sort them.
	19: Production system technology artificially seed eels in mass quantities, raise them, and ship them.
	31: Home freshness-sensing devices to detect the freshness of foods.
2013	07: Completely control pine wilt in Japan.
	12: Technology to ferment alcohol or methane from wood biomass through the development of highly-efficient lignin decomposition.
	16: Biological crop protection methods (phage, plant activators, natural enemies, pheromones, allelopathy, etc.) that reduce use of synthetic chemical pesticides and fertilizers.
	20: Sensor networks that monitor environmental and biological data in fields, barns, ponds, and so on in real time for the early detection of abnormalities in livestock, such as pest outbreaks and avian influenza and other infections.
	26: Foods and diets especially for the elderly that prevent declines in antioxidant, brain, and mastication functions and that use food to support a healthy aging society.
	28: Sensor network technology that monitors foods from production to table with DNA chips, spectrum sensors, and other sensors in order to prevent contamination with harmful substances, bacteria, and so on.
	30: Forest treatment methods based on physiological elucidation of the comfort-increasing effects of forests and wood.
	32: Prevention, diagnosis, and treatment technology through the complete elucidation of BSE onset.
	35: Production of transformed livestocks with secreted antibacterial proteins, blood coagulation factor and other physiologically active substances in milk
	38: Industrial production of useful substances such as medicines through the utilization of insect cell cultures and other transformants.
2014	04: Systems that utilize remote sensing technology to periodically provide useful data on agriculture, forestry, and fisheries resources for all climate zones and topographies in order to estimate agricultural product harvests, forest biomass, and real-time ocean environment data.
	06: Understand genetic geographic classification through molecular markers to analyze regional differentiation and genetic diversity of the world's major commercial tree types.

Year	Topic
	14: Technology to effectively remove dioxins and heavy metals from soil by utilizing plants and microorganisms.
	15: Achievement of low costs agriculture and forestry and rural communities oriented towards zero emissions by using local agricultural and forestry resources, organic waste, and other sources of biomass energy.
	21: Cultivation of ultrahigh-yield soy beans through varieties that produce large numbers of root nodes.
	22: Production technology for food and drugs that utilize the physiology of unused microorganisms from the deep ocean.
	24: Food manufacturing that avoids causing allergic reactions by using allergen measurement technology.
	25: Functional foods tailored to individual physical characteristics to prevent lifestyle disease.
	27: Precision taste analysis robots that sense taste and other properties and analyze them.
	37: Improvement and farming of new organisms for fisheries with advantageous characteristics (e.g., environmental tolerance and resistance to disease) by applying DNA markers and other genome technology.
	41: Production of aquaculture varieties fixed preferred properties (disease resistance, high growth) through chromosomal manipulation cloning.
	42: Production of livestock cloned from somatic cells based on elucidation of epigenetic and other nuclear genetic information reprogramming mechanism
	46: Genetically engineered plants in which artificially introduced genes do not spread over the environment because of the special timing/site expression of genes.
2015	01: Technology to assess the impact of global climate change and environmental changes on an ocean-wide scale in particular on changes in the amount of large migratory fish resources such as salmon and tuna.
	02: Technology to estimate long-term changes in resource amounts in order to appropriately manage true sardines and other important fisheries resources.
	08: Elucidation of the mechanisms by which nonpathogenic microorganisms (endophytes) become established inside plants and how they influence plant growth.
	11: Widespread use of biomass energy fuel cells.
	18: Technology to restore coastal environments such as marine forests and tidal flats based on elucidation of material cycling systems that connect land, river, and coastal areas.
	29: Food crop safety assessment systems that utilize proteomics and metabolics.
	33: Risk management technology for harmful chemicals (endocrine disruptors, heavy metals, etc.) based on elucidation of their long-term impacts on human beings, crops, livestock, and ecosystems.
	36: Preventation of diseases, recovery of homeostasis, improvement of feeding and milk production control based on elucidation of immune system and endocrine mechanisms of adenohypophysis
	39: Crop production and greening in the strict environment, such as deserts, by using new plants enhanced/added salt, drought or cold tolerance.
2016	03: Technology to assess various species living in a one mass through school detection systems that enable accurate measurement of fish length and differentiation of fish species.
	10: Creation of biomass production crops of greater than 50 tons/hectare/year (dry).
	43: Prevention of infection disease based on the knowledge of the immune system and its regulatory factors of fish.
2017	40: Modeling of all process about the rice plant growth based on the complete elucidation of gene functions and interaction of transcripts.
2019	05: Systems that use global sensor networks to monitor major element and material cycles in agriculture, forestry, and fisheries ecosystems.
	45: Growth regulation of crop/tree based on the knowledge of the mechanism about biosynthesis, transport, and receptor-mediated signaling by regulators in plants.
2027	44: Communication technology between human and livestock utilized sensing of the neuro-transmission in the brain.

Social application

Year	Topic
2014	09: Widespread use of low-price agriculture, forestry, and fisheries materials (multi-films for outdoor cultivation, fishing tackle, etc.) and containers that use biodegradable materials.
2015	23: Systems that utilize wearable computers (ultra-small PCs that can be worn on the body) to enable computer and internet use even during farm work, to serve as automatic input systems for production record data and as navigation systems that advise on use of inputs, pest control, and so on.

Year	Topic
	34: Formation of positive understanding and consensus on genetically engineered plants and foods.
2018	17: Robots that selectively harvest fruit according to quality and ripeness and automatically sort them.
	31: Home freshness-sensing devices to detect the freshness of foods.
2019	13: Manufacturing technology for reusable wood compound materials through advances in technology to compound wood and non-wood materials.
2020	19: Production system technology artificially seed eels in mass quantities, raise them, and ship them.
	20: Sensor networks that monitor environmental and biological data in fields, barns, ponds, and so on in real time for the early detection of abnormalities in livestock, such as pest outbreaks and avian influenza and other infections.
	26: Foods and diets especially for the elderly that prevent declines in antioxidant, brain, and mastication functions and that use food to support a healthy aging society.
	30: Forest treatment methods based on physiological elucidation of the comfort-increasing effects of forests and wood.
	32: Prevention, diagnosis, and treatment technology through the complete elucidation of BSE onset.
2021	07: Completely control pine wilt in Japan.
	16: Biological crop protection methods (phage, plant activators, natural enemies, pheromones, allelopathy, etc.) that reduce use of synthetic chemical pesticides and fertilizers.
	24: Food manufacturing that avoids causing allergic reactions by using allergen measurement technology.
	35: Production of transformed livestocks with secreted antibacterial proteins, blood coagulation factor and other physiologically active substances in milk
	38: Industrial production of useful substances such as medicines through the utilization of insect cell cultures and other transformants.
2022	02: Technology to estimate long-term changes in resource amounts in order to appropriately manage true sardines and other important fisheries resources.
	12: Technology to ferment alcohol or methane from wood biomass through the development of highly-efficient lignin decomposition.
	14: Technology to effectively remove dioxins and heavy metals from soil by utilizing plants and microorganisms.
	15: Achievement of low costs agriculture and forestry and rural communities oriented towards zero emissions by using local agricultural and forestry resources, organic waste, and other sources of biomass energy.
	25: Functional foods tailored to individual physical characteristics to prevent lifestyle disease.
	28: Sensor network technology that monitors foods from production to table with DNA chips, spectrum sensors, and other sensors in order to prevent contamination with harmful substances, bacteria, and so on.
2023	01: Technology to assess the impact of global climate change and environmental changes on an ocean-wide scale in particular on changes in the amount of large migratory fish resources such as salmon and tuna.
	04: Systems that utilize remote sensing technology to periodically provide useful data on agriculture, forestry, and fisheries resources for all climate zones and topographies in order to estimate agricultural product harvests, forest biomass, and real-time ocean environment data.
	21: Cultivation of ultrahigh-yield soy beans through varieties that produce large numbers of root nodes.
	22: Production technology for food and drugs that utilize the physiology of unused microorganisms from the deep ocean.
	41: Production of aquaculture varieties fixed preferred properties (disease resistance, high growth) through chromosomal manipulation cloning.
	42: Production of livestock cloned from somatic cells based on elucidation of epigenetic and other nuclear genetic information reprogramming mechanism
2024	03: Technology to assess various species living in a one mass through school detection systems that enable accurate measurement of fish length and differentiation of fish species.
	06: Understand genetic geographic classification through molecular markers to analyze regional differentiation and genetic diversity of the world's major commercial tree types.
	11: Widespread use of biomass energy fuel cells.
	27: Precision taste analysis robots that sense taste and other properties and analyze them.
	29: Food crop safety assessment systems that utilize proteomics and metabolics.
	33: Risk management technology for harmful chemicals (endocrine disruptors, heavy metals, etc.) based on elucidation of their long-term impacts on human beings, crops, livestock, and ecosystems.
	37: Improvement and farming of new organisms for fisheries with advantageous characteristics (e.g., environmental tolerance and resistance to disease) by applying DNA markers and other genome technology.

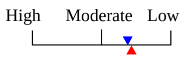
Year	Topic
2025	36: Preventation of diseases, recovery of homeostasis, improvement of feeding and milk production control based on elucidation of immune system and endocrine mechanisms of adenohypophysis
	46: Genetically engineered plants in which artificially introduced genes do not spread over the environment because of the special timing/site expression of genes.
2026	10: Creation of biomass production crops of greater than 50 tons/hectare/year (dry).
	18: Technology to restore coastal environments such as marine forests and tidal flats based on elucidation of material cycling systems that connect land, river, and coastal areas.
2027	39: Crop production and greening in the strict environment, such as deserts, by using new plants enhanced/added salt, drought or cold tolerance.
	43: Prevention of infection disease based on the knowledge of the immune system and its regulatory factors of fish.
2028	40: Modeling of all process about the rice plant growth based on the complete elucidation of gene functions and interaction of transcripts.
2029	05: Systems that use global sensor networks to monitor major element and material cycles in agriculture, forestry, and fisheries ecosystems.
2031	45: Growth regulation of crop/tree based on the knowledge of the mechanism about biosynthesis, transport, and receptor-mediated signaling by regulators in plants.
2036-	44: Communication technology between human and livestock utilized sensing of the neuro-transmission in the brain.

Appendix: Results of R1 and R2

I. Elucidation of the complex interaction between biodiversity and ecosystems

1. Questions regarding the relevant area

1) Degree of expertise in the area

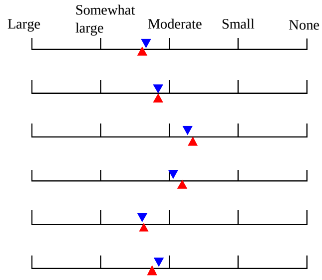


2) Current impacts

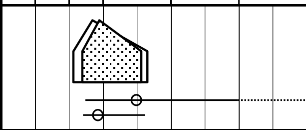
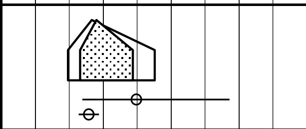
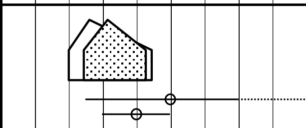
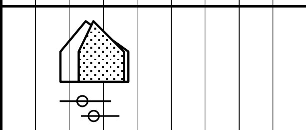
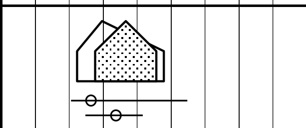
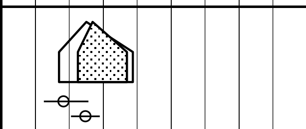
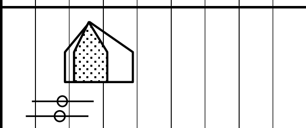
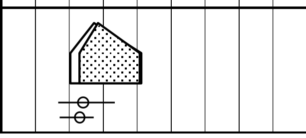
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

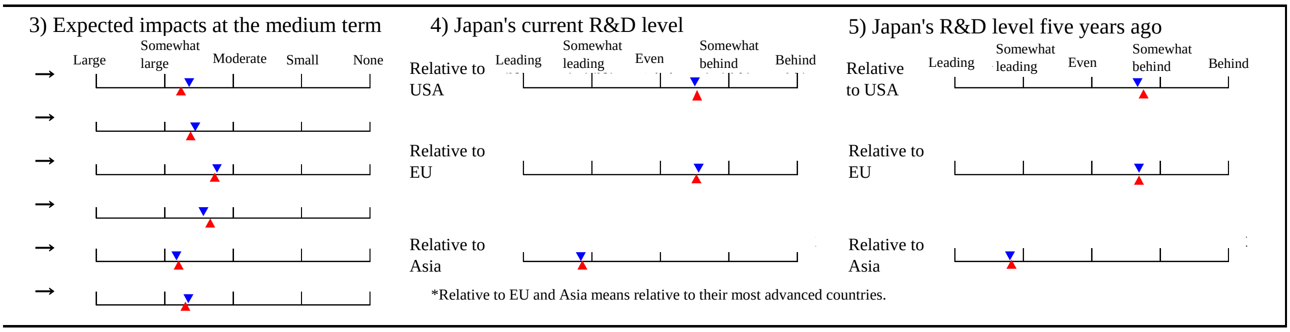
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life

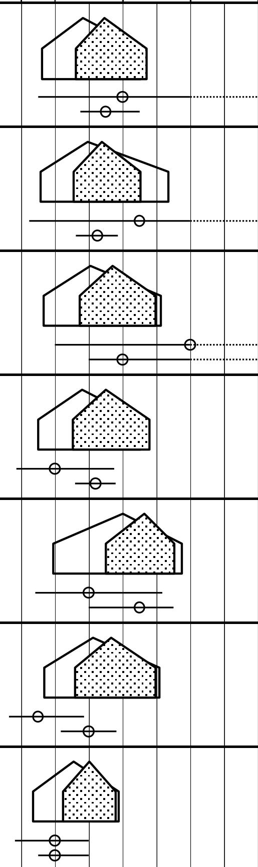


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
1	Technology to assess the impact of global climate change and environmental changes on an ocean-wide scale in particular on changes in the amount of large migratory fish resources such as salmon and tuna.	1	120	7	13	80	-	78	58	39	3	0		4	19
		2	116	6	9	85	-	82	64	36	0	0		1	4
		E	7	100	0	0	-	93	86	14	0	0		0	0
2	Technology to estimate long-term changes in resource amounts in order to appropriately manage true sardines and other important fisheries resources.	1	110	8	14	78	-	82	65	33	2	0		3	16
		2	108	6	12	82	-	87	73	27	0	0		0	5
		E	6	100	0	0	-	100	100	0	0	0		0	0
3	Technology to assess various species living in a one mass through school detection systems that enable accurate measurement of fish length and differentiation of fish species.	1	90	9	12	79	-	60	31	51	16	2		2	17
		2	94	4	12	84	-	56	19	69	12	0		0	4
		E	4	100	0	0	-	69	50	25	25	0		0	0
4	Systems that utilize remote sensing technology to periodically provide useful data on agriculture, forestry, and fisheries resources for all climate zones and topographies in order to estimate agricultural product harvests, forest biomass, and real-time ocean	1	209	7	28	65	-	71	48	42	10	0		1	9
		2	178	3	24	73	-	74	50	47	3	0		1	2
		E	6	100	0	0	-	100	100	0	0	0		0	0
5	Systems that use global sensor networks to monitor major element and material cycles in agriculture, forestry, and fisheries ecosystems.	1	182	8	26	66	-	63	36	45	17	2		4	14
		2	168	5	20	75	-	63	29	67	3	1		2	3
		E	8	100	0	0	-	88	75	25	0	0		0	0
6	Understand genetic geographic classification through molecular markers to analyze regional differentiation and genetic diversity of the world's major commercial tree types.	1	143	11	22	67	-	54	22	52	24	2		3	10
		2	135	4	17	79	-	49	11	64	24	1		1	4
		E	5	100	0	0	-	45	0	80	20	0		0	0
7	Completely control pine wilt in Japan.	1	140	8	31	61	-	66	41	41	17	1		6	14
		2	142	6	27	67	-	67	39	52	7	2		6	7
		E	9	100	0	0	-	78	56	44	0	0		0	0
8	Elucidation of the mechanisms by which nonpathogenic microorganisms (endophytes) become established inside plants and how they influence plant growth.	1	151	15	19	66	-	52	18	53	28	1		1	14
		2	146	7	27	66	-	49	9	71	18	2		1	5
		E	10	100	0	0	-	63	30	60	10	0		0	0



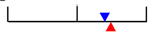
Countries at the leading edge					Regarding technological realization													Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't												Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)										(%)		(%)				(%)						
47	40	8	2	3	67	24	7	2	37	30	37	55	41	3	2	2		2	25	56	27	14	3	43	47	11	16	7	22	4
65	29	6	0	0	77	21	1	1	37	18	39	63	40	2	0	0		0	9	69	26	3	2	58	58	2	9	4	16	0
29	71	0	0	0	100	0	0	0	57	14	57	71	86	0	0	0		0	14	100	0	0	0	86	57	0	14	0	71	0
79	14	6	0	1	68	24	6	2	40	29	44	62	26	2	4	1		0	19	57	28	13	2	48	44	9	21	6	23	2
92	7	1	0	0	79	20	0	1	45	19	38	69	17	2	0	0		0	6	72	23	4	1	63	55	1	14	4	16	0
83	17	0	0	0	100	0	0	0	83	0	83	100	33	0	0	0		0	0	100	0	0	0	67	67	0	33	17	33	0
53	25	20	0	2	28	46	21	5	29	51	37	55	12	1	2	1		1	21	30	37	28	5	42	54	17	21	4	11	0
75	13	12	0	0	21	68	10	1	18	53	23	58	8	2	0	0		0	5	20	59	18	3	43	73	7	11	6	3	0
50	0	50	0	0	0	75	25	0	25	75	25	75	0	0	0	0		0	0	0	75	25	0	25	75	25	25	0	0	0
7	81	10	1	1	53	37	8	2	35	45	46	56	37	3	1	0		2	13	44	40	13	3	41	63	27	28	7	4	2
2	94	4	0	0	68	30	1	1	31	44	48	64	24	2	0	0		1	6	53	42	4	1	49	75	11	22	4	1	1
0	100	0	0	0	100	0	0	0	33	67	67	67	50	0	0	0		0	0	100	0	0	0	33	83	17	50	0	0	0
7	72	20	0	1	45	39	13	3	44	38	48	55	39	4	2	0		5	16	39	41	14	6	51	58	24	30	9	8	1
2	89	8	0	1	63	33	3	1	39	29	46	60	26	2	0	0		3	4	43	49	7	1	54	72	10	18	3	2	1
13	87	0	0	0	75	25	0	0	50	50	63	50	50	0	0	0		0	0	62	38	0	0	38	88	0	38	13	13	0
13	62	24	0	1	27	45	24	4	42	26	37	54	37	6	2	0		5	15	21	49	23	7	46	55	13	20	12	12	1
4	89	6	0	1	23	61	14	2	48	13	31	65	19	2	2	0		3	4	16	61	22	1	54	66	10	9	2	4	2
0	100	0	0	0	40	60	0	0	80	20	40	80	40	0	0	0		0	0	60	40	0	0	60	80	20	20	0	40	0
91	2	5	0	2	47	36	14	3	39	46	32	51	2	7	8	1		8	19	44	38	14	4	30	39	13	48	9	17	2
97	1	2	0	0	66	28	4	2	34	54	19	60	2	4	4	1		5	10	58	36	5	1	30	52	5	53	6	12	1
100	0	0	0	0	67	22	0	11	88	25	13	63	13	0	0	0		11	0	75	25	0	0	38	25	13	63	0	25	0
18	63	17	0	2	18	47	30	5	45	33	33	67	8	2	1	1														
8	84	7	0	1	15	61	21	3	56	22	26	74	4	1	1	0														
0	100	0	0	0	50	40	10	0	80	50	50	80	10	0	10	0														



II. Biological solutions of environmental problems and achievement of a sustanable society

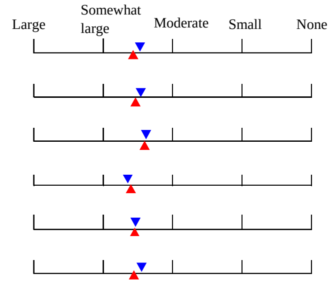
1. Questions regarding the relevant area

1) Degree of expertise in the area

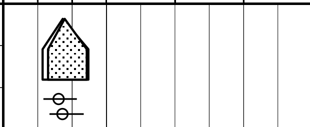
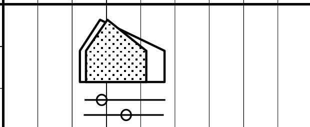
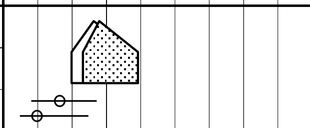
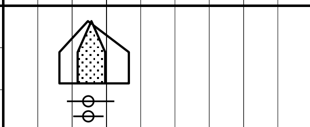
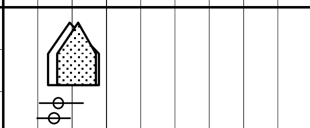
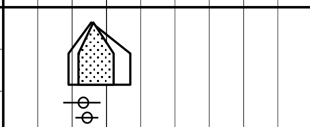
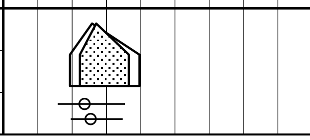


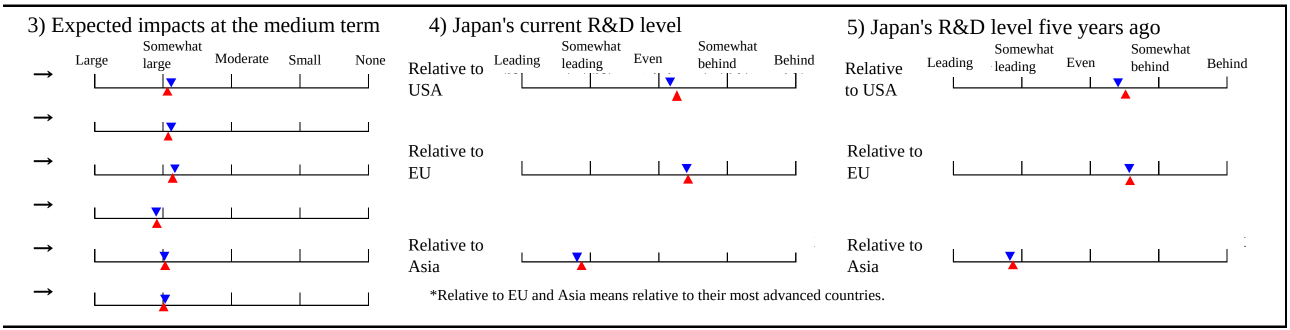
2) Current impacts

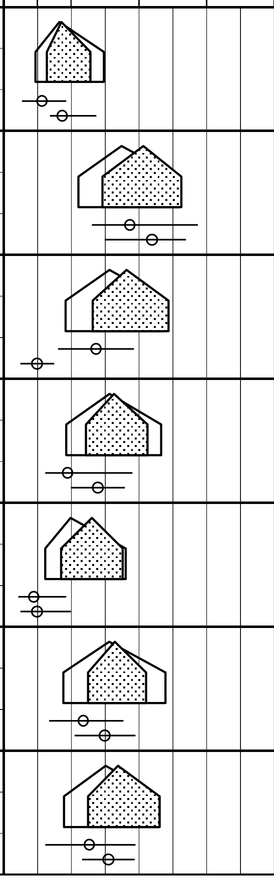
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
9	Widespread use of low-price agriculture, forestry, and fisheries materials (multi-films for outdoor cultivation, fishing tackle, etc.) and containers that use biodegradable materials.	1	202	10	30	60	-	71	44	50	6	0		1	5
		2	185	5	25	70	-	70	41	57	2	0		1	0
		E	9	100	0	0	-	67	33	67	0	0		0	0
10	Creation of biomass production crops of greater than 50 tons/hectare/year (dry).	1	165	13	28	59	-	62	35	43	21	1		10	17
		2	163	8	31	61	-	58	23	66	10	1		6	3
		E	13	100	0	0	-	73	54	31	15	0		15	0
11	Widespread use of biomass energy fuel cells.	1	151	7	22	71	-	68	42	44	13	1		4	9
		2	143	1	17	82	-	70	46	44	9	1		1	1
		E	2	100	0	0	-	50	0	100	0	0		0	0
12	Technology to ferment alcohol or methane from wood biomass through the development of highly-efficient lignin decomposition.	1	154	10	25	65	-	58	29	46	24	1		3	8
		2	140	6	19	75	-	59	22	68	10	0		0	1
		E	9	100	0	0	-	66	38	49	13	0		0	0
13	Manufacturing technology for reusable wood compound materials through advances in technology to compound wood and non-wood materials.	1	111	8	23	69	-	57	25	52	23	0		1	7
		2	112	4	14	82	-	54	16	66	18	0		0	0
		E	4	100	0	0	-	75	50	50	0	0		0	0
14	Technology to effectively remove dioxins and heavy metals from soil by utilizing plants and microorganisms.	1	209	13	27	60	-	74	51	44	5	0		2	9
		2	186	10	22	68	-	80	62	35	2	1		1	1
		E	19	100	0	0	-	92	83	17	0	0		0	0
15	Achievement of low costs agriculture and forestry and rural communities oriented towards zero emissions by using local agricultural and forestry resources, organic waste, and other sources of biomass energy.	1	210	16	26	58	-	79	62	35	3	0		3	9
		2	190	9	27	64	-	88	77	21	1	1		1	1
		E	17	100	0	0	-	88	82	12	0	6		6	0

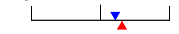


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
49	25	24	1	1	25	45	24	6	20	59	21	55	4	10	17	2		1	7	33	42	19	6	13	42	30	50	18	34	1
73	16	10	0	1	13	73	13	1	8	81	9	60	0	6	14	0		1	1	25	66	8	1	6	53	15	67	8	31	1
78	22	0	0	0	33	67	0	0	11	67	11	56	0	22	33	0		0	0	44	56	0	0	11	33	0	78	11	22	0
11	68	14	4	3	29	44	23	4	34	33	42	55	15	8	4	1		9	15	29	39	21	11	29	53	30	33	15	9	2
4	88	7	0	1	22	68	8	2	28	36	36	72	6	2	3	0		6	7	18	67	11	4	21	68	16	40	10	3	1
15	85	0	0	0	46	38	8	8	42	25	42	67	17	8	8	0		23	0	25	59	8	8	55	55	18	36	9	0	0
39	40	19	0	2	36	42	18	4	29	57	39	59	8	9	5	0		6	8	33	37	26	4	19	54	43	48	23	12	1
40	51	9	0	0	33	60	6	1	18	64	23	75	3	4	1	0		1	4	40	47	12	1	11	68	33	56	14	7	0
100	0	0	0	0	50	50	0	0	0	50	0	50	0	0	0	0		0	0	100	0	0	0	0	0	50	50	0	0	0
37	30	28	1	4	22	45	28	5	29	56	38	56	6	10	1	0		5	12	18	45	29	8	17	56	41	38	19	5	0
49	32	18	0	1	18	71	10	1	20	71	22	68	1	3	0	0		1	2	21	63	15	1	10	70	34	46	11	4	0
56	33	11	0	0	33	45	22	0	0	67	22	67	0	0	0	0		11	0	56	22	22	0	0	44	33	56	0	0	0
58	24	16	1	1	18	39	36	7	27	61	27	53	5	9	3	0		2	8	14	42	35	9	20	53	33	36	17	10	0
89	9	2	0	0	8	66	25	1	13	76	12	60	2	3	2	0		0	0	7	69	22	2	10	73	25	39	7	3	0
75	0	25	0	0	50	25	25	0	0	75	25	50	0	0	0	0		0	0	25	50	25	0	0	50	75	50	0	0	0
34	38	27	1	0	53	37	7	3	36	50	47	64	5	8	7	0		3	10	49	39	9	3	26	55	32	46	15	23	1
36	53	10	0	1	69	27	3	1	28	63	31	72	4	3	3	0		2	2	61	33	4	2	16	76	23	58	10	16	0
26	58	16	0	0	77	17	0	6	29	76	29	59	12	12	0	0		0	5	84	11	0	5	28	89	28	56	17	39	0
22	12	62	2	2	54	37	8	1	38	60	43	56	6	20	10	1		3	13	60	32	7	1	36	49	32	59	27	30	0
12	3	82	2	1	79	18	2	1	28	73	33	63	2	13	4	0		2	3	81	16	2	1	28	60	15	69	15	28	0
18	6	64	12	0	88	0	6	6	20	80	27	60	0	7	0	0		12	6	75	13	6	6	27	53	13	67	13	7	0

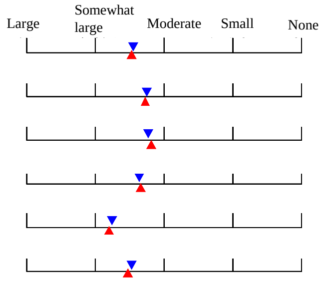
III. Development of production technology that harmonizes with ecosystems and improves the environment

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

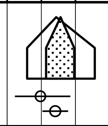
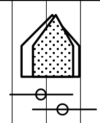
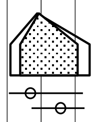
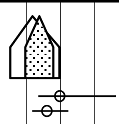
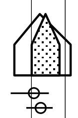
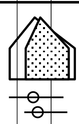
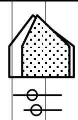
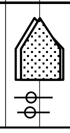


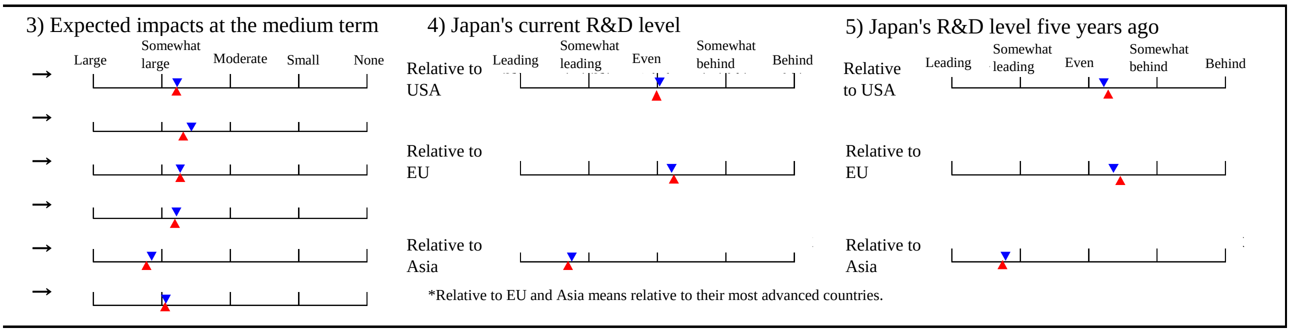
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

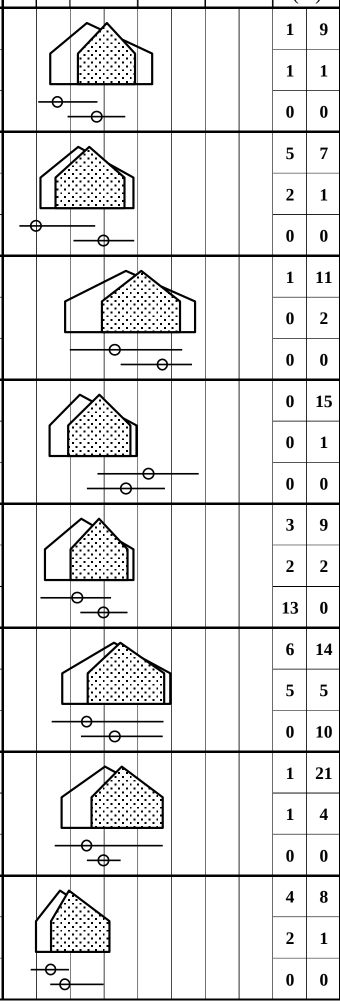
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
16	Biological crop protection methods (phage, plant activators, natural enemies, pheromones, allelopathy, etc.) that reduce use of synthetic chemical pesticides and fertilizers.	1	201	22	25	53	-	70	43	51	5	1		1	9
		2	184	18	21	61	-	74	48	50	1	1		1	1
		E	34	100	0	0	-	86	73	24	3	0		0	0
17	Robots that selectively harvest fruit according to quality and ripeness and automatically sort them.	1	170	9	28	63	-	47	15	48	32	5		4	5
		2	159	6	21	73	-	47	8	65	27	0		1	1
		E	9	100	0	0	-	53	11	78	11	0		0	0
18	Technology to restore coastal environments such as marine forests and tidal flats based on elucidation of material cycling systems that connect land, river, and coastal areas.	1	137	13	20	67	-	74	52	42	6	0		2	7
		2	136	6	17	77	-	83	66	31	2	1		0	2
		E	8	100	0	0	-	100	100	0	0	0		0	0
19	Production system technology artificially seed eels in mass quantities, raise them, and ship them.	1	115	10	18	72	-	49	17	47	33	3		2	8
		2	115	6	9	85	-	47	9	62	28	1		0	1
		E	7	100	0	0	-	79	57	43	0	0		0	0
20	Sensor networks that monitor environmental and biological data in fields, barns, ponds, and so on in real time for the early detection of abnormalities in livestock, such as pest outbreaks and avian influenza and other infections.	1	160	13	21	66	-	69	43	44	12	1		4	6
		2	138	6	19	75	-	73	48	48	3	1		1	2
		E	8	100	0	0	-	81	62	38	0	0		13	0
21	Cultivation of ultrahigh-yield soy beans through varieties that produce large numbers of root nodes.	1	152	13	27	60	-	51	20	48	28	4		6	12
		2	160	13	18	69	-	51	14	67	15	4		4	2
		E	20	100	0	0	-	58	20	70	10	0		5	5
22	Production technology for food and drugs that utilize the physiology of unused microorganisms from the deep ocean.	1	146	7	23	70	-	58	29	49	20	2		0	17
		2	140	2	21	77	-	55	17	69	14	0		0	3
		E	3	100	0	0	-	100	100	0	0	0		0	0
23	Systems that utilize wearable computers (ultra-small PCs that can be worn on the body) to enable computer and internet use even during farm work, to serve as automatic input systems for production record data and as navigation systems that advise on use of inputs, pest control, and so on.	1	165	11	28	61	-	54	25	44	27	4		1	5
		2	167	7	19	74	-	54	15	71	13	1		0	0
		E	12	100	0	0	-	73	50	42	8	0		0	0



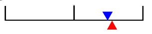
Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application			Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
21	30	47	1	1	32	53	13	2	45	46	42	65	8	13	12	0		1	9	32	49	16	3	35	52	30	48	28	27	1
9	24	67	0	0	25	71	3	1	39	57	26	73	4	8	5	1		1	1	27	69	2	2	23	68	16	63	17	20	1
12	15	73	0	0	38	62	0	0	47	59	44	82	9	18	6	0		0	0	44	53	0	3	30	67	36	64	33	21	0
72	20	5	1	2	8	37	41	14	19	56	30	54	6	5	1	1		5	7	7	31	45	17	20	57	35	44	12	3	0
94	6	0	0	0	4	45	45	6	7	79	15	61	0	1	0	0		2	1	4	34	58	4	8	76	24	42	3	0	0
89	11	0	0	0	11	56	22	11	13	75	0	50	0	0	0	0		0	0	11	33	56	0	11	67	33	33	0	0	0
37	24	37	0	2	55	37	7	1	47	48	42	65	8	12	8	1		1	11	56	35	8	1	41	53	16	41	16	29	2
44	10	46	0	0	77	20	3	0	41	50	30	72	4	4	6	0		0	2	79	19	2	0	39	74	5	43	5	26	1
17	0	83	0	0	100	0	0	0	71	29	57	71	14	0	29	0		0	0	100	0	0	0	43	71	14	43	0	57	0
93	3	1	1	2	16	36	37	11	32	39	28	59	8	3	2	1		0	15	8	29	44	19	27	38	44	37	12	8	0
99	0	1	0	0	7	50	38	5	23	53	12	70	1	2	0	0		0	1	2	30	60	8	12	52	56	32	3	2	0
100	0	0	0	0	43	57	0	0	43	57	14	86	0	0	0	0		0	0	29	29	42	0	14	43	57	57	0	14	0
39	42	17	1	1	39	41	17	3	35	51	45	64	18	10	6	0		3	9	37	44	16	3	36	62	30	44	11	20	1
40	58	2	0	0	42	53	5	0	26	65	30	71	5	3	2	0		2	2	34	60	5	1	20	84	13	49	5	10	0
29	71	0	0	0	57	43	0	0	29	43	43	86	0	0	0	0		13	0	43	43	14	0	14	86	14	43	14	0	0
37	49	9	1	4	17	40	34	9	32	27	30	73	9	5	2	1		6	14	14	34	40	12	35	40	20	38	16	5	6
24	75	1	0	0	10	65	21	4	31	25	24	79	2	3	0	1		5	5	7	51	35	7	30	58	10	46	7	1	2
50	45	5	0	0	15	65	15	5	42	16	32	79	5	11	0	0		0	10	11	62	16	11	47	41	12	47	12	0	0
39	50	8	0	3	22	47	25	6	39	49	50	61	11	11	1	0		1	21	19	34	36	11	34	59	46	25	25	3	1
20	80	0	0	0	10	68	19	3	21	48	47	65	5	3	1	0		1	4	8	47	41	4	19	77	35	18	12	2	0
33	67	0	0	0	67	33	0	0	67	67	33	100	0	0	0	0		0	0	67	33	0	0	100	67	33	100	0	0	0
54	37	8	0	1	19	40	33	8	30	71	30	55	4	9	2	0		4	8	19	35	36	10	27	59	38	49	16	9	1
76	23	1	0	0	9	67	23	1	16	80	20	57	0	6	1	0		2	1	9	50	39	2	13	79	29	47	5	5	0
92	8	0	0	0	33	42	25	0	17	83	25	50	0	8	0	0		0	0	34	33	33	0	8	83	50	42	0	0	0

IV. Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



2) Current impacts

Large / Somewhat large / Moderate / Small / None

[Increased intellectual assets]

Contribution of the relevant area itself to increased intellectual assets

Contribution to the development of other fields

[Economic impacts]

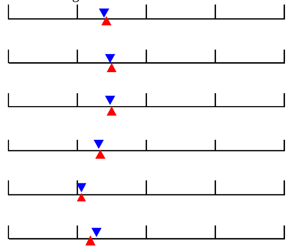
Contribution to the development of existing Japanese industry

Contribution to the creation of new industries or businesses

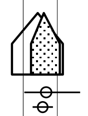
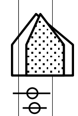
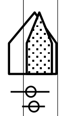
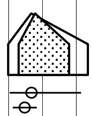
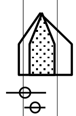
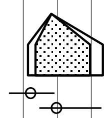
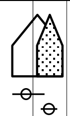
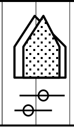
[Social impacts]

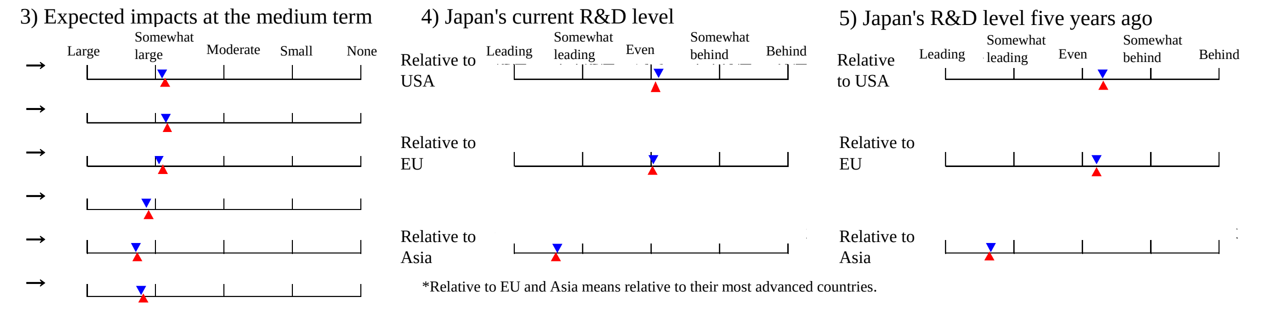
Contribution to safety and security

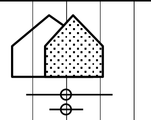
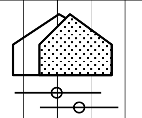
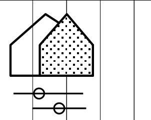
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
24	Food manufacturing that avoids causing allergic reactions by using allergen measurement technology.	1	150	9	25	66	-	66	37	54	8	1		3	10
		2	147	4	22	74	-	60	23	73	3	1		1	3
		E	6	100	0	0	-	83	67	33	0	0		0	0
25	Functional foods tailored to individual physical characteristics to prevent lifestyle disease.	1	166	11	30	59	-	66	39	50	10	1		4	10
		2	158	4	28	68	-	59	22	71	6	1		2	1
		E	7	100	0	0	-	71	43	57	0	0		0	0
26	Foods and diets especially for the elderly that prevent declines in antioxidant, brain, and mastication functions and that use food to support a healthy aging society.	1	151	9	32	59	-	74	52	42	6	0		3	5
		2	145	6	19	75	-	78	58	35	6	1		0	1
		E	8	100	0	0	-	94	87	13	0	0		0	0
27	Precision taste analysis robots that sense taste and other properties and analyze them.	1	123	11	19	70	-	37	7	38	46	9		3	11
		2	144	5	14	81	-	34	2	34	58	6		2	6
		E	7	100	0	0	-	43	14	29	57	0		0	0
28	Sensor network technology that monitors foods from production to table with DNA chips, spectrum sensors, and other sensors in order to prevent contamination with harmful substances, bacteria, and so on.	1	161	11	27	62	-	59	31	45	21	3		3	8
		2	165	3	22	75	-	56	18	71	11	0		1	1
		E	5	100	0	0	-	65	40	40	20	0		0	0
29	Food crop safety assessment systems that utilize proteomics and metabolics.	1	130	16	23	61	-	57	29	45	23	3		5	11
		2	124	6	25	69	-	54	16	70	13	1		1	0
		E	8	100	0	0	-	66	38	49	13	0		0	0
30	Forest treatment methods based on physiological elucidation of the comfort-increasing effects of forests and wood.	1	128	4	18	78	-	44	12	45	38	5		5	10
		2	121	2	19	79	-	44	7	56	35	2		3	2
		E	3	100	0	0	-	67	33	67	0	0		0	0
31	Home freshness-sensing devices to detect the freshness of foods.	1	138	12	21	67	-	36	7	37	42	14		5	8
		2	149	5	18	77	-	32	3	27	61	9		4	1
		E	8	100	0	0	-	47	13	49	38	0		0	0



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
35	48	17	0	0	30	47	20	3	33	57	42	57	8	11	4	0		3	9	27	45	22	6	28	57	36	34	16	16	1
19	80	1	0	0	15	73	11	1	23	72	25	66	4	4	1	0		0	5	15	66	18	1	17	75	24	33	15	8	0
0	100	0	0	0	67	33	0	0	33	67	17	50	33	17	0	0		0	0	50	50	0	0	50	67	33	17	17	33	0
33	53	13	1	0	28	46	22	4	32	64	38	57	8	14	2	1		4	9	23	43	28	6	24	61	36	32	30	13	0
19	79	2	0	0	11	70	18	1	12	80	25	60	3	7	1	0		3	2	12	64	23	1	10	75	33	25	28	6	0
0	100	0	0	0	42	29	29	0	0	57	14	57	0	14	0	0		0	0	29	57	14	0	0	57	14	14	43	0	0
42	42	14	1	1	31	44	22	3	42	58	35	56	8	11	2	1		1	6	27	38	31	4	31	64	39	39	27	7	1
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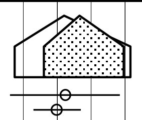
87	13	0	0	0	49	38	13	0	13	50	13	63	0	0	0	0		0	0	38	49	13	0	38	63	13	25	13	0	0
61	30	9	0	0	9	27	45	19	34	48	37	57	5	4	2	1		4	16	9	20	43	28	24	68	43	37	9	2	0
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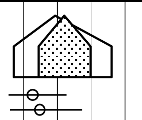
100	0	0	0	0	14	14	72	0	0	57	0	57	0	0	0	0		0	0	14	14	72	0	14	71	29	14	0	0	0
37	50	12	0	1	32	38	25	5	33	56	46	59	9	8	7	1		3	11	31	33	27	9	29	61	34	46	16	22	0
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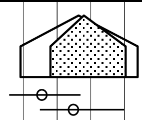
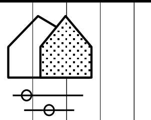
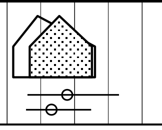
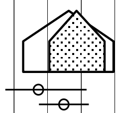
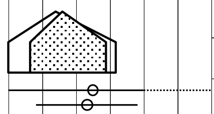
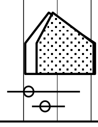
0	100	0	0	0	40	40	20	0	40	80	20	40	0	0	0	0		0	0	40	20	40	0	20	60	40	40	0	0	0
12	68	17	0	3	23	46	26	5	33	42	47	60	7	4	4	1		3	14	26	39	28	7	29	57	32	35	10	17	3
3	92	5	0	0	12	73	14	1	18	55	39	73	2	3	1	0		2	0	12	71	15	2	14	79	19	38	4	13	0
0	100	0	0	0	49	38	13	0	50	63	75	50	13	13	0	0		0	0	42	29	29	0	71	57	43	57	14	14	0
27	13	57	0	3	12	36	40	12	41	42	33	52	7	8	0	0		4	16	11	32	41	16	44	51	27	31	17	4	0
14	4	81	0	1	6	43	46	5	37	47	21	61	2	3	0	0		3	3	4	31	59	6	41	71	14	21	5	0	1
34	33	33	0	0	33	67	0	0	67	33	33	67	0	0	0	0		0	0	33	67	0	0	33	100	0	0	0	0	0
69	21	6	0	4	3	22	49	26	17	60	28	49	3	8	2	0		5	14	5	22	42	31	18	48	49	28	12	8	1
88	5	6	0	1	1	13	70	16	8	81	10	48	1	3	2	0		6	1	2	15	65	18	10	67	56	16	4	5	0
87	13	0	0	0	14	14	72	0	0	86	0	71	0	0	0	0		13	0	13	25	62	0	0	75	50	38	0	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
32	Prevention, diagnosis, and treatment technology through the complete elucidation of BSE onset.	1	**148**	**7**	**20**	**73**	**-**	**77**	**60**	**32**	**5**	**3**							**3**	**7**
		2	**144**	**2**	**19**	**79**	**-**	**89**	**79**	**16**	**4**	**1**							**1**	**1**
		E	**3**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**
33	Risk management technology for harmful chemicals (endocrine disruptors, heavy metals, etc.) based on elucidation of their long-term impacts on human beings, crops, livestock, and ecosystems.	1	**195**	**8**	**29**	**63**	**-**	**79**	**60**	**35**	**4**	**1**							**2**	**11**
		2	**185**	**5**	**22**	**73**	**-**	**93**	**85**	**14**	**1**	**0**							**1**	**1**
		E	**9**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**
34	Formation of positive understanding and consensus on genetically engineered plants and foods.	1	**205**	**26**	**29**	**45**	**-**	**78**	**61**	**27**	**10**	**2**								
		2	**192**	**19**	**29**	**52**	**-**	**90**	**80**	**17**	**2**	**1**								
		E	**36**	**100**	**0**	**0**	**-**	**92**	**86**	**11**	**0**	**3**								

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
19	**14**	**67**	**0**	**0**	**65**	**26**	**6**	**3**	**49**	**37**	**50**	**65**	**28**	**5**	**10**	**0**						**1**	**10**	**66**	**22**	**8**	**4**	**48**	**47**	**14**	**47**	**11**	**31**	**1**
7	**4**	**89**	**0**	**0**	**87**	**10**	**2**	**1**	**54**	**29**	**55**	**73**	**14**	**2**	**2**	**1**						**1**	**1**	**87**	**10**	**2**	**1**	**60**	**60**	**3**	**50**	**6**	**24**	**1**
0	**0**	**100**	**0**	**0**	**100**	**0**	**0**	**0**	**67**	**0**	**67**	**100**	**67**	**0**	**0**	**0**						**0**	**0**	**100**	**0**	**0**	**0**	**100**	**33**	**0**	**100**	**0**	**33**	**0**
14	**47**	**39**	**0**	**0**	**64**	**28**	**7**	**1**	**50**	**43**	**49**	**64**	**20**	**5**	**12**	**1**						**1**	**13**	**62**	**27**	**11**	**0**	**47**	**52**	**16**	**34**	**10**	**37**	**2**
3	**68**	**29**	**0**	**0**	**87**	**11**	**2**	**0**	**62**	**34**	**45**	**78**	**7**	**2**	**4**	**0**						**0**	**3**	**88**	**10**	**2**	**0**	**53**	**71**	**6**	**37**	**6**	**27**	**1**
0	**67**	**33**	**0**	**0**	**100**	**0**	**0**	**0**	**56**	**11**	**56**	**100**	**11**	**0**	**0**	**0**						**0**	**0**	**100**	**0**	**0**	**0**	**56**	**67**	**0**	**56**	**11**	**44**	**0**
																						**6**	**12**	**64**	**23**	**10**	**3**	**58**	**42**	**11**	**14**	**33**	**22**	**10**
																						2	**8**	**79**	**16**	**3**	**2**	**76**	**55**	**7**	**8**	**37**	**14**	**2**
																						6	**6**	**80**	**11**	**3**	**6**	**82**	**61**	**18**	**21**	**39**	**15**	**0**

V. Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

2) Current impacts

Large / Somewhat large / Moderate / Small / None

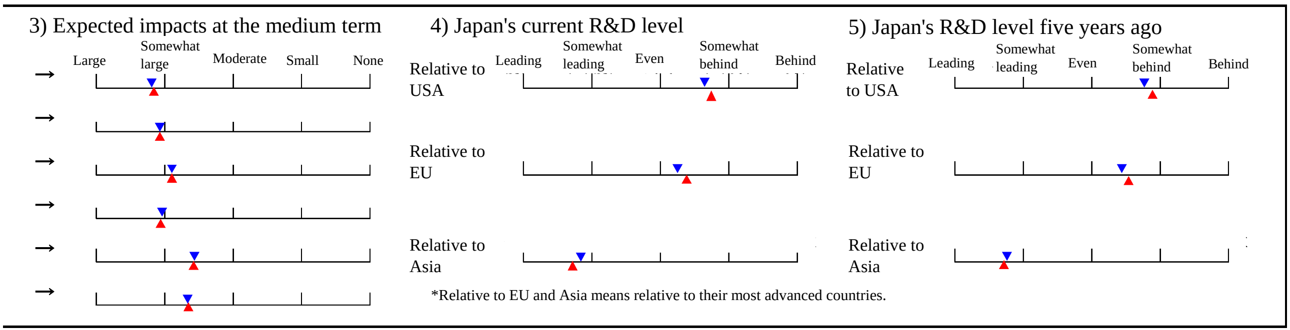
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

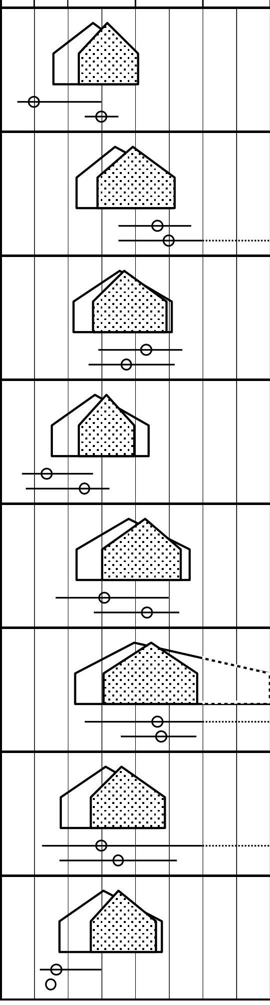
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
35	Production of transformed livestocks with secreted antibacterial proteins, blood coagulation factor and other physiologically active substances in milk	1	97	7	29	64	-	46	13	51	31	5							4	9
		2	116	2	22	76	-	47	6	69	25	0							0	3
		E	2	100	0	0	-	75	50	50	0	0							0	0
36	Preventation of diseases, recovery of homeostasis, improvement of feeding and milk production control based on elucidation of immune system and endocrine mechanisms of adenohypophysis	1	82	9	24	67	-	44	11	46	38	5							2	16
		2	99	3	17	80	-	45	5	65	30	0							0	0
		E	3	100	0	0	-	67	33	67	0	0							0	0
37	Improvement and farming of new organisms for fisheries with advantageous characteristics (e.g., environmental tolerance and resistance to disease) by applying DNA markers and other genome technology.	1	123	17	24	59	-	60	31	50	16	3							2	12
		2	131	7	22	71	-	57	18	73	9	0							0	2
		E	9	100	0	0	-	78	56	44	0	0							0	0
38	Industrial production of useful substances such as medicines through the utilization of insect cell cultures and other transformants.	1	130	10	23	67	-	59	30	50	17	3							1	9
		2	141	2	28	70	-	56	15	79	6	0							1	1
		E	3	100	0	0	-	100	100	0	0	0							0	0
39	Crop production and greening in the strict environment, such as deserts, by using new plants enhanced/added salt, drought or cold tolerance.	1	179	26	24	50	-	55	25	49	23	3							3	10
		2	175	15	29	56	-	56	18	68	13	1							1	2
		E	27	100	0	0	-	65	30	70	0	0							0	0
40	Modeling of all process about the rice plant growth based on the complete elucidation of gene functions and interaction of transcripts.	1	155	25	22	53	-	65	42	38	18	2							4	10
		2	153	14	21	65	-	72	47	47	5	1							3	2
		E	21	100	0	0	-	81	62	38	0	0							0	0
41	Production of aquaculture varieties fixed preferred properties (disease resistance, high growth) through chromosomal manipulation cloning.	1	107	13	21	66	-	56	26	50	20	4							2	12
		2	115	7	15	78	-	50	9	73	18	0							1	4
		E	8	100	0	0	-	56	25	50	25	0							13	0
42	Production of livestock cloned from somatic cells based on elucidation of epigenetic and other nuclear genetic information reprogramming mechanism	1	81	9	25	66	-	50	16	53	28	3							0	11
		2	92	1	22	77	-	47	4	78	17	1							0	2
		E	1	100	0	0	-	100	100	0	0	0							0	0

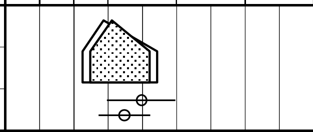
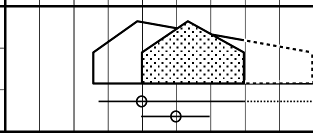
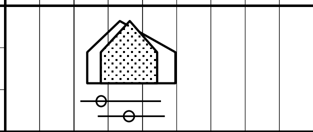
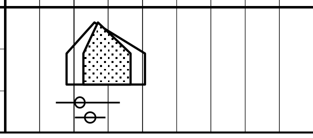


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
4	68	26	0	2	19	41	31	9	32	50	37	60	10	15	5	1
0	96	3	1	0	6	70	23	1	17	64	15	72	4	8	2	0
0	100	0	0	0	50	50	0	0	0	50	0	100	0	0	0	0
3	77	19	0	1	16	44	35	5	33	40	43	64	12	8	0	0
1	97	2	0	0	6	69	25	0	23	47	28	71	3	3	1	0
33	67	0	0	0	33	67	0	0	0	100	33	100	0	0	0	0
39	48	11	1	1	29	46	22	3	41	45	46	66	11	7	0	0
33	64	3	0	0	19	69	12	0	35	47	41	76	3	2	1	1
56	44	0	0	0	67	33	0	0	56	33	67	100	11	0	0	0
36	56	8	0	0	29	41	23	7	34	53	37	63	9	11	2	1
20	79	1	0	0	11	78	11	0	29	66	25	74	2	5	1	0
33	67	0	0	0	67	33	0	0	33	67	0	100	33	0	0	0
26	63	9	1	1	34	45	17	4	42	36	37	62	39	11	0	1
11	86	1	1	1	28	63	8	1	47	36	24	74	25	6	2	1
15	81	4	0	0	41	59	0	0	41	41	30	81	22	7	0	0
73	25	1	0	1	44	35	16	5	43	33	48	73	22	5	0	1
91	9	0	0	0	59	35	5	1	47	26	44	78	7	3	0	0
76	24	0	0	0	71	29	0	0	71	29	38	86	5	5	0	0
57	32	9	0	2	29	41	26	4	38	42	40	67	3	8	3	0
78	18	4	0	0	15	69	16	0	27	45	29	77	1	2	0	0
75	25	0	0	0	37	38	25	0	50	50	50	88	13	0	0	0
17	48	35	0	0	25	44	27	4	31	33	46	64	8	13	6	0
7	82	11	0	0	7	81	11	1	22	33	45	67	0	1	1	0
100	0	0	0	0	100	0	0	0	100	100	100	100	0	100	0	0

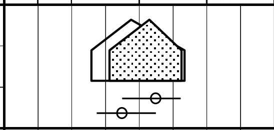
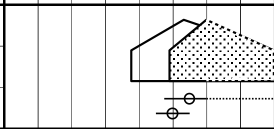
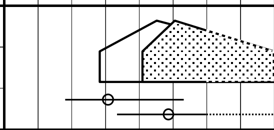
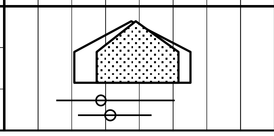
Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–



Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
6	17	22	34	34	10	25	54	34	27	33	14	2
2	4	7	56	34	3	19	79	22	21	23	9	0
0	0	50	50	0	0	0	100	50	0	0	0	0
1	20	15	38	37	10	41	58	27	27	13	6	1
0	3	5	57	37	1	36	77	10	14	11	4	0
0	0	0	100	0	0	67	67	0	33	0	0	0
2	12	21	46	28	5	38	64	37	36	17	8	3
0	6	9	74	16	1	31	80	20	32	8	4	1
0	0	56	33	11	0	67	56	22	78	0	11	0
2	15	20	41	31	8	31	59	43	27	28	11	0
1	2	8	74	17	1	25	78	40	19	20	6	0
0	0	33	67	0	0	0	100	67	33	33	0	0
3	16	34	45	16	5	47	52	28	35	19	4	4
2	5	27	62	9	2	51	73	20	38	10	2	1
0	0	44	49	7	0	52	70	26	59	19	0	0
5	17	33	32	25	10	47	53	21	26	15	2	6
7	7	36	45	16	3	53	75	10	23	7	1	1
0	10	53	33	14	0	81	76	19	33	10	0	0
6	14	28	32	36	4	35	53	33	30	18	12	1
4	5	9	55	34	2	36	72	20	20	12	8	0
13	0	38	13	49	0	38	50	25	50	25	25	0
1	20	27	40	28	5	33	42	25	29	23	10	4
1	2	7	77	15	1	38	73	9	20	10	8	0
0	0	100	0	0	0	100	100	100	100	100	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
43	Prevention of infection disease based on the knowledge of the immune system and its regulatory factors of fish .	1	**100**	**6**	**20**	**74**	**-**	**62**	**34**	**50**	**13**	**3**		**1**	**18**
		2	**104**	**4**	**13**	**83**	**-**	**57**	**16**	**78**	**6**	**0**		**1**	**3**
		E	**4**	**100**	**0**	**0**	**-**	**81**	**75**	**0**	**25**	**0**		**25**	**0**
44	Communication technology between human and livestock utilized sensing of the neuro-transmission in the brain.	1	**72**	**7**	**17**	**76**	**-**	**37**	**12**	**28**	**46**	**14**		**13**	**25**
		2	**89**	**2**	**9**	**89**	**-**	**31**	**3**	**25**	**61**	**11**		**10**	**15**
		E	**2**	**100**	**0**	**0**	**-**	**50**	**0**	**100**	**0**	**0**		**0**	**0**
45	Growth regulation of crop/tree based on the knowledge of the mechanism about biosynthesis, transport, and receptor-mediated signaling by regulators in plants.	1	**145**	**25**	**23**	**52**	**-**	**56**	**23**	**56**	**21**	**0**		**1**	**14**
		2	**145**	**16**	**28**	**56**	**-**	**58**	**19**	**76**	**5**	**0**		**1**	**4**
		E	**23**	**100**	**0**	**0**	**-**	**73**	**45**	**55**	**0**	**0**		**0**	**0**
46	Genetically engineered plants in which artificially introduced genes do not spread over the environment because of the special timing/site expression of genes.	1	**151**	**28**	**28**	**44**	**-**	**69**	**47**	**38**	**12**	**3**		**5**	**10**
		2	**159**	**18**	**25**	**57**	**-**	**78**	**58**	**37**	**4**	**1**		**2**	**2**
		E	**28**	**100**	**0**	**0**	**-**	**86**	**74**	**22**	**4**	**0**		**0**	**4**

Time of technological realization columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–

Countries at the leading edge					Regarding technological realization													Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't												Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 2011–2015 2016–2025 2026–2035 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
47	39	13	1	0	32	45	19	4	43	36	49	66	9	7	1	0		1	18	27	45	22	6	40	55	26	28	14	10	2
67	24	9	0	0	17	78	5	0	38	29	42	75	3	1	0	0		1	4	12	76	10	2	46	72	9	24	4	4	0
50	50	0	0	0	50	50	0	0	50	50	50	100	0	0	0	0		0	0	50	25	25	0	75	50	0	75	0	25	0
0	82	16	0	2	14	32	36	18	42	37	46	60	13	0	2	4		14	32	14	22	39	25	52	44	27	25	4	6	6
0	98	2	0	0	5	23	60	12	37	26	36	71	1	0	3	0		17	16	2	24	60	14	62	60	10	16	0	3	0
0	100	0	0	0	50	50	0	0	50	50	50	100	0	0	0	0		0	0	0	50	50	0	50	100	50	50	0	0	0
11	75	12	0	2	25	48	23	4	42	31	42	75	12	5	2	0		4	17	19	42	30	9	52	46	20	26	13	5	3
2	96	2	0	0	17	73	8	2	54	23	36	82	4	4	1	1		4	8	13	69	14	4	60	66	11	21	7	1	1
4	96	0	0	0	35	61	4	0	52	4	39	100	4	4	0	0		0	0	22	78	0	0	61	65	4	26	9	0	0
12	77	10	0	1	43	37	17	3	41	40	48	70	12	10	8	2		5	17	41	35	19	5	38	44	17	30	36	23	8
1	98	1	0	0	56	38	4	2	44	39	43	78	5	7	3	0		3	10	50	43	4	3	42	69	11	24	34	15	1
0	96	4	0	0	71	29	0	0	50	36	36	93	7	11	4	0		0	11	68	32	0	0	39	64	11	36	50	4	4

6. Frontier field

6.1. Overview

(1) The role of science and technology related to the frontier field

A characteristic of the relationship between modern society and science and technology is that the fruits of science and technology penetrate every corner of human life, while at the same time the future of that life is threatened by the products of science and technology. Whatever the fate of human life on Earth may be, it is unimaginable without some relationship with science and technology.

In particular, science and technology related to the frontier field, which developed radically in the 20th century, speaks eloquently of the fact that life on Earth is the product of a cosmogony that has played out over the few billion years since the Big Bang. In that sense, the frontier field influences human life (in each of its senses) on the largest scale and with the longest vision.

This comprehensiveness, broadness, long-term perspective, and leadership held by the frontier field brings a needed inevitability to fundamental measures on various problems facing today's society, and requires a corresponding degree of national support based on a long-term vision.

(2) The future shape of Japan's frontier field

In the survey, the fields of energy and resources, environment, information and communications, life science, social technology, and nanotechnology and materials all receive high support, with slight variation, as fields with which the frontier field should seek to integrate and collaborate into the future. This reflects and suggests that the frontier field is formed by integrating the elemental technologies of other science and technology fields and plays a leadership role by providing a foundation for the perspective of modern outlooks on the universe and the Earth, thus giving other fields a strategic basis for development. Forecasting the world 30 years from now, the fact that "unmanned space exploration," "manned space activities," "human activity in ocean spaces," and "human activity in underground spaces" all received the answer "Will be more active than now" speaks of the high expectations for the frontier field.

(3) Expected impacts from the frontier field

For current expected impacts, the response was "Large" or "Somewhat large" for increased intellectual assets in each of the frontier field's 11 areas, demonstrating a consciousness that these are essential topics for increasing Japan's intellectual presence. The highest expectations are for the areas of space, ocean, and Earth technology for a safe and secure society; technology for high precise observation of Earth environments and for prediction of change; and space, ocean, and Earth technology that drives science and technology innovation.

Results for expected impact at the medium term were roughly equivalent to those for current expected impacts. This tells us that the frontier field is already deeply connected to our lives, and that it is leading technology that will open the way to the future in comprehensive, long-term manner.

As for contributing to the creation of new industries and business, we wish to draw attention to basic technology for space transportation and manned space activity, planetary exploration, and ocean and deep ocean floor observation research technology as areas with high expectations shifting from the present to the medium term. These areas are likely to open new worlds of curiosity, and humanity looks to Japan to contribute the results to the world's intellectual pursuits.

Taking a comprehensive look at the history of 20th century science and technology, the frontier field is the basic science field that has made the most fundamental contribution to the creation of new industries and businesses. Of course, the current age, which some call the Information Revolution, would not have begun if its most basic theory, quantum mechanics, had not been established and if innumerable particle experiments had not been performed in order to prove it.

A country striving to base itself on creating science and technology must stand firmly on the foundation of the long-range revolution brought by basic science.

(4) Japan's R&D level

In comparison with the USA, and the countries of Europe and Asia, on average Japan is "somewhat behind" the USA and Europe while "leading" Asia in every sector. Areas where Japan is about even with or ahead of the USA include space and particle research, technology for high precise observation of Earth environments and for prediction of change, ocean and deep ocean floor observation research technology, deep Earth observation technology, and space, ocean, and Earth technology for a safe and secure society. The R&D level five years ago showed approximately the same results. Even in areas in which Japan trails Europe and the USA, planetary exploration for example, Japan leads in several technologies for individual topics, such as sample-and-return exploration of solid planets.

(5) Degrees of importance of individual foresight topics

The following topics ranked highest in terms of the degree of importance to Japan index.

- The topic to construct a risk management system that utilizes disaster observation satellites, communications satellites, and so on
- The topic to forecast volcanic eruptions by observing and assessing magma conditions inside volcanoes that are likely to erupt
- The topic to precisely forecast the earthquakes of magnitude 7 or greater

Of the top 10 topics in terms of the degree of importance index, 6 deal with predicting or managing disasters such as earthquakes, volcanoes, and torrential rainfall. The other 4 are reaching agreement on greenhouse gas regulation, predicting climate change, underground disposal of radioactive waste, and an integrated, digital, national land management and use system that covers all of Japan.

By area, space, ocean, and Earth technology for a safe and secure society had the highest score on the degree of importance index.

(6) Technological realization

The overwhelming majority of respondents believe that time of realization for the frontier field will be between 2011 and 2015. Most believe that government involvement in the field is necessary, with the total of those selecting either "high" or "moderate" reaching 93 percent. Space, ocean, and Earth technology for a safe and secure society was the area for which the highest number of responses said government involvement is most necessary, followed by the planetary exploration technology area. The strength of interest in these topics underlies these responses on necessity of government. The frontier field includes many nationally-promoted projects around the world, and if we are to truly pioneer this field, the important measures that the government should take are research and development funding and human resources development.

(7) Social application

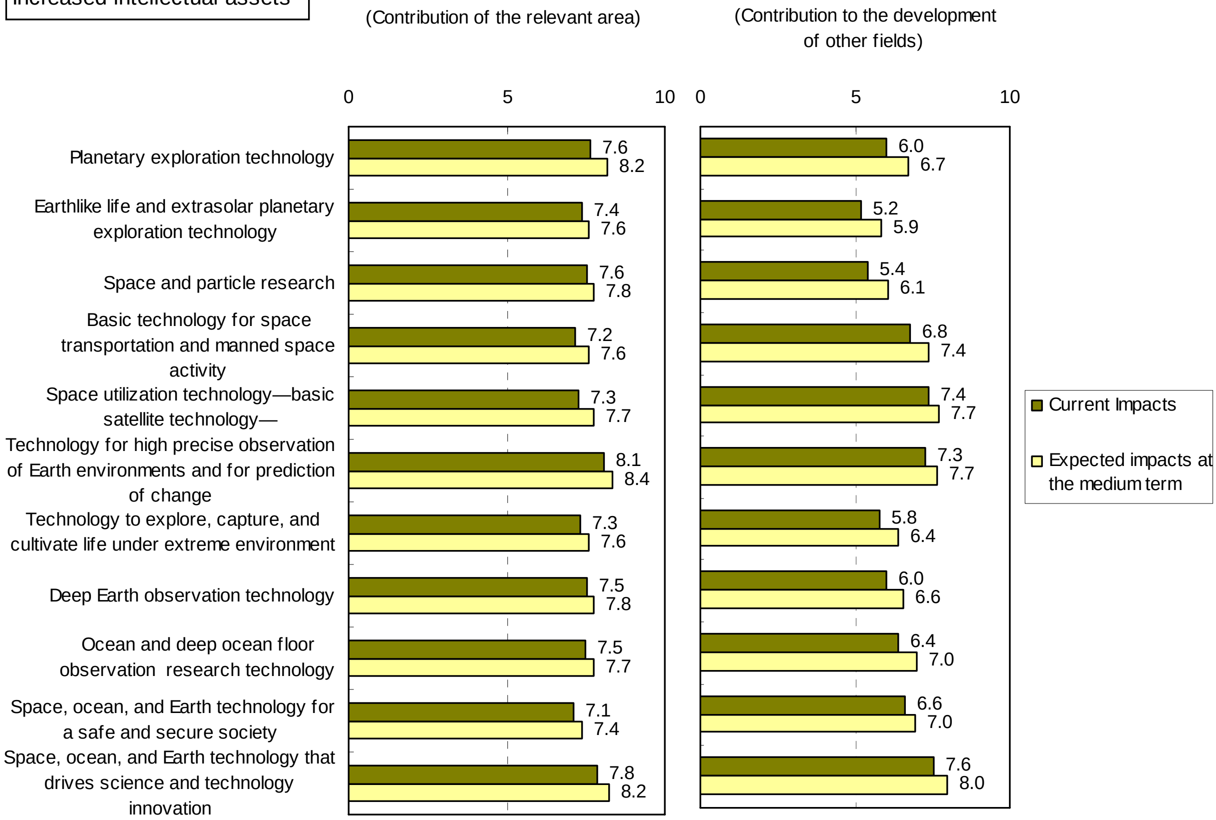
Social application in the frontier field is predicted between 2021 and 2025, gently curving to a peak. Ten years is seen as the average time from technological realization to social application. Because these are very advanced technologies, perhaps respondents imagine the necessity of a long technological ordeal until social application, but actually, once the technologies of the frontier field achieve technological realization, most of them will be rapidly applied to civil life. Barcodes, which began as technology for quality control in space programs, are an example of this phenomenon.

(MATOGAWA Yasunori)

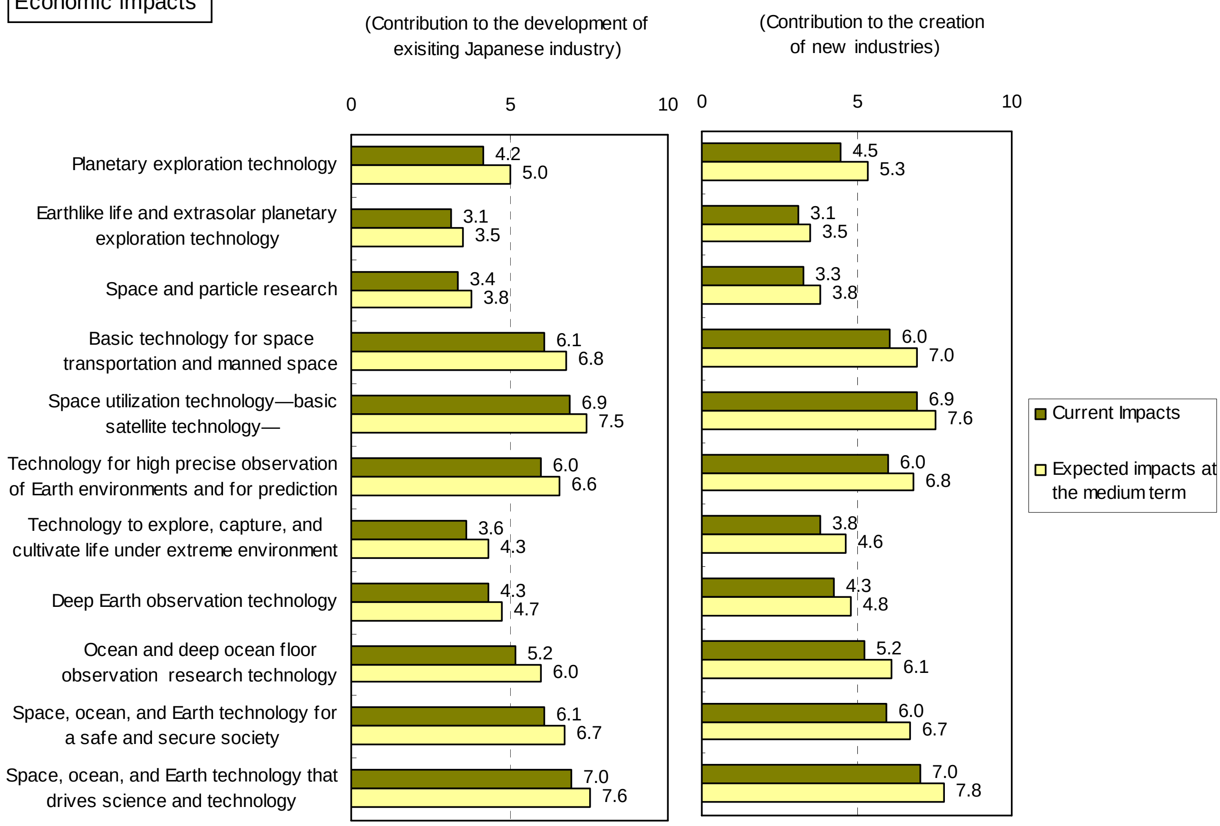
6.2. Main results

A. Impacts

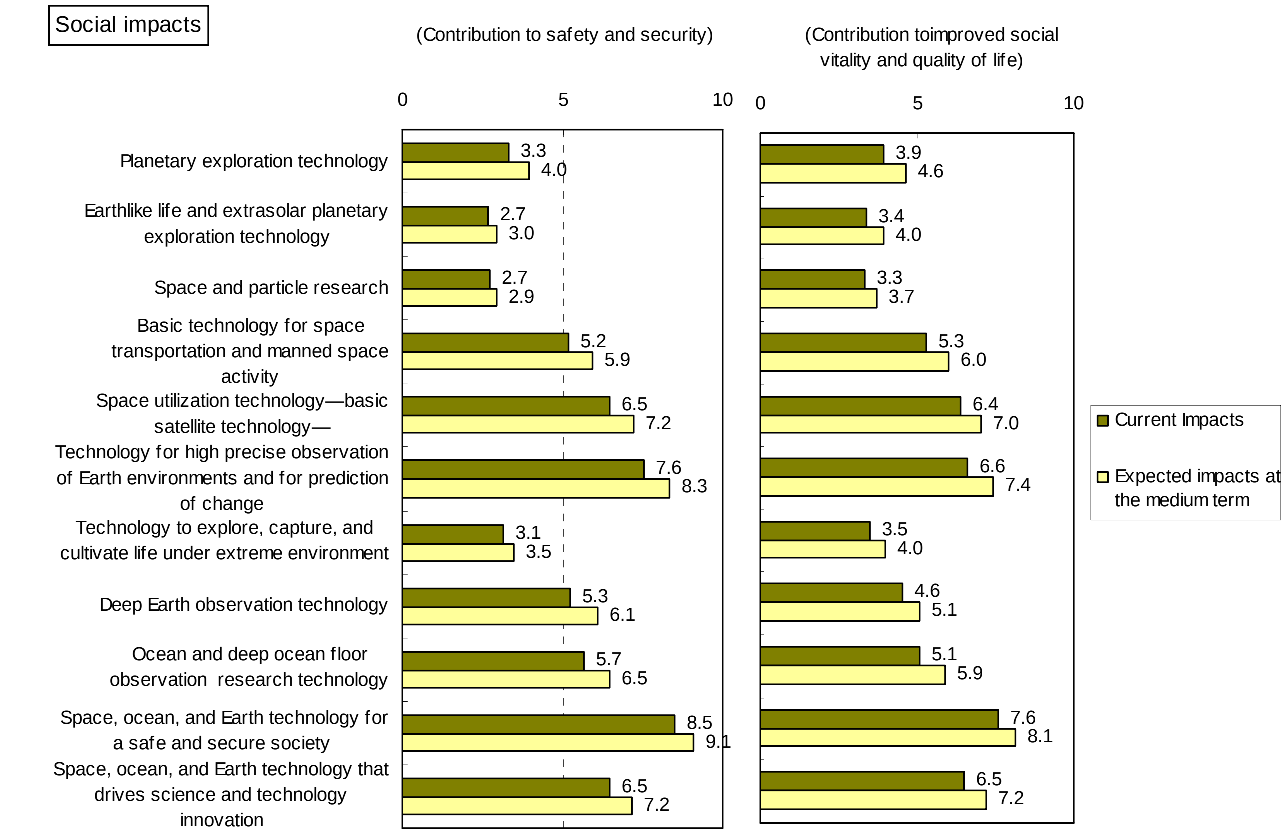
Increased intellectual assets



Economic impacts

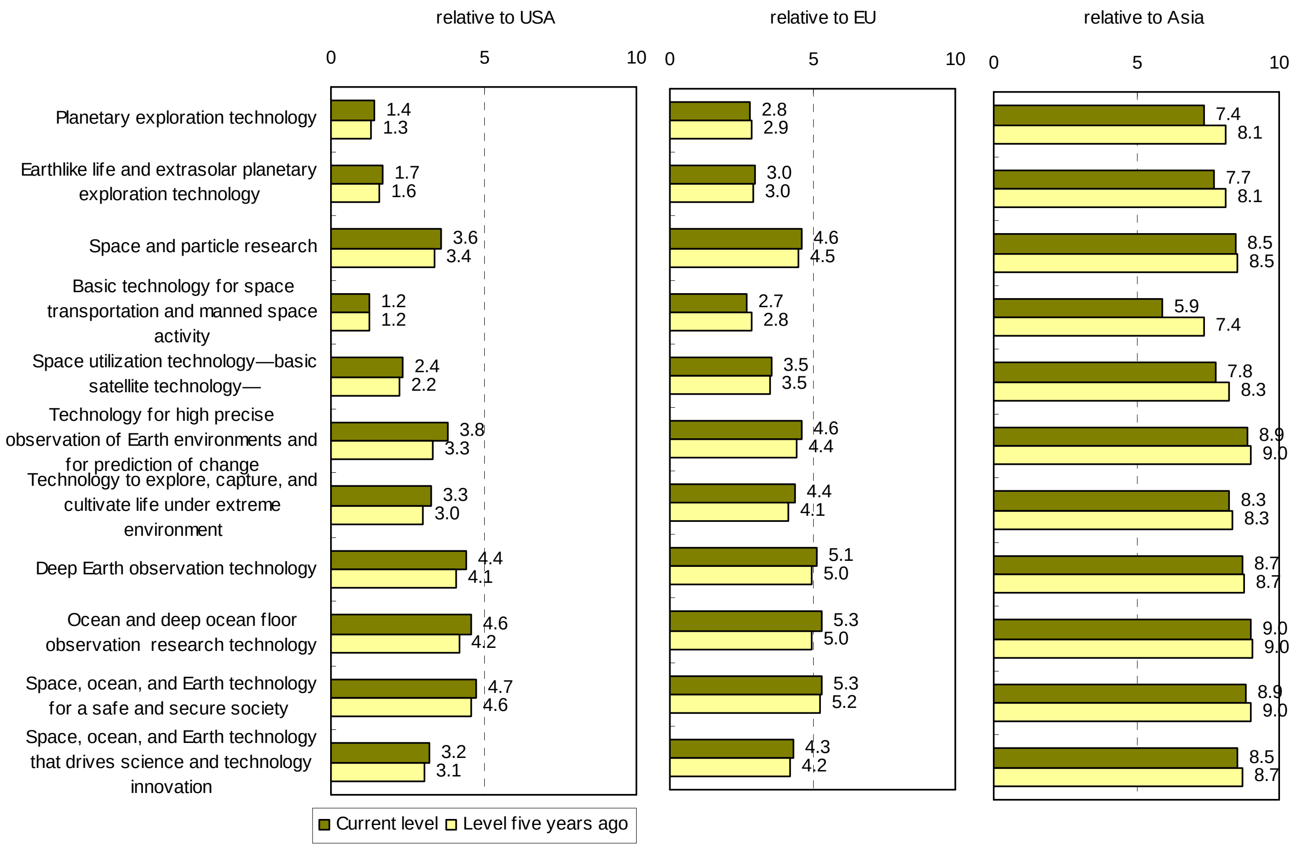


*Responses are indexed on a 10-point scale.



*Responses are indexed on a 10-point scale.

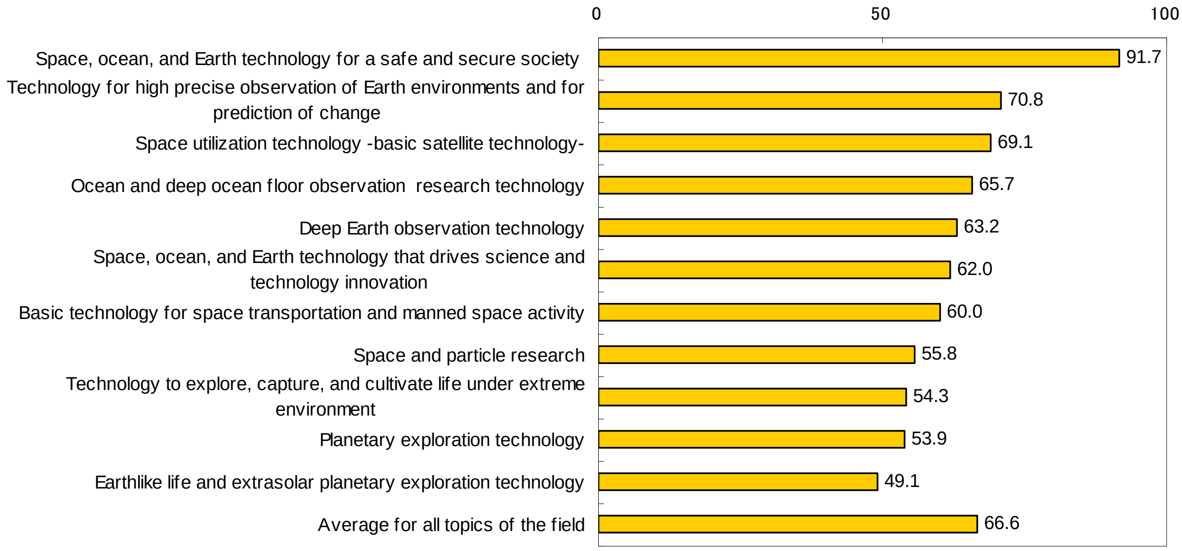
B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan

Average importance index by area



The most important 10 topics

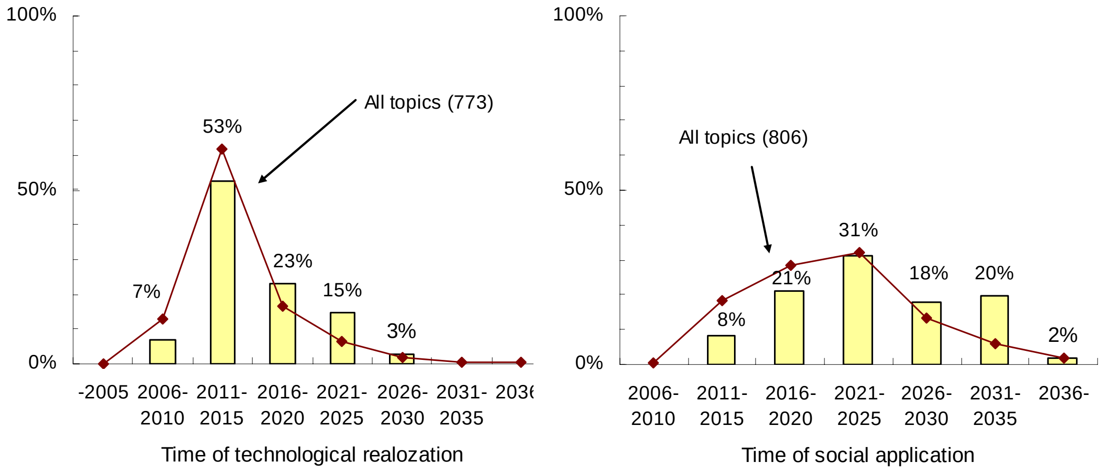
	Topic	Index	Year T*	Year S*
1	52: A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand situations after disasters occur, and respond swiftly (send the necessary information where it is needed).	98	2009	2014
2	58: Technology to forecast the timing and scale of volcanic eruptions by observing and assessing in real time magma conditions inside volcanoes that are likely to erupt.	98	2014	2022
3	57: Technology to precisely forecast the imminence (place and time period) of earthquakes (plate boundary earthquakes and inland earthquakes) of magnitude 7 or greater that are likely to cause damage, helping mitigate human disasters.	98	2021	2030
4	60: Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.	96	2010	2016
5	59: Formation of a worldwide consensus, including developing countries, on international regulations on the output of carbon dioxide and other greenhouse gases.	96	-	2014
6	61: Elucidation of the mechanisms of rainfall, snow accumulation, torrential rain, and so on.	95	2013	2020
7	45: Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones.	95	2015	2026
8	23: Forecasting technology for year-to-year variation of climate system.	94	2014	2022
9	55: Technology to assess the safety of geologic disposal of high-level radioactive waste.	93	2013	2021
10	53: An integrated national land management and use system (using Earth observation satellite data, GPS, communications satellites, GIS, and so on to digitize land use, ocean data, maps, etc.) that covers all of Japan, including the sea.	93	2009	2014

Year T: Time of technological realization Year S: Time of social application

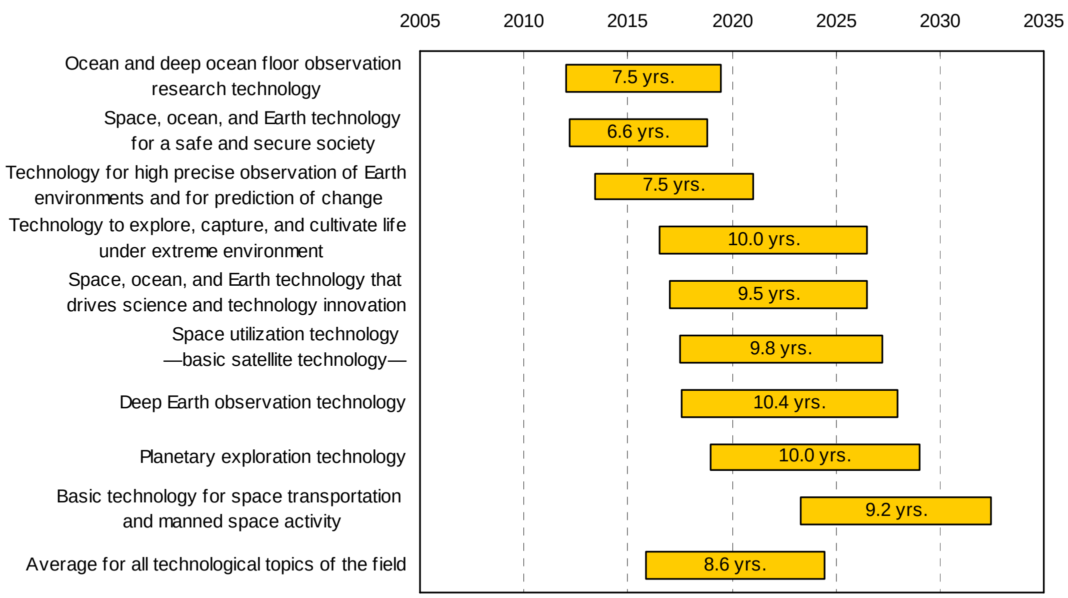
*Responses were indexed on a 100-point scale.

D. Time of realization

Distributions of forecasted realization time



Gap between technological realization and social application



Topics with short or long periods until social application

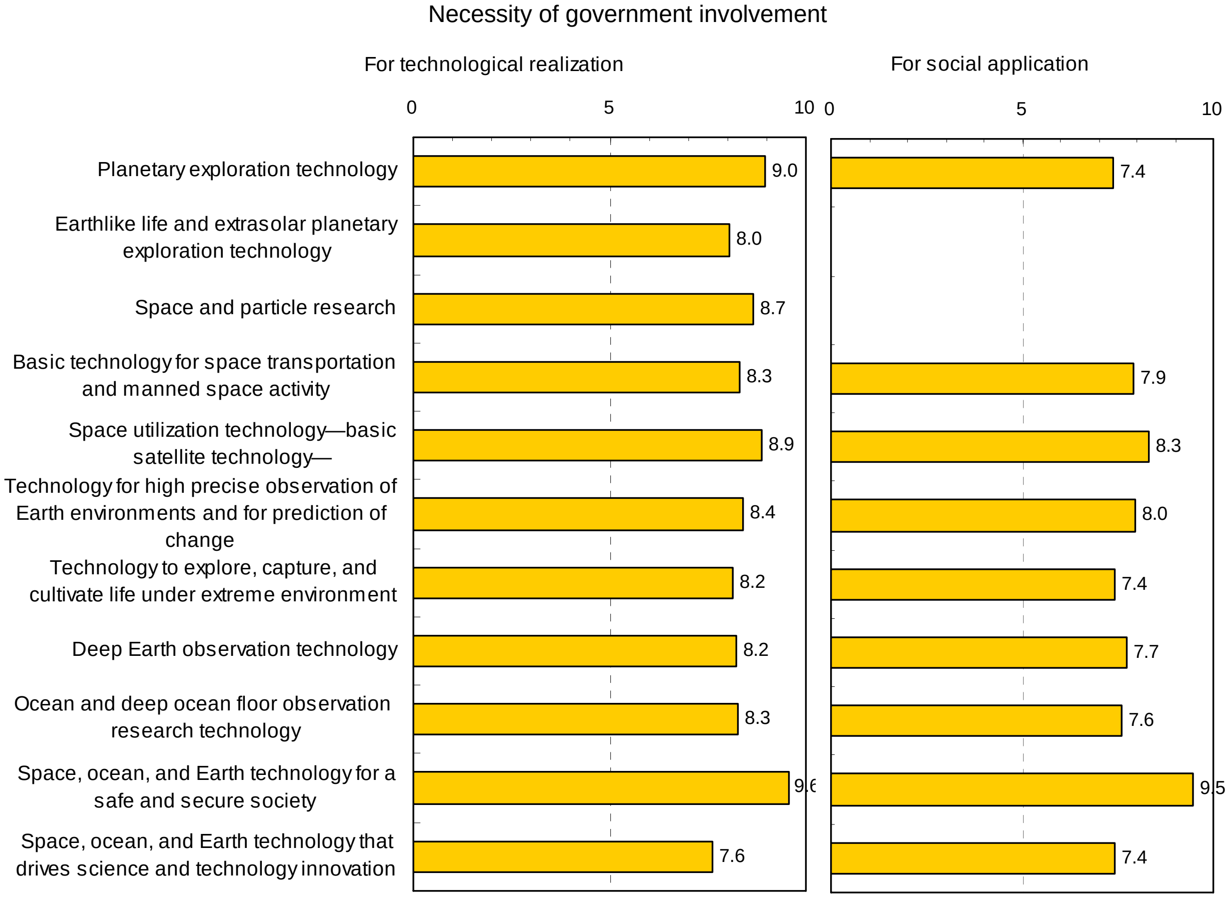
Topic	Year T*	Period*	Area
42: Technology to statically achieve samples of a size of a few centimeters or more from the high-temperature, high-pressure conditions near the center of the Earth.	2016	12	Deep Earth observation technology
43: Technology to use satellite magnetic field observation and surface observation to estimate the core's current dynamo action and future changes in the magnetic field.	2016	12	Deep Earth observation technology
13: Japan's own reusable space vessels that travel between the Earth and Earth orbit.	2020	11	Basic technology for robotic and manned space activity
38: Exploration technology to seek the extraterrestrial life on the other planets (including satellites) within the solar system.	2021	11	Technology to explore, capture, and keep extreme life forms
44: Technology sensitive enough to detect shifts in matter of a few centimeters a year deep inside the Earth.	2020	11	Deep Earth observation technology

Topic	Year T*	Period*	Area
45: Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones.	2015	11	Deep Earth observation technology
63: Solar photoelectric power generation plants in space that transmit electricity to the ground with microwaves or lasers.	2022	11	Space, ocean, and Earth technology that drives science and technology innovation
74: Saltwater engines that remove oxygen and hydrogen form seawater and generate energy.	2021	11	Space, ocean, and Earth technology that drives science and technology innovation

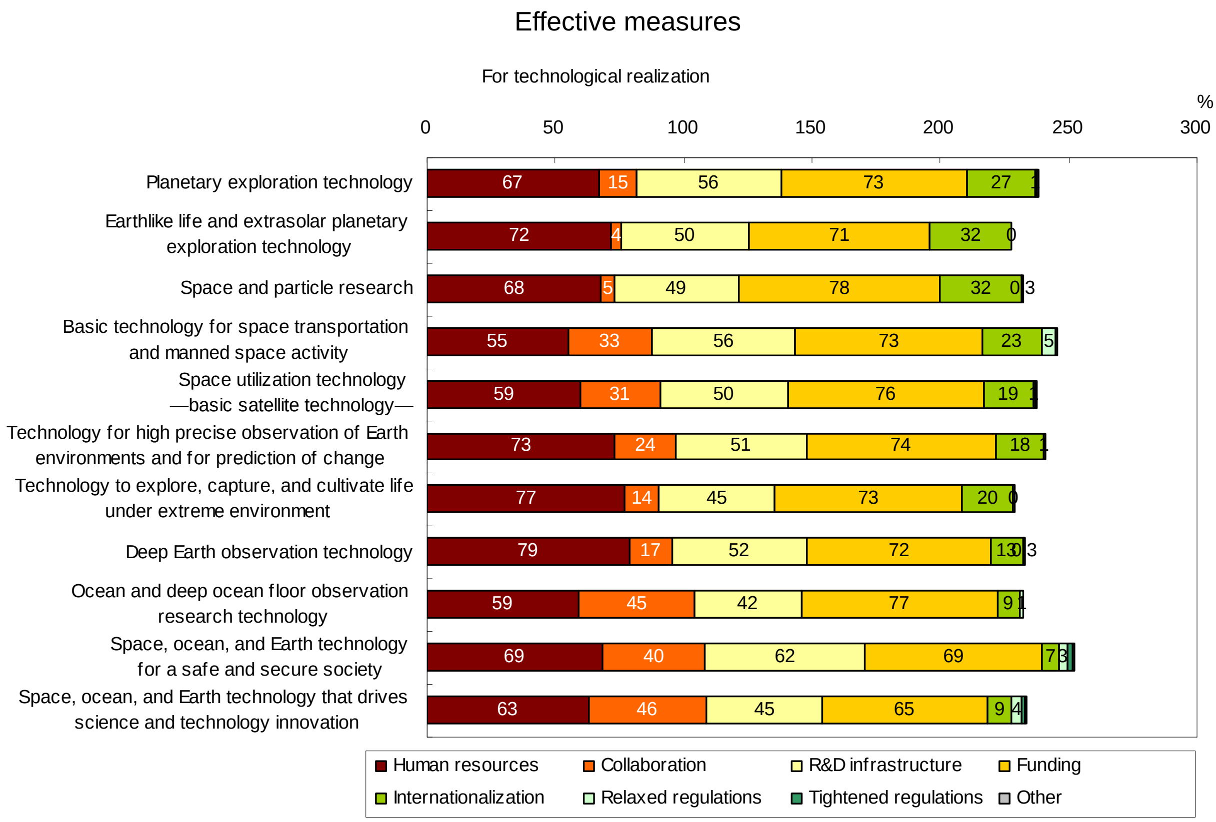
Topic	Year T*	Period*	Area
52: A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand situations after disasters occur, and respond swiftly (send the necessary information where it is needed).	2009	5	Space, ocean, and Earth technology for a safe and secure society
53: An integrated national land management and use system (using Earth observation satellite data, GPS, communications satellites, GIS, and so on to digitize land use, ocean data, maps, etc.) that covers all of Japan, including the sea.	2009	5	Space, ocean, and Earth technology for a safe and secure society
54: Integrated usage and conservation technology for entire bays such as Tokyo Bay and Osaka Bay that are densely used.	2010	5	Space, ocean, and Earth technology for a safe and secure society
33: Three-dimensional image analysis systems that can distinguish tiny ocean organisms (microorganisms, plankton, etc.).	2012	6	Technology for highly accurate observation of Earth environments and prediction of change
49: High-tech survey vessels with a single specialized function.	2008	6	Ocean and deep ocean floor observation research technology
56: Technology that uses monitoring technology on moment-to-moment characteristics of falling and accumulated snow to predict the scale of surface avalanches, degree of risk, and so on over wide areas.	2011	6	Space, ocean, and Earth technology for a safe and secure society
60: Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.	2010	6	Space, ocean, and Earth technology for a safe and secure society

*Year T: Time of technological realization Period: Period until social application (years)

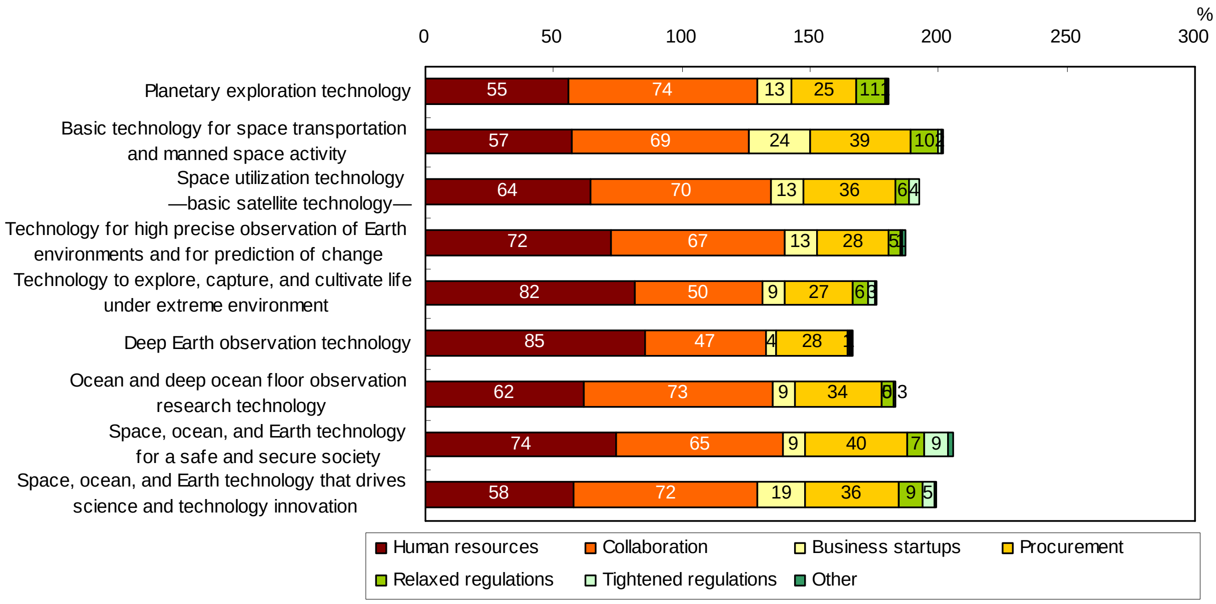
E. Effective measures that should taken by government



*Responses were indexed on a 10-point scale



For social application



F. Time-line of topics

Technological realization

Year	Topic
2008	49: High-tech survey vessels with a single specialized function.
2009	52: A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand situations after disasters occur, and respond swiftly (send the necessary information where it is needed).
	53: An integrated national land management and use system (using Earth observation satellite data, GPS, communications satellites, GIS, and so on to digitize land use, ocean data, maps, etc.) that covers all of Japan, including the sea.
2010	54: Integrated usage and conservation technology for entire bays such as Tokyo Bay and Osaka Bay that are densely used.
	60: Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.
2011	31: Automatic observation systems in the open ocean that monitor water temperature, salinity, and chemical tracers with high reliability while going for long periods without maintenance.
	56: Technology that uses monitoring technology on moment-to-moment characteristics of falling and accumulated snow to predict the scale of surface avalanches, degree of risk, and so on over wide areas.
	75: Three-dimensional autonomous navigation systems for water vessels.
2012	01: Technology to orbit Mercury, Venus, and Mars and observe their surfaces.
	33: Three-dimensional image analysis systems that can distinguish tiny ocean organisms (microorganisms, plankton, etc.).
	37: Technology to isolate and cultivate life forms that inhabit extreme Earth environments.
	47: Automatic observation systems in the open ocean that can monitor oceanographic phenomena and conditions from a depth of 6,000 m to near the surface for a long period of time (about 5 years).
	50: Robots that autonomously perform heavy duty work in the deep ocean.
2013	03: Sample returns from planets.
	05: Become able to directly image Jupiter-type planets orbiting nearby stars outside the solar system by using technology such as negative-type interferometers and coronagraphs.
	26: Systems to observe clouds and aerosol all over the Earth from satellites with high precision, resolution, and frequency.
	27: Stationary satellite observation (vertical resolution 500 m to 1 km, horizontal resolution 1–5 km) of water vapor distribution.
	32: Ocean observation systems that use various flight vehicles to agilely perform sample collection and instrument set up and collection.

Year	Topic
	34: Sensors that can distinguish body shapes underwater from a distance of several hundred meters.
	35: Microwave radiometers loaded on satellites to measure at a spatial resolution of 1 km or less worldwide water, soil moisture, salt deposition density, and snow and ice distribution on land.
	36: Methods to accurately calculate heat transfer in the water cycle such as from a water vapor to clouds and clouds to rain .
	39: Technology to place permanent geophysical observation bases on the deep ocean floor and radically increase the precision of exploration of the Earth's interior by networking them.
	48: Fuel cells that are closed systems (no atmospheric exposure), portable, and can provide 10 kilowatt output for one year with a single fueling.
	51: Probes that can penetrate 10 km below the sea floor.
	55: Technology to assess the safety of geologic disposal of high-level radioactive waste.
	61: Elucidation of the mechanisms of rainfall, snow accumulation, torrential rain, and so on.
	69: Offshore cities (bases for transportation, communications, research, production, leisure activities) with structures with legs or that float.
	76: Wireless communications technology that works over several horizontal kilometers in seawater to enable smooth performance of underwater work.
2014	23: Forecasting technology for year-to-year variation of climate system.
	25: Technology to precisely observe carbon dioxide gas emission and absorption within country, using space technology.
	28: High-precision Earth environment models with about 100–500 m resolution for a short-range forecasting that can distinguish buildings and predict air pollution, and urban flooding.
	46: Technology that precisely estimates the contributions of deep-sea chemical ecosystems to oceanic matter and energy.
	58: Technology to forecast the timing and scale of volcanic eruptions by observing and assessing in real time magma conditions inside volcanoes that are likely to erupt.
	67: Technology for the creation of recreational water-use areas through the development of seawater cleaning systems such as cleaning blocks and biofilters.
	72: Technology to grow bacteria that break down chemical substances that disrupt endocrines and other environmental pollutants.
	73: Establishment of quantitative models for ocean ecosystems.
2015	10: Multi-wavelength observations (in infrared, visible light, ultraviolet, x-rays, gamma rays, etc.), conducted by scientific satellites from outside the atmosphere, attain sensitivity improvements by two orders of magnitude.
	11: Technology to explore difficult-to-detect particles such as cosmic neutrinos, ultrahigh-energy gamma rays, and dark matter particles will markedly improve, leading to major developments.
	21: To respond to the increase in satellite-based communications volume accompanying the growth of Earth-based communications volume, a system of multiple stationary platforms with transmission capacities in the several terabits/second class, linked by optical intersatellite communications.
	29: Climate change simulations for the Earth's history, including the Snowball Earth and the ice age cycle.
	45: Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones.
	68: Technology to fix carbon dioxide to the seafloor.
	70: Marine farms that carry out optimal environmental management by adopting biology technology as well as a broad array of engineering technology.
	71: Methane hydrate mining utilization technology.
2016	42: Technology to statically achieve samples of a size of a few centimeters or more from the high-temperature, high-pressure conditions near the center of the Earth.
	43: Technology to use satellite magnetic field observation and surface observation to estimate the core's current dynamo action and future changes in the magnetic field.
2017	19: Satellite systems whose maintenance, repair, and functional upgrade may be performed by robots in orbit.
2018	08: High-precision space positioning technology utilizing multi-satellite formation flight will become available, with the goal of realizing gravitational wave detectors and ultrahigh-angle-resolution submillimeter interferometers.
	09: Various space observatories that utilize the lunar surface and Sun-Earth Lagrangian points will be realized, enabling far-infrared telescopes, ultrahigh-resolution visible light telescopes, and other technologies which cannot be achieved via Earth-based observations.

Year	Topic
	20: Operation of semi-permanent large platforms (a system in which mission apparatuses can appropriately exchanged and maintenance, inspection, and repair can be performed in orbit) in order to effectively utilize the limited stationary orbits available.
	24: Earth environment change forecasting technology with a scale of several decades by Earth system models that handle the composition of the atmosphere and oceans, ecosystems, and the material cycles within them.
2019	02: Quantum communications technology that is 1 million times faster than current optical communications for high-capacity communications with planetary exploration satellites and so on.
	04: Observation technology for satellites orbiting planets beyond Jupiter.
	12: Particle accelerator technology will advance markedly, leading to breakthroughs in human understanding of the natural world (the origins of the universe, the asymmetry between matter and antimatter, the origins of elements, etc.).
	62: Construction of computer life form models based on advances in system biology.
2020	06: Find Earthlike planets orbiting nearby stars outside the solar system by greatly improving exploration technology for extrasolar planets.
	07: Find environments suitable for life or subtle signs of biological activity on extrasolar planets by carrying out spectroscopic analysis of their atmospheres and surface compositions using remote sensing in infrared and visible wavelengths.
	13: Japan's own reusable space vessels that travel between the Earth and Earth orbit.
	22: Drastic technical measures (debris-free space systems, collection of debris already left, disposal by injection into the atmosphere, etc.) against the debris problem.
	44: Technology sensitive enough to detect shifts in matter of a few centimeters a year deep inside the Earth.
	64: Self-repairing space vessels.
2021	17: Geostationary orbital bases that can be used comprehensively for Earth observation and as space factories and communications bases.
	38: Exploration technology to seek the extraterrestrial life on the other planets (including satellites) within the solar system.
	41: Technology to extract mantle matter by deep drilling into the Earth from any location.
	57: Technology to precisely forecast the imminence (place and time period) of earthquakes (plate boundary earthquakes and inland earthquakes) of magnitude 7 or greater that are likely to cause damage, helping mitigate human disasters.
	74: Saltwater engines that remove oxygen and hydrogen form seawater and generate energy.
2022	16: Life support technology that utilizes closed ecosystems for self-supply of foods such as vegetables, grains, and animal protein in space.
	40: Technology to extract matter from the Earth's core in order to identify the light elements included there.
	63: Solar photoelectric power generation plants in space that transmit electricity to the ground with microwaves or lasers.
	66: Satellite-borne computers that operate on the level of thermal noise energy.
2023	15: Space tourism (including education and cultural activities) in Earth orbit.
2024	14: Japan's own manned space vessels.
2026	65: Space and planetary exploration technology using robots with overall decision-making ability equivalent to that of human beings.
2030	18: Permanent manned moon surface bases (scientific observation from the moon, lunar science, development of technology to utilize resources, etc.).

Social application

Year	Topic
2014	49: High-tech survey vessels with a single specialized function.
	52: A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand situations after disasters occur, and respond swiftly (send the necessary information where it is needed).
	53: An integrated national land management and use system (using Earth observation satellite data, GPS, communications satellites, GIS, and so on to digitize land use, ocean data, maps, etc.) that covers all of Japan, including the sea.
	59: Formation of a worldwide consensus, including developing countries, on international regulations on the output of carbon dioxide and other greenhouse gases.

Year	Topic
2015	54: Integrated usage and conservation technology for entire bays such as Tokyo Bay and Osaka Bay that are densely used.
2016	60: Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.
2017	56: Technology that uses monitoring technology on moment-to-moment characteristics of falling and accumulated snow to predict the scale of surface avalanches, degree of risk, and so on over wide areas.
2018	31: Automatic observation systems in the open ocean that monitor water temperature, salinity, and chemical tracers with high reliability while going for long periods without maintenance.
	33: Three-dimensional image analysis systems that can distinguish tiny ocean organisms (microorganisms, plankton, etc.).
2019	30: Establishment of corporate management methods based on precise seasonal forecasts.
	47: Automatic observation systems in the open ocean that can monitor oceanographic phenomena and conditions from a depth of 6,000 m to near the surface for a long period of time (about 5 years).
	50: Robots that autonomously perform heavy duty work in the deep ocean.
	75: Three-dimensional autonomous navigation systems for water vessels.
2020	26: Systems to observe clouds and aerosol all over the Earth from satellites with high precision, resolution, and frequency.
	32: Ocean observation systems that use various flight vehicles to agilely perform sample collection and instrument set up and collection.
	34: Sensors that can distinguish body shapes underwater from a distance of several hundred meters.
	48: Fuel cells that are closed systems (no atmospheric exposure), portable, and can provide 10 kilowatt output for one year with a single fueling.
	61: Elucidation of the mechanisms of rainfall, snow accumulation, torrential rain, and so on.
2021	27: Stationary satellite observation (vertical resolution 500 m to 1 km, horizontal resolution 1–5 km) of water vapor distribution.
	35: Microwave radiometers loaded on satellites to measure at a spatial resolution of 1 km or less worldwide water, soil moisture, salt deposition density, and snow and ice distribution on land.
	37: Technology to isolate and cultivate life forms that inhabit extreme Earth environments.
	39: Technology to place permanent geophysical observation bases on the deep ocean floor and radically increase the precision of exploration of the Earth's interior by networking them.
	55: Technology to assess the safety of geologic disposal of high-level radioactive waste.
2022	23: Forecasting technology for year-to-year variation of climate system.
	25: Technology to precisely observe carbon dioxide gas emission and absorption within country, using space technology.
	28: High-precision Earth environment models with about 100–500 m resolution for a short-range forecasting that can distinguish buildings and predict air pollution, and urban flooding.
	51: Probes that can penetrate 10 km below the sea floor.
	58: Technology to forecast the timing and scale of volcanic eruptions by observing and assessing in real time magma conditions inside volcanoes that are likely to erupt.
	67: Technology for the creation of recreational water-use areas through the development of seawater cleaning systems such as cleaning blocks and biofilters.
	76: Wireless communications technology that works over several horizontal kilometers in seawater to enable smooth performance of underwater work.
2023	46: Technology that precisely estimates the contributions of deep-sea chemical ecosystems to oceanic matter and energy.
	69: Offshore cities (bases for transportation, communications, research, production, leisure activities) with structures with legs or that float.
	72: Technology to grow bacteria that break down chemical substances that disrupt endocrines and other environmental pollutants.
2025	21: To respond to the increase in satellite-based communications volume accompanying the growth of Earth-based communications volume, a system of multiple stationary platforms with transmission capacities in the several terabits/second class, linked by optical intersatellite communications.
	68: Technology to fix carbon dioxide to the seafloor.
	70: Marine farms that carry out optimal environmental management by adopting biology technology as well as a broad array of engineering technology.

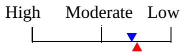
Year	Topic
	71: Methane hydrate mining utilization technology.
2026	19: Satellite systems whose maintenance, repair, and functional upgrade may be performed by robots in orbit.
	45: Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones.
2027	24: Earth environment change forecasting technology with a scale of several decades by Earth system models that handle the composition of the atmosphere and oceans, ecosystems, and the material cycles within them.
2028	20: Operation of semi-permanent large platforms (a system in which mission apparatuses can appropriately exchanged and maintenance, inspection, and repair can be performed in orbit) in order to effectively utilize the limited stationary orbits available.
	42: Technology to statically achieve samples of a size of a few centimeters or more from the high-temperature, high-pressure conditions near the center of the Earth.
2028	43: Technology to use satellite magnetic field observation and surface observation to estimate the core's current dynamo action and future changes in the magnetic field.
2029	02: Quantum communications technology that is 1 million times faster than current optical communications for high-capacity communications with planetary exploration satellites and so on.
2030	17: Geostationary orbital bases that can be used comprehensively for Earth observation and as space factories and communications bases.
	22: Drastic technical measures (debris-free space systems, collection of debris already left, disposal by injection into the atmosphere, etc.) against the debris problem.
	57: Technology to precisely forecast the imminence (place and time period) of earthquakes (plate boundary earthquakes and inland earthquakes) of magnitude 7 or greater that are likely to cause damage, helping mitigate human disasters.
	64: Self-repairing space vessels.
2031	13: Japan's own reusable space vessels that travel between the Earth and Earth orbit.
	40: Technology to extract matter from the Earth's core in order to identify the light elements included there.
	41: Technology to extract mantle matter by deep drilling into the Earth from any location.
	44: Technology sensitive enough to detect shifts in matter of a few centimeters a year deep inside the Earth.
	66: Satellite-borne computers that operate on the level of thermal noise energy.
2032	15: Space tourism (including education and cultural activities) in Earth orbit.
	16: Life support technology that utilizes closed ecosystems for self-supply of foods such as vegetables, grains, and animal protein in space.
	38: Exploration technology to seek the extraterrestrial life on the other planets (including satellites) within the solar system.
	74: Saltwater engines that remove oxygen and hydrogen form seawater and generate energy.
2033	14: Japan's own manned space vessels.
	63: Solar photoelectric power generation plants in space that transmit electricity to the ground with microwaves or lasers.
2034	65: Space and planetary exploration technology using robots with overall decision-making ability equivalent to that of human beings.
2036-	18: Permanent manned moon surface bases (scientific observation from the moon, lunar science, development of technology to utilize resources, etc.).

Appendix: Results of R1 and R2

I. Planetary exploration technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

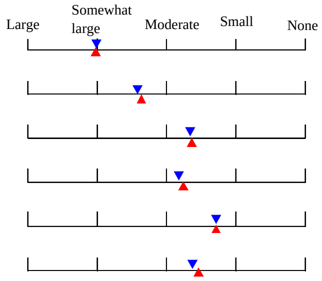


2) Current impacts

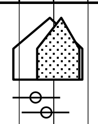
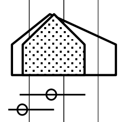
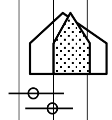
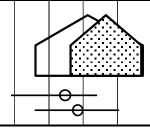
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

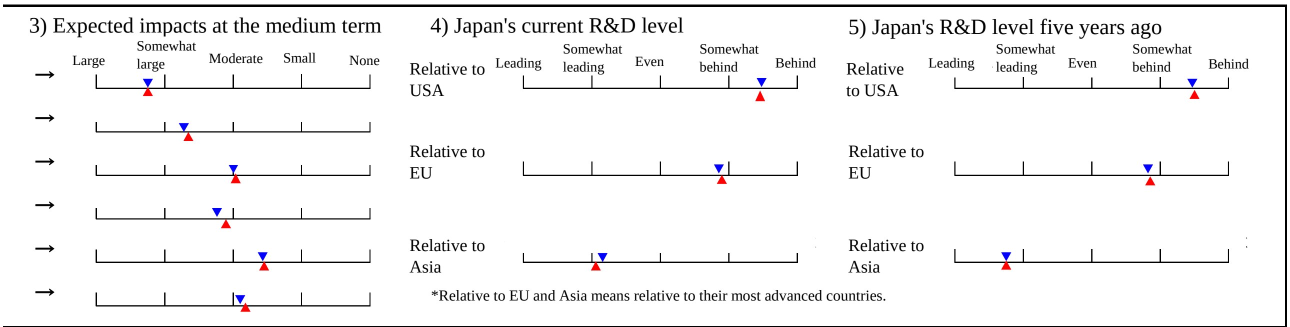
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

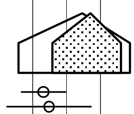


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
1	Technology to orbit Mercury, Venus, and Mars and observe their surfaces.	1	186	15	27	58	-	59	28	51	20	1		0	2
		2	171	13	21	66	-	53	15	68	16	1		0	2
		E	23	100	0	0	-	78	57	43	0	0		0	0
2	Quantum communications technology that is 1 million times faster than current optical communications for high-capacity communications with planetary exploration satellites and so on.	1	124	7	16	77	-	69	44	45	9	2		6	19
		2	131	4	13	83	-	61	27	66	5	2		0	7
		E	5	100	0	0	-	90	80	20	0	0		0	0
3	Sample returns from planets.	1	183	16	20	64	-	62	36	44	18	2		1	7
		2	170	13	20	67	-	57	22	63	14	1		1	2
		E	22	100	0	0	-	88	77	18	5	0		0	0
4	Observation technology for satellites orbiting planets beyond Jupiter.	1	157	14	24	62	-	50	20	42	35	3		2	10
		2	156	11	15	74	-	45	8	55	36	1		2	4
		E	17	100	0	0	-	65	35	53	12	0		0	0

Time of technological realization columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
0	100	0	0	0	75	18	6	1	56	23	56	67	41	2	1	1																		
0	100	0	0	0	82	16	2	0	73	11	58	73	35	0	0	0																		
0	100	0	0	0	100	0	0	0	87	4	70	83	35	0	0	0																		
11	85	3	0	1	52	34	12	2	46	39	51	63	15	4	2	2						5	22	38	36	18	8	47	56	20	33	16	3	3
2	95	2	1	0	58	36	6	0	61	33	52	71	10	1	0	1						0	13	32	61	3	4	55	74	13	25	11	1	1
0	100	0	0	0	60	40	0	0	80	20	60	40	40	0	0	0						0	0	40	40	20	0	80	60	40	40	40	0	0
7	92	1	0	0	69	23	6	2	50	17	50	71	40	3	0	1																		
2	97	0	1	0	82	15	3	0	65	10	57	75	31	1	0	0																		
10	90	0	0	0	95	5	0	0	68	0	55	86	32	5	0	0																		
0	99	1	0	0	61	23	15	1	55	18	51	67	41	3	0	1																		
0	99	1	0	0	75	17	7	1	69	6	56	71	31	1	0	0																		
0	100	0	0	0	94	6	0	0	76	0	59	82	29	6	0	0																		

II. Earthlike life and extrasolar planetary exploration technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

2) Current impacts

Large / Somewhat large / Moderate / Small / None

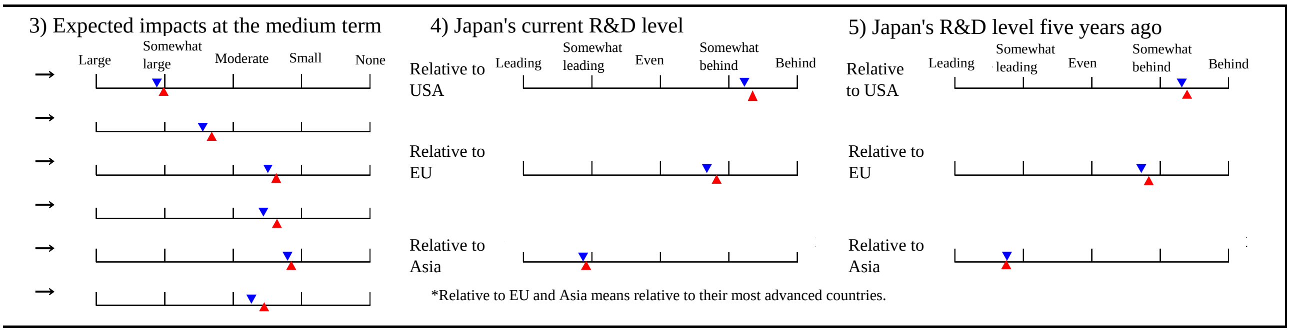
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
5	Become able to directly image Jupiter-type planets orbiting nearby stars outside the solar system by using technology such as negative-type interferometers and coronagraphs.	1	**104**	**10**	**30**	**60**	**-**	**56**	**26**	**51**	**19**	**4**							**1**	**14**
		2	**116**	**4**	**17**	**79**	**-**	**49**	**11**	**65**	**22**	**2**							**1**	**10**
		E	**5**	**100**	**0**	**0**	**-**	**80**	**60**	**40**	**0**	**0**							**0**	**0**
6	Find Earthlike planets orbiting nearby stars outside the solar system by greatly improving exploration technology for extrasolar planets.	1	**134**	**10**	**28**	**62**	**-**	**53**	**23**	**47**	**25**	**5**							**5**	**18**
		2	**140**	**4**	**16**	**80**	**-**	**48**	**11**	**64**	**21**	**4**							**2**	**12**
		E	**5**	**100**	**0**	**0**	**-**	**80**	**60**	**40**	**0**	**0**							**0**	**0**
7	Find environments suitable for life or subtle signs of biological activity on extrasolar planets by carrying out spectroscopic analysis of their atmospheres and surface compositions using remote sensing in infrared and visible wavelengths.	1	**144**	**12**	**24**	**64**	**-**	**56**	**26**	**49**	**21**	**4**							**1**	**18**
		2	**147**	**5**	**18**	**77**	**-**	**50**	**13**	**65**	**19**	**3**							**1**	**10**
		E	**7**	**100**	**0**	**0**	**-**	**79**	**57**	**43**	**0**	**0**							**0**	**0**

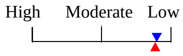


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (%)							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
3	91	3	0	3	44	34	17	5	57	11	50	67	32	0	0	0																		
0	100	0	0	0	49	39	8	4	73	6	49	72	30	0	0	0																		
0	100	0	0	0	80	20	0	0	80	0	60	80	40	0	0	0																		
2	94	2	0	2	49	27	21	3	58	10	46	64	38	2	0	1																		
0	98	2	0	0	62	27	9	2	73	3	49	70	35	0	0	0																		
0	100	0	0	0	100	0	0	0	80	0	60	80	60	0	0	0																		
2	96	0	0	2	46	31	19	4	60	11	46	63	35	0	0	0																		
0	100	0	0	0	59	30	8	3	70	4	51	70	31	0	0	0																		
0	100	0	0	0	86	14	0	0	71	0	57	71	57	0	0	0																		

III. Space and particle research

1. Questions regarding the relevant area

1) Degree of expertise in the area

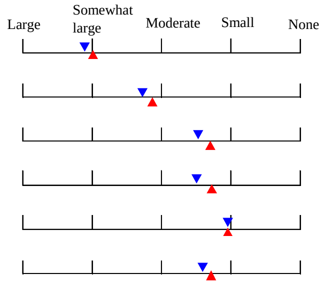


2) Current impacts

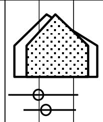
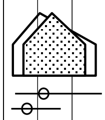
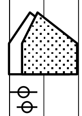
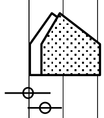
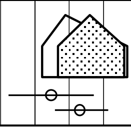
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

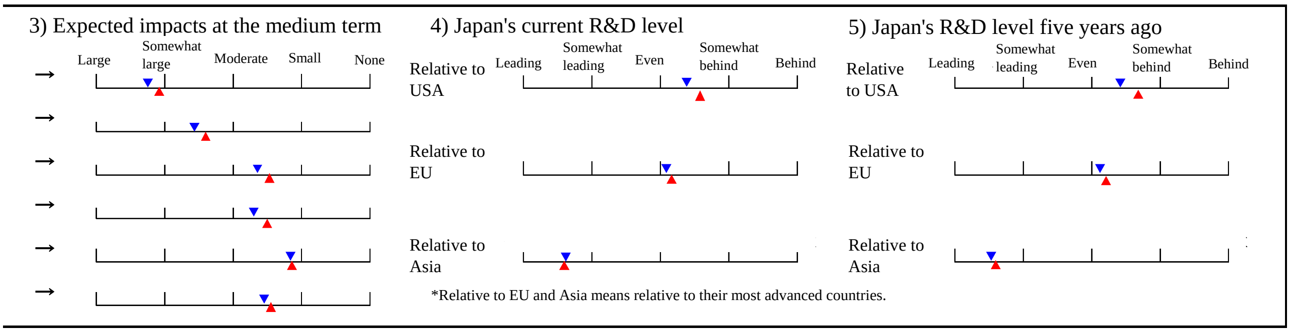
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
8	High-precision space positioning technology utilizing multi-satellite formation flight will become available, with the goal of realizing gravitational wave detectors and ultrahigh-angle-resolution submillimeter interferometers.	1	128	12	30	58	-	55	25	52	18	5							2	7
		2	139	12	20	68	-	54	15	70	14	1							0	4
		E	16	100	0	0	-	69	38	62	0	0							0	0
9	Various space observatories that utilize the lunar surface and Sun-Earth Lagrangian points will be realized, enabling far-infrared telescopes, ultrahigh-resolution visible light telescopes, and other technologies which cannot be achieved via Earth-based observations.	1	136	14	28	58	-	62	34	48	17	1							1	7
		2	145	12	23	65	-	58	22	68	10	0							0	3
		E	17	100	0	0	-	75	53	41	6	0							0	0
10	Multi-wavelength observations (in infrared, visible light, ultraviolet, x-rays, gamma rays, etc.), conducted by scientific satellites from outside the atmosphere, attain sensitivity improvements by two orders of magnitude.	1	120	12	30	58	-	65	37	48	14	1							0	6
		2	134	13	13	74	-	56	18	72	10	0							0	2
		E	17	100	0	0	-	74	47	53	0	0							0	0
11	Technology to explore difficult-to-detect particles such as cosmic neutrinos, ultrahigh-energy gamma rays, and dark matter particles will markedly improve, leading to major developments.	1	104	9	18	73	-	61	32	50	17	1							0	11
		2	129	6	14	80	-	54	16	70	13	1							0	6
		E	8	100	0	0	-	69	38	62	0	0							0	0
12	Particle accelerator technology will advance markedly, leading to breakthroughs in human understanding of the natural world (the origins of the universe, the asymmetry between matter and antimatter, the origins of elements, etc.).	1	101	8	15	77	-	60	30	51	17	2							2	21
		2	121	5	13	82	-	56	18	72	9	1							1	5
		E	6	100	0	0	-	54	17	66	17	0							17	0



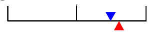
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (%)							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
5	83	10	0	2	51	35	11	3	51	14	46	78	34	0	0	0																		
0	97	3	0	0	67	25	6	2	67	8	52	79	35	1	0	0																		
0	94	6	0	0	75	19	6	0	69	13	38	81	44	0	0	0																		
5	93	2	0	0	55	35	8	2	52	13	48	81	40	1	0	0																		
3	96	1	0	0	68	25	6	1	64	6	51	76	36	0	0	0																		
12	88	0	0	0	70	24	6	0	76	29	59	82	71	0	0	0																		
26	71	3	0	0	52	36	12	0	53	9	47	79	35	1	0	0																		
12	88	0	0	0	69	25	6	0	70	4	48	79	30	0	0	0																		
29	71	0	0	0	71	29	0	0	76	12	53	94	41	0	0	0																		
55	42	3	0	0	48	37	14	1	59	9	44	75	29	0	0	1																		
63	35	2	0	0	68	26	6	0	70	4	47	81	28	0	0	0																		
87	13	0	0	0	49	38	13	0	75	0	25	75	25	0	0	0																		
21	58	21	0	0	50	32	14	4	54	10	49	68	42	1	0	1																		
9	87	4	0	0	67	25	6	2	68	4	45	76	31	0	0	0																		
17	66	17	0	0	33	33	17	17	80	0	40	60	40	0	0	0																		

IV. Basic technology for space transportation and manned space activity

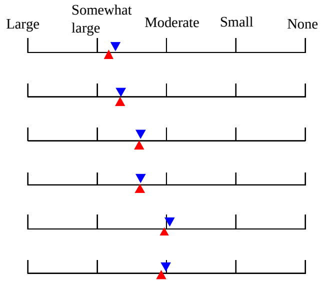
1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

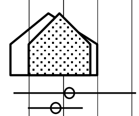
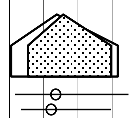
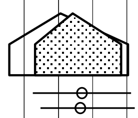
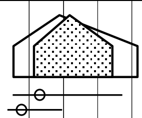
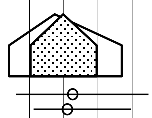
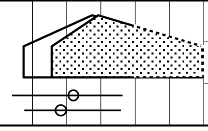


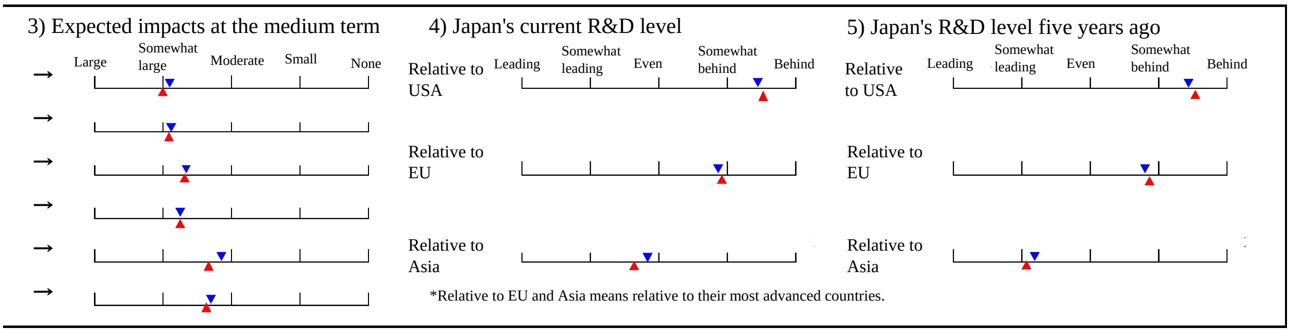
2) Current impacts



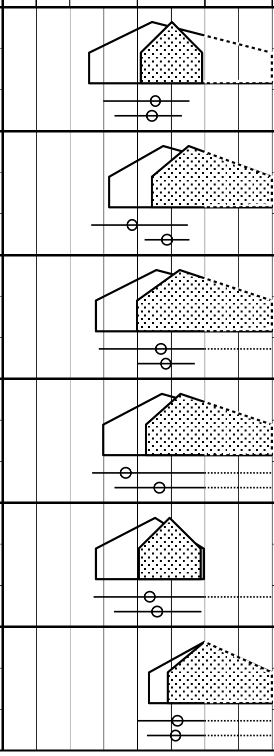
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
13	Japan's own reusable space vessels that travel between the Earth and Earth orbit.	1	171	15	25	60	-	65	42	39	14	5		6	8
		2	165	10	17	73	-	69	45	42	12	1		2	3
		E	17	100	0	0	-	88	76	24	0	0		0	0
14	Japan's own manned space vessels.	1	169	13	21	66	-	54	33	29	27	11		12	13
		2	165	10	18	72	-	59	36	31	28	5		6	8
		E	16	100	0	0	-	72	63	6	25	6		6	6
15	Space tourism (including education and cultural activities) in Earth orbit.	1	163	13	17	70	-	46	22	33	31	14		4	11
		2	160	9	13	78	-	46	18	38	36	8		4	8
		E	15	100	0	0	-	75	59	27	7	7		7	0
16	Life support technology that utilizes closed ecosystems for self-supply of foods such as vegetables, grains, and animal protein in space.	1	137	10	18	72	-	52	23	47	20	10		4	11
		2	147	5	9	86	-	53	21	53	21	5		1	7
		E	8	100	0	0	-	78	62	25	13	0		0	0
17	Geostationary orbital bases that can be used comprehensively for Earth observation and as space factories and communications bases.	1	181	18	26	56	-	69	46	41	10	3		3	6
		2	168	8	27	65	-	75	54	38	7	1		1	2
		E	14	100	0	0	-	84	72	21	7	0		0	0
18	Permanent manned moon surface bases (scientific observation from the moon, lunar science, development of technology to utilize resources, etc.).	1	178	15	26	59	-	57	32	39	23	6		7	12
		2	166	9	23	68	-	58	28	50	19	3		4	8
		E	15	100	0	0	-	83	74	13	13	0		0	0



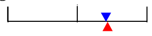
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
1	98	0	0	1	69	21	6	4	51	43	54	73	21	6	0	1						8	13	49	34	11	6	51	56	26	43	18	2	3
0	100	0	0	0	85	13	2	0	56	36	64	78	14	3	0	0						4	10	71	26	2	1	62	74	17	47	8	0	1
0	100	0	0	0	94	6	0	0	63	25	50	81	19	13	0	0						6	0	94	6	0	0	59	71	24	59	24	0	0
1	96	0	0	3	66	15	8	11	53	40	52	68	21	7	1	2						12	21	51	28	10	11	55	57	22	40	16	4	4
1	98	0	0	1	79	15	2	4	58	29	60	77	14	1	0	0						9	12	71	21	3	5	61	75	15	43	8	0	0
6	88	0	0	6	93	0	0	7	57	29	50	86	21	7	0	0						13	13	86	0	0	14	58	75	25	58	17	0	0
1	91	0	0	8	26	24	25	25	38	45	36	45	27	24	6	1						9	19	21	24	26	29	34	40	45	32	33	11	3
0	98	1	0	1	25	28	30	17	38	52	39	50	25	23	1	0						6	15	23	27	34	16	33	52	52	31	29	6	1
0	93	0	0	7	50	29	0	21	55	55	55	64	18	27	0	0						20	0	57	29	0	14	33	67	50	50	42	0	0
6	90	2	0	2	40	37	15	8	48	35	52	67	28	7	0	0						7	22	33	35	22	10	49	57	28	34	14	2	2
2	96	1	0	1	56	33	9	2	55	30	56	74	18	3	0	1						2	10	38	47	12	3	55	70	27	35	6	0	1
13	87	0	0	0	87	13	0	0	50	13	50	75	38	0	0	0						0	0	86	14	0	0	57	57	29	29	0	0	0
2	94	1	0	3	64	24	8	4	50	36	49	66	32	5	1	1						5	12	47	34	14	5	52	57	27	41	13	3	3
0	100	0	0	0	85	10	4	1	57	32	55	81	31	1	1	1						1	7	70	27	2	1	63	74	19	43	7	1	1
0	100	0	0	0	77	15	8	0	69	38	38	62	38	0	0	0						0	0	77	23	0	0	69	77	23	31	15	8	0
1	96	1	0	2	61	26	8	5	54	29	51	65	42	6	0	1						10	20	45	36	11	8	63	56	19	36	14	5	2
0	99	0	0	1	76	12	8	4	65	19	60	75	37	1	0	1						7	16	66	25	5	4	69	66	13	38	5	2	1
0	100	0	0	0	72	21	7	0	71	14	43	71	50	0	0	7						7	13	69	23	0	8	75	58	17	25	0	0	0



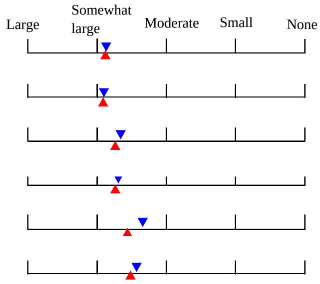
V. Space utilization technology—basic satellite technology—

1. Questions regarding the relevant area

1) Degree of expertise in the area

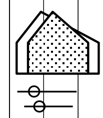
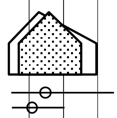
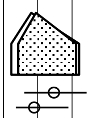
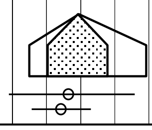


2) Current impacts

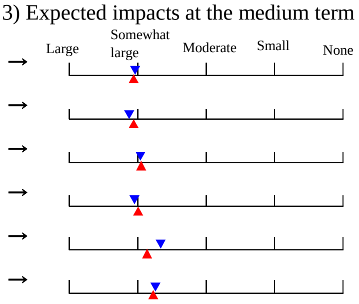


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

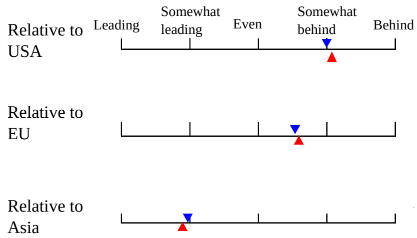
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High	Moderate	Low	None (%)	Importance to Japan: Index	High	Moderate	Low	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized	Do not know (%)
19	Satellite systems whose maintenance, repair, and functional upgrade may be performed by robots in orbit.	1	140	17	31	52	-	71	45	47	7	1		1	4
		2	147	12	24	64	-	69	41	54	5	0		0	3
		E	18	100	0	0	-	86	72	28	0	0		0	0
20	Operation of semi-permanent large platforms (a system in which mission apparatuses can appropriately exchanged and maintenance, inspection, and repair can be performed in orbit) in order to effectively utilize the limited stationary orbits available.	1	147	20	25	55	-	68	41	48	10	1		1	5
		2	150	11	24	65	-	67	37	58	5	0		0	1
		E	17	100	0	0	-	85	71	29	0	0		0	0
21	To respond to the increase in satellite-based communications volume accompanying the growth of Earth-based communications volume, a system of multiple stationary platforms with transmission capacities in the several terabits/second class, linked by optical intersatellite communications.	1	146	19	31	50	-	69	46	41	10	3		2	7
		2	145	11	25	64	-	73	50	44	5	1		1	2
		E	16	100	0	0	-	80	63	31	6	0		0	6
22	Drastic technical measures (debris-free space systems, collection of debris already left, disposal by injection into the atmosphere, etc.) against the debris problem.	1	133	21	28	51	-	66	40	45	13	2		4	10
		2	136	12	23	65	-	67	37	56	7	0		2	2
		E	16	100	0	0	-	80	63	31	6	0		0	0

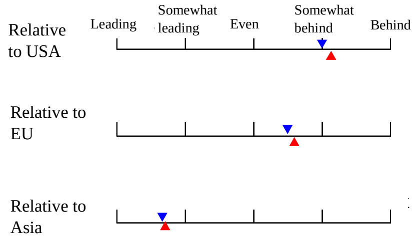
3) Expected impacts at the medium term



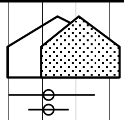
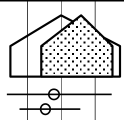
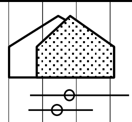
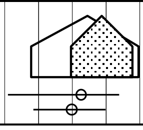
4) Japan's current R&D level



5) Japan's R&D level five years ago



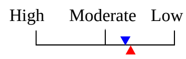
*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application					(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
15	80	1	0	4	50	42	7	1	49	41	45	66	22	3	0	1						1	8	40	42	15	3	50	56	20	42	10	2	1
7	93	0	0	0	68	28	3	1	65	31	47	76	17	0	0	0						0	2	55	42	3	0	67	72	15	35	3	0	0
17	83	0	0	0	94	6	0	0	83	28	56	89	22	0	0	0						0	0	82	18	0	0	82	82	12	35	6	0	0
4	92	1	0	3	57	37	5	1	45	36	46	66	25	6	1	1						1	8	43	42	13	2	49	54	19	37	13	4	1
1	99	0	0	0	74	23	2	1	58	27	52	76	18	1	0	1						0	5	57	39	3	1	61	75	9	37	5	1	0
0	100	0	0	0	94	6	0	0	65	41	53	82	12	0	0	0						0	0	76	24	0	0	71	76	0	35	12	0	0
10	85	4	0	1	50	36	13	1	41	49	40	64	20	9	2	1						0	13	35	37	24	4	46	58	26	33	16	5	2
3	96	1	0	0	66	30	3	1	53	42	47	77	14	4	0	0						1	4	47	42	10	1	58	72	16	36	12	3	0
6	94	0	0	0	75	19	0	6	60	53	27	73	7	0	0	0						0	6	81	13	6	0	63	69	13	31	19	0	0
5	89	2	0	4	58	35	6	1	48	30	50	59	36	5	5	0						6	13	52	36	9	3	55	53	15	33	9	15	3
1	98	0	0	1	73	23	4	0	62	26	53	76	27	0	2	0						1	5	64	33	2	1	71	62	11	34	3	11	0
6	94	0	0	0	88	6	6	0	75	38	50	88	31	0	13	0						0	0	94	0	6	0	81	69	13	31	0	25	0

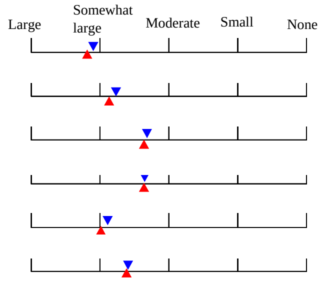
VI. Technology for high precise observation of Earth environments and for prediction of change

1. Questions regarding the relevant area

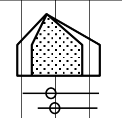
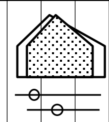
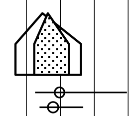
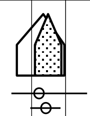
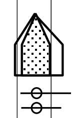
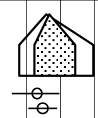
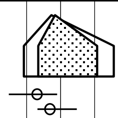
1) Degree of expertise in the area

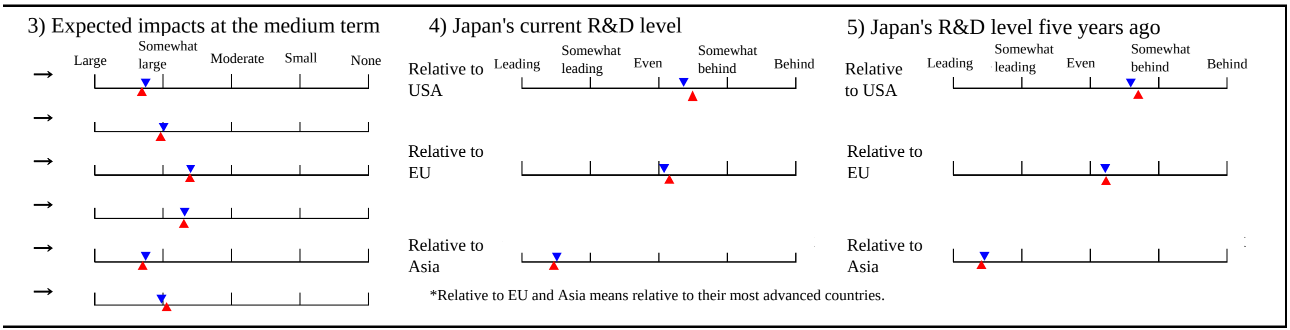


2) Current impacts



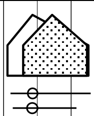
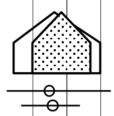
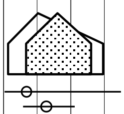
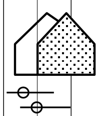
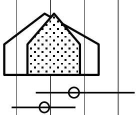
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
23	Forecasting technology for year-to-year variation of climate system.	1	192	17	30	53	-	85	71	26	3	0		3	9
		2	170	12	34	54	-	94	88	11	1	0		3	2
		E	20	100	0	0	-	98	95	5	0	0		0	0
24	Earth environment change forecasting technology with a scale of several decades by Earth system models that handle the composition of the atmosphere and oceans, ecosystems, and the material cycles within them.	1	199	19	31	50	-	80	61	34	4	1		5	12
		2	176	11	33	56	-	90	81	18	1	0		2	4
		E	20	100	0	0	-	95	90	10	0	0		0	0
25	Technology to precisely observe carbon dioxide gas emission and absorption within country, using space technology.	1	185	11	28	61	-	75	54	40	5	1		4	12
		2	171	8	25	67	-	83	68	30	2	0		2	5
		E	14	100	0	0	-	93	86	14	0	0		0	0
26	Systems to observe clouds and aerosol all over the Earth from satellites with high precision, resolution, and frequency.	1	190	15	25	60	-	72	48	46	6	0		0	6
		2	169	10	25	65	-	78	57	42	1	0		0	3
		E	17	100	0	0	-	94	88	12	0	0		0	0
27	Stationary satellite observation (vertical resolution 500 m to 1 km, horizontal resolution 1–5 km) of water vapor distribution.	1	177	16	21	63	-	69	44	45	10	1		2	11
		2	161	11	27	62	-	75	51	47	2	0		1	4
		E	18	100	0	0	-	86	72	28	0	0		0	0
28	High-precision Earth environment models with about 100–500 m resolution for a short-range forecasting that can distinguish buildings and predict air pollution, and urban flooding.	1	165	10	24	66	-	77	58	34	7	1		1	9
		2	159	6	22	72	-	85	71	26	3	0		1	3
		E	10	100	0	0	-	90	80	20	0	0		0	0
29	Climate change simulations for the Earth's history, including the Snowball Earth and the ice age cycle.	1	157	10	31	59	-	54	23	48	28	1		3	14
		2	147	7	31	62	-	52	13	69	17	1		2	7
		E	10	100	0	0	-	63	30	60	10	0		0	0
30	Establishment of corporate management methods based on precise seasonal forecasts.	1	100	10	16	74	-	66	43	40	13	4			
		2	114	6	10	84	-	61	29	56	14	1			
		E	7	100	0	0	-	79	57	43	0	0			



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
24	67	8	0	1	63	31	5	1	71	29	50	64	37	3	1	1						2	13	51	33	11	5	77	53	16	25	9	6	2
15	81	4	0	0	88	10	1	1	85	15	59	76	26	0	0	0						2	7	83	13	3	1	84	62	11	32	4	1	0
10	60	30	0	0	90	10	0	0	95	15	65	75	10	0	0	0						0	0	90	5	5	0	90	75	15	30	10	0	0
16	76	7	0	1	60	32	6	2	73	26	55	65	39	3	0	1						6	19	50	34	13	3	76	54	15	25	8	4	3
11	87	2	0	0	83	15	1	1	84	14	61	76	25	1	0	0						2	6	77	19	3	1	86	66	8	27	3	2	0
11	84	5	0	0	94	6	0	0	100	11	67	78	22	0	0	0						0	5	80	10	5	5	89	68	11	26	16	0	0
15	73	8	0	4	57	35	5	3	52	32	51	65	38	2	1	2						3	14	53	34	9	4	58	52	15	32	9	11	2
7	91	2	0	0	81	17	1	1	69	22	64	74	27	0	0	0						2	8	76	21	2	1	75	66	9	34	2	3	0
29	64	7	0	0	100	0	0	0	79	21	71	79	50	0	0	0						0	0	100	0	0	0	79	86	14	29	0	7	0
11	83	5	0	1	56	37	6	1	55	31	53	68	39	2	0	1						1	10	47	39	12	2	62	51	13	31	9	5	2
4	95	1	0	0	75	22	2	1	71	16	62	79	28	0	0	0						1	5	72	25	2	1	81	67	8	30	1	1	1
6	94	0	0	0	100	0	0	0	76	12	65	82	41	0	0	0						0	0	100	0	0	0	88	76	0	29	0	0	6
7	90	2	0	1	52	39	8	1	53	30	52	66	33	2	0	1						2	14	45	39	13	3	59	54	14	30	9	3	2
2	97	1	0	0	72	25	3	0	71	17	55	79	21	1	0	0						1	6	68	28	3	1	77	69	6	28	1	1	1
0	100	0	0	0	89	11	0	0	67	11	67	83	33	0	0	0						0	0	88	6	6	0	78	67	6	28	6	0	6
25	69	3	0	3	51	40	8	1	59	44	54	56	22	4	2	1						4	11	42	44	12	2	63	57	24	29	11	7	1
20	78	1	0	1	74	23	2	1	74	33	60	73	13	1	1	1						1	6	64	31	4	1	77	71	12	30	3	3	1
30	60	0	0	10	100	0	0	0	90	50	60	50	0	0	0	0						0	0	100	0	0	0	90	60	10	30	0	0	0
11	76	11	0	2	30	38	27	5	79	12	45	52	26	0	0	0																		
8	92	0	0	0	27	57	15	1	87	4	41	59	20	0	0	0																		
22	78	0	0	0	56	44	0	0	100	0	33	56	0	0	0	0																		
																						1	13	17	37	37	9	56	57	41	28	16	4	2
																						2	7	7	56	31	6	57	66	29	16	16	1	2
																						0	0	14	72	14	0	57	57	14	14	0	0	14

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High	Moderate	Low	None	Importance to Japan: Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
				(%)					(%)										(%)	
31	Automatic observation systems in the open ocean that monitor water temperature, salinity, and chemical tracers with high reliability while going for long periods without maintenance.	1	**156**	**26**	**26**	**48**	**-**	**72**	**47**	**46**	**7**	**0**							**0**	**6**
		2	**152**	**16**	**26**	**58**	**-**	**74**	**50**	**48**	**2**	**0**							**0**	**3**
		E	**25**	**100**	**0**	**0**	**-**	**90**	**80**	**20**	**0**	**0**							**0**	**0**
32	Ocean observation systems that use various flight vehicles to agilely perform sample collection and instrument set up and collection.	1	**148**	**19**	**29**	**52**	**-**	**62**	**32**	**52**	**15**	**1**							**2**	**6**
		2	**147**	**12**	**24**	**64**	**-**	**61**	**26**	**67**	**7**	**0**							**0**	**3**
		E	**17**	**100**	**0**	**0**	**-**	**71**	**47**	**41**	**12**	**0**							**0**	**0**
33	Three-dimensional image analysis systems that can distinguish tiny ocean organisms (microorganisms, plankton, etc.).	1	**136**	**10**	**23**	**67**	**-**	**55**	**22**	**56**	**21**	**1**							**0**	**8**
		2	**137**	**9**	**20**	**71**	**-**	**53**	**11**	**78**	**11**	**0**							**0**	**4**
		E	**12**	**100**	**0**	**0**	**-**	**67**	**33**	**67**	**0**	**0**							**0**	**0**
34	Sensors that can distinguish body shapes underwater from a distance of several hundred meters.	1	**117**	**9**	**22**	**69**	**-**	**57**	**24**	**56**	**18**	**2**							**2**	**11**
		2	**132**	**5**	**21**	**74**	**-**	**56**	**20**	**63**	**16**	**1**							**1**	**5**
		E	**6**	**100**	**0**	**0**	**-**	**70**	**40**	**60**	**0**	**0**							**0**	**0**
35	Microwave radiometers loaded on satellites to measure at a spatial resolution of 1 km or less worldwide water, soil moisture, salt deposition density, and snow and ice distribution on land.	1	**145**	**16**	**26**	**58**	**-**	**66**	**37**	**54**	**9**	**0**							**2**	**9**
		2	**146**	**8**	**27**	**65**	**-**	**64**	**30**	**67**	**3**	**0**							**0**	**6**
		E	**12**	**100**	**0**	**0**	**-**	**79**	**58**	**42**	**0**	**0**							**0**	**0**
36	Methods to accurately calculate heat transfer in the water cycle such as from a water vapor to clouds and clouds to rain .	1	**142**	**15**	**22**	**63**	**-**	**67**	**40**	**48**	**12**	**0**							**0**	**14**
		2	**139**	**7**	**21**	**72**	**-**	**65**	**33**	**61**	**6**	**0**							**1**	**4**
		E	**10**	**100**	**0**	**0**	**-**	**80**	**60**	**40**	**0**	**0**							**0**	**0**

Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
25	74	1	0	0	46	42	11	1	51	40	47	72	33	5	1	0						3	9	39	43	15	3	54	60	19	41	12	4	1
18	82	0	0	0	61	36	3	0	66	30	41	79	19	2	0	0						0	4	42	53	5	0	63	71	9	31	7	1	1
4	96	0	0	0	84	8	8	0	76	40	52	80	24	4	0	0						0	0	68	24	8	0	56	72	12	56	12	0	0
10	87	3	0	0	41	41	17	1	47	36	57	69	28	8	0	0						3	9	32	44	20	4	55	57	21	34	15	4	2
7	92	0	0	1	48	46	5	1	62	33	56	78	16	3	0	0						1	4	33	60	6	1	67	74	12	29	7	1	1
7	93	0	0	0	56	38	6	0	69	50	56	75	31	13	0	0						0	0	60	27	13	0	67	67	27	67	33	7	0
21	70	7	0	2	24	47	27	2	58	38	40	61	18	1	1	2						1	13	17	43	35	5	58	48	28	30	3	1	2
11	89	0	0	0	24	63	12	1	68	26	38	70	6	0	0	0						0	4	18	61	20	1	67	59	15	22	3	1	1
33	67	0	0	0	42	58	0	0	75	8	42	42	17	0	0	0						0	0	42	58	0	0	67	42	17	25	8	8	0
15	82	1	0	2	31	41	23	5	51	49	37	61	14	3	0	1						2	18	21	44	30	5	54	54	23	35	2	1	2
4	95	0	0	1	33	53	14	0	66	47	35	74	6	0	0	0						0	5	24	57	19	0	67	66	17	28	2	0	1
17	83	0	0	0	83	17	0	0	67	50	17	50	0	0	0	0						0	0	67	33	0	0	67	50	0	50	0	0	0
12	85	2	0	1	45	42	11	2	52	39	49	65	30	1	0	0						4	15	31	46	20	3	56	59	16	33	3	2	3
7	92	1	0	0	54	42	4	0	68	34	50	78	16	1	0	1						1	6	30	62	8	0	68	71	15	30	4	0	2
17	83	0	0	0	92	8	0	0	67	33	50	75	8	8	0	0						8	0	75	25	0	0	75	75	17	42	0	0	0
17	74	7	0	2	38	47	13	2	67	24	44	59	23	1	0	0																		
5	94	1	0	0	38	56	5	1	80	17	44	68	12	0	0	0																		
0	100	0	0	0	50	50	0	0	90	0	30	70	0	0	0	0																		

VII. Technology to explore, capture, and cultivative life under extreme environment

1. Questions regarding the relevant area

1) Degree of expertise in the area

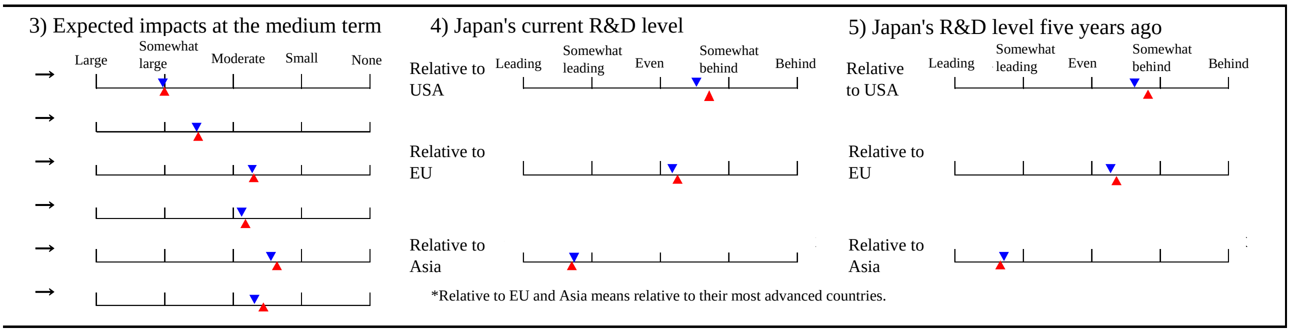
High　Moderate　Low

2) Current impacts

		Large / Somewhat large / Moderate / Small / None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

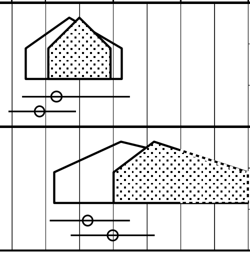
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
37	Technology to isolate and cultivate life forms that inhabit extreme Earth environments.	1	106	13	30	57	-	65	39	45	14	2							2	8
		2	119	10	18	72	-	58	24	62	12	2							1	4
		E	12	100	0	0	-	75	55	36	9	0							0	0
38	Exploration technology to seek the extraterrestrial life on the other planets (including satellites) within the solar system.	1	136	10	21	69	-	52	26	35	34	5							5	16
		2	129	8	14	78	-	50	14	60	25	1							1	7
		E	10	100	0	0	-	78	60	30	10	0							0	0



Countries at the leading edge					Regarding technological realization												Time of social application		Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't										Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)								(%)		(%)				(%)						
28	62	8	0	2	49	38	11	2	63	31	46	76	26	6	0	1	9	11	35	37	23	5	60	59	21	30	12	3	1
24	74	2	0	0	46	46	6	2	76	18	43	76	12	0	0	0	1	9	31	48	19	2	77	57	12	28	9	3	0
59	33	8	0	0	50	42	8	0	75	42	42	58	8	0	0	0	0	8	34	33	25	8	73	64	18	27	9	0	0
1	95	2	0	2	48	27	18	7	67	21	48	62	35	2	0	1	17	22	40	23	23	14	71	45	13	26	6	5	2
0	100	0	0	0	68	20	10	2	77	10	46	70	28	0	0	2	10	13	57	25	16	2	86	42	5	26	3	2	2
0	100	0	0	0	90	10	0	0	100	20	60	90	40	0	0	0	0	0	70	20	10	0	100	70	10	20	10	0	0

Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–

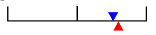


VIII. Deep Earth observation technology

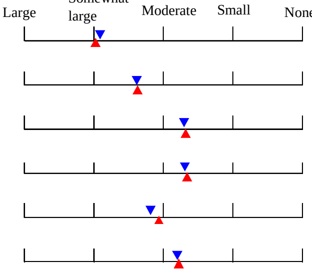
1. Questions regarding the relevant area

1) Degree of expertise in the area

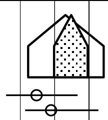
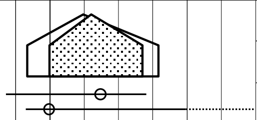
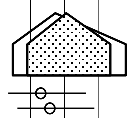
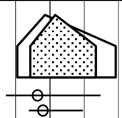
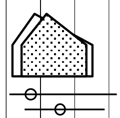
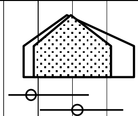
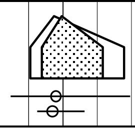
High Moderate Low

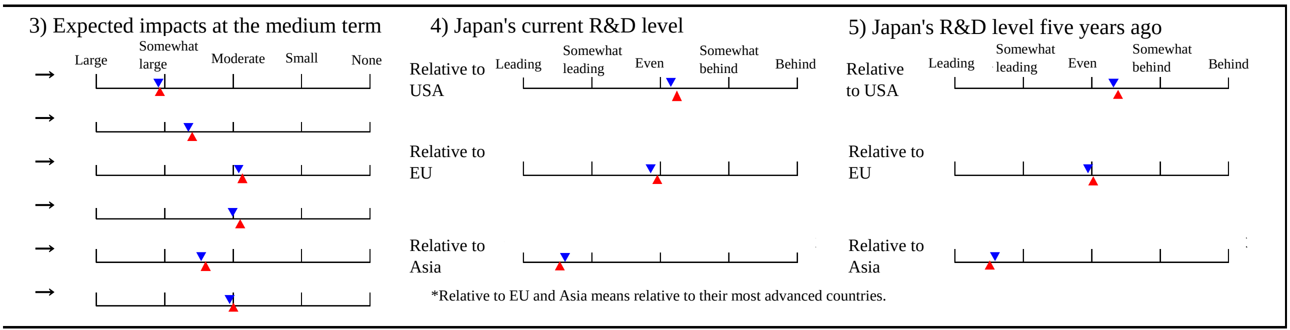


2) Current impacts

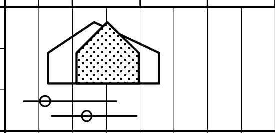
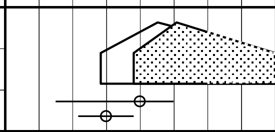
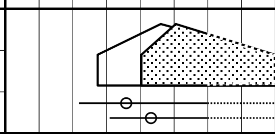
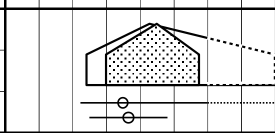
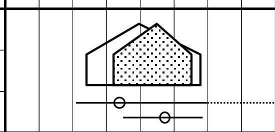
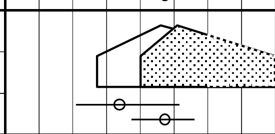
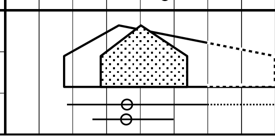
		Large / Somewhat large / Moderate / Small / None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
39	Technology to place permanent geophysical observation bases on the deep ocean floor and radically increase the precision of exploration of the Earth's interior by networking them.	1	147	20	27	53	-	72	49	43	6	2		1	6
		2	141	15	24	61	-	77	57	38	5	0		0	4
		E	21	100	0	0	-	83	71	19	10	0		0	0
40	Technology to extract matter from the Earth's core in order to identify the light elements included there.	1	109	9	27	64	-	46	13	51	31	5		10	26
		2	116	7	21	72	-	48	8	70	21	1		3	9
		E	8	100	0	0	-	54	14	72	14	0		0	0
41	Technology to extract mantle matter by deep drilling into the Earth from any location.	1	122	15	30	55	-	56	26	48	24	2		4	13
		2	119	12	28	60	-	53	15	65	19	1		3	3
		E	14	100	0	0	-	66	36	57	7	0		7	0
42	Technology to statically achieve samples of a size of a few centimeters or more from the high-temperature, high-pressure conditions near the center of the Earth.	1	114	10	29	61	-	54	25	44	26	5		4	12
		2	115	9	24	67	-	51	14	65	18	3		1	4
		E	10	100	0	0	-	63	30	60	10	0		0	0
43	Technology to use satellite magnetic field observation and surface observation to estimate the core's current dynamo action and future changes in the magnetic field.	1	130	13	28	59	-	54	20	58	20	2		2	14
		2	127	11	21	68	-	55	15	75	10	0		1	6
		E	14	100	0	0	-	57	21	65	14	0		7	0
44	Technology sensitive enough to detect shifts in matter of a few centimeters a year deep inside the Earth.	1	116	16	25	59	-	60	31	47	19	3		8	17
		2	121	12	23	65	-	62	30	60	8	2		4	3
		E	14	100	0	0	-	73	58	21	21	0		7	0
45	Technology that makes it possible to measure regional stress fields in the Earth's crust on a region-wide scale in earthquake zones.	1	135	21	23	56	-	89	79	18	2	1		2	13
		2	130	15	25	60	-	95	90	8	2	0		0	2
		E	20	100	0	0	-	96	95	0	5	0		0	0



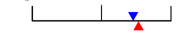
*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
42	57	0	0	1	61	29	8	2	63	35	55	71	39	5	0	1		4	18	47	36	12	5	66	52	21	36	7	2	3
50	50	0	0	0	77	20	3	0	74	20	56	77	22	1	1	0		1	6	66	28	6	0	82	58	6	33	1	1	1
76	24	0	0	0	90	5	5	0	71	5	52	90	19	10	5	0		0	0	81	14	5	0	86	43	5	57	10	5	0
14	78	5	0	3	33	37	23	7	65	24	57	55	25	1	0	1		16	24	27	33	28	12	70	42	11	28	4	1	4
8	87	1	0	4	42	42	12	4	79	11	55	62	9	0	0	0		16	13	28	50	18	4	83	39	4	22	0	0	1
25	75	0	0	0	57	14	29	0	86	0	43	71	0	0	0	0		13	25	62	25	13	0	88	25	0	25	0	0	0
33	54	7	0	6	44	36	17	3	57	29	59	70	32	2	0	1		14	19	34	36	20	10	64	50	11	35	7	1	2
23	74	1	0	2	59	32	9	0	70	17	56	70	9	0	0	0		12	9	38	48	11	3	78	52	3	27	0	0	1
36	50	0	0	14	61	31	8	0	77	8	54	54	8	0	0	0		14	7	64	29	7	0	71	36	0	57	0	0	0
39	52	5	0	4	35	36	25	4	62	24	49	68	19	2	0	1		10	15	25	35	30	10	66	47	16	29	6	1	3
39	60	1	0	0	39	45	15	1	75	16	49	71	10	0	0	0		9	9	31	49	18	2	84	49	6	23	0	1	1
70	30	0	0	0	40	50	10	0	80	0	30	60	0	0	0	0		20	10	22	67	11	0	67	44	0	33	0	0	0
13	78	7	0	2	38	40	19	3	72	20	49	65	34	3	0	1		11	20	27	41	23	9	75	37	9	30	7	0	3
7	90	2	1	0	39	55	6	0	82	14	43	74	15	0	0	0		3	10	29	58	10	3	90	35	0	26	1	1	1
21	72	0	7	0	29	57	14	0	79	7	29	57	14	0	0	0		17	8	31	46	15	8	92	8	0	25	0	0	0
18	73	5	0	4	36	42	19	3	69	23	55	61	27	2	0	1		13	23	31	36	23	10	79	36	14	32	2	0	2
13	86	1	0	0	50	42	8	0	86	14	52	69	10	0	0	0		9	8	43	45	9	3	90	38	4	24	0	0	1
21	79	0	0	0	57	29	14	0	86	7	57	71	7	0	0	0		31	15	59	25	8	8	91	36	0	27	0	0	0
61	35	1	0	3	76	21	2	1	67	39	58	75	19	1	0	1		4	17	65	26	7	2	73	60	12	41	3	3	2
91	9	0	0	0	90	8	2	0	85	27	57	79	13	1	0	0		1	5	90	8	2	0	91	62	5	41	2	2	1
80	20	0	0	0	90	5	5	0	90	15	70	85	15	5	0	0		0	0	90	5	5	0	90	55	0	55	0	5	0

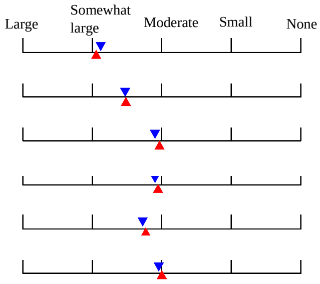
IX. Ocean and deep ocean floor observation research technology

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

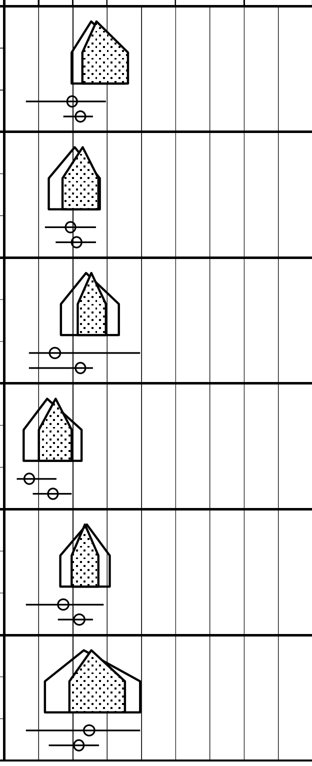


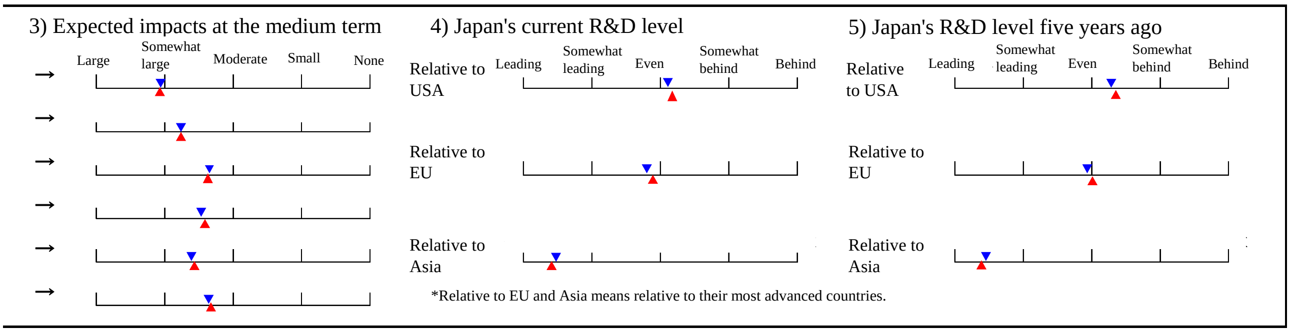
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

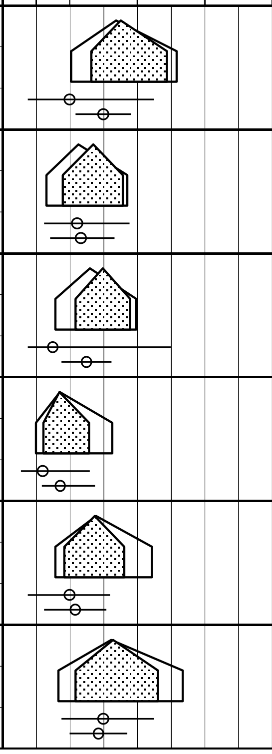
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
46	Technology that precisely estimates the contributions of deep-sea chemical ecosystems to oceanic matter and energy.	1	108	7	24	69	-	57	27	50	20	3		0	19
		2	120	5	18	77	-	53	13	73	14	0		1	8
		E	6	100	0	0	-	63	33	50	17	0		0	0
47	Automatic observation systems in the open ocean that can monitor oceanographic phenomena and conditions from a depth of 6,000 m to near the surface for a long period of time (about 5 years).	1	147	24	28	48	-	73	49	44	6	1		1	8
		2	151	17	21	62	-	78	57	42	1	0		1	2
		E	26	100	0	0	-	94	88	12	0	0		4	0
48	Fuel cells that are closed systems (no atmospheric exposure), portable, and can provide 10 kilowatt output for one year with a single fueling.	1	103	6	22	72	-	70	44	48	8	0		0	13
		2	109	3	17	80	-	72	47	48	5	0		0	5
		E	3	100	0	0	-	58	34	33	33	0		0	0
49	High-tech survey vessels with a single specialized function.	1	136	23	28	49	-	60	33	47	17	3		1	10
		2	147	18	20	62	-	63	29	63	8	0		0	3
		E	26	100	0	0	-	77	54	46	0	0		0	0
50	Robots that autonomously perform heavy duty work in the deep ocean.	1	127	12	21	67	-	68	40	51	9	0		0	6
		2	137	8	21	71	-	67	36	60	4	0		0	2
		E	11	100	0	0	-	85	70	30	0	0		0	0
51	Probes that can penetrate 10 km below the sea floor.	1	124	8	23	69	-	58	31	44	21	4		3	9
		2	133	9	18	73	-	61	29	59	11	1		0	2
		E	12	100	0	0	-	86	73	27	0	0		0	0

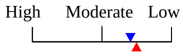


Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization: Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application: Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
17	75	3	0	5	42	40	17	1	66	28	49	58	27	3	0	0		5	22	31	32	27	10	66	60	11	29	4	1	1
5	94	1	0	0	49	46	5	0	75	17	48	73	18	0	0	0		3	9	28	59	12	1	77	64	6	23	5	1	0
17	83	0	0	0	33	50	17	0	67	17	33	50	0	0	0	0		17	0	33	50	0	17	60	60	0	20	0	0	0
30	66	3	0	1	51	38	11	0	58	35	47	70	28	6	0	0		3	15	46	36	14	4	57	59	17	38	4	3	2
21	78	1	0	0	71	27	2	0	70	32	51	80	18	1	0	0		1	3	57	38	5	0	74	70	4	32	6	1	1
8	92	0	0	0	84	16	0	0	68	48	56	84	16	0	0	0		4	0	67	29	4	0	67	83	8	38	13	0	0
56	38	1	0	5	34	48	16	2	44	57	38	69	9	6	0	0		0	14	29	42	23	6	45	67	27	43	9	1	2
78	21	0	0	1	31	64	5	0	53	64	37	76	2	2	0	0		1	5	22	67	11	0	52	83	17	38	6	0	0
67	0	0	0	33	0	67	33	0	33	67	0	0	0	0	0	0		0	0	0	67	33	0	50	50	0	0	0	0	0
34	62	4	0	0	45	35	15	5	44	43	38	75	18	6	0	0		6	20	37	37	19	7	45	57	14	44	12	2	2
28	69	3	0	0	56	38	6	0	50	47	34	78	6	2	0	0		1	4	41	49	9	1	50	77	4	34	6	0	1
35	61	4	0	0	71	29	0	0	58	29	38	83	0	8	0	0		0	0	57	39	4	0	65	57	0	48	9	0	0
53	44	2	0	1	43	45	10	2	49	50	41	74	11	3	0	0		2	16	37	41	16	6	46	64	23	41	10	2	1
70	28	2	0	0	43	52	5	0	50	62	37	75	5	1	0	0		0	2	32	59	9	0	56	78	13	38	5	0	0
70	30	0	0	0	55	45	0	0	45	55	27	82	0	0	0	0		0	0	45	55	0	0	55	64	9	64	0	0	0
49	41	9	0	1	46	37	14	3	46	47	45	70	17	1	0	0		11	19	34	39	20	7	50	55	15	42	3	1	3
68	31	1	0	0	64	32	4	0	56	48	45	78	3	0	0	0		2	6	42	47	11	0	63	69	9	36	2	0	0
75	25	0	0	0	91	9	0	0	64	45	45	82	0	0	0	0		0	0	75	25	0	0	58	67	0	58	0	0	0

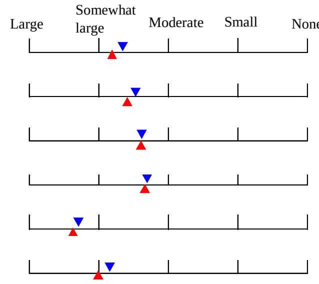
X. Space, ocean, and Earth technology for a safe and secure society

1. Questions regarding the relevant area

1) Degree of expertise in the area

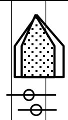
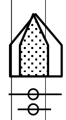
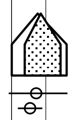
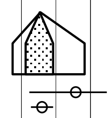
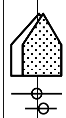
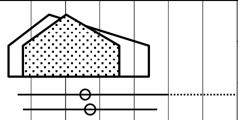
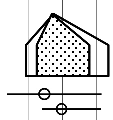


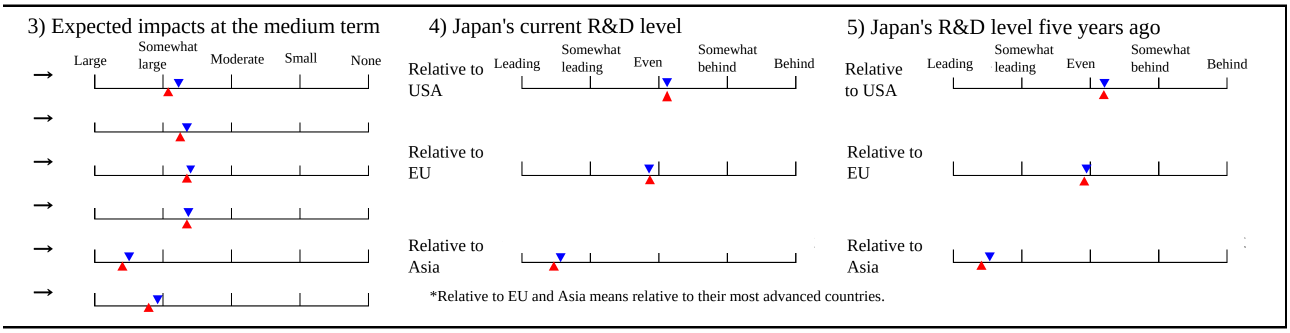
2) Current impacts

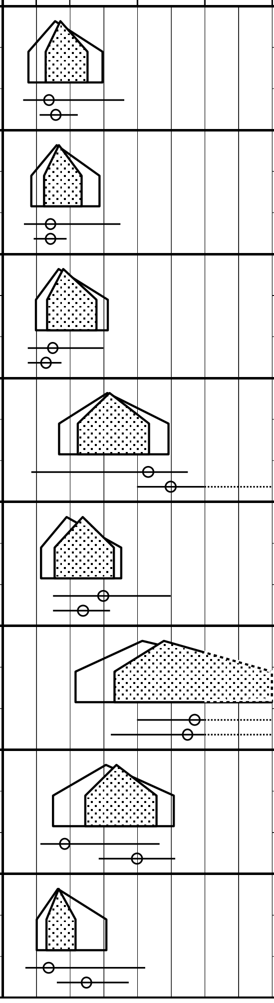


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
52	A risk management system that utilizes disaster observation satellites, communications satellites, GPS, unmanned aircraft, and so on to observe disasters, understand situations after disasters occur, and respond swiftly (send the necessary information where it is needed).	1	189	19	30	51	-	89	78	21	1	0		0	2
		2	183	11	26	63	-	98	95	4	1	0		0	1
		E	21	100	0	0	-	98	95	5	0	0		0	0
53	An integrated national land management and use system (using Earth observation satellite data, GPS, communications satellites, GIS, and so on to digitize land use, ocean data, maps, etc.) that covers all of Japan, including the sea.	1	191	18	32	50	-	80	61	35	4	0		0	2
		2	186	9	28	63	-	93	86	14	0	0		0	1
		E	16	100	0	0	-	97	94	6	0	0		0	0
54	Integrated usage and conservation technology for entire bays such as Tokyo Bay and Osaka Bay that are densely used.	1	124	15	25	60	-	75	53	40	7	0		1	7
		2	134	8	19	73	-	84	70	28	2	0		0	2
		E	11	100	0	0	-	95	91	9	0	0		0	9
55	Technology to assess the safety of geologic disposal of high-level radioactive waste.	1	113	10	19	71	-	80	65	29	4	2		10	12
		2	117	5	18	77	-	93	87	11	1	1		4	3
		E	6	100	0	0	-	100	100	0	0	0		17	0
56	Technology that uses monitoring technology on moment-to-moment characteristics of falling and accumulated snow to predict the scale of surface avalanches, degree of risk, and so on over wide areas.	1	102	8	28	64	-	65	39	43	18	0		3	8
		2	117	7	12	81	-	67	37	57	6	0		0	3
		E	8	100	0	0	-	75	50	50	0	0		0	0
57	Technology to precisely forecast the imminence (place and time period) of earthquakes (plate boundary earthquakes and inland earthquakes) of magnitude 7 or greater that are likely to cause damage, helping mitigate human disasters.	1	154	23	25	52	-	92	86	11	3	0		9	17
		2	148	14	22	64	-	98	95	5	0	0		5	5
		E	21	100	0	0	-	100	100	0	0	0		0	10
58	Technology to forecast the timing and scale of volcanic eruptions by observing and assessing in real time magma conditions inside volcanoes that are likely to erupt.	1	138	17	27	56	-	89	78	20	2	0		1	11
		2	138	12	21	67	-	98	95	4	1	0		1	3
		E	16	100	0	0	-	94	87	13	0	0		0	0
59	Formation of a worldwide consensus, including developing countries, on international regulations on the output of carbon dioxide and other greenhouse gases.	1	139	10	21	69	-	88	77	20	3	0			
		2	138	4	13	83	-	96	91	9	0	0			
		E	6	100	0	0	-	92	83	17	0	0			



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application			Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
24	72	3	0	1	80	19	1	0	50	54	54	66	16	12	2	0		0	4	73	24	3	0	54	65	23	48	19	7	2
11	87	1	0	1	97	3	0	0	64	56	60	76	8	7	1	0		0	2	91	8	1	0	67	74	11	52	9	5	1
24	66	5	0	5	95	5	0	0	67	43	48	67	5	0	0	0		0	0	81	19	0	0	67	62	14	48	5	10	0
27	71	1	0	1	62	29	9	0	48	57	56	56	11	12	1	1		1	5	50	37	11	2	49	66	29	41	20	6	1
14	84	1	0	1	88	11	1	0	54	60	60	72	5	5	0	1		0	2	80	18	2	0	59	80	14	43	12	2	1
25	75	0	0	0	94	6	0	0	56	63	63	63	0	6	0	0		0	0	80	20	0	0	60	73	20	53	20	7	0
65	25	5	0	5	55	40	4	1	41	53	53	49	5	19	8	1		1	10	49	38	12	1	49	65	19	40	21	16	2
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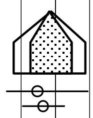
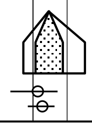
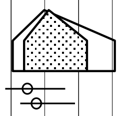
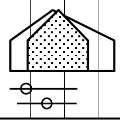
89	11	0	0	0	100	0	0	0	64	45	55	55	0	27	18	0		0	10	90	10	0	0	70	80	10	50	40	20	0
23	46	27	0	4	73	20	4	3	54	39	55	55	20	10	13	1		11	19	68	21	5	6	60	54	16	38	12	20	3
13	69	18	0	0	95	4	0	1	63	34	65	59	9	4	11	1		4	6	93	5	1	1	78	62	5	31	10	18	3
40	40	20	0	0	100	0	0	0	50	50	50	33	33	0	33	0		20	0	75	25	0	0	75	25	25	25	0	25	0
53	26	14	0	7	48	40	11	1	47	33	55	48	10	4	0	1		2	14	44	42	12	2	53	53	17	40	4	4	4
86	7	6	0	1	58	38	3	1	60	32	63	58	3	1	0	1		1	4	56	40	3	1	67	63	10	36	4	2	2
62	38	0	0	0	50	50	0	0	63	25	50	25	0	0	0	0		0	0	50	50	0	0	75	38	0	38	0	0	0
80	18	0	0	2	78	16	5	1	74	34	64	63	20	4	1	2		9	21	76	16	4	4	73	51	12	43	9	7	5
97	3	0	0	0	96	3	0	1	84	28	66	71	12	1	1	1		7	11	94	4	1	1	88	52	6	44	4	3	2
95	5	0	0	0	95	5	0	0	100	29	67	86	14	0	0	0		5	14	90	10	0	0	90	52	5	67	10	5	0
78	18	2	0	2	80	16	3	1	71	31	63	70	14	3	0	2		2	15	72	23	4	1	73	47	19	45	4	5	5
95	5	0	0	0	98	1	1	0	83	23	68	74	12	0	1	2		2	4	95	4	1	0	89	55	4	44	3	5	2
75	25	0	0	0	94	6	0	0	94	19	56	75	25	0	0	0		0	0	94	6	0	0	94	56	0	63	6	6	0
																		3	20	87	10	2	1	48	51	16	33	14	44	7
																		2	6	96	3	0	1	67	63	7	29	5	45	2
																		0	0	100	0	0	0	50	33	0	0	0	33	17

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan Index	High (%)	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know
60	Technology to evenly and densely place comprehensive earthquake/crust change observation equipment in major cities, mountainous areas, continental shelves, and so on in order to predict earthquakes.	1	**148**	**21**	**21**	**58**	**-**	**84**	**69**	**28**	**3**	**0**							**1**	**8**
		2	**143**	**15**	**24**	**61**	**-**	**96**	**92**	**8**	**0**	**0**							**0**	**2**
		E	**22**	**100**	**0**	**0**	**-**	**95**	**91**	**9**	**0**	**0**							**0**	**0**
61	Elucidation of the mechanisms of rainfall, snow accumulation, torrential rain, and so on.	1	**122**	**17**	**27**	**56**	**-**	**87**	**74**	**26**	**0**	**0**							**1**	**9**
		2	**133**	**11**	**21**	**68**	**-**	**95**	**91**	**9**	**0**	**0**							**2**	**2**
		E	**14**	**100**	**0**	**0**	**-**	**96**	**93**	**7**	**0**	**0**							**0**	**0**

Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
81	**18**	**0**	**0**	**1**	**76**	**20**	**3**	**1**	**58**	**39**	**57**	**72**	**14**	**3**	**1**	**0**						**3**	**15**	**70**	**25**	**4**	**1**	**54**	**52**	**24**	**44**	**8**	**4**	**7**
99	**1**	**0**	**0**	**0**	**96**	**4**	**0**	**0**	**74**	**30**	**60**	**81**	**6**	**2**	**1**	**0**						**0**	**6**	**95**	**4**	**0**	**1**	**82**	**65**	**8**	**48**	**4**	**2**	**2**
95	**5**	**0**	**0**	**0**	**95**	**5**	**0**	**0**	**82**	**32**	**59**	**77**	**9**	**5**	**0**	**0**						**0**	**0**	**91**	**9**	**0**	**0**	**91**	**55**	**0**	**68**	**14**	**0**	**0**
55	**38**	**5**	**0**	**2**	**64**	**32**	**4**	**0**	**67**	**37**	**57**	**60**	**12**	**3**	**1**	**2**						**1**	**14**	**59**	**34**	**5**	**2**	**70**	**55**	**19**	**30**	**7**	**2**	**3**
83	**17**	**0**	**0**	**0**	**87**	**13**	**0**	**0**	**87**	**26**	**60**	**73**	**9**	**1**	**0**	**0**						**1**	**5**	**86**	**13**	**0**	**1**	**88**	**61**	**10**	**30**	**2**	**1**	**1**
79	**21**	**0**	**0**	**0**	**93**	**7**	**0**	**0**	**71**	**7**	**43**	**64**	**7**	**0**	**0**	**0**						**0**	**0**	**86**	**14**	**0**	**0**	**79**	**36**	**7**	**21**	**0**	**0**	**0**

XI. Space, ocean, and Earth technology that drives science and technology innovation

1. Questions regarding the relevant area

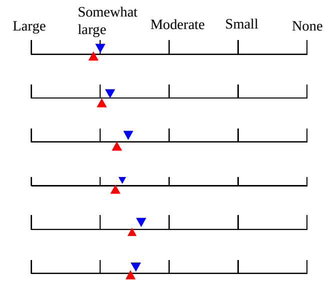
1) Degree of expertise in the area — High / Moderate / Low

2) Current impacts

[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



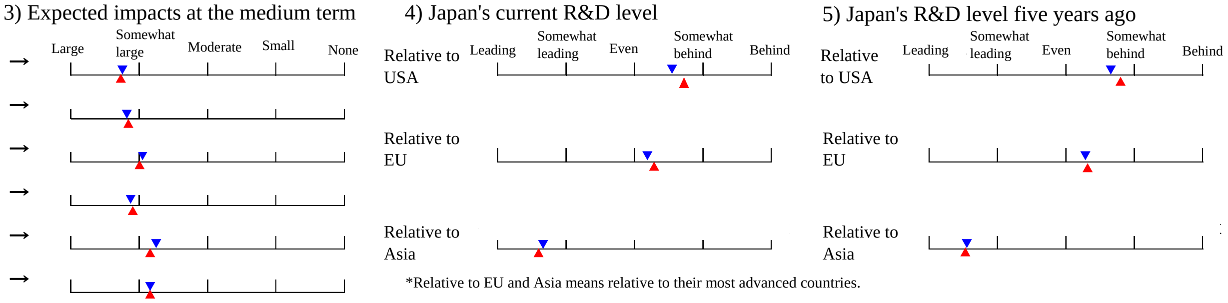
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Will not be realized (%)	Do not know (%)
62	Construction of computer life form models based on advances in system biology.	1	82	9	9	82	-	60	34	40	23	3	3	13
		2	92	2	13	85	-	51	13	69	15	3	2	8
		E	2	100	0	0	-	75	50	50	0	0	0	0
63	Solar photoelectric power generation plants in space that transmit electricity to the ground with microwaves or lasers.	1	158	19	25	56	-	56	36	28	28	8	13	10
		2	155	14	21	65	-	65	43	33	20	4	11	7
		E	21	100	0	0	-	80	66	24	5	5	10	0
64	Self-repairing space vessels.	1	128	11	29	60	-	62	32	53	13	2	2	12
		2	125	10	21	69	-	59	23	69	6	2	1	7
		E	13	100	0	0	-	81	62	38	0	0	0	0
65	Space and planetary exploration technology using robots with overall decision-making ability equivalent to that of human beings.	1	134	13	22	65	-	64	40	40	17	3	11	9
		2	139	12	15	73	-	63	33	55	10	2	4	8
		E	16	100	0	0	-	84	69	31	0	0	0	0
66	Satellite-borne computers that operate on the level of thermal noise energy.	1	97	9	14	77	-	60	33	44	20	3	3	20
		2	102	6	14	80	-	55	18	67	15	0	4	10
		E	6	100	0	0	-	54	17	66	17	0	17	0
67	Technology for the creation of recreational water-use areas through the development of seawater cleaning systems such as cleaning blocks and biofilters.	1	89	8	18	74	-	67	41	48	9	2	1	15
		2	100	5	15	80	-	62	28	66	4	2	1	4
		E	5	100	0	0	-	70	40	60	0	0	0	0
68	Technology to fix carbon dioxide to the seafloor.	1	130	7	31	62	-	66	44	35	16	5	10	17
		2	134	4	19	77	-	75	54	38	7	1	5	7
		E	5	100	0	0	-	75	50	50	0	0	0	0
69	Offshore cities (bases for transportation, communications, research, production, leisure activities) with structures with legs or that float.	1	91	8	18	74	-	54	27	40	27	6	6	11
		2	102	7	14	79	-	54	19	61	17	3	3	4
		E	7	100	0	0	-	79	57	43	0	0	0	0

3) Expected impacts at the medium term

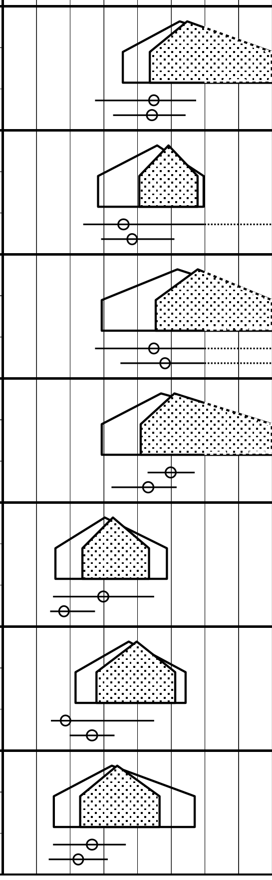
4) Japan's current R&D level

5) Japan's R&D level five years ago



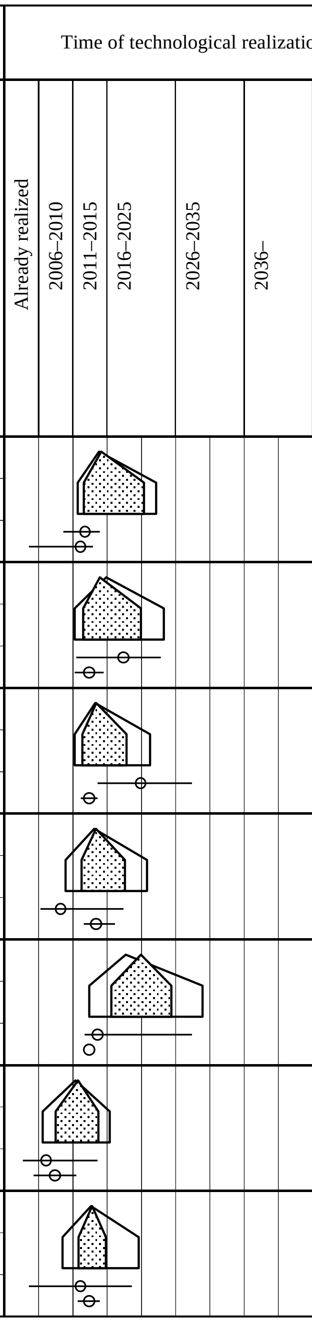
*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
10	87	0	0	3	34	31	27	8	68	37	43	53	13	3	3	1																		
2	98	0	0	0	29	50	18	3	81	27	42	53	6	0	1	0																		
0	100	0	0	0	50	50	0	0	100	0	50	50	0	0	0	0																		
33	64	1	0	2	45	30	14	11	51	44	44	63	28	8	2	2						16	17	41	26	20	13	47	58	28	45	17	9	3
19	81	0	0	0	58	25	13	4	64	43	45	71	21	4	1	2						15	13	57	22	13	8	64	66	13	48	13	5	1
38	62	0	0	0	66	24	5	5	65	55	35	75	15	10	0	0						14	0	66	24	0	10	63	74	26	42	32	11	0
6	90	2	0	2	46	39	14	1	61	42	48	66	20	3	0	0						3	14	40	36	22	2	63	55	22	37	7	2	1
2	98	0	0	0	57	39	3	1	71	38	47	74	13	2	0	0						1	9	46	46	6	2	72	68	12	33	4	1	0
8	92	0	0	0	69	31	0	0	77	38	54	77	8	8	0	0						0	0	77	15	8	0	77	62	23	31	15	0	0
18	77	1	0	4	45	36	16	3	64	42	47	65	19	2	0	1						8	17	42	33	22	3	60	56	17	40	7	1	1
5	94	0	0	1	53	38	8	1	74	41	45	68	13	2	0	1						6	14	44	41	13	2	75	62	5	34	4	1	1
6	94	0	0	0	81	19	0	0	75	56	63	88	13	6	0	0						0	6	75	19	0	6	87	67	7	40	20	0	0
11	83	2	0	4	34	46	17	3	49	43	47	63	11	1	0	1						3	22	30	38	25	7	61	56	23	32	5	0	3
1	98	0	0	1	28	62	7	3	64	49	38	67	6	0	0	0						4	10	29	57	10	4	68	69	17	30	2	0	1
0	100	0	0	0	17	66	17	0	83	33	33	50	0	0	0	0						17	0	33	50	17	0	67	33	33	33	0	0	0
58	29	9	0	4	40	39	15	6	47	52	53	63	13	11	4	1						0	20	35	50	10	5	46	68	34	43	23	9	1
77	18	5	0	0	49	44	7	0	53	65	46	66	6	6	2	0						0	5	28	63	9	0	60	70	24	41	10	6	0
75	25	0	0	0	40	40	20	0	20	80	40	40	0	40	20	0						0	0	60	40	0	0	40	60	40	60	40	20	0
40	42	12	0	6	54	29	10	7	46	47	51	60	32	8	5	0						12	24	50	25	16	9	41	58	27	44	19	17	5
45	53	2	0	0	70	22	5	3	59	38	51	70	16	2	0	0						7	10	70	22	6	2	49	70	12	39	10	11	3
60	40	0	0	0	80	20	0	0	50	0	25	75	0	0	0	0						0	0	100	0	0	0	25	25	0	75	25	25	0
66	27	6	0	1	36	32	21	11	36	55	41	47	9	26	7	5						6	20	27	37	21	15	34	62	37	35	29	10	3
87	10	2	0	1	41	46	8	5	40	65	38	55	7	19	3	1						4	7	33	50	13	4	39	77	25	32	20	4	2
83	17	0	0	0	86	14	0	0	71	57	14	71	14	29	29	14						0	0	100	0	0	0	43	43	14	43	43	29	14

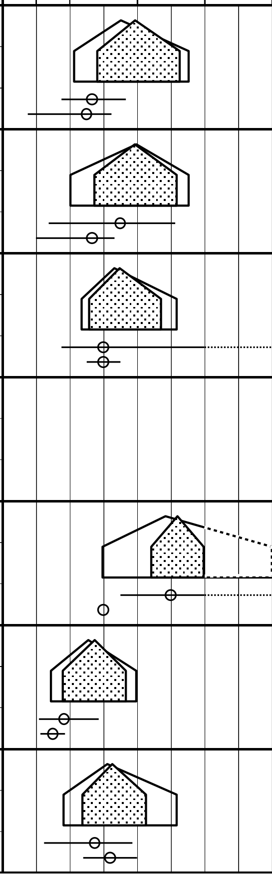


No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan Index	High (%)	Moderate	Low	None	Will not be realized (%)	Do not know
70	Marine farms that carry out optimal environmental management by adopting biology technology as well as a broad array of engineering technology.	1	**90**	**8**	**14**	**78**	**-**	**60**	**31**	**51**	**15**	**3**	**4**	**13**
		2	**108**	**3**	**18**	**79**	**-**	**63**	**30**	**61**	**9**	**0**	**0**	**1**
		E	**3**	**100**	**0**	**0**	**-**	**83**	**67**	**33**	**0**	**0**	**0**	**0**
71	Methane hydrate mining utilization technology.	1	**124**	**10**	**27**	**63**	**-**	**79**	**63**	**28**	**6**	**3**	**1**	**12**
		2	**118**	**5**	**24**	**71**	**-**	**88**	**78**	**17**	**4**	**1**	**3**	**2**
		E	**6**	**100**	**0**	**0**	**-**	**75**	**60**	**20**	**20**	**0**	**17**	**0**
72	Technology to grow bacteria that break down chemical substances that disrupt endocrines and other environmental pollutants.	1	**76**	**4**	**28**	**68**	**-**	**65**	**37**	**51**	**11**	**1**	**3**	**16**
		2	**89**	**3**	**17**	**80**	**-**	**63**	**30**	**63**	**7**	**0**	**0**	**5**
		E	**3**	**100**	**0**	**0**	**-**	**67**	**33**	**67**	**0**	**0**	**0**	**0**
73	Establishment of quantitative models for ocean ecosystems.	1	**122**	**12**	**24**	**64**	**-**	**62**	**34**	**47**	**18**	**1**	**3**	**13**
		2	**121**	**6**	**19**	**75**	**-**	**60**	**26**	**64**	**9**	**1**	**2**	**3**
		E	**7**	**100**	**0**	**0**	**-**	**86**	**71**	**29**	**0**	**0**	**0**	**0**
74	Saltwater engines that remove oxygen and hydrogen form seawater and generate energy.	1	**83**	**5**	**17**	**78**	**-**	**62**	**36**	**43**	**16**	**5**	**8**	**19**
		2	**92**	**2**	**7**	**91**	**-**	**61**	**28**	**61**	**9**	**2**	**4**	**5**
		E	**2**	**100**	**0**	**0**	**-**	**25**	**0**	**50**	**0**	**50**	**50**	**0**
75	Three-dimensional autonomous navigation systems for water vessels.	1	**96**	**10**	**25**	**65**	**-**	**55**	**26**	**46**	**24**	**4**	**0**	**9**
		2	**104**	**7**	**17**	**76**	**-**	**54**	**15**	**70**	**15**	**0**	**0**	**1**
		E	**7**	**100**	**0**	**0**	**-**	**71**	**43**	**57**	**0**	**0**	**0**	**0**
76	Wireless communications technology that works over several horizontal kilometers in seawater to enable smooth performance of underwater work.	1	**91**	**13**	**22**	**65**	**-**	**58**	**29**	**46**	**24**	**1**	**6**	**11**
		2	**102**	**10**	**13**	**77**	**-**	**57**	**20**	**69**	**10**	**1**	**2**	**2**
		E	**10**	**100**	**0**	**0**	**-**	**70**	**40**	**60**	**0**	**0**	**10**	**0**

Time of technological realization



Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application			Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
60	34	0	0	6	31	39	26	4	51	55	50	50	13	16	8	4		4	17	25	40	29	6	40	60	36	39	27	17	3
86	14	0	0	0	25	67	8	0	54	62	55	55	5	13	3	1		1	4	25	64	10	1	50	76	32	38	22	12	0
67	33	0	0	0	33	67	0	0	100	33	0	33	33	0	0	0		0	0	100	0	0	0	100	33	0	33	0	0	0
38	47	8	0	7	58	33	7	2	50	57	53	64	24	10	3	0		2	15	48	35	13	4	49	66	37	44	18	11	2
28	69	2	0	1	76	20	3	1	54	58	55	74	14	3	3	0		3	5	73	20	5	2	50	78	26	45	16	5	0
40	60	0	0	0	80	20	0	0	80	20	40	60	40	0	0	0		33	0	83	0	0	17	60	40	0	60	0	0	0
26	54	12	0	8	26	53	18	3	57	42	49	55	13	4	1	1		3	18	21	55	21	3	49	58	40	35	9	11	2
17	79	4	0	0	24	74	2	0	66	40	44	62	4	2	2	0		0	5	23	71	6	0	59	78	24	33	3	5	1
33	67	0	0	0	0	100	0	0	67	33	33	0	0	0	0	0		0	0	33	67	0	0	67	67	0	0	0	0	0
19	69	8	0	4	31	39	27	3	69	29	44	52	23	2	0	2														
6	87	6	0	1	29	57	12	2	84	18	42	57	16	1	1	0														
17	83	0	0	0	57	43	0	0	86	14	29	29	0	14	14	0														
26	63	5	0	6	34	40	23	3	56	44	49	51	18	6	0	1		3	22	32	36	26	6	48	67	31	36	10	1	4
11	87	2	0	0	30	61	7	2	71	43	49	63	3	2	1	0		3	8	28	56	13	3	59	74	21	32	5	2	0
0	100	0	0	0	0	100	0	0	100	0	0	0	0	0	0	0		0	0	100	0	0	0	100	0	0	0	0	0	0
28	69	1	0	2	24	43	25	8	51	52	41	63	11	6	0	2		1	12	24	35	33	8	40	66	22	34	13	1	3
10	90	0	0	0	23	63	14	0	57	48	37	68	4	2	1	1		1	2	24	59	16	1	52	76	16	32	7	4	1
29	71	0	0	0	43	57	0	0	67	33	33	67	17	0	0	0		0	0	57	43	0	0	86	71	0	29	0	0	0
16	81	0	0	3	25	37	36	2	49	44	45	63	11	6	1	3		1	16	24	30	40	6	49	55	22	34	9	1	3
2	98	0	0	0	26	56	18	0	56	52	36	66	4	0	1	3		2	3	28	43	28	1	52	72	17	35	5	4	1
0	100	0	0	0	50	40	10	0	56	44	22	56	0	0	0	11		11	0	60	10	30	0	40	40	20	50	0	0	10



7. Energy and resources field

7.1. Overview

(1) Overview of areas in the field

In the energy and resources field, we established 10 areas, bearing in mind a system structure spanning exploration, conversion, transport and storage, use, and finally waste processing, disposal, and recycling.

First, we set three areas, innovative nuclear power systems, renewable energy, and clean-coal technology, by type of energy. Although it fits the broad category of nuclear power, we established nuclear fusion energy, which is receiving much policy attention, as a single topic in one area. In addition, for resource exploration and mining, we established the resource assessment area. For energy conversion, transport, storage, and use, we designated the areas hydrogen energy systems, fuel cells, and decentralized energy systems, for which recent trends are particularly noteworthy. The remainder we consolidated in the efficient energy conversion and use area. Regarding waste processing and use, we established the recycling systems (including biomass and waste) area. We set 51 topics for these 10 areas to carry out the survey.

(2) Expectations and degree of importance

Comparing areas, expectations are high for hydrogen energy systems, fuel cells, and efficient energy conversion and use, followed by recycling systems (including biomass and waste). Expectations for decentralized energy systems, clean-coal technology, and renewable energy are moderate, while those for innovative nuclear power systems, nuclear fusion energy, and resource assessment are relatively low. The highest expected impacts are for the contribution of the fuel cells area to increased intellectual assets and for the medium- and long-term contribution of the hydrogen energy systems area to the creation of new industries.

Comparing degree of importance to Japan by area, clean-coal technology is the highest and renewable energy is the lowest. Even within a single area, however, degree of importance varies widely by technological topic, and is highly dependent on the specialties of respondents as well.

Looking at the technological topics, technology for geologic disposal of high-level radioactive waste received the highest degree of importance, with recycling systems, gasification power generation and synthetic fuels manufacturing, fuel cells, hydrogen supply infrastructure, and CO_2 separation and storage also receiving high scores. The group with a high degree of expertise assigned fast breeder reactor (FBR) systems, energy management technology, and efficient large combined cycle power generation a high degree of importance, but the average assessment was relatively low. Other technological topics with wide differences in the degree of importance assessment between specialists and non-specialists were ocean uranium extraction, nuclear fusion power generation, production of hydrogen using solar heat, solar power generation systems in space, electric power devices that utilize high-temperature superconductivity, and resource recovery. Of these, ocean uranium extraction technology and production of hydrogen using solar heat differed from the others in that the group with more expertise rated them lower in degree of importance. Such difference is also found in technological topics in the resource assessment area, but caution is needed because of the low number of respondents with a high degree of expertise.

These survey results regarding expected impacts and degree of importance suggest changes in views of the future of energy technology. Rather than emphasizing technologies for separate types of energy such as FBR, nuclear fusion, and various types of natural energy, these views emphasize integrated responses that combine different types of technologies, such as hydrogen energy systems including fuel cells, efficient use of energy, processing and disposal of radioactive and other waste, and cyclic utilization.

(3) Predicted technological realization and social application

Looking at time of technological realization by area, the overall characteristics were as follows. Early realization was forecast for the recycling system (including biomass and waste) area, with all technological topics expected to be realized by 2010. On the other hand, realization of topics in the innovative nuclear power systems area is seen as far off, with FBR seen as coming after 2020. Realization of nuclear fusion is predicted for after 2035. Most topics in other areas are forecast for realization in the first half of the 2010s, but some topics in the hydrogen energy systems and renewable energy areas are expected to require a long time for realization. About 30 percent of respondents answered that solar power generation systems in space will not be realized, while one-fourth answered "Don't know" for nuclear fusion power generation, and the combined total with those answering "Will not be realized" was over 30 percent.

Area characteristics for time of social application show trends similar to those for time of technological realization. Practical application of the recycling system (including biomass and waste) area is predicted for 2010 to 2020, while it is predicted for 2030 or later for innovative nuclear power systems (2040 or later for nuclear fusion). Social application for other areas is generally predicted for 2015 to 2030. The social application of large-scale hydrogen energy supply infrastructure is expected to take a long time, far beyond the time of technological realization.

Referring to the comments on topics provided by respondents, a scattered lack of knowledge on some points appears to exist among them. We are therefore somewhat reluctant to take the survey results at face value, but there seems to be an aspect of those energy and resources field technologies that require large-scale development to require more time for technological realization and social application than other fields do.

(4) The proper form of government involvement

Government involvement has a variety of aspects, such as human resources development, research infrastructure and funding, industry collaboration, international development, and proper regulation. While it is therefore difficult to summarize the proper form of government involvement for all topics, we can offer the following generalizations.

Regarding the necessity of government involvement for technological realization, it tends to be high for the innovative nuclear power systems and nuclear fusion areas, which are long-term topics seen as having a relatively high degree of importance. Research infrastructure development is emphasized. In addition, necessity of government involvement for the clean-coal technology area is also relatively high, with high demand for expanded research funding.

For social application as well, government involvement is strongly desired for innovative nuclear power systems and nuclear fusion, but with human resources development for practical application tending to be emphasized. Government involvement for social application is characterized by desire for support through aspects such as tax support, industrial collaboration, and relaxed regulation, and this kind of government support is relatively strongly desired in clean-coal technology and in hydrogen energy systems. As for international comparison of technological levels, at least 90 percent of respondents evaluated Japan as leading Europe and the USA in the topics of heat pumps, solar cells, and resource recovery technology. It is important to carefully examine how these technologies developed for considering future research and development policy as well as the proper form of government involvement in the process of applying these technological strengths to the real world.

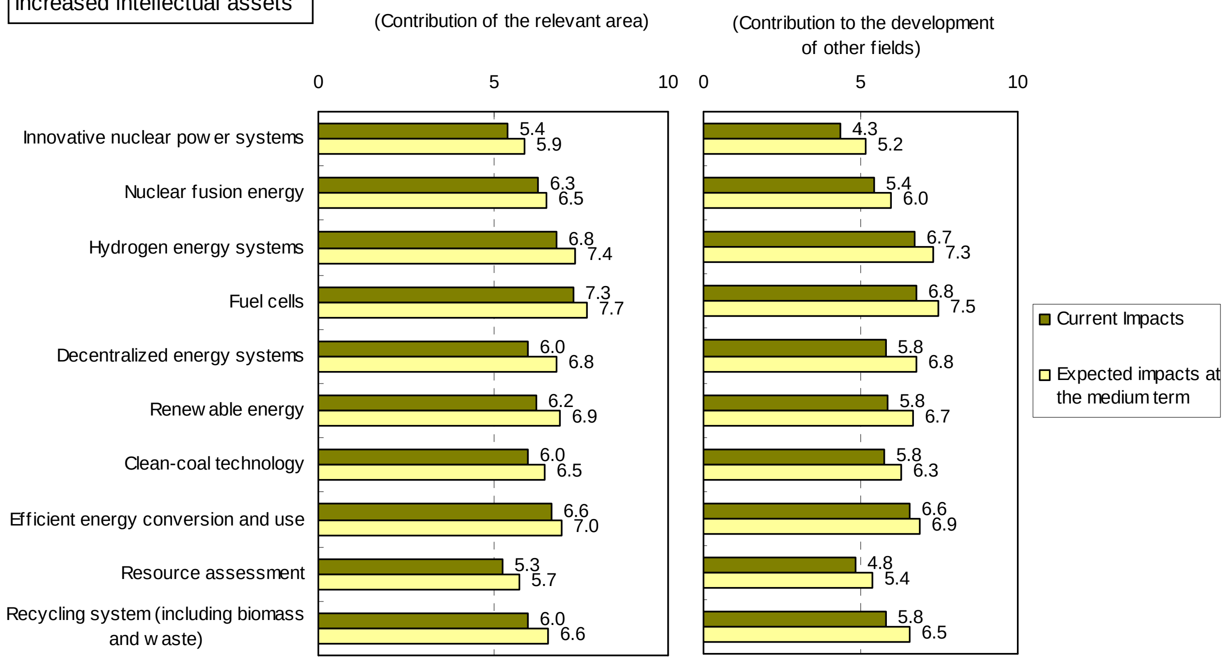
Demand is high for government involvement with energy and resources field technologies that are social infrastructure that will require much time for practical application. It is fair to say that Japanese government support for technological development in the energy field has been heavier than that of other countries, and the survey results demonstrate that continued strong support centered on the nuclear power field is wanted. However, many of the topics in areas that have received such government support are seen as still trailing Europe and the USA in terms of technological level. The proper form of government involvement in the technological development of the energy and resources field needs to be reexamined.

(YAMAJI Kenji)

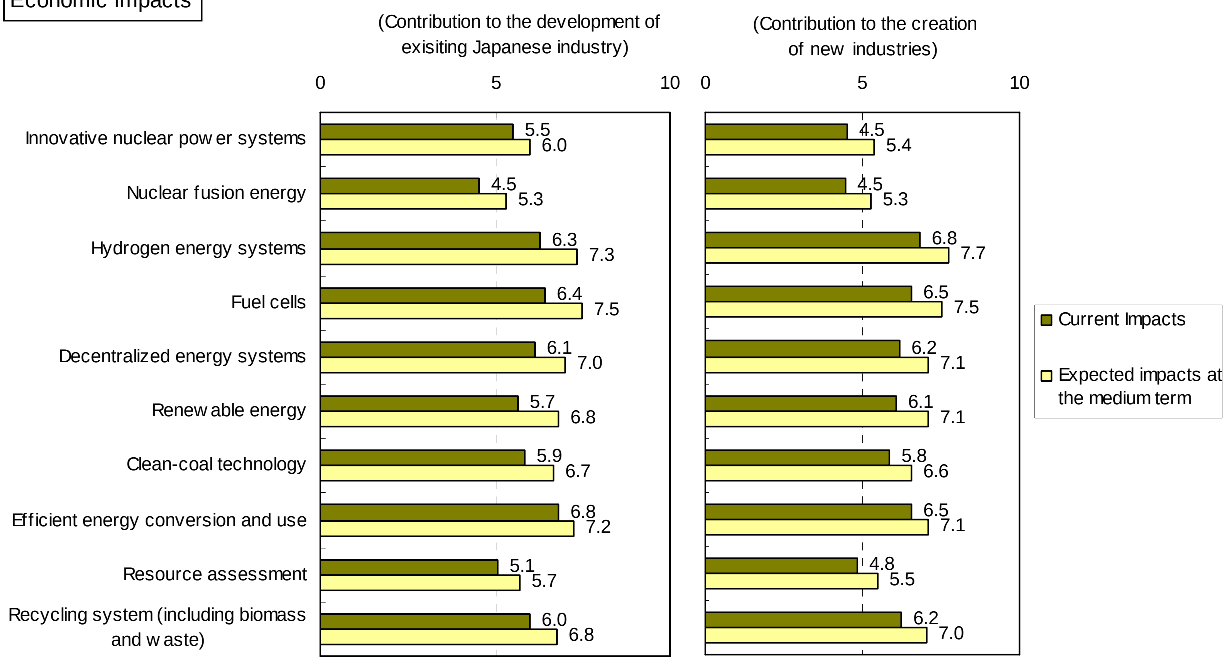
7.2. Main results

A. Impacts

Increased intellectual assets

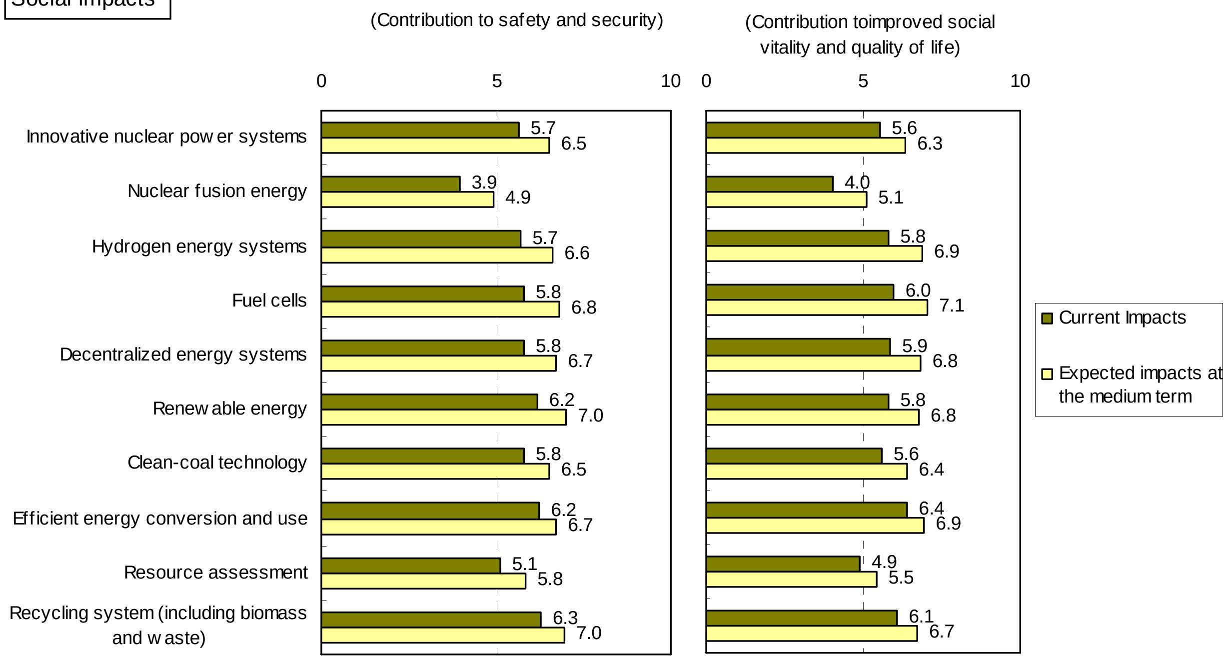


Economic impacts



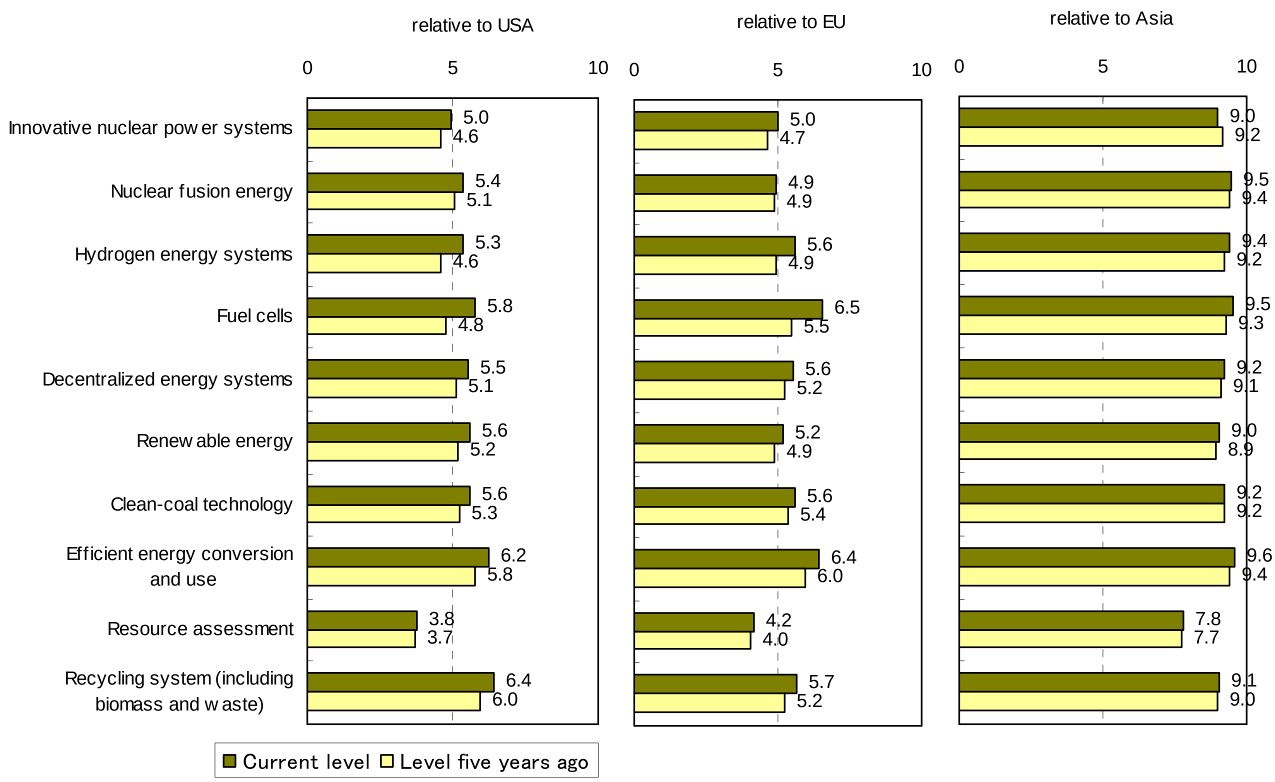
*Responses are indexed on a 10-point scale.

Social impacts



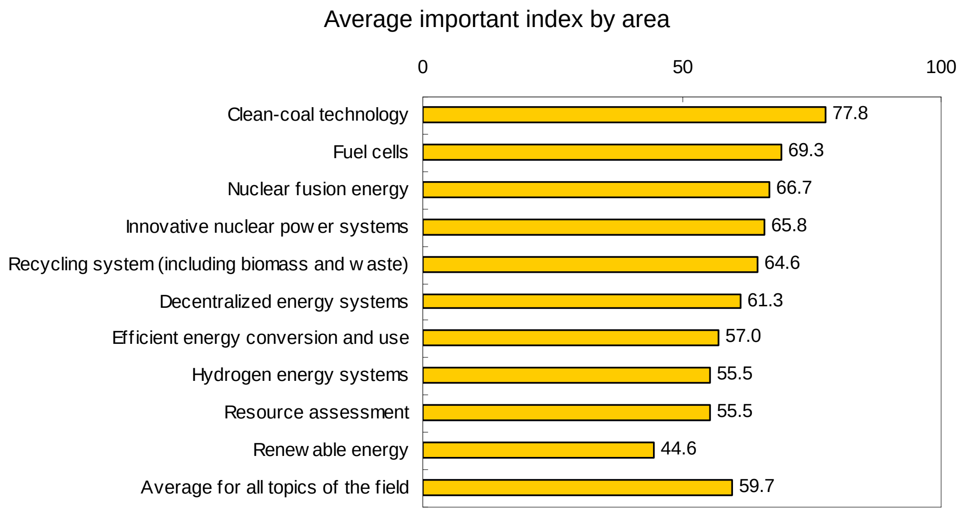
*Responses are indexed on a 10-point scale.

B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan



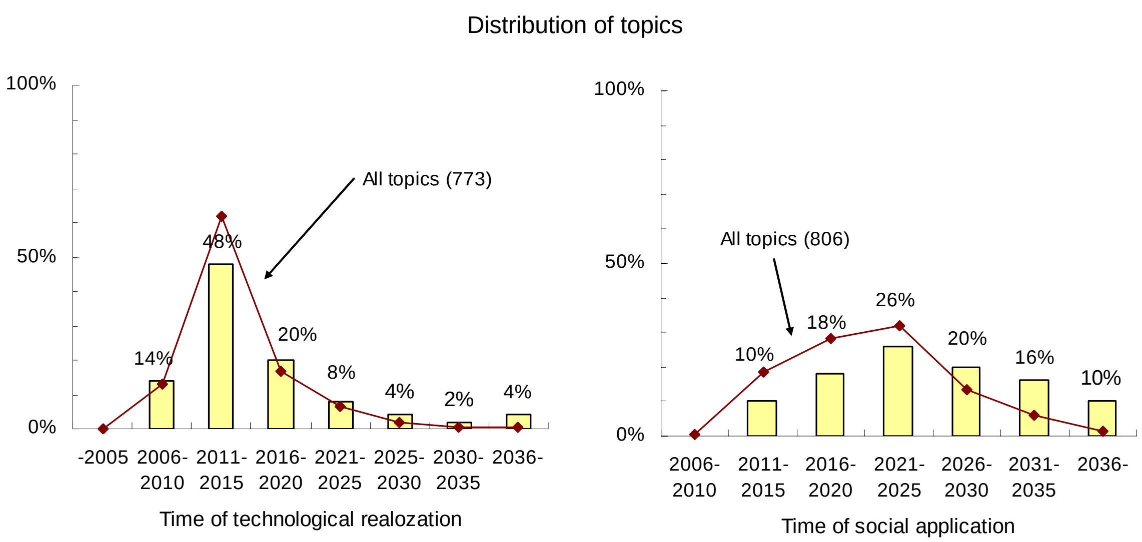
The most important 10 topics

	Topic	Index	Year T*	Year S*
1	04: Geologic disposal technology for high-level radioactive waste.	90	2020	2032
2	47: Recycle systems for the production, distribution, and consumption of recovered materials and products based on new economic criteria/standards.	86	-	2016
3	27: Technology for electric power generation and synthetic fuels manufacturing using the gasification of coal, biomass, and waste.	83	2010	2018
4	13: Polymer electrolyte fuel cells for automobile use.	82	2012	2020
5	10: Hydrogen supply infrastructure networks for fuel cell automobiles.	80	2013	2023
6	29: CO_2 recover, sequestration and storage technology.	77	2015	2027
7	22: Large-area thin-film solar cells with a conversion efficiency of at least 20 percent.	76	2015	2023
8	03: Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.	74	2032	2039
9	15: Solid oxide fuel cells for stationary use.	74	2013	2022
10	30: Large capacity combined cycle power generation through the use of large scale gas turbines with high efficiency (Turbine inlet temperature higher than 1700°C).	74	2013	2021

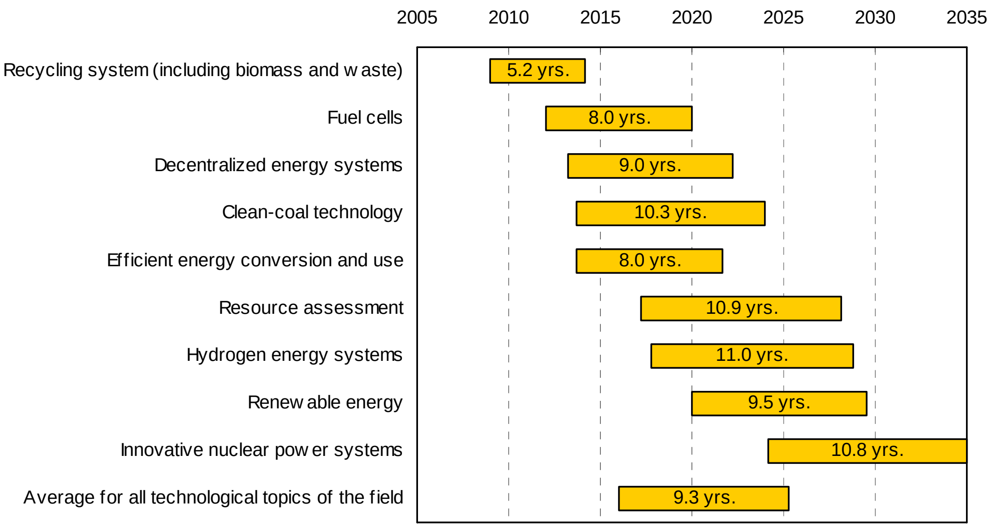
Year T: Time of technological realization   Year S: Time of social application

*Responses were indexed on a 100-point scale.

D. Time of realization



Gap between technological realization and social application



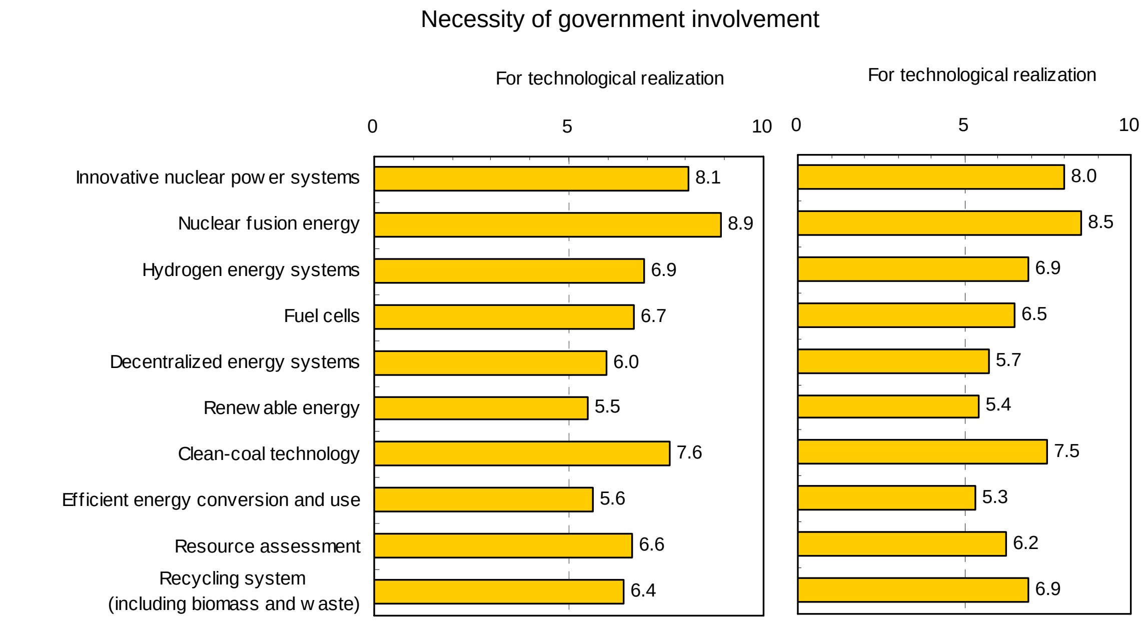
Topics with short or long periods until social application

Topic	Year T*	Period*	Area
23: Ocean-thermal conversion electric power generation.	2014	16	Renewable energy
42: Technology to extract methane hydrate from continental permafrost areas.	2015	14	Resource assessment
02: Medium and small cogeneration nuclear reactors.	2018	13	Innovative nuclear power systems
01: Fast breeder reactor (FBR) systems that include the nuclear fuel cycle.	2023	12	Innovative nuclear power systems
04: Geologic disposal technology for high-level radioactive waste.	2020	12	Innovative nuclear power systems
08: A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.	2020	12	Hydrogen energy systems
11: Hydrogen production by ultrahigh temperature using solar heat.	2022	12	Hydrogen energy systems
17: 66-77 kV superconducting power cables with capacities equivalent of current 275 kV CV cables.	2014	12	Decentralized energy systems
29: CO_2 recover, sequestration and storage technology.	2015	12	Clean-coal technology
40: Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.	2015	12	Resource assessment
43: Technology to extract methane hydrate from sediments under the deepsea floor.	2020	12	Resource assessment

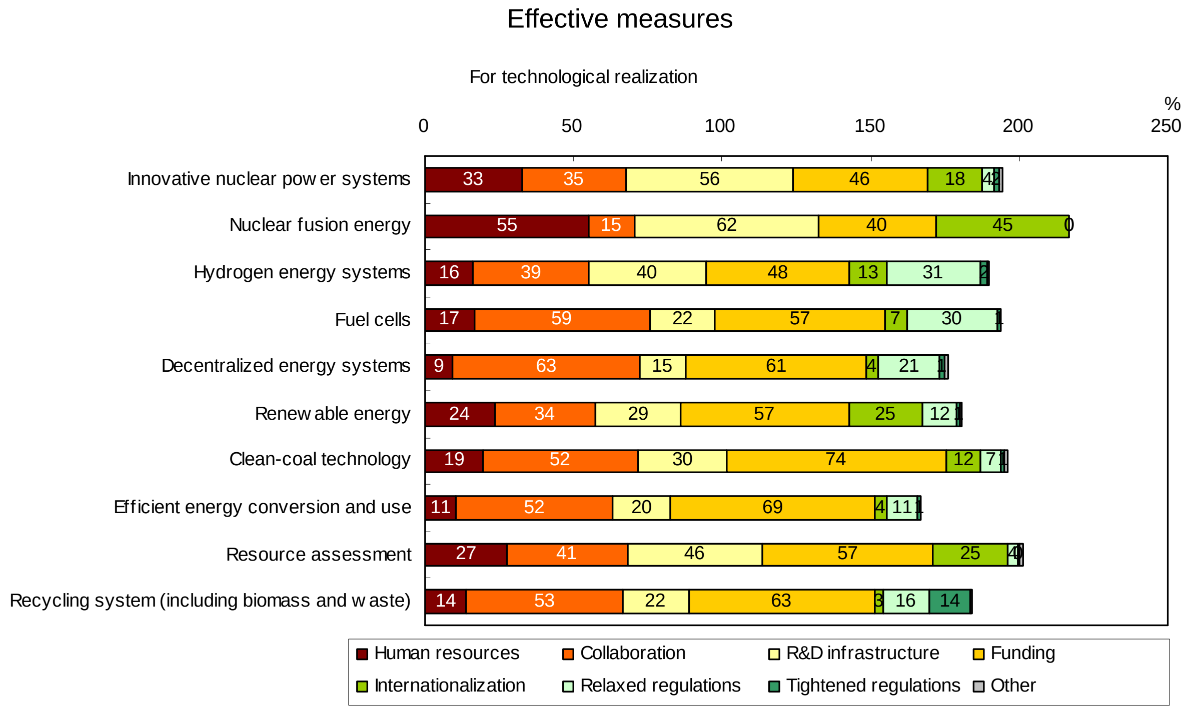
Topic	Year T*	Period*	Area
46: Rational recovery methods for valuable resources in urban garbage.	2010	5	Recycling system
48: Shredder dust disposal technology (energy and resource recovery) for post-consumer automobiles.	2008	5	Recycling system
50: Recovery of rare metals from electronic circuit boards.	2008	5	Recycling system s
51: Recovery of resources from incinerator and fly ash.	2009	5	Recycling system
14: Polymer electrolyte fuel cells for stationary use.	2011	6	Fuel cells
34: Micro cogeneration systems for residential use	2009	6	Efficient energy conversion and use
49: Manufacture of polylactic acid plastics from municipal waste.	2010	6	Recycling system

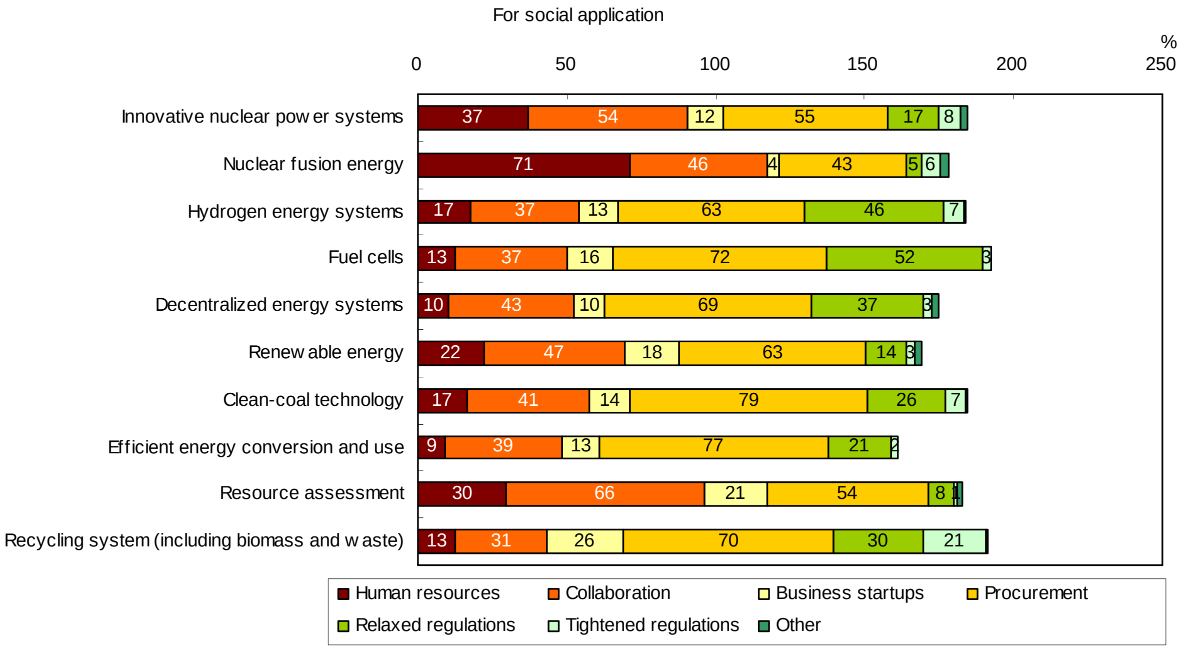
*Year T: Time of technological realization　　Period: Period until social application (years)

E. Effective measures that should taken by government



*Responses were indexed on a 10-point scale





F. Time-line of topics

Technological realization

year	topic
2008	48: Shredder dust disposal technology (energy and resource recovery) for post-consumer automobiles.
	50: Recovery of rare metals from electronic circuit boards.
2009	34: Micro cogeneration systems for residential use
	51: Recovery of resources from incinerator and fly ash.
2010	27: Technology for electric power generation and synthetic fuels manufacturing using the gasification of coal, biomass, and waste.
	46: Rational recovery methods for valuable resources in urban garbage.
	49: Manufacture of polylactic acid plastics from municipal waste.
2011	14: Polymer electrolyte fuel cells for stationary use.
2012	12: Molten carbonate fuel cells for medium- and large-scale power generation.
	13: Polymer electrolyte fuel cells for automobile use.
	19: Energy management technology that uses electricity storage technology in order to efficiently use distributed generation on the demand side.
	25: Meet 1 percent of the world's primary energy supply with wind power energy.
	33: Heat pump water heaters with COP ratings over 5 (currently the highest on the market is 4.2).
2013	09: Hydrogen fueled automobile engines.
	10: Hydrogen supply infrastructure networks for fuel cell automobiles.
	15: Solid oxide fuel cells for stationary use.
	16: Low cost (about ¥100,000 per kW) secondary batteries for efficient operation of compact fuel cells and stabilization of solar cell output.
	20: New grid technology such as micro grids that expand the stability of distributed generation (giving free access) and efficiently supply it.
	24: Biomass plantations for energy on idle land with high plant production capacity in sunbelts in the tropics and elsewhere that receive much sunlight.
	30: Large capacity combined cycle power generation through the use of large scale gas turbines with high efficiency (Turbine inlet temperature higher than 1700°C).
	35: Ceramic micro gas turbines with thermal efficiency of 40 percent.
2014	17: 66-77 kV superconducting power cables with capacities equivalent of current 275 kV CV cables.
	18: Superconducting magnetic energy storage (SMES) systems of several kWh to several tens of kWh for improved electric stability.

year	topic
	23: Ocean-thermal conversion electric power generation.
	32: Compression coolers with COP ratings over 8 (currently 4.0–6.4).
	36: Wet smelting technology whose extraction rate of copper and precious metals is equivalent to that of the process cimbining ore dressing and dry smelting (e.g. 85% x 98% = 83% approx.).
2015	22: Large-area thin-film solar cells with a conversion efficiency of at least 20 percent.
	29: CO_2 recover, sequestration and storage technology.
	37: High-efficient unmanned mining technology including robotics.
	40: Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.
	42: Technology to extract methane hydrate from continental permafrost areas.
2016	28: Technology to manufacture hydrogen from coal without emitting CO_2 into the environment.
2017	45: Technology to asssess ultimate resereves of conventional resources.
2018	02: Medium and small cogeneration nuclear reactors.
2019	41: Ultra-deep drilling technology whose specifications are for depths of 15 km and temperatures of 400°C.
2020	04: Geologic disposal technology for high-level radioactive waste.
	08: A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.
	38: Extraction and separation technology of metallic elements based on biotechnology.
	39: Technology to economically extract seafloor metal resources such as manganese nodules, cobalt crusts, heavy metal sludge, and hydrothermal mineral deposits.
	43: Technology to extract methane hydrate from sediments under the deepsea floor.
	44: Discovery of unconventional underground resources such as methane hydrate (energy resources) and seafloor hydrothermal deposits (mineral resources) as a result of changes in economic conditions, advances in earth sciences, and development of exploration technology (improved estimation, development of materials resistant to ultrahigh temperature and pressure, increased exploration depth).
2021	07: Hydrogen production processes by thermochemical method using nuclear heart.
	31: Motors and other industrial electric power apparatuses that utilize high-temperature superconductivity.
2022	11: Hydrogen production by ultrahigh temperature using solar heat.
2023	01: Fast breeder reactor (FBR) systems that include the nuclear fuel cycle.
2028	05: Technology to efficiently extract ocean uranium in an economical way.
2030	26: Artificial photosynthesis technology with a solar energy conversion efficiency of 3 percent or more (vs. about 1 percent in plant photosynthesis).
2032	03: Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.
2036-	21: Solar electric power generation systems in space.
	06: Nuclear fusion electric power generation furnaces.

Social application

year	topic
2013	48: Shredder dust disposal technology (energy and resource recovery) for post-consumer automobiles.
	50: Recovery of rare metals from electronic circuit boards.
2014	51: Recovery of resources from incinerator and fly ash.
2015	34: Micro cogeneration systems for residential use
	46: Rational recovery methods for valuable resources in urban garbage.
2016	47: Recycle systems for the production, distribution, and consumption of recovered materials and products based on new economic criteria/standards.
	49: Manufacture of polylactic acid plastics from municipal waste.
2017	14: Polymer electrolyte fuel cells for stationary use.
2018	27: Technology for electric power generation and synthetic fuels manufacturing using the gasification of coal, biomass, and waste.
2019	33: Heat pump water heaters with COP ratings over 5 (currently the highest on the market is 4.2).
2020	13: Polymer electrolyte fuel cells for automobile use.

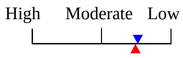
year	topic
	16: Low cost (about ¥100,000 per kW) secondary batteries for efficient operation of compact fuel cells and stabilization of solar cell output.
	19: Energy management technology that uses electricity storage technology in order to efficiently use distributed generation on the demand side.
2020	20: New grid technology such as micro grids that expand the stability of distributed generation (giving free access) and efficiently supply it.
2021	12: Molten carbonate fuel cells for medium- and large-scale power generation.
	30: Large capacity combined cycle power generation through the use of large scale gas turbines with high efficiency (Turbine inlet temperature higher than 1700°C).
	32: Compression coolers with COP ratings over 8 (currently 4.0–6.4).
2022	15: Solid oxide fuel cells for stationary use.
	25: Meet 1 percent of the world's primary energy supply with wind power energy.
	35: Ceramic micro gas turbines with thermal efficiency of 40 percent.
	36: Wet smelting technology whose extraction rate of copper and precious metals is equivalent to that of the process cimbining ore dressing and dry smelting (e.g. 85% x 98% = 83% approx.).
2023	09: Hydrogen fueled automobile engines.
	10: Hydrogen supply infrastructure networks for fuel cell automobiles.
	22: Large-area thin-film solar cells with a conversion efficiency of at least 20 percent.
	24: Biomass plantations for energy on idle land with high plant production capacity in sunbelts in the tropics and elsewhere that receive much sunlight.
2025	18: Superconducting magnetic energy storage (SMES) systems of several kWh to several tens of kWh for improved electric stability.
	37: High-efficient unmanned mining technology including robotics.
2026	17: 66-77 kV superconducting power cables with capacities equivalent of current 275 kV CV cables.
2027	28: Technology to manufacture hydrogen from coal without emitting CO2 into the environment.
	29: CO2 recover, sequestration and storage technology.
	40: Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.
2028	45: Technology to asssess ultimate resereves of conventional resources.
2029	42: Technology to extract methane hydrate from continental permafrost areas.
2030	23: Ocean-thermal conversion electric power generation.
	38: Extraction and separation technology of metallic elements based on biotechnology.
	39: Technology to economically extract seafloor metal resources such as manganese nodules, cobalt crusts, heavy metal sludge, and hydrothermal mineral deposits.
	41: Ultra-deep drilling technology whose specifications are for depths of 15 km and temperatures of 400°C.
2031	02: Medium and small cogeneration nuclear reactors.
2032	04: Geologic disposal technology for high-level radioactive waste.
	07: Hydrogen production processes by thermochemical method using nuclear heart.
	08: A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.
	31: Motors and other industrial electric power apparatuses that utilize high-temperature superconductivity.
	43: Technology to extract methane hydrate from sediments under the deepsea floor.
2034	11: Hydrogen production by ultrahigh temperature using solar heat.
2035	01: Fast breeder reactor (FBR) systems that include the nuclear fuel cycle.
2036-	05: Technology to efficiently extract ocean uranium in an economical way.
	03: Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.
	26: Artificial photosynthesis technology with a solar energy conversion efficiency of 3 percent or more (vs. about 1 percent in plant photosynthesis).
	06: Nuclear fusion electric power generation furnaces.
	21: Solar electric power generation systems in space.

Appendix: Results of R1 and R2

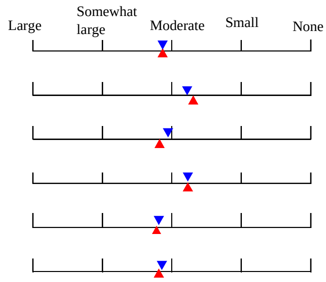
I. Innovative nuclear power systems

1. Questions regarding the relevant area

1) Degree of expertise in the area

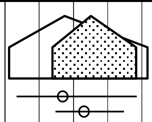
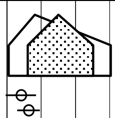
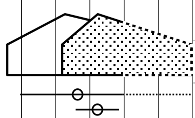
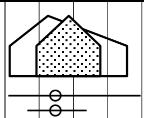
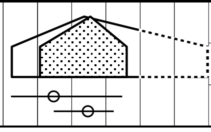


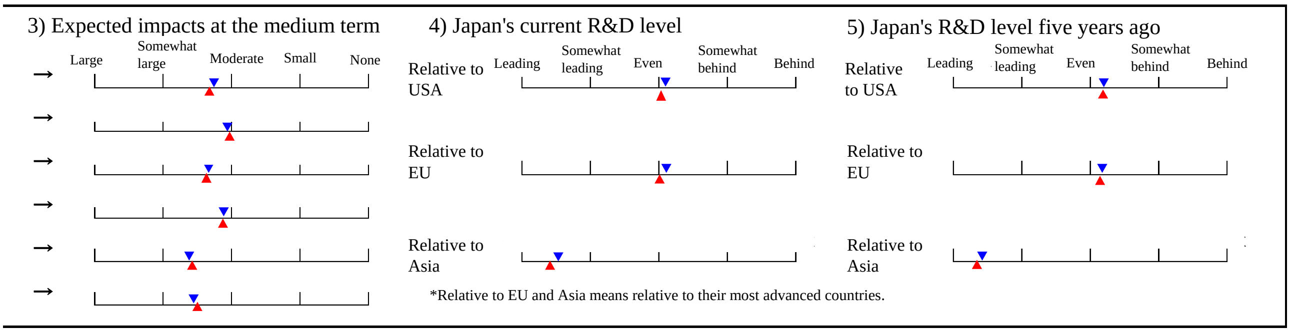
2) Current impacts



[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

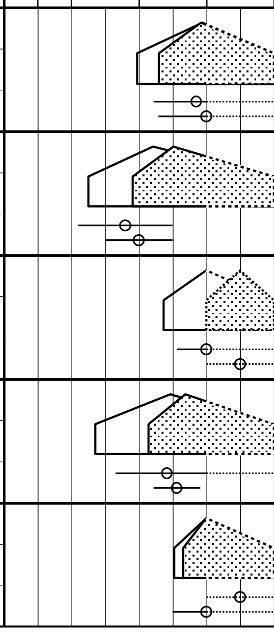
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High	Moderate	Low	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
1	Fast breeder reactor (FBR) systems that include the nuclear fuel cycle.	1	137	20	18	62	-	69	50	32	13	5		7	9
		2	129	17	16	67	-	72	51	35	13	1		6	5
		E	22	100	0	0	-	94	90	5	5	0		9	0
2	Medium and small cogeneration nuclear reactors.	1	119	15	21	64	-	46	16	44	35	5		5	12
		2	112	9	23	68	-	45	6	64	30	0		2	6
		E	10	100	0	0	-	50	10	70	20	0		11	0
3	Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.	1	100	18	16	66	-	67	47	29	23	1		8	18
		2	99	11	20	69	-	74	57	29	13	1		5	12
		E	11	100	0	0	-	77	64	27	0	9		9	0
4	Geologic disposal technology for high-level radioactive waste.	1	131	14	21	65	-	81	68	21	8	3		2	11
		2	116	9	17	74	-	90	83	11	6	0		0	3
		E	11	100	0	0	-	100	100	0	0	0		0	0
5	Technology to efficiently extract ocean uranium in an economical way.	1	113	10	26	64	-	49	23	37	30	10		16	15
		2	109	5	13	82	-	47	16	46	33	5		10	9
		E	5	100	0	0	-	30	20	0	40	40		40	0



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (%): Will not be applied	Do not know	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
36	10	52	0	2	77	14	6	3	44	35	41	35	29	9	9	5	11	13	69	21	6	4	40	40	17	40	18	17	11
30	1	69	0	0	81	12	6	1	52	32	60	41	21	4	2	2	7	13	77	17	4	2	54	56	10	57	11	8	3
32	0	68	0	0	90	5	5	0	62	38	76	57	43	0	0	5	9	0	86	9	5	0	68	59	27	77	18	5	9
19	43	25	3	10	32	35	24	9	20	38	37	31	23	16	10	6	14	19	32	34	23	11	21	35	19	31	30	19	9
7	63	22	1	7	27	51	18	4	18	48	51	32	19	7	2	1	6	11	31	50	14	5	22	65	14	41	32	5	1
10	70	0	10	10	22	56	22	0	25	63	38	25	50	0	0	0	0	11	20	60	10	10	11	89	33	67	44	0	0
19	33	45	0	3	58	23	14	5	34	27	42	38	33	2	6	8	8	25	47	33	11	9	37	32	13	45	13	13	8
9	15	75	0	1	74	18	7	1	39	19	67	45	29	1	0	1	8	18	70	22	6	2	52	47	5	53	10	3	2
9	0	91	0	0	60	30	0	10	78	11	67	56	56	0	0	0	18	0	55	36	0	9	90	20	20	70	10	0	0
8	47	45	0	0	76	19	5	0	32	34	31	39	22	17	12	6	3	14	70	25	4	1	28	34	15	42	20	28	9
3	53	44	0	0	90	7	3	0	35	45	44	56	16	5	5	2	2	8	84	13	3	0	38	47	10	63	21	21	2
20	60	20	0	0	90	10	0	0	60	50	80	60	10	0	10	0	0	0	91	9	0	0	91	64	9	73	27	18	0
60	28	7	0	5	28	36	24	12	24	27	38	38	13	3	1	8	15	28	23	33	30	14	18	38	25	46	11	4	6
79	11	8	0	2	22	49	18	11	20	29	59	55	6	2	0	1	13	19	28	36	26	10	19	53	21	63	10	1	3
100	0	0	0	0	25	0	25	50	50	0	0	50	0	0	0	0	40	20	20	20	20	40	33	0	33	67	0	0	0

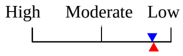
Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–



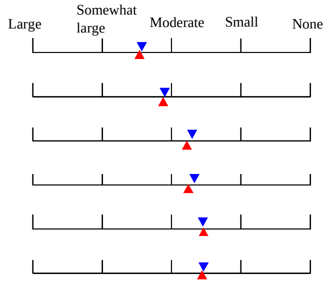
II. Nuclear fusion energy

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts



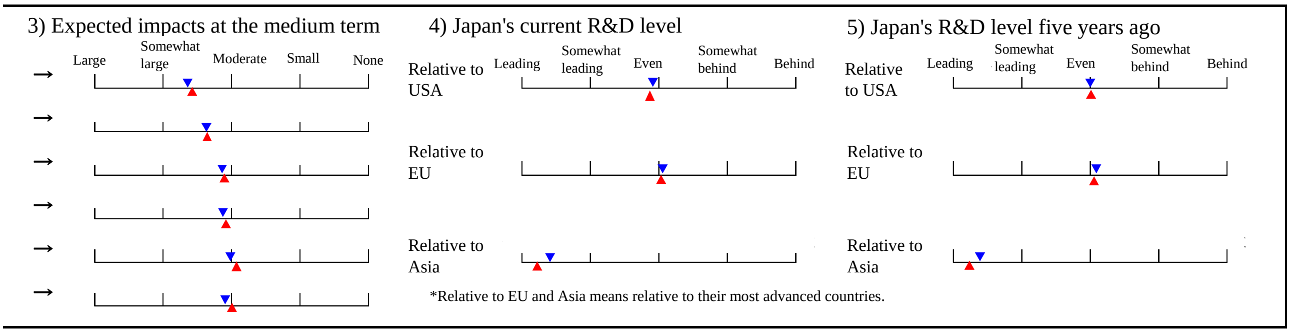
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
6	Nuclear fusion electric power generation furnaces.	1	125	10	22	68	-	67	43	39	16	2							7	20
		2	121	6	20	74	-	67	41	45	12	2							8	24
		E	7	100	0	0	-	79	57	43	0	0							14	0

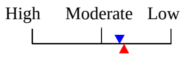


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
27	24	47	0	2	69	18	13	0	40	20	47	41	44	3	4	3						10	30	58	26	13	3	44	42	11	37	9	17	8
17	9	73	0	1	78	11	11	0	55	15	62	40	45	0	0	0						9	31	70	17	10	3	71	46	4	43	5	6	3
43	0	57	0	0	86	14	0	0	29	14	57	71	71	0	0	0						14	29	86	14	0	0	71	43	0	0	0	14	14

III. Hydrogen energy systems

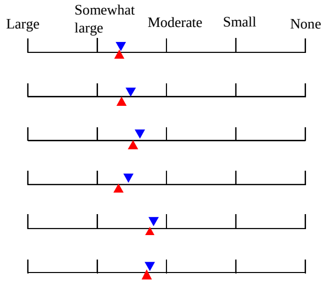
1. Questions regarding the relevant area

1) Degree of expertise in the area

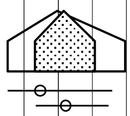
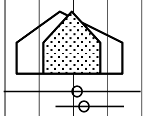
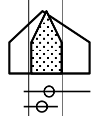
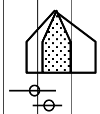
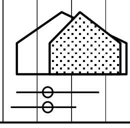


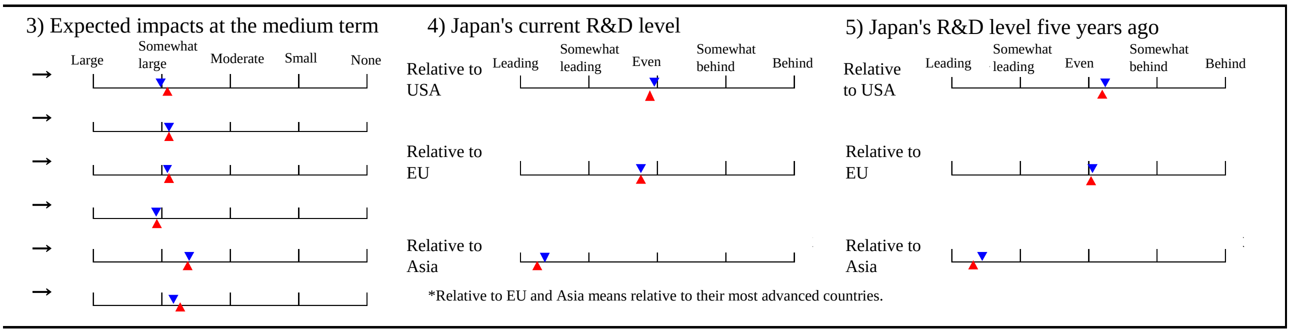
2) Current impacts

[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know
7	Hydrogen production processes by thermochemical method using nuclear heart.	1	146	10	30	60	-	53	28	38	26	8		7	10
		2	136	7	25	68	-	48	13	55	29	3		5	7
		E	9	100	0	0	-	47	13	61	13	13		22	0
8	A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.	1	167	11	31	58	-	53	27	40	25	8		12	8
		2	160	8	24	68	-	49	13	62	21	4		7	3
		E	12	100	0	0	-	50	27	37	18	18		17	0
9	Hydrogen fueled automobile engines.	1	162	9	26	65	-	66	41	43	14	2		4	2
		2	160	7	18	75	-	60	30	54	13	3		3	1
		E	11	100	0	0	-	61	27	64	9	0		0	0
10	Hydrogen supply infrastructure networks for fuel cell automobiles.	1	183	16	32	52	-	75	55	37	6	2		3	2
		2	167	14	26	60	-	80	66	27	5	2		2	1
		E	24	100	0	0	-	82	75	13	4	8		8	0
11	Hydrogen production by ultrahigh temperature using solar heat.	1	117	15	17	68	-	45	20	33	36	11		16	21
		2	119	6	11	83	-	40	11	35	45	9		13	12
		E	7	100	0	0	-	32	14	14	43	29		29	0



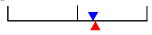
Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
51	32	13	0	4	44	33	14	9	32	38	48	48	19	14	6	5		12	10	43	33	15	9	33	40	23	49	24	21	4
67	28	4	0	1	52	35	11	2	26	32	66	53	8	5	2	1		7	10	53	33	10	4	34	52	10	66	15	5	1
67	33	0	0	0	45	33	11	11	14	57	71	43	43	0	0	0		22	0	56	11	22	11	0	75	13	63	13	0	13
31	29	33	0	7	39	36	16	9	18	34	28	38	30	37	12	3		16	10	39	33	18	10	13	30	18	42	49	18	4
29	24	43	0	4	53	31	10	6	12	43	27	47	29	38	3	0		9	8	53	31	10	6	16	36	10	57	59	9	1
41	17	42	0	0	33	25	25	17	30	40	50	30	40	30	0	0		27	18	55	18	18	9	30	30	20	50	60	0	10
51	18	29	0	2	21	39	34	6	19	38	21	42	12	36	11	1		4	8	23	38	30	9	13	30	22	43	49	20	1
75	1	23	0	1	12	52	32	4	13	49	18	48	9	45	1	1		3	4	15	50	28	7	10	27	16	60	68	8	1
82	0	18	0	0	0	82	18	0	9	73	27	36	0	36	0	0		0	0	9	55	27	9	10	40	0	60	50	10	0
46	20	30	0	4	44	40	14	2	16	42	28	39	11	51	15	2		3	6	48	32	17	3	13	28	21	51	56	23	2
69	6	23	0	2	52	35	12	1	11	49	24	47	7	61	4	0		2	4	57	29	12	2	9	25	16	65	75	10	1
66	17	17	0	0	49	38	13	0	8	50	25	42	21	63	8	0		8	8	50	33	13	4	9	26	9	65	65	22	4
29	37	20	0	14	22	31	31	16	28	29	45	41	22	9	3	2		20	20	22	30	31	17	24	35	20	45	19	13	3
16	69	12	0	3	17	40	33	10	19	21	63	46	12	8	0	0		15	11	15	42	33	10	18	45	13	67	15	2	2
29	57	0	0	14	14	14	43	29	0	20	40	40	20	20	0	0		43	0	14	14	58	14	0	33	17	33	17	33	17

IV. Fuel cells

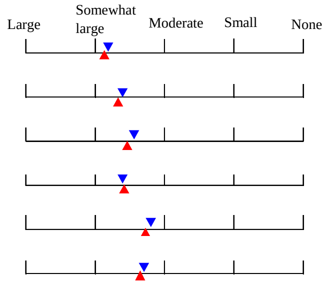
1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

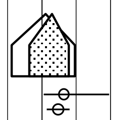
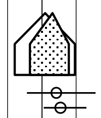
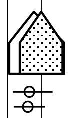
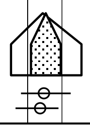


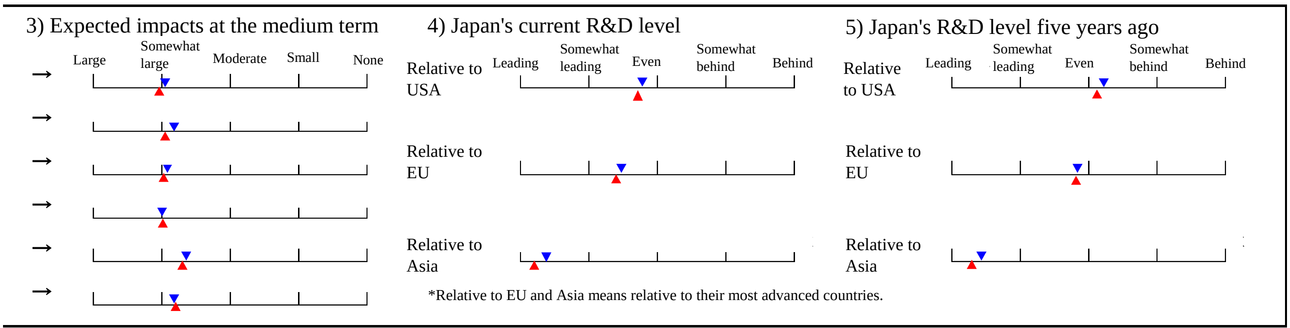
2) Current impacts

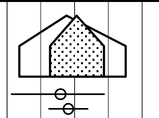
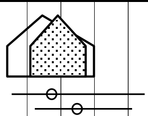
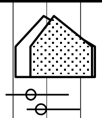
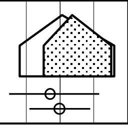


Category	Item
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
12	Molten carbonate fuel cells for medium- and large-scale power generation.	1	**161**	**10**	**36**	**54**	-	**53**	**21**	**51**	**24**	**4**		**7**	**7**
		2	**146**	**7**	**32**	**61**	-	**49**	**10**	**66**	**23**	**1**		**3**	**2**
		E	**10**	**100**	**0**	**0**	-	**55**	**30**	**40**	**20**	**10**		**20**	**0**
13	Polymer electrolyte fuel cells for automobile use.	1	**163**	**17**	**33**	**50**	-	**77**	**60**	**32**	**6**	**2**		**3**	**3**
		2	**149**	**11**	**30**	**59**	-	**82**	**67**	**28**	**4**	**1**		**1**	**1**
		E	**16**	**100**	**0**	**0**	-	**92**	**86**	**7**	**7**	**0**		**7**	**0**
14	Polymer electrolyte fuel cells for stationary use.	1	**167**	**21**	**42**	**37**	-	**69**	**45**	**42**	**11**	**2**		**1**	**4**
		2	**154**	**16**	**38**	**46**	-	**72**	**49**	**41**	**10**	**0**		**1**	**1**
		E	**25**	**100**	**0**	**0**	-	**85**	**75**	**17**	**8**	**0**		**0**	**0**
15	Solid oxide fuel cells for stationary use.	1	**156**	**21**	**37**	**42**	-	**71**	**48**	**41**	**9**	**2**		**2**	**4**
		2	**141**	**14**	**31**	**55**	-	**74**	**51**	**45**	**3**	**1**		**1**	**0**
		E	**20**	**100**	**0**	**0**	-	**80**	**69**	**21**	**5**	**5**		**5**	**0**



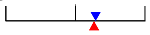
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
39	50	9	0	2	19	39	35	7	23	41	20	45	10	28	7	3		12	11	22	30	34	14	18	33	23	50	36	15	2
16	83	1	0	0	8	60	27	5	16	51	16	58	9	23	1	1		7	3	8	54	31	7	12	37	15	73	42	2	1
30	60	10	0	0	10	50	10	30	57	71	0	43	0	0	0	0		20	10	22	34	33	11	25	38	13	50	25	0	13
49	36	9	0	6	35	33	25	7	24	49	26	44	14	41	9	0		2	6	37	34	23	6	17	33	25	53	49	15	1
75	23	1	0	1	31	48	18	3	18	60	22	50	9	38	1	1		1	3	32	49	16	3	13	35	15	70	60	4	0
81	19	0	0	0	43	44	13	0	44	50	25	63	25	38	0	0		6	0	53	40	7	0	33	40	13	80	53	13	0
51	38	6	0	5	33	37	24	6	21	49	27	52	11	41	9	1		3	7	32	36	23	9	17	37	24	57	50	13	1
76	20	3	0	1	32	45	20	3	15	63	23	56	7	37	1	0		2	3	30	47	20	3	12	36	16	71	59	2	1
83	13	4	0	0	60	24	12	4	22	70	30	57	9	43	0	0		8	0	66	17	13	4	27	36	14	86	59	0	0
40	47	12	0	1	36	38	20	6	26	51	29	57	9	23	6	0		3	5	34	37	23	6	19	40	24	55	40	12	2
29	66	5	0	0	32	51	16	1	18	63	26	66	5	22	1	0		1	1	27	53	18	2	14	40	16	72	49	2	0
35	50	15	0	0	45	40	10	5	32	53	21	68	0	37	5	0		5	5	37	47	16	0	28	11	6	78	72	6	0

V. Decentralized energy systems

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



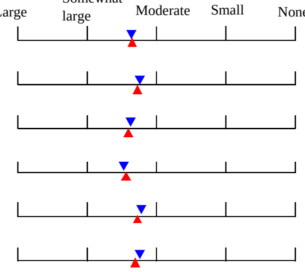
2) Current impacts

Large | Somewhat large | Moderate | Small | None

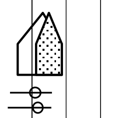
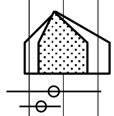
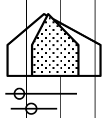
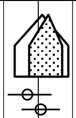
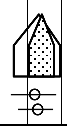
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

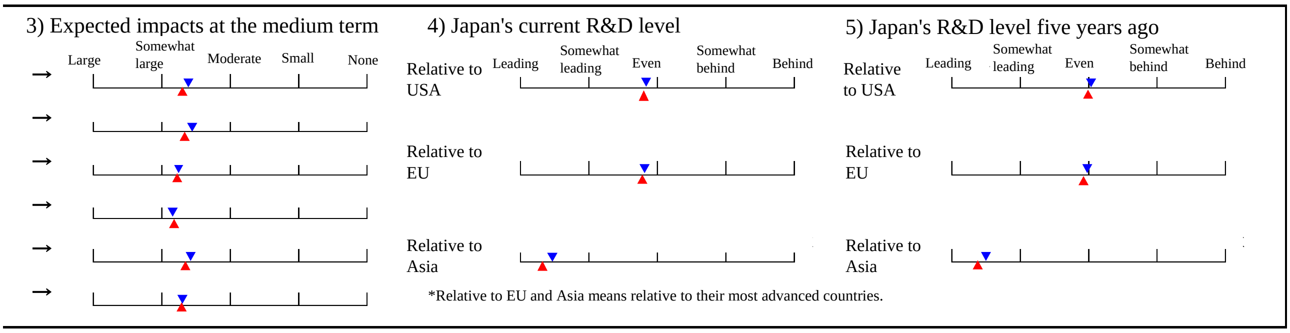
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

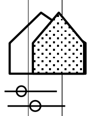
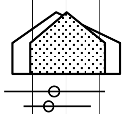
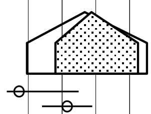
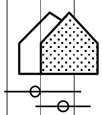
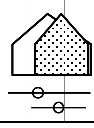
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan Index	High (%)	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know
16	Low cost (about ¥100,000 per kW) secondary batteries for efficient operation of compact fuel cells and stabilization of solar cell output.	1	147	16	35	49	-	71	46	46	7	1							1	7
		2	147	11	36	53	-	71	45	50	4	1							1	2
		E	16	100	0	0	-	77	53	47	0	0							0	0
17	66-77 kV superconducting power cables with capacities equivalent of current 275 kV CV cables.	1	92	13	22	65	-	48	14	51	33	2							9	13
		2	96	10	14	76	-	48	8	70	20	2							3	7
		E	10	100	0	0	-	53	20	60	10	10							10	0
18	Superconducting magnetic energy storage (SMES) systems of several kWh to several tens of kWh for improved electric stability.	1	107	10	27	63	-	45	11	53	30	6							7	14
		2	108	9	18	73	-	47	8	67	22	3							5	5
		E	10	100	0	0	-	50	20	50	20	10							10	0
19	Energy management technology that uses electricity storage technology in order to efficiently use distributed generation on the demand side.	1	142	19	33	48	-	70	48	42	9	1							1	6
		2	140	16	26	58	-	72	47	46	7	0							1	3
		E	22	100	0	0	-	88	77	18	5	0							0	0
20	New grid technology such as micro grids that expand the stability of distributed generation (giving free access) and efficiently supply it.	1	127	25	25	50	-	67	42	44	11	3							2	6
		2	122	24	22	54	-	68	39	55	6	0							0	3
		E	29	100	0	0	-	75	54	39	7	0							0	0

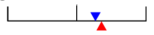


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other				High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
65	23	8	1	3	27	39	27	7	18	48	26	57	5	28	5	2		2	7	27	37	27	9	10	28	21	62	35	7	3
87	11	1	0	1	10	65	19	6	10	60	15	65	2	21	1	1		1	3	13	59	23	5	10	36	11	80	33	2	1
100	0	0	0	0	19	69	6	6	13	67	0	80	0	33	7	0		0	0	31	57	6	6	20	60	0	80	33	7	0
61	30	2	0	7	13	44	30	13	14	39	25	55	11	24	7	3		11	17	14	33	37	16	16	36	12	49	32	9	5
82	15	2	0	1	5	62	28	5	6	55	17	65	7	15	2	1		5	11	6	51	37	6	8	42	9	73	29	2	4
80	20	0	0	0	22	45	33	0	0	33	33	56	11	0	0	0		10	0	10	50	40	0	0	40	0	70	10	0	10
41	47	6	0	6	14	41	34	11	18	44	32	46	10	19	3	3		12	17	11	35	38	16	16	39	15	45	32	8	4
33	64	0	0	3	5	63	26	6	6	58	22	64	5	9	0	2		4	10	4	50	37	9	10	48	11	69	26	2	2
70	30	0	0	0	22	56	11	11	0	50	13	75	13	0	0	0		10	0	10	40	40	10	0	67	0	56	11	0	11
53	30	14	0	3	18	44	30	8	22	54	23	40	3	30	12	2		1	7	26	35	32	7	15	35	22	48	39	12	2
77	18	5	0	0	11	65	20	4	14	73	12	56	3	21	1	1		1	4	11	56	29	4	14	42	12	66	43	5	1
76	24	0	0	0	19	67	14	0	14	76	19	43	0	24	0	0		0	0	24	47	29	0	10	52	0	48	62	0	0
37	42	18	0	3	31	40	21	8	15	52	27	44	2	45	11	2		3	7	34	34	26	6	12	38	19	48	51	17	4
33	61	6	0	0	18	64	15	3	9	70	10	55	2	37	3	1		0	3	23	55	19	3	8	45	8	59	56	5	2
28	55	17	0	0	29	53	11	7	8	69	12	54	0	38	8	0		0	0	46	29	18	7	8	42	4	54	65	4	0

VI. Renewable energy

1. Questions regarding the relevant area

1) Degree of expertise in the area

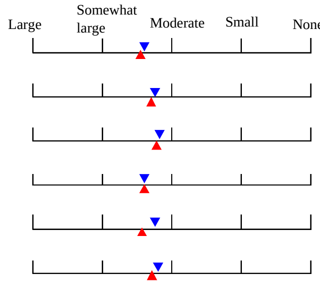


2) Current impacts

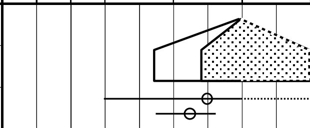
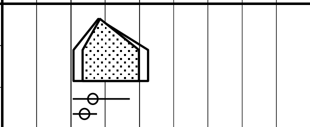
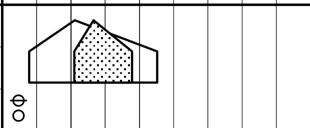
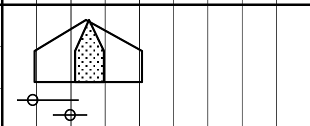
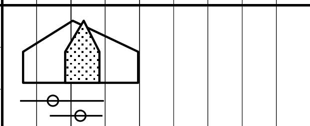
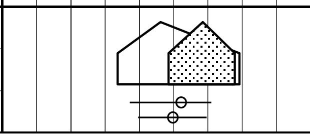
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

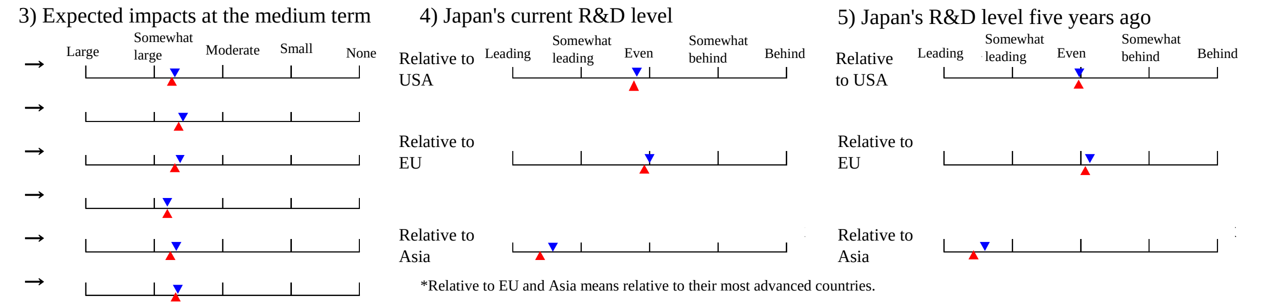
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

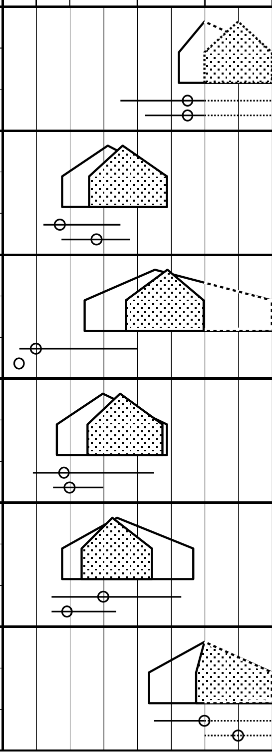


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
21	Solar electric power generation systems in space.	1	115	11	19	70	-	37	11	27	49	13		28	17
		2	114	5	11	84	-	31	5	18	65	12		31	10
		E	6	100	0	0	-	67	50	17	33	0		0	0
22	Large-area thin-film solar cells with a conversion efficiency of at least 20 percent.	1	145	10	26	64	-	72	49	40	10	1		3	8
		2	136	7	18	75	-	76	54	41	4	1		1	2
		E	10	100	0	0	-	85	70	30	0	0		0	0
23	Ocean-thermal conversion electric power generation.	1	138	5	26	69	-	39	10	33	48	9		11	12
		2	129	3	15	82	-	33	4	25	65	6		7	3
		E	4	100	0	0	-	38	25	0	50	25		75	0
24	Biomass plantations for energy on idle land with high plant production capacity in sunbelts in the tropics and elsewhere that receive much sunlight.	1	118	9	24	67	-	45	15	42	37	6		6	7
		2	120	3	16	81	-	39	6	43	47	4		5	3
		E	3	100	0	0	-	42	34	0	33	33		33	0
25	Meet 1 percent of the world's primary energy supply with wind power energy.	1	163	13	28	59	-	50	20	46	30	4		5	8
		2	148	9	22	69	-	44	8	52	38	2		3	2
		E	13	100	0	0	-	50	15	54	31	0		0	0
26	Artificial photosynthesis technology with a solar energy conversion efficiency of 3 percent or more (vs. about 1 percent in plant photosynthesis).	1	102	9	17	74	-	50	21	42	31	6		10	20
		2	106	3	15	82	-	45	11	53	32	4		4	14
		E	3	100	0	0	-	50	33	0	67	0		33	0



*Relative to EU and Asia means relative to their most advanced countries.

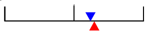
Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
24	72	2	0	2	31	23	30	16	28	25	44	42	40	5	3	1		35	27	30	21	24	25	35	46	16	36	13	6	8
9	87	1	0	3	25	20	41	14	27	24	52	48	43	4	1	0		39	15	29	19	35	17	31	69	9	41	14	3	7
33	67	0	0	0	83	0	17	0	67	50	67	100	50	33	0	0		17	0	100	0	0	0	50	67	17	83	67	17	0
79	15	4	0	2	25	36	35	4	25	43	25	63	8	7	0	2		1	11	27	35	32	6	19	34	20	65	19	5	2
94	5	1	0	0	12	61	26	1	19	57	23	70	8	8	0	1		1	4	13	60	23	4	15	44	19	78	10	1	0
100	0	0	0	0	0	70	30	0	40	70	40	70	10	20	0	0		0	0	0	70	30	0	30	50	30	80	20	0	0
59	28	12	0	1	18	29	41	12	21	32	42	44	19	8	1	2		22	19	18	28	37	17	21	36	30	47	14	8	4
80	13	7	0	0	4	31	59	6	18	30	41	55	15	5	0	1		13	10	6	32	53	9	15	41	22	66	8	4	2
75	0	25	0	0	25	0	50	25	33	33	0	67	67	0	0	0		75	0	25	0	50	25	33	67	33	33	0	0	33
10	38	25	6	21	17	43	32	8	26	26	22	29	59	6	2	0		7	14	24	40	28	8	24	38	30	38	14	4	3
4	69	15	6	6	14	51	28	7	30	23	15	35	64	5	1	0		6	3	12	53	26	9	24	50	28	58	12	1	2
0	34	33	0	33	67	0	0	33	0	0	0	0	50	50	0	0		33	0	67	0	0	33	0	50	0	0	50	0	0
3	10	87	0	0	19	35	32	14	19	27	19	40	21	30	13	3		3	17	22	36	32	10	12	25	23	60	37	15	3
1	3	96	0	0	12	49	33	6	13	26	11	59	8	43	5	2		3	4	15	48	31	6	8	22	16	79	33	5	2
8	0	92	0	0	23	47	15	15	30	40	10	50	0	60	30	10		0	0	31	31	23	15	9	55	27	73	45	9	0
25	55	12	0	8	20	43	28	9	34	38	37	52	16	6	1	2		9	24	19	33	38	10	35	43	24	40	15	6	1
14	80	4	0	2	12	60	21	7	35	42	29	73	8	6	0	0		8	21	10	43	38	9	42	56	15	56	4	2	0
34	33	33	0	0	34	33	0	33	0	50	0	0	50	0	0	0		33	0	34	33	0	33	50	50	0	0	0	0	0

VII. Clean-coal technology

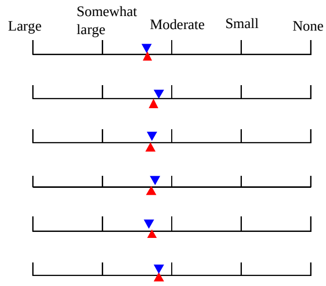
1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

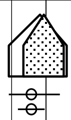
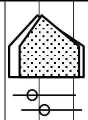
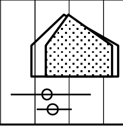


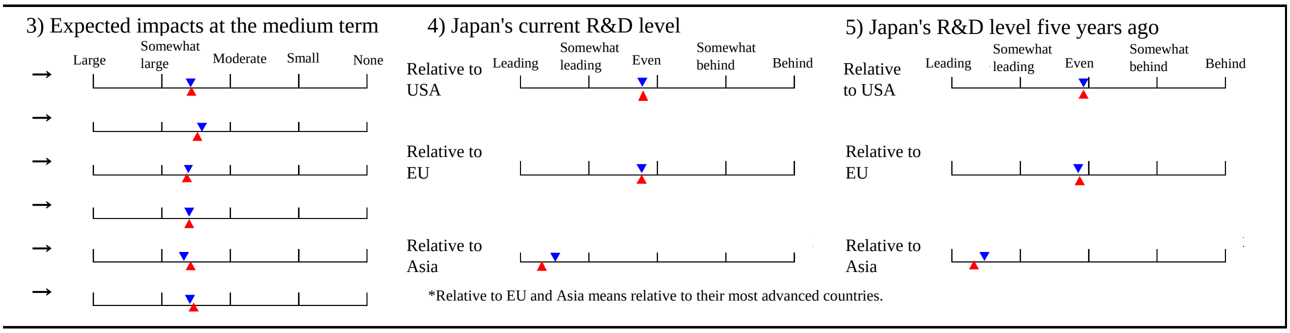
2) Current impacts

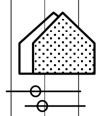
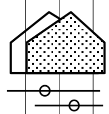
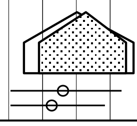


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
27	Technology for electric power generation and synthetic fuels manufacturing using the gasification of coal, biomass, and waste.	1	166	30	31	39	-	77	59	34	7	0		1	2
		2	154	23	31	46	-	83	68	29	3	0		0	1
		E	36	100	0	0	-	89	78	22	0	0		0	0
28	Technology to manufacture hydrogen from coal without emitting CO_2 into the environment.	1	152	21	26	53	-	67	44	37	16	3		10	7
		2	144	19	28	53	-	73	55	35	6	4		5	1
		E	27	100	0	0	-	68	49	35	4	12		11	0
29	CO_2 recover, sequestration and storage technology.	1	164	19	27	54	-	71	51	34	12	3		7	6
		2	153	13	25	62	-	77	62	26	9	3		5	3
		E	20	100	0	0	-	82	73	11	11	5		5	0



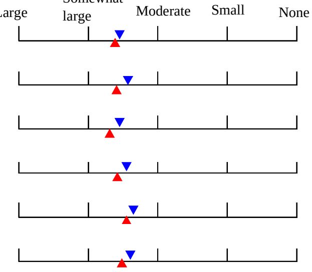
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application						(%)	Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
42	32	24	1	1	36	46	17	1	24	50	28	61	15	14	4	1						1	4	38	43	18	1	16	34	31	64	33	11	0
62	24	14	0	0	27	63	9	1	17	61	21	70	9	13	1	1						0	3	30	61	8	1	13	36	18	81	34	4	0
64	33	3	0	0	47	47	6	0	28	53	19	72	14	22	0	0						0	0	47	47	6	0	20	31	23	74	43	6	0
35	44	15	0	6	38	36	18	8	28	43	40	64	19	4	4	1						9	10	33	38	22	7	23	46	23	54	22	10	0
23	71	5	0	1	40	47	9	4	20	52	32	76	8	3	1	1						5	4	35	52	9	4	20	45	11	77	23	5	1
37	55	4	0	4	49	31	12	8	21	42	21	83	8	8	0	0						15	0	46	42	4	8	21	42	4	75	29	4	0
37	41	20	0	2	48	31	15	6	22	41	38	58	24	11	7	1						10	11	44	37	13	6	19	41	21	53	29	20	5
28	64	7	0	1	57	31	9	3	21	44	35	76	18	5	1	1						5	6	56	31	7	6	17	42	12	80	22	12	1
45	50	5	0	0	79	16	5	0	26	42	32	84	11	5	5	5						5	5	85	5	5	5	24	35	18	76	24	24	0

VIII. Efficient energy conversion and use

1. Questions regarding the relevant area

1) Degree of expertise in the area

2) Current impacts



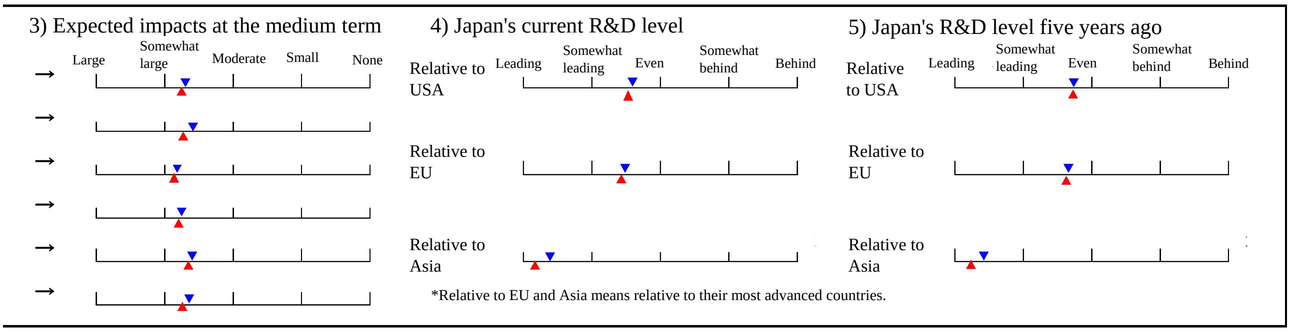
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization	Will not be realized (%)	Do not know (%)
30	Large capacity combined cycle power generation through the use of large scale gas turbines with high efficiency (Turbine inlet temperature higher than 1700°C).	1	133	17	32	51	-	73	48	47	5	0		1	6
		2	140	8	29	63	-	74	49	47	4	0		0	1
		E	11	100	0	0	-	91	82	18	0	0		0	0
31	Motors and other industrial electric power apparatuses that utilize high-temperature superconductivity.	1	108	12	27	61	-	53	21	49	28	2		6	11
		2	115	5	18	77	-	48	8	68	23	1		3	5
		E	6	100	0	0	-	63	33	50	17	0		17	0
32	Compression coolers with COP ratings over 8 (currently 4.0–6.4).	1	96	16	28	56	-	61	31	54	13	2		1	9
		2	110	7	18	75	-	59	21	73	6	0		2	2
		E	8	100	0	0	-	72	49	38	13	0		13	0
33	Heat pump water heaters with COP ratings over 5 (currently the highest on the market is 4.2).	1	107	14	30	56	-	60	29	54	15	2		0	8
		2	110	9	20	71	-	57	19	73	6	2		0	2
		E	10	100	0	0	-	65	40	40	20	0		0	0
34	Micro cogeneration systems for residential use	1	161	21	27	52	-	58	31	42	24	3		1	4
		2	148	15	32	53	-	57	21	64	14	1		0	1
		E	22	100	0	0	-	68	41	50	9	0		0	0
35	Ceramic micro gas turbines with thermal efficiency of 40 percent.	1	130	14	22	64	-	50	18	50	29	3		2	12
		2	133	7	25	68	-	47	6	72	20	2		2	5
		E	9	100	0	0	-	56	45	11	22	22		22	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application					(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
33	62	4	0	1	27	38	26	9	25	43	26	61	10	6	3	1						3	7	24	31	29	16	18	32	20	60	16	6	3
14	86	0	0	0	13	63	22	2	15	53	17	73	6	6	0	1						0	1	13	55	29	3	8	42	10	78	13	1	0
36	64	0	0	0	36	46	18	0	18	55	18	82	18	9	0	0						0	0	46	36	18	0	9	64	9	73	9	0	0
50	42	4	0	4	21	41	30	8	25	40	43	47	12	5	1	1						7	15	21	35	32	12	19	38	26	50	16	7	1
60	38	2	0	0	6	70	19	5	16	46	33	65	8	4	0	0						4	6	5	60	30	5	14	49	16	72	11	1	1
17	83	0	0	0	33	50	17	0	20	20	0	60	20	0	0	0						20	0	17	33	50	0	0	33	0	50	0	0	17
73	17	8	0	2	14	39	36	11	14	49	27	58	2	6	5	1						3	13	13	35	39	13	13	31	16	59	19	7	1
92	7	0	0	1	6	60	30	4	6	58	12	77	2	3	1	0						2	2	6	47	42	5	8	38	10	79	12	4	0
74	13	0	0	13	13	25	37	25	0	83	0	67	0	0	0	0						13	0	13	37	25	25	0	67	17	50	17	33	0
79	9	9	0	3	12	36	41	11	13	48	32	51	3	10	4	2						0	10	11	38	37	14	12	28	18	63	24	11	1
94	4	2	0	0	5	52	37	6	7	56	18	65	3	5	2	0						0	2	5	47	40	8	9	37	14	75	17	3	0
100	0	0	0	0	10	30	50	10	22	56	11	67	0	11	11	0						0	0	10	30	50	10	22	44	22	44	22	11	0
58	22	19	0	1	20	36	31	13	17	38	27	43	7	40	5	2						3	4	21	34	32	13	10	25	24	67	44	13	1
86	10	4	0	0	8	56	29	7	8	51	16	57	2	38	2	1						0	3	11	55	27	7	7	25	15	80	47	2	0
86	9	5	0	0	18	63	14	5	19	62	14	62	5	38	10	5						0	5	14	63	18	5	19	29	5	76	52	10	0
35	54	8	0	3	10	42	37	11	14	41	33	51	8	15	2	1						3	9	7	38	39	16	12	37	25	53	27	9	1
16	82	1	0	1	5	53	37	5	11	50	22	74	3	8	0	0						4	3	3	44	45	8	9	43	13	76	26	1	0
33	56	0	0	11	22	11	45	22	29	57	14	71	0	14	0	0						22	0	22	11	45	22	29	71	14	43	14	14	0

IX. Resource assessment

1. Questions regarding the relevant area

1) Degree of expertise in the area

High — Moderate — Low

2) Current impacts

Scale: Large — Somewhat large — Moderate — Small — None

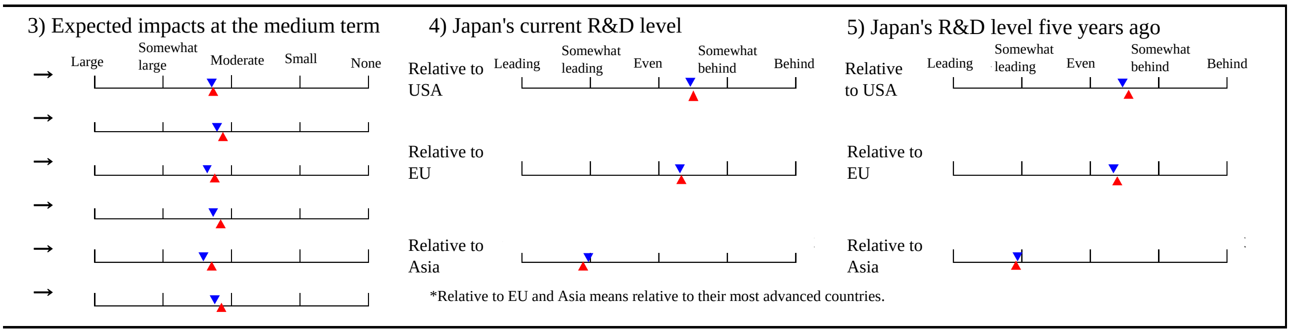
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

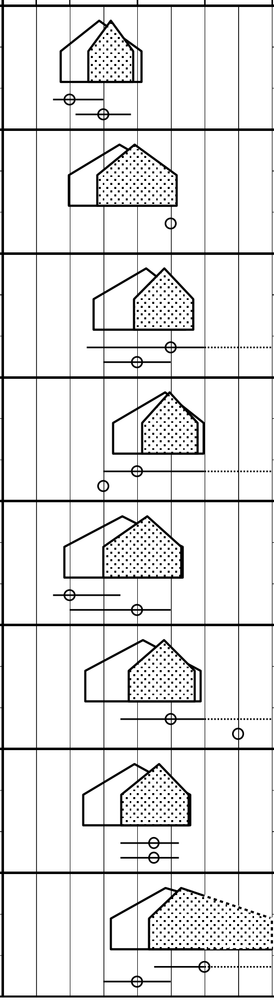
2. Questions regarding topics

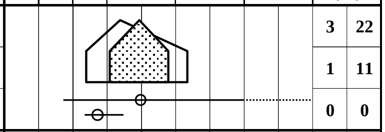
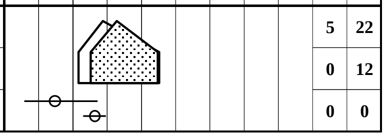
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
36	Wet smelting technology whose extraction rate of copper and precious metals is equivalent to that of the process cimbining ore dressing and dry smelting (e.g. 85% x 98% = 83% approx.).	1	52	10	13	77	-	51	18	50	30	2		4	16
		2	61	8	15	77	-	44	2	73	23	2		0	8
		E	5	100	0	0	-	45	0	80	20	0		0	0
37	High-efficient unmanned mining technology including robotics.	1	66	2	17	81	-	44	11	43	44	2		2	14
		2	74	0	14	86	-	39	3	51	45	1		0	3
		E													
38	Extraction and separation technology of metallic elements based on biotechnology.	1	74	7	18	75	-	48	15	52	29	4		7	15
		2	80	4	9	87	-	44	3	68	26	3		4	3
		E	3	100	0	0	-	42	0	67	33	0		0	0
39	Technology to economically extract seafloor metal resources such as manganese nodules, cobalt crusts, heavy metal sludge, and hydrothermal mineral deposits.	1	83	5	25	70	-	65	40	44	15	1		2	15
		2	85	1	16	83	-	60	27	60	12	1		1	4
		E	1	100	0	0	-	100	100	0	0	0		0	0
40	Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.	1	73	8	16	76	-	57	28	47	24	1		1	14
		2	80	5	6	89	-	55	17	69	14	0		3	5
		E	4	100	0	0	-	100	100	0	0	0		0	0
41	Ultra-deep drilling technology whose specifications are for depths of 15 km and temperatures of 400°C.	1	59	10	15	75	-	58	26	57	14	3		4	9
		2	72	3	10	87	-	51	13	72	11	4		0	6
		E	2	100	0	0	-	100	100	0	0	0		0	0
42	Technology to extract methane hydrate from continental permafrost areas.	1	107	5	22	73	-	53	24	46	23	7		2	12
		2	108	4	15	81	-	49	15	57	23	5		3	4
		E	4	100	0	0	-	50	25	50	0	25		0	0
43	Technology to extract methane hydrate from sediments under the deepsea floor.	1	124	6	20	74	-	70	50	34	13	3		3	13
		2	119	4	16	80	-	71	51	34	10	5		3	5
		E	5	100	0	0	-	70	60	20	0	20		0	0

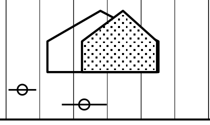


*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
30	58	5	0	7	12	39	43	6	30	50	39	37	22	7	0	0		4	18	8	45	41	6	38	44	18	31	11	7	4
8	89	0	0	3	3	45	49	3	22	67	34	34	12	5	0	3		0	10	2	62	31	5	30	73	18	43	4	0	4
40	60	0	0	0	0	40	60	0	40	60	0	20	20	0	0	0		0	0	0	60	20	20	50	75	0	25	0	0	0
26	62	7	0	5	11	40	39	10	29	39	38	43	16	4	0	0		2	17	10	37	40	13	27	40	27	38	6	2	0
13	86	1	0	0	3	45	46	6	26	51	37	54	15	1	0	1		1	4	1	39	53	7	24	62	32	52	6	0	2
16	66	11	0	7	11	46	37	6	32	35	42	41	14	6	0	2		9	21	10	45	39	6	32	43	33	38	8	5	3
4	93	0	0	3	4	64	28	4	29	44	48	53	17	5	0	0		5	8	4	57	34	5	25	63	30	52	10	3	1
0	100	0	0	0	0	67	33	0	0	33	67	33	33	0	0	0		0	33	0	33	67	0	0	100	0	33	0	0	0
30	58	7	0	5	41	34	20	5	32	52	41	55	27	9	3	0		3	19	29	43	24	4	35	51	27	41	15	5	4
9	89	1	0	1	33	51	14	2	21	50	39	71	23	5	1	1		2	5	20	64	14	2	27	69	20	57	7	2	2
0	100	0	0	0	0	100	0	0	100	100	100	100	0	0	0	0		0	0	0	100	0	0	100	100	0	100	0	0	0
3	92	3	0	2	30	38	26	6	31	38	40	52	34	8	2	0		1	16	29	40	27	4	29	46	29	45	8	3	3
1	99	0	0	0	19	64	16	1	27	42	47	68	31	4	0	1		3	6	16	67	16	1	29	62	26	59	9	1	3
0	100	0	0	0	100	0	0	0	100	50	75	100	25	0	0	0		0	0	75	25	0	0	75	50	50	100	25	0	0
9	77	8	0	6	31	41	24	4	29	33	42	54	33	8	2	2		5	15	23	41	32	4	25	45	21	47	15	6	6
1	97	1	0	1	13	68	15	4	21	37	49	68	22	6	0	0		1	8	11	68	17	4	22	63	19	62	13	1	1
0	100	0	0	0	100	0	0	0	100	0	0	100	0	0	0	0		0	0	100	0	0	0	0	0	100	100	0	0	0
14	55	11	0	20	34	34	26	6	29	38	41	47	47	4	1	1		4	19	33	36	21	10	39	55	28	38	11	7	5
5	86	1	0	8	23	53	19	5	18	27	39	58	53	3	0	1		3	7	22	55	17	6	26	68	21	51	9	0	0
25	75	0	0	0	50	25	0	25	33	33	67	33	100	33	0	0		0	25	25	50	0	25	67	67	33	67	33	0	0
32	56	5	0	7	49	31	16	4	31	38	51	58	28	4	1	2		6	16	43	36	13	8	38	49	27	48	16	7	5
14	82	1	0	3	55	33	9	3	20	31	54	71	25	5	0	1		3	8	50	36	10	4	25	65	17	68	12	3	1
60	40	0	0	0	60	20	0	20	75	50	100	75	50	50	0	0		0	20	60	20	0	20	75	100	25	75	25	0	0



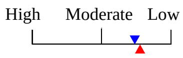
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
44	Discovery of unconventional underground resources such as methane hydrate (energy resources) and seafloor hydrothermal deposits (mineral resources) as a result of changes in economic conditions, advances in earth sciences, and development of exploration technology (improved estimation, development of materials resistant to ultrahigh temperature and pressure, increased exploration depth).	1	90	4	24	72	-	67	43	39	17	1		3	22
		2	100	3	16	81	-	72	51	39	8	2		1	11
		E	3	100	0	0	-	100	100	0	0	0		0	0
45	Technology to asssess ultimate resereves of conventional resources.	1	90	7	24	69	-	64	41	36	19	4		5	22
		2	95	4	17	79	-	70	45	44	10	1		0	12
		E	4	100	0	0	-	100	100	0	0	0		0	0

Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application							Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
14	**76**	**5**	**0**	**5**	**42**	**32**	**21**	**5**	**43**	**42**	**44**	**43**	**36**	**2**	**0**	**0**																		
4	**92**	**2**	**0**	**2**	**58**	**35**	**5**	**2**	**38**	**33**	**59**	**53**	**24**	**1**	**0**	**0**																		
33	**67**	**0**	**0**	**0**	**100**	**0**	**0**	**0**	**100**	**67**	**100**	**100**	**67**	**33**	**0**	**0**																		
4	**82**	**10**	**0**	**4**	**36**	**31**	**26**	**7**	**49**	**32**	**42**	**41**	**38**	**2**	**0**	**4**						**5**	**23**	**34**	**33**	**26**	**7**	**55**	**54**	**15**	**34**	**8**	**3**	**4**
1	**98**	**1**	**0**	**0**	**48**	**41**	**10**	**1**	**51**	**25**	**51**	**42**	**27**	**1**	**0**	**1**						**0**	**13**	**38**	**44**	**17**	**1**	**60**	**71**	**9**	**42**	**7**	**1**	**0**
0	**100**	**0**	**0**	**0**	**100**	**0**	**0**	**0**	**100**	**50**	**50**	**75**	**25**	**0**	**0**	**0**						**0**	**0**	**50**	**50**	**0**	**0**	**100**	**50**	**25**	**50**	**25**	**0**	**0**

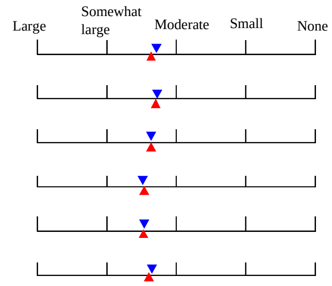
X. Recycling systems (including biomass and waste)

1. Questions regarding the relevant area

1) Degree of expertise in the area

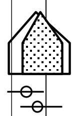
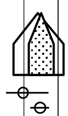
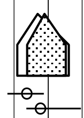
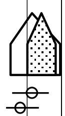
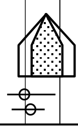


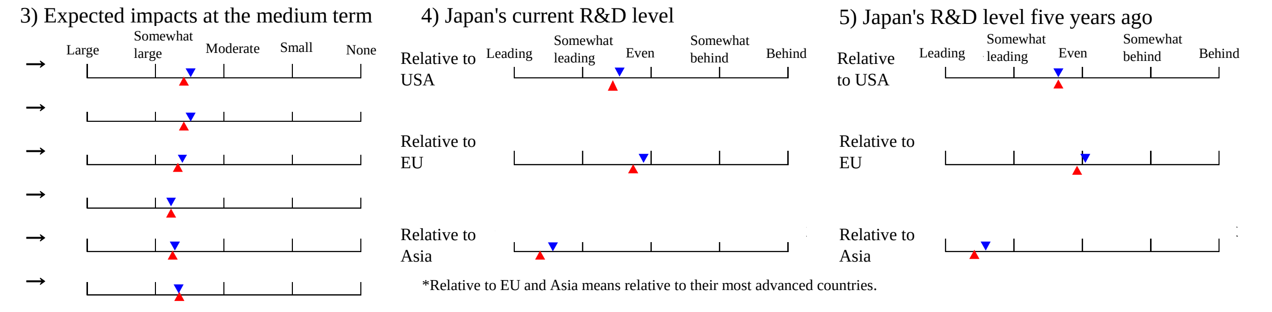
2) Current impacts

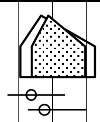
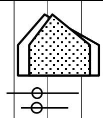
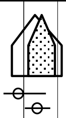
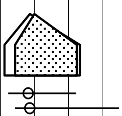
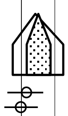
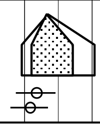


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
46	Rational recovery methods for valuable resources in urban garbage.	1	129	21	17	62	-	67	43	42	13	2		0	9
		2	123	15	16	69	-	74	50	44	6	0		0	2
		E	18	100	0	0	-	83	67	33	0	0		0	0
47	Recycle systems for the production, distribution, and consumption of recovered materials and products based on new economic criteria/standards.	1	124	19	23	58	-	75	54	39	6	1			
		2	109	16	10	74	-	86	75	21	3	1			
		E	17	100	0	0	-	97	94	6	0	0			
48	Shredder dust disposal technology (energy and resource recovery) for post-consumer automobiles.	1	117	21	18	61	-	67	40	48	10	2		0	2
		2	112	16	13	71	-	61	25	68	7	0		0	3
		E	18	100	0	0	-	67	33	67	0	0		0	0
49	Manufacture of polylactic acid plastics from municipal waste.	1	100	13	20	67	-	49	19	45	30	6		5	6
		2	95	9	17	74	-	51	15	61	23	1		1	3
		E	9	100	0	0	-	53	22	45	33	0		11	0
50	Recovery of rare metals from electronic circuit boards.	1	114	11	23	66	-	62	34	48	16	2		0	5
		2	103	10	14	76	-	61	26	64	10	0		0	2
		E	10	100	0	0	-	85	70	30	0	0		0	0
51	Recovery of resources from incinerator and fly ash.	1	126	16	24	60	-	55	24	49	24	3		0	6
		2	121	15	16	69	-	54	17	67	16	0		0	2
		E	18	100	0	0	-	74	50	44	6	0		0	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
53	8	38	0	1	33	43	22	2	24	46	38	52	7	27	25	1		0	9	32	50	16	2	19	34	34	56	37	38	0
80	1	19	0	0	23	67	8	2	18	53	29	59	2	23	19	0		0	3	25	69	5	1	12	35	22	75	37	26	0
83	0	17	0	0	41	59	0	0	12	47	24	47	6	35	24	0		0	0	44	56	0	0	11	39	22	72	39	33	0
																		0	5	49	42	9	0	24	44	28	47	40	35	2
																		0	4	61	32	5	2	19	38	17	68	38	23	0
																		0	0	82	12	6	0	19	38	19	56	31	25	0
66	5	28	0	1	25	47	23	5	21	38	30	46	7	29	25	1		0	2	32	42	23	3	16	28	33	45	34	33	2
93	0	7	0	0	15	66	15	4	12	50	17	61	3	22	17	0		0	2	21	61	15	3	12	27	26	67	35	25	0
94	0	6	0	0	35	59	0	6	6	56	19	63	0	13	19	0		0	0	39	49	6	6	6	35	18	65	47	47	0
63	10	24	0	3	24	39	30	7	25	42	29	56	8	14	18	2		8	11	20	47	26	7	15	34	41	46	25	24	2
86	10	3	0	1	15	56	24	5	12	48	23	64	1	8	10	1		5	3	14	61	22	3	9	27	30	71	19	14	2
100	0	0	0	0	34	33	22	11	0	50	25	50	13	0	0	0		22	0	22	56	11	11	13	38	13	75	13	25	0
68	7	24	0	1	24	41	29	6	24	45	29	43	8	16	21	1		0	6	24	44	30	2	19	34	38	42	28	28	1
91	2	6	0	1	12	64	21	3	15	61	20	61	4	9	11	2		0	2	12	69	18	1	14	31	34	65	25	18	0
100	0	0	0	0	20	60	10	10	22	44	22	33	0	0	22	11		0	0	20	70	0	10	11	22	22	44	33	22	0
68	6	24	0	2	23	49	25	3	18	41	31	48	5	25	18	3		1	8	24	51	22	3	16	32	34	47	36	25	0
91	2	7	0	0	13	69	15	3	12	52	22	70	3	16	10	0		0	3	15	69	14	2	10	26	26	75	29	22	0
100	0	0	0	0	31	50	13	6	20	53	20	47	0	13	27	0		0	0	33	50	11	6	12	29	24	76	35	47	0

8. Environment field

8.1. Overview

For this survey, the environment field was divided into 55 topics in Areas 1 through 7.

When we were preparing questions, there was a very strong possibility that the Kyoto Protocol come into force, and partly because of that, Area 1 became "global environment (focus on global warming)," with questions regarding the global environment mainly concerning climate change. Area 2 is "urban environment," based on the awareness that urban environmental issues will become increasingly important. Area 3, "focus on identification and mitigation of ecological effects (including soil and water)," reflects international recognition of the importance of maintaining biodiversity. Area 4 is "environmental economic index," a rapidly developing area. Area 5 covers "lifestyle based on environment," which will be an important element in solving environmental issues. Although Area 6, "environmental disasters (urban and community security—science and technology for disaster minimization and prevention)," only has three survey questions, it combines the environment and disaster management. Finally, Area 7 covers "water resources (water cycle research and water resources management)," an area of increasing international importance.

First, we would like to address the environmental expertise of the respondents. Only 8.7 percent of respondents claimed a high degree in the environment field, versus an average of 15 percent in other fields. Throughout the field, from Area 1 through Area 7, on average a high percentage of respondents evaluated themselves as having a low degree of expertise. In Area 7, environmental disasters, in particular, more respondents than in other fields described their expertise as low.

The question of how to assess this characteristic of the respondents is one that requires considerable debate. Similar issues probably exist outside the environment field, but a particular characteristic of the environment field is that the general media cover environmental issues, and people with a low level of expertise predictably have a strong tendency to accept this media coverage uncritically. The responses must therefore be taken as having a certain kind of bias.

Another characteristic of the environment field is that it is necessary to create topics that have a low possibility of realization. More precisely, this refers to the disposal of carbon dioxide in the ocean. "03 Formation of international consensus on the CO_2 disposal in the deep-sea below 3,000m." is the topic in question. One-third of those responding answered that this will never be realized. For those who answered the question negatively, questions regarding the necessity of government involvement or effective measures that should be taken by government in Japan lost any meaning. In the lifestyle and the environment area as well, almost 30 percent responded negatively to the possibility of realizing "40 Energy consumption per capita in Japan reduces by half."

With this situation in mind, how are we to read the results for times of technological realization and social application, or importance to Japan in the environment field?

What tendencies do the responses of those with somewhat low expertise show? In general, they tend to appear rather pessimistic about technology and optimistic about times of social application. The responses this time displayed this perspective, but there was not a particularly large difference between the responses of experts and responses that included a large number from those claiming a low degree of expertise. If we must note the categories in which large differences were found, there appeared to be many places where gaps exist between experts and general respondents on whether tightened and new regulations are effective measures towards social application. In some cases, experts strongly asserted the need for tightened and new regulation, while in other cases they judged other methods effective, so there was no regular tendency. Because of the low number of experts, however, further examination is needed to determine whether this is statistically significant.

Regarding the adequacy of individual questions on time of technological realization and time of social application, we will leave that to the descriptions of each area. Checking those items where my own opinion differs relatively largely from the response, however, I was left with the sense that they tend to be those that are more important internationally than to Japan. For example, for the topics "43: Technology for the early detection of and response to large-scale forest fires around the world" and "55: Social consensus building on the process for avoiding water conflicts associated with development," a majority of responses answered that their importance to Japan is low, but I wish that the questions had been interpreted as whether Japanese science and technology can make a contribution to the world rather than whether such things are likely to occur in Japan.

Another characteristic of environmental issues is that there are shared global topics such as those related to climate change, and there are topics specific to individual countries. Japan's environmental problems began with Minamata disease and other pollution issues. Looking around the world, this is an anomaly. In addition, the social systems that adopted the world's strictest—arguably excessive—safety measures against BSE and the public's sense of risk that demanded those measures further point out Japan's idiosyncratic character.

Considered in this way, discussion of the results of this Delphi analysis in terms of international competitiveness may not necessarily be appropriate. Instead, it may be essential to consider the mission of the environment field of science and technology, including responses to the idiosyncrasies of Japanese society.

Based on points such as those above, I will consider the results of the current questionnaire. The category of degree of importance to Japan is one that draws much attention. The highest score was that of "45: Technology for forecasting abnormal weather disasters resulting from climate change." This suggests the necessity not just of predicting climate change, but also of studying it from the perspective of how it can cause disasters. In other words, it asserts the need for continued analysis not just of an environmental issue, but also of how that issue affects human activity. This point is extremely easy to agree with, and can be considered something that transcends high or low levels of expertise.

In second place was "34: Technology for predicting and assessing global depletion of the resources that area used in Japan." This evaluation of degree of importance is also easy to agree with. Indeed, there is a high possibility that a lack of expertise in the environment led to a balanced response. In order for a resource-poor country such as Japan to survive, it must import resources from around the world. Lack of security on this point therefore is probably seen as dangerous.

In third place was the topic "40: Energy consumption per capita in Japan reduces by half." This is meant as a combination with the second-place topic of resources.

On the other hand, topics for which the degree of importance index was relatively low include "12: Widespread use of technology for the active control of urban noise and vibration to conform to environmental standards," "30: Technology for efficient revegetation in deserts," and "48: Groundwater observation from satellites (improvement of spatial accuracy from a few hundreds to a few kilometers)." As discussed above, the latter two are probably distorted by the idea of degree of importance specifically to Japan. Regarding the low score for control of urban noise, it is impossible to judge whether it is because the problem is considered under control, or because other issues are seen as more important.

The results for necessity of government involvement correlate strongly with the above-described values for degree of importance. Many of the areas where human resources development is necessary are related to ecology, and in fact the actual number of personnel is low. A number of composite areas are named as requiring strengthened collaboration, which seems a very appropriate selection.

In conclusion, this Delphi method questionnaire itself covers a very extensive array of questions and responses, and it is nearly impossible to analyze them in detail. In general, however, it strongly reflects today's Japan, and I could agree with many of its judgments on degree of importance. Yet, as I have already stated, the importance of environmental issues in Japan, particularly those related to the effects of the environment on the human body, is declining because of progress in improving the environment. Instead, we have reached a point when a shared awareness that it is necessary to judge importance based on contribution to global environmental improvement, is essential.

(YASUI Itaru)

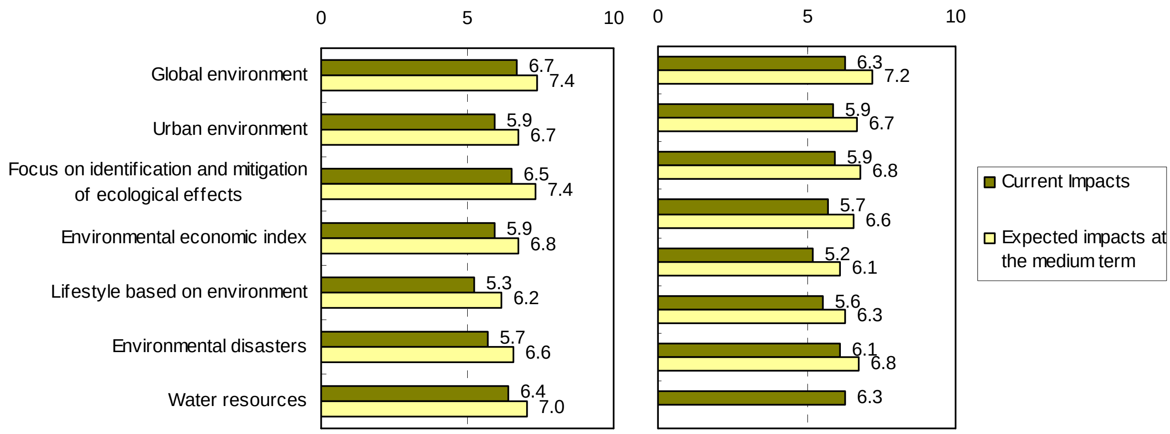
8.2. Main results

A. Impacts

Increased intellectual assets

(Contribution of the relevant area)

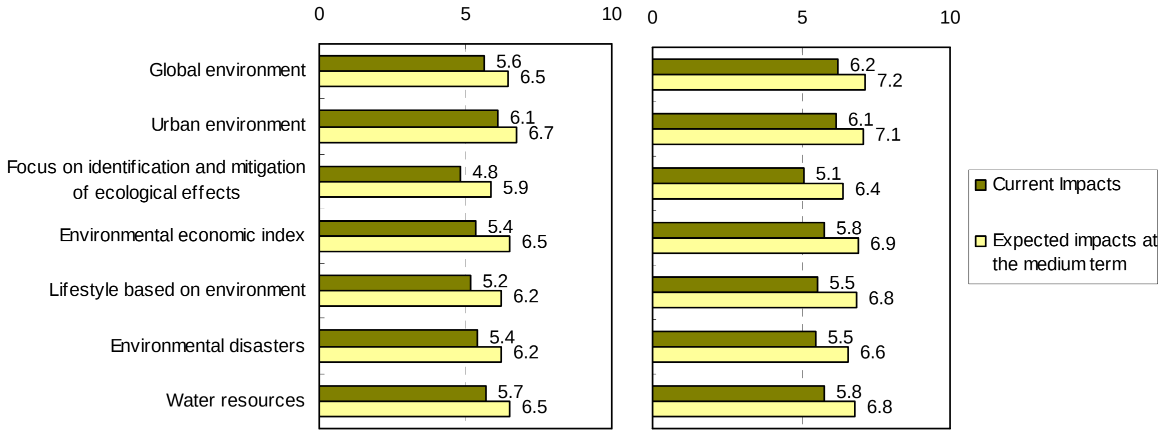
(Contribution to the development of other fields)



Economic impacts

(Contribution to the development of exisiting Japanese industry)

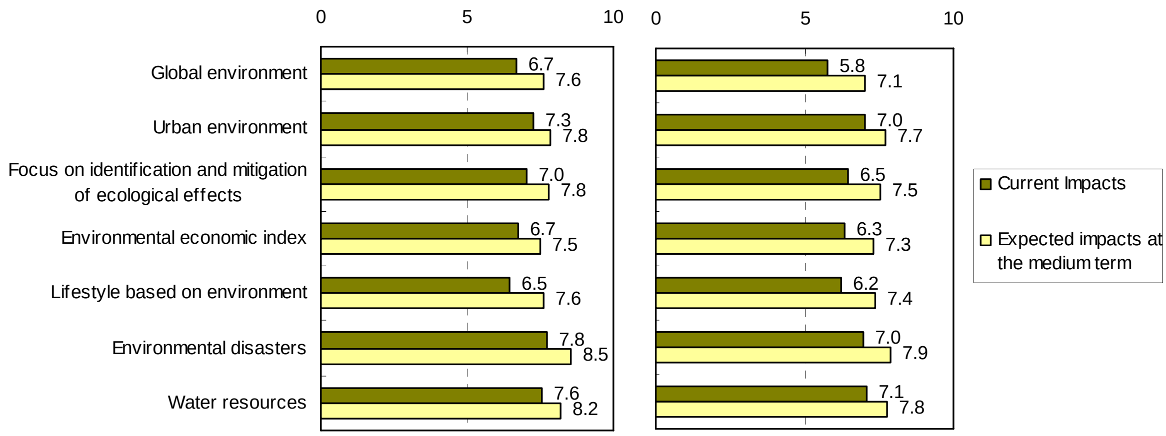
(Contribution to the creation of new industries)



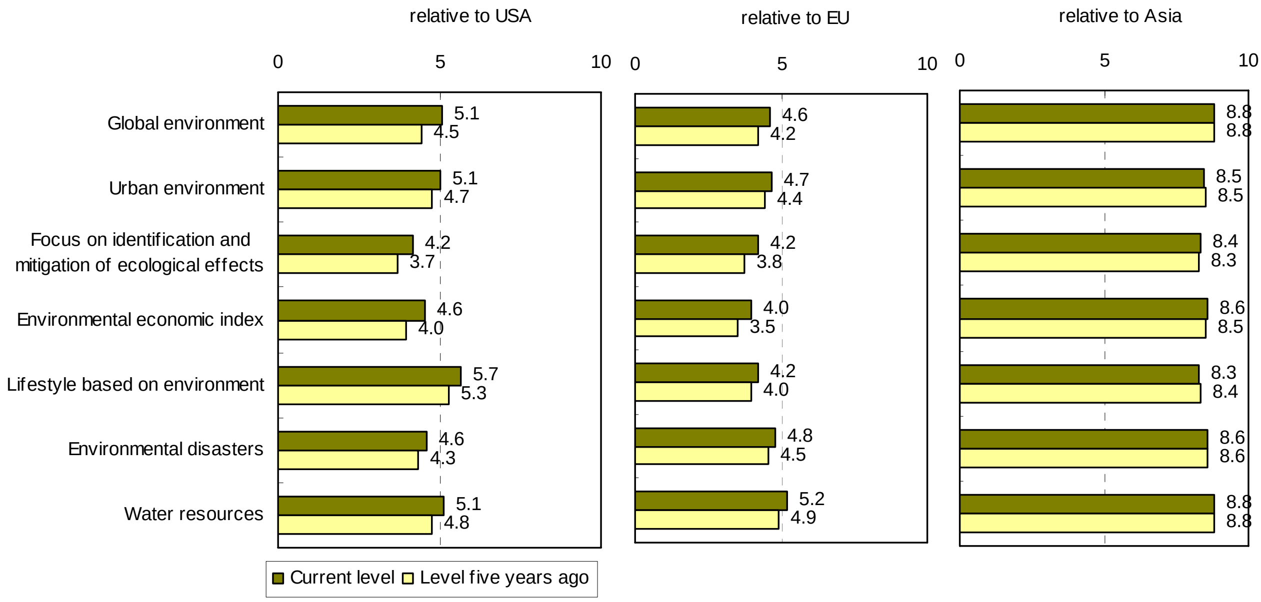
Social impacts

(Contribution to safety and security)

(Contribution toimproved social vitality and quality of life)



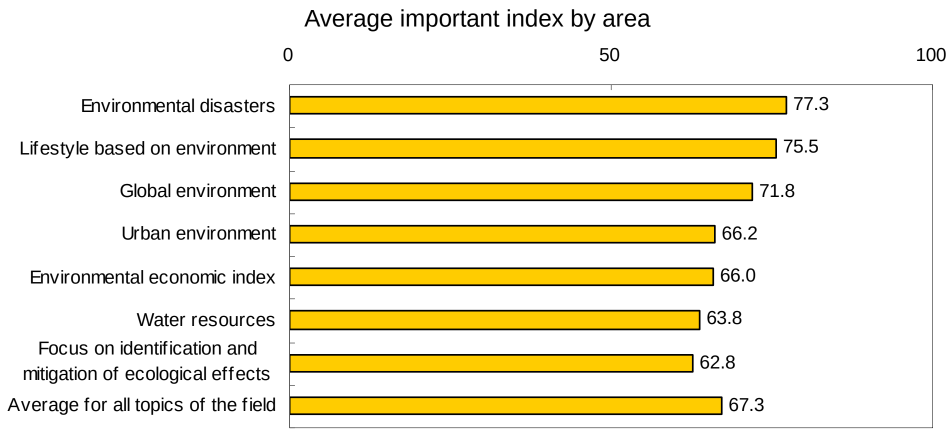
*Responses are indexed on a 10-point scale.



B. Japan's R&D Level

*Responses are indexed on a 10-point scale.

C. Importance to Japan



The most important 10 topics

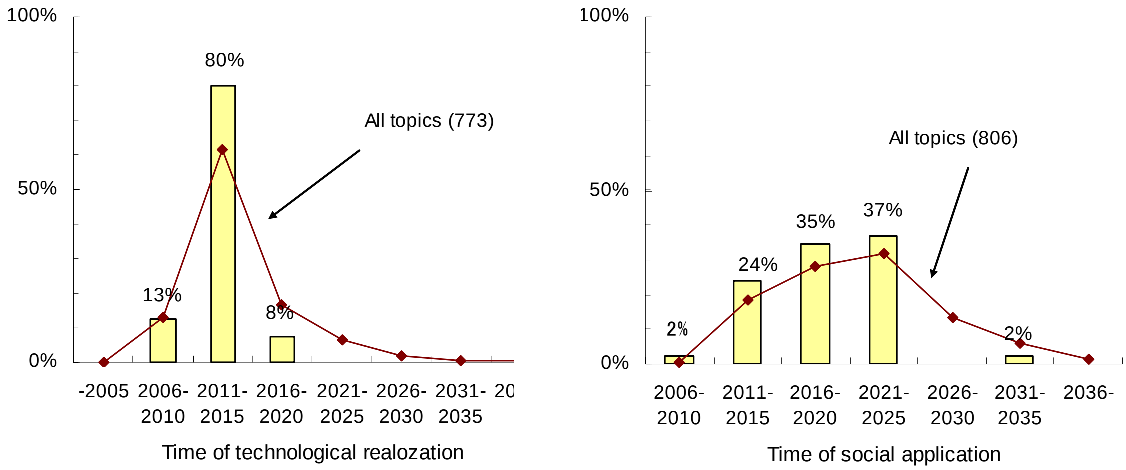
	Topic	Index	Year T*	Year S*
1	45: Technology for forecasting abnormal weather disasters resulting from climate change.	94	2015	2023
2	34: Technology for predicting and assessing global depletion of the resources that are used in Japan.	93	2012	2018
3	40: Energy consumption per capita in Japan reduces by half.	92	-	2031
4	44: Technology for minimizing the impacts of and restoring damage from large-scale industrial accidents.	90	2012	2017
5	42: Introduction of an automobile tax based on CO_2 emissions.	90	-	2013
6	14: Clean fuel (other than hydrogen) that does not emit particulates, NOx, etc.	90	2014	2021
7	09: Discovery of the seeds of new practical technologies for the safe disposal of CO_2 with long-term stability.	87	2017	-
8	01: Elucidation of the emission, absorption and fixation mechanism of greenhouse gases in a natural system as a result of climate change.	87	2014	-
9	50: Meso-scale (about 10-km mesh) precipitation simulation.	85	2011	2018
10	07: Development of a global monitoring system for marine pollution.	83	2014	2022

Year T: Time of technological realization Year S: Time of social application

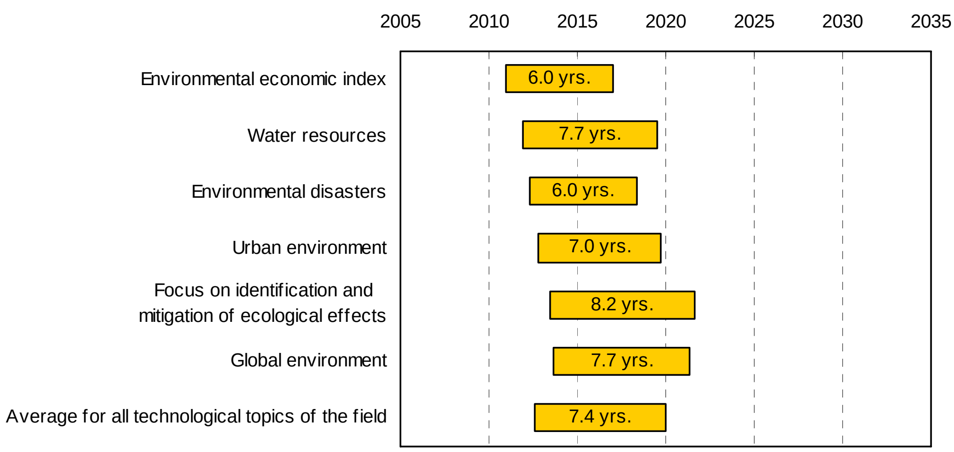
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



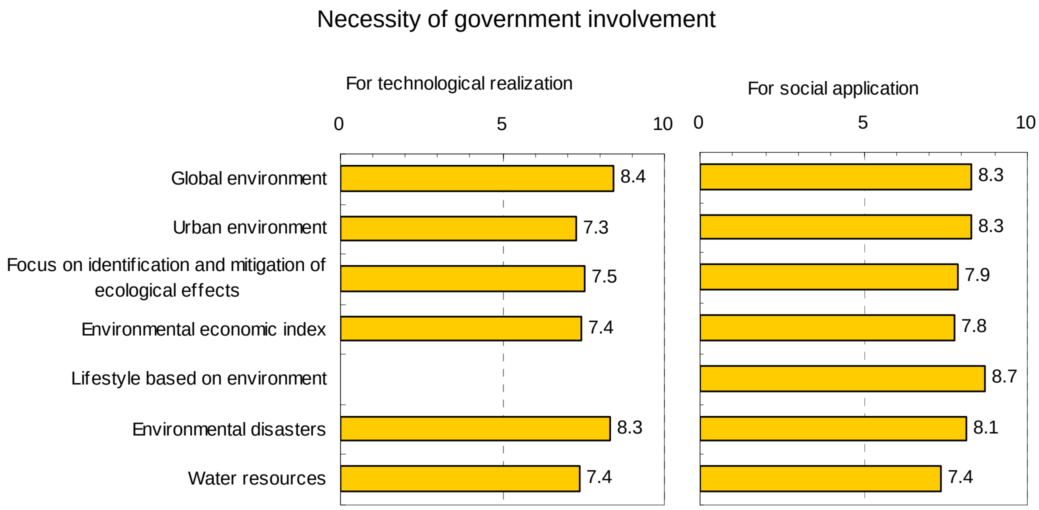
Topics with short or long periods until social application

Topic	Year T*	Period*	Area
22: Technology for conserving and restoring the genetic diversity of endangered species.	2015	10	Focus on identification and mitigation of ecological effects
04: Deveolpment of a technology for accurately forecasting climate changes resulting from global warming using a mesh with a resolution of about 10 km around the globe.	2015	9	Global environment
23: Technology for ecologically identifying invasive foreign species.	2013	9	Focus on identification and mitigation of ecological effects
24: Environmental monitoring technology based on high-precision satellite sensors and the Internet for vegetation mapping.	2010	9	Focus on identification and mitigation of ecological effects
26: Technology for controlling species inhibiting the conservation and restoration of the natural ecosystem.	2016	9	Focusing on identification and mitigation of ecological effects
46: Global-scale observation of water use and water contaminants (data acquisition with a global 1-km mesh; including rivers, lakes and marshes, ground water, extraction, drainage, siltation in dams, urban pollution, industrial pollution, natural chemical substances).	2014	9	Water resources

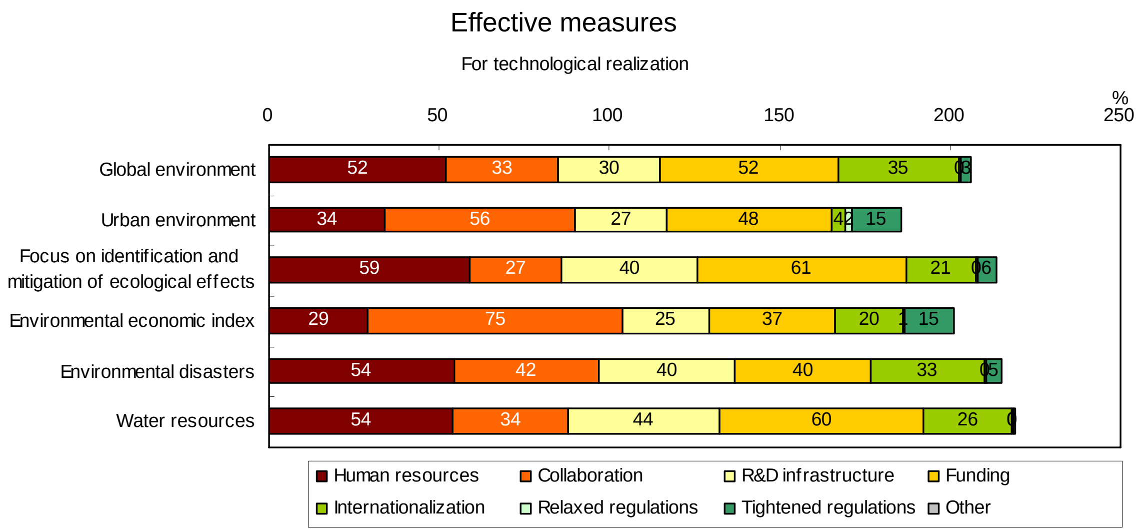
Topic	Year T*	Period*	Area
12: Widespread use of technology for the active control of urban noise and vibration to conform to environmental standards.	2013	5	Urban environment
33: Methodology for tracing and identifying recycled materials (plastics and metals).	2010	5	Environmental economic index
43: Technology for the early detection of and response to large-scale forest fires around the world.	2010	5	Environmental disasters
44: Technology for minimizing the impacts of and restoring damage from large-scale industrial accidents.	2012	5	Environmental disasters
08: Development of alternative substances or processes for SF6 gas, which has been additionally listed as a regulated substance by the Kyoto Protocol.	2012	6	Global environment
34: Technology for predicting and assessing global depletion of the resources that are used in Japan.	2012	6	Environmental economic index

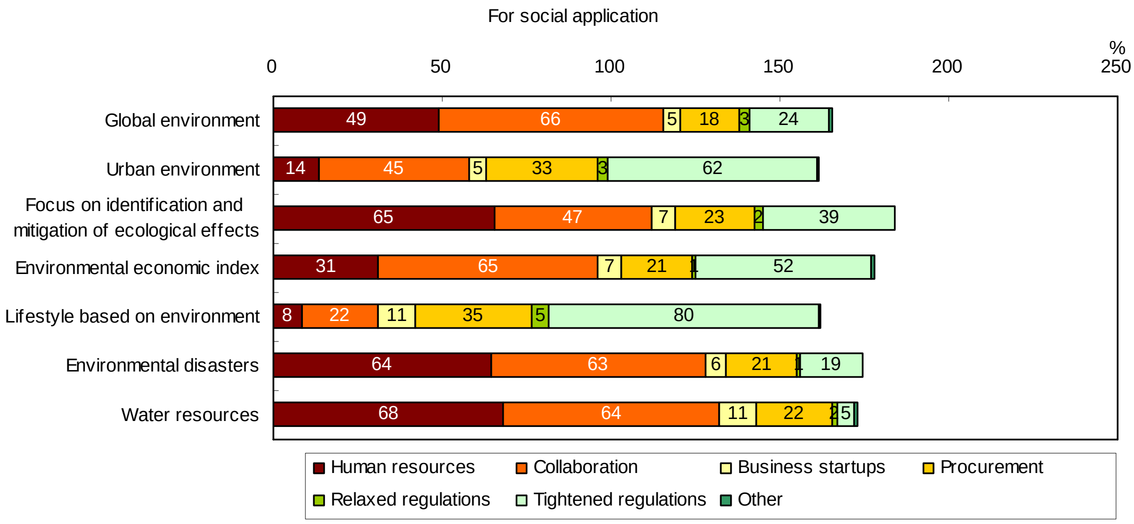
*Year T: Time of technological realization   Period: Period until social application (years)

E. Effective measures that should taken by government



*Responses were indexed on a 10-point scale





F. Time-line of topics

Technological realization

year	topic
2006	52: Technology for economically and practically desalinating seawater and purifying polluted water using reverse osmosis membrane or other methods.
2009	53: Technology for identifying the groundwater pollution sources using isotopes.
2010	24: Environmental monitoring technology based on high-precision satellite sensors and the Internet for vegetation mapping.
	33: Methodology for tracing and identifying recycled materials (plastics and metals).
	43: Technology for the early detection of and response to large-scale forest fires around the world.
2011	17: Technology for utilizing underground cold energy to mitigate heat island effects.
	37: Technology for an efficient recovery of rare metals from molten fly ash as a domestic source of its sypply.
	50: Meso-scale (about 10-km mesh) precipitation simulation.
2012	08: Development of alternative substances or processes for SF6 gas, which has been additionally listed as a regulated substance by the Kyoto Protocol.
	16: Verification of emission inventory data through monitoring.
	20: Elucidation of the mechanism of the effect of acid rain on the flora and fauna and the ecosystem.
	25: Quantitative elucidation of the effect of the flow structure on the tideland ecosystem structure and function.
	34: Technology for predicting and assessing global depletion of the resources that are used in Japan.
	44: Technology for minimizing the impacts of and restoring damage from large-scale industrial accidents.
	47: Streamflow measurement and flood forecasts to prevent unexpected disasters by using satellite observation.
2013	05: Elucidation of the acid deposition mechanisms including lond-distance transport of SOx and NOx and their accumulation and decomposition in soil.
	12: Widespread use of technology for the active control of urban noise and vibration to conform to environmental standards.
	18: Application of prediction and assessment technologies possibly useful for the minimization of environmental burdens on urban planning.
	23: Technology for ecologically identifying invasive foreign species.
	27: Technology for addressing endocrine disruptors emitted from sewage into the rivers.
	51: Integration of hydrology (basin water cycle) and meteorology on the Earth Simulator.
	54: Technology for reclamation of salinized soils.
2014	01: Elucidation of the emission, absorption and fixation mechanism of greenhouse gases in a natural system as a result of climate change.
	07: Development of a global monitoring system for marine pollution.
	13: Scientific elucidation of the impacts of the stress in an urban living environment on children's physical and mental development.

year	topic
	14: Clean fuel (other than hydrogen) that does not emit particulates, NOx, etc.
	21: Technology for restoring the ecosystem and biodiversity of wetlands.
	29: Technology for removing dioxin and other POPs (Persistent Organic Pollutants) from ocean floor soil.
	30: Technology for efficient revegetation in deserts.
	46: Global-scale observation of water use and water contaminants (data acquisition with a global 1-km mesh; including rivers, lakes and marshes, ground water, extraction, drainage, siltation in dams, urban pollution, industrial pollution, natural chemical substances).
	49: Construction of a hydrologic prediction model (including soil, snow/ice, and groundwater) for basins where there is poor ground observations.
2015	04: Deveolpment of a technology for accurately forecasting climate changes resulting from global warming using a mesh with a resolution of about 10 km around the globe.
	06: Elucidation of the global impacts of fine particulates associated with extension of arid land.
	10: Near-complete elucidation of the correlation between environmental pollutants and allergic diseases.
	22: Technology for conserving and restoring the genetic diversity of endangered species.
	45: Technology for forecasting abnormal weather disasters resulting from climate change.
	48: Groundwater observation from satellites (improvement of spatial resolution from a few hundreds to a few kilometers).
2016	02: Establishment of a quantitative model of global warming, including disruption in the oceanic general circulation.
	26: Technology for controlling species inhibiting the conservation and restoration of the natural ecosystem.
2017	09: Discovery of the seeds of new practical technologies for the safe disposal of CO_2 with long-term stability.

Social application

year	topic
2010	11: Mandatory addition of an idling-stop function to automobiles.
2012	38: Publication of an environmental report by all listed companies.
2013	19: Listing of additional environmental pollutants contained in motor vehicle emissions as regulated substances.
	31: Development and standardization of socially approved tools for the risk assessment of chemical substances (including RoHS (Restriction of the Use of Hazardous Substances)-compliant alternatives).
	32: Establishment of the definition and calculation method of corporate environmental efficiency indicators.
	42: Introduction of an automobile tax based on CO_2 emissions.
2013	52: Technology for economically and practically desalinating seawater and purifying polluted water using reverse osmosis membrane or other methods.
2014	35: Social recognition of life cycle assessment (LCA) as an objective and quantitative tool.
	36: Pervasion of the standardized life cycle cost (LCC) assessment in the pricing of products and serivices.
2015	28: Establishment of a system for ensuring that development projects involve setting up targets concerning ecosystem conservation and restoration through a consensus-building process.
	33: Methodology for tracing and identifying recycled materials (plastics and metals).
	43: Technology for the early detection of and response to large-scale forest fires around the world.
2016	39: Use of virgin natural resources (non-recycled material) becomes taxable in Japan for global environmental conservation.
	53: Technology for identifying the groundwater pollution sources using isotopes.
2017	44: Technology for minimizing the impacts of and restoring damage from large-scale industrial accidents.
2018	08: Development of alternative substances or processes for SF_6 gas, which has been additionally listed as a regulated substance by the Kyoto Protocol.
	12: Widespread use of technology for the active control of urban noise and vibration to conform to environmental standards.
	34: Technology for predicting and assessing global depletion of the resources that are used in Japan.
	37: Technology for an efficient recovery of rare metals from molten fly ash as a domestic source of its sypply.
	50: Meso-scale (about 10-km mesh) precipitation simulation.
	55: Social consensus building on the process for avoiding water conflicts associated with development.
2019	15: Full implementation of traffic demand management (TDM) for the optimization and minimization of traffic volume in large cities.

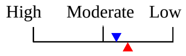
year	topic
2020	17: Technology for utilizing underground cold energy to mitigate heat island effects.
	24: Environmental monitoring technology based on high-precision satellite sensors and the Internet for vegetation mapping.
	25: Quantitative elucidation of the effect of the flow structure on the tideland ecosystem structure and function.
	27: Technology for addressing endocrine disruptors emitted from sewage into the rivers.
	47: Streamflow measurement and flood forecasts to prevent unexpected disasters by using satellite observation.
	54: Technology for reclamation of salinized soils.
2021	14: Clean fuel (other than hydrogen) that does not emit particulates, NOx, etc.
	18: Application of prediction and assessment technologies possibly useful for the minimization of environmental burdens on urban planning.
	21: Technology for restoring the ecosystem and biodiversity of wetlands.
	29: Technology for removing dioxin and other POPs (Persistent Organic Pollutants) from ocean floor soil.
	51: Integration of hydrology (basin water cycle) and meteorology on the Earth Simulator.
2022	07: Development of a global monitoring system for marine pollution.
	23: Technology for ecologically identifying invasive foreign species.
	30: Technology for efficient revegetation in deserts.
	49: Construction of a hydrologic prediction model (including soil, snow/ice, and groundwater) for basins where there is poor ground observations.
2023	45: Technology for forecasting abnormal weather disasters resulting from climate change.
	46: Global-scale observation of water use and water contaminants (data acquisition with a global 1-km mesh; including rivers, lakes and marshes, ground water, extraction, drainage, siltation in dams, urban pollution, industrial pollution, natural chemical substances).
	48: Groundwater observation from satellites (improvement of spatial resolution from a few hundreds to a few kilometers).
2024	03: Formation of international consensus on the CO2 disposal in the deep-sea below 3,000m.
	04: Deveolpment of a technology for accurately forecasting climate changes resulting from global warming using a mesh with a resolution of about 10 km around the globe.
	41: Most consumer durables are not purchased but leased.
2025	22: Technology for conserving and restoring the genetic diversity of endangered species.
	26: Technology for controlling species inhibiting the conservation and restoration of the natural ecosystem.
2031	40: Energy consumption per capita in Japan reduces by half.

Appendix: Results of R1 and R2

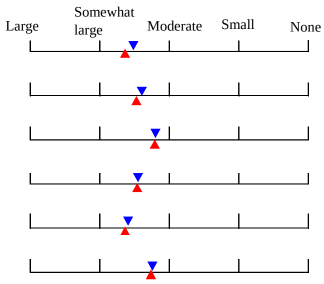
I. Global environment (focus on global warming)

1. Questions regading therelevant area

1) Degree of expertise in the area

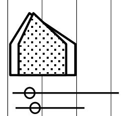
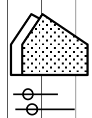
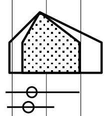
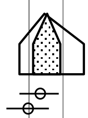
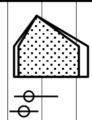
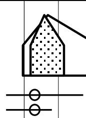
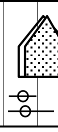


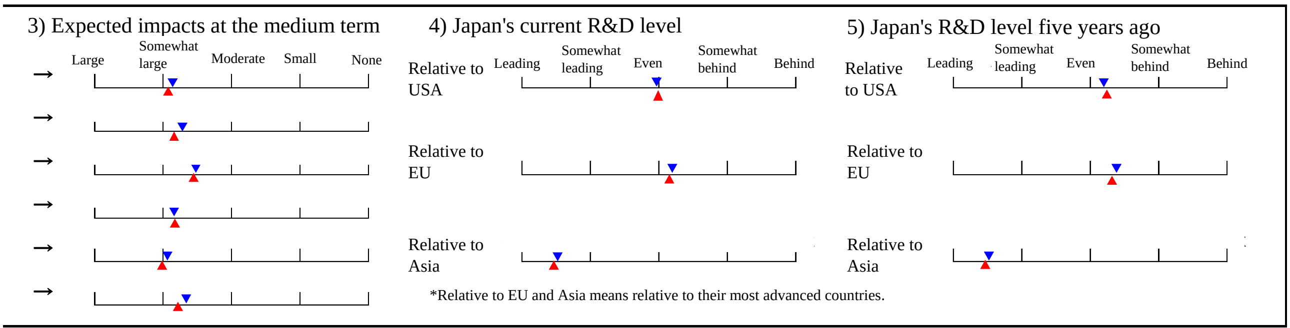
2) Currrent impacts

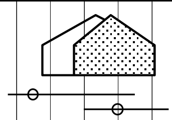
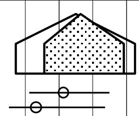
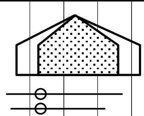
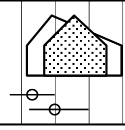


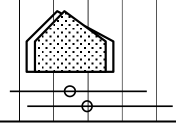
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
1	Elucidation of the emission, absorption and fixation mechanism of greenhouse gases in a natural system as a result of climate change.	1	161	12	42	46	-	79	62	30	8	0		4	8
		2	150	9	30	61	-	87	75	23	2	0		1	5
		E	14	100	0	0	-	100	100	0	0	0		0	0
2	Establishment of a quantitative model of global warming, including disruption in the oceanic general circulation.	1	134	6	31	63	-	75	53	42	4	1		5	10
		2	128	7	16	77	-	82	65	33	2	0		2	5
		E	9	100	0	0	-	94	89	11	0	0		11	0
3	Formation of international consensus on the CO_2 disposal in the deep-sea below 3,000m.	1	133	6	28	66	-	57	31	44	16	9			
		2	128	7	17	76	-	51	19	54	20	7			
		E	9	100	0	0	-	61	45	33	0	22			
4	Deveolpment of a technology for accurately forecasting climate changes resulting from global warming using a mesh with a resolution of about 10 km around the globe.	1	144	12	31	57	-	65	40	41	16	3		9	6
		2	141	10	19	71	-	68	41	50	8	1		5	3
		E	14	100	0	0	-	96	93	7	0	0		0	0
5	Elucidation of the acid deposition mechanisms including lond-distance transport of SOx and NOx and their accumulation and decomposition in soil.	1	143	10	33	57	-	66	39	49	11	1		1	6
		2	133	8	22	70	-	65	33	60	7	0		1	1
		E	10	100	0	0	-	80	60	40	0	0		0	0
6	Elucidation of the global impacts of fine particulates associated with extension of arid land.	1	123	14	28	58	-	59	30	48	21	1		3	11
		2	122	8	17	75	-	57	22	61	16	1		0	3
		E	10	100	0	0	-	70	40	60	0	0		0	0
7	Development of a global monitoring system for marine pollution.	1	133	11	29	60	-	74	53	38	8	1		5	8
		2	126	10	17	73	-	83	67	31	2	0		2	2
		E	12	100	0	0	-	96	92	8	0	0		0	0
8	Development of alternative substances or processes for SF6 gas, which has been additionally listed as a regulated substance by the Kyoto Protocol.	1	110	8	34	58	-	69	44	45	11	0		4	9
		2	117	5	21	74	-	66	35	60	4	1		1	3
		E	6	100	0	0	-	83	67	33	0	0		0	0



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
8	50	41	0	1	55	34	9	2	44	38	38	49	36	1	10	1														
4	69	27	0	0	77	20	2	1	62	37	30	58	32	1	3	0														
14	65	21	0	0	93	7	0	0	86	36	43	57	21	0	0	0														
9	65	24	0	2	43	44	11	2	43	27	36	43	40	1	1	1														
2	86	12	0	0	58	37	4	1	65	16	32	54	38	0	2	0														
11	67	22	0	0	67	33	0	0	89	22	67	56	22	0	0	0														
																		33	14	56	21	10	13	30	44	14	22	19	35	8
																		32	7	66	18	6	10	38	67	6	8	5	41	3
																		33	0	67	11	0	22	14	71	0	0	29	29	14
36	50	13	0	1	44	36	15	5	46	29	41	51	41	1	1	1		9	11	38	39	14	9	54	53	14	25	6	7	5
28	70	2	0	0	60	29	8	3	62	21	37	58	32	0	2	0		5	5	46	43	7	4	65	67	5	16	2	2	0
71	29	0	0	0	72	21	0	7	100	15	38	69	31	0	0	0		0	0	50	42	8	0	67	75	8	8	17	8	0
29	33	37	0	1	38	45	15	2	38	35	28	44	38	1	7	0														
22	22	56	0	0	34	59	5	2	40	35	24	60	40	0	2	0														
40	20	40	0	0	40	50	10	0	60	50	10	40	10	0	0	0														
20	45	30	2	3	42	39	17	2	45	31	34	44	45	1	1	1														
13	71	13	3	0	50	38	9	3	59	18	21	54	53	1	0	0														
60	40	0	0	0	67	22	11	0	67	33	11	44	44	0	0	0														
18	63	16	0	3	53	39	6	2	40	28	44	47	51	1	4	1		2	14	59	29	10	2	49	52	9	28	5	20	6
4	90	5	0	1	79	17	4	0	52	18	40	43	55	0	2	0		2	5	78	18	3	1	65	68	3	19	3	15	2
42	58	0	0	0	84	8	8	0	67	33	42	58	50	0	0	0		0	8	75	17	8	0	58	67	8	25	17	25	8
39	25	34	0	2	44	38	17	1	24	46	32	39	25	5	22	0		4	8	44	36	17	3	30	45	17	33	8	34	0
60	14	26	0	0	63	29	6	2	19	62	22	39	20	0	14	0		0	4	59	33	6	2	28	64	7	27	3	37	0
67	33	0	0	0	66	0	17	17	40	60	40	60	0	0	20	0		0	0	17	49	17	17	40	80	0	0	0	40	0

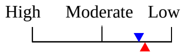
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan (%)					Time of technological realization						(%)	
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
9	Discovery of the seeds of new practical technologies for the safe disposal of CO_2 with long-term stability.	1	**143**	**9**	**31**	**60**	**-**	**77**	**61**	**28**	**8**	**3**							**10**	**14**
		2	**136**	**5**	**17**	**78**	**-**	**87**	**78**	**17**	**3**	**2**							**7**	**5**
		E	**7**	**100**	**0**	**0**	**-**	**89**	**86**	**0**	**14**	**0**							**29**	**0**

Countries at the leading edge (%)					Regarding technological realization													Time of social application (%)							Regarding social application										
					Necessity of gov't involvement (%)				Effective measures that should be taken by gov't (%)															Necessity of gov't involvement (%)				Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
34	**38**	**23**	**0**	**5**	**48**	**33**	**13**	**6**	**46**	**46**	**41**	**42**	**21**	**3**	**5**	**1**																		
38	**51**	**11**	**0**	**0**	**71**	**21**	**3**	**5**	**57**	**58**	**32**	**51**	**14**	**0**	**2**	**0**																		
71	**29**	**0**	**0**	**0**	**72**	**0**	**14**	**14**	**33**	**67**	**17**	**67**	**17**	**0**	**17**	**0**																		

II. Urban environment

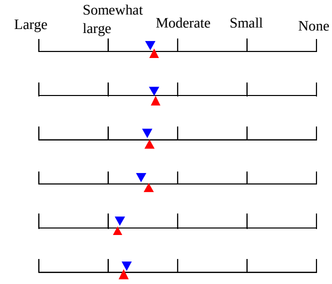
1. Questions regading therelevant area

1) Degree of expertise in the area

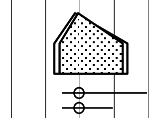
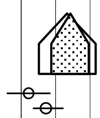
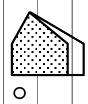
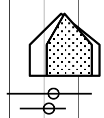
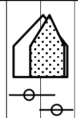
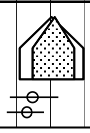


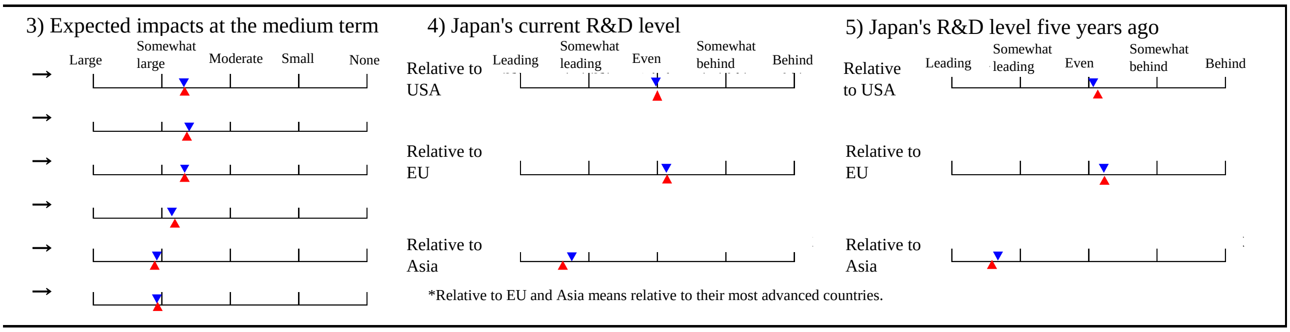
2) Current impacts

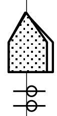
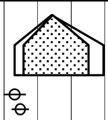
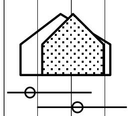
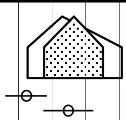
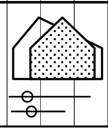
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



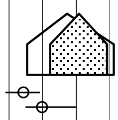
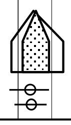
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
10	Near-complete elucidation of the correlation between environmental pollutants and allergic diseases.	1	107	6	21	73	-	71	44	51	5	0		8	10
		2	112	2	18	80	-	68	39	58	2	1		4	5
		E	2	100	0	0	-	100	100	0	0	0		0	0
11	Mandatory addition of an idling-stop function to automobiles.	1	119	5	29	66	-	59	34	37	26	3			
		2	125	5	14	81	-	62	31	54	13	2			
		E	6	100	0	0	-	54	17	66	17	0			
12	Widespread use of technology for the active control of urban noise and vibration to conform to environmental standards.	1	107	5	23	72	-	51	19	51	27	3		5	9
		2	109	4	12	84	-	47	7	67	25	1		5	3
		E	4	100	0	0	-	44	0	75	25	0		25	0
13	Scientific elucidation of the impacts of the stress in an urban living environment on children's physical and mental development.	1	86	2	16	82	-	66	37	55	7	1		7	15
		2	94	0	6	94	-	59	24	66	9	1		2	13
		E													
14	Clean fuel (other than hydrogen) that does not emit particulates, NOx, etc.	1	127	15	24	61	-	76	55	38	6	1		2	14
		2	125	10	23	67	-	90	79	21	0	0		1	5
		E	12	100	0	0	-	79	58	42	0	0		0	0
15	Full implementation of traffic demand management (TDM) for the optimization and minimization of traffic volume in large cities.	1	115	5	23	72	-	76	57	34	8	1			
		2	112	3	16	81	-	83	67	31	2	0			
		E	3	100	0	0	-	100	100	0	0	0			
16	Verification of emission inventory data through monitoring.	1	107	18	26	56	-	61	30	55	14	1		4	4
		2	104	8	22	70	-	55	14	79	7	0		2	1
		E	8	100	0	0	-	59	25	62	13	0		0	0
17	Technology for utilizing underground cold energy to mitigate heat island effects.	1	119	9	31	60	-	55	26	48	20	6		4	9
		2	111	5	23	72	-	51	13	67	18	2		4	4
		E	6	100	0	0	-	54	17	66	17	0		0	0



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization: Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know	Regarding social application: Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
17	63	17	1	2	43	45	11	1	43	30	42	53	12	1	20	0														
6	87	7	0	0	43	52	3	2	56	30	37	63	5	1	8	0														
0	50	50	0	0	100	0	0	0	0	100	0	50	0	0	0	0														
																		4	7	56	23	15	6	5	22	7	32	7	75	3
																		2	2	84	12	2	2	3	21	2	34	4	80	0
																		17	0	49	17	17	17	20	0	0	20	20	60	0
48	21	26	0	5	23	46	26	5	26	38	31	34	4	7	29	4		6	9	36	37	21	6	14	23	12	30	11	66	5
83	9	8	0	0	12	72	12	4	15	64	17	41	1	0	35	0		4	6	37	53	7	3	6	27	4	39	1	71	0
50	25	25	0	0	0	75	0	25	0	67	0	33	0	0	67	0		25	0	50	25	0	25	0	0	0	0	0	100	0
14	57	20	3	6	25	57	17	1	50	29	44	40	9	1	12	1														
10	81	9	0	0	19	69	10	2	65	22	36	38	4	0	8	0														
52	19	24	0	5	38	39	21	2	27	46	32	46	9	10	21	0		2	10	50	37	11	2	15	35	21	42	15	51	0
84	6	8	0	2	45	49	3	3	18	68	19	64	4	3	18	0		1	3	74	20	3	3	9	43	13	47	5	56	0
83	0	17	0	0	33	51	8	8	0	64	9	27	9	9	27	0		0	0	66	17	0	17	10	30	30	20	10	40	0
																		8	10	60	31	7	2	13	44	10	30	15	58	3
																		1	5	90	9	1	0	7	52	4	22	3	77	0
																		0	0	100	0	0	0	0	33	0	0	0	67	0
33	27	37	0	3	44	41	11	4	30	40	35	37	18	2	23	2														
37	15	48	0	0	58	36	6	0	25	68	31	41	7	0	16	0														
37	38	25	0	0	62	25	13	0	38	38	38	63	13	0	13	0														
58	16	21	1	4	23	39	29	9	25	45	31	52	4	11	14	2		5	15	25	40	25	10	19	40	16	41	19	33	3
86	5	8	0	1	13	70	10	7	20	66	25	55	4	5	5	1		7	9	16	63	14	7	13	68	9	44	9	33	1
66	17	17	0	0	17	66	0	17	40	60	0	60	20	20	20	0		0	17	33	50	0	17	20	60	20	60	20	80	0

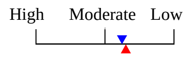
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Degree of expertise (%) Moderate	Degree of expertise (%) Low	Degree of expertise (%) None	Importance to Japan Index	Importance to Japan (%) High	Importance to Japan (%) Moderate	Importance to Japan (%) Low	Importance to Japan (%) None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
18	Application of prediction and assessment technologies possibly useful for the minimization of environmental burdens on urban planning.	1	**117**	**16**	**29**	**55**	**-**	**69**	**46**	**40**	**12**	**2**							**3**	**7**
		2	**116**	**7**	**24**	**69**	**-**	**74**	**52**	**43**	**5**	**0**							**0**	**3**
		E	**8**	**100**	**0**	**0**	**-**	**91**	**87**	**0**	**13**	**0**							**0**	**0**
19	Listing of additional environmental pollutants contained in motor vehicle emissions as regulated substances.	1	**120**	**18**	**23**	**59**	**-**	**68**	**43**	**44**	**12**	**1**								
		2	**119**	**10**	**21**	**69**	**-**	**72**	**47**	**47**	**6**	**0**								
		E	**12**	**100**	**0**	**0**	**-**	**67**	**41**	**42**	**17**	**0**								

Countries at the leading edge (%)					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement (%)				Effective measures that should be taken by gov't (%)													(%)		Necessity of gov't involvement (%)				Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
33	**20**	**45**	**0**	**2**	**35**	**44**	**20**	**1**	**37**	**49**	**33**	**42**	**8**	**6**	**19**	**1**						**4**	**10**	**36**	**45**	**18**	**1**	**38**	**51**	**15**	**24**	**6**	**29**	**0**
28	**8**	**63**	**0**	**1**	**25**	**66**	**8**	**1**	**37**	**73**	**24**	**37**	**5**	**3**	**13**	**0**						**0**	**4**	**27**	**62**	**9**	**2**	**47**	**68**	**2**	**20**	**0**	**37**	**1**
62	**0**	**38**	**0**	**0**	**38**	**49**	**13**	**0**	**25**	**63**	**0**	**13**	**0**	**13**	**13**	**0**						**0**	**0**	**38**	**49**	**13**	**0**	**38**	**63**	**0**	**0**	**0**	**38**	**0**
																						**4**	**10**	**66**	**26**	**6**	**2**	**16**	**26**	**6**	**23**	**6**	**75**	**2**
																						2	**2**	**86**	**12**	**2**	**0**	**10**	**35**	**1**	**22**	**0**	**79**	**2**
																						8	**0**	**83**	**17**	**0**	**0**	**25**	**33**	**0**	**17**	**0**	**58**	**0**

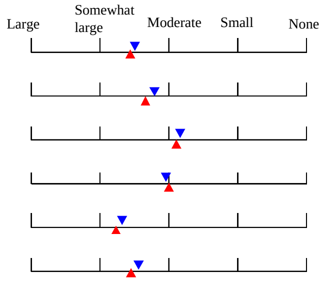
III. Focus on identification and mitigation of ecological effects (including soil and water)

1. Questions regading therelevant area

1) Degree of expertise in the area



2) Current impacts



[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

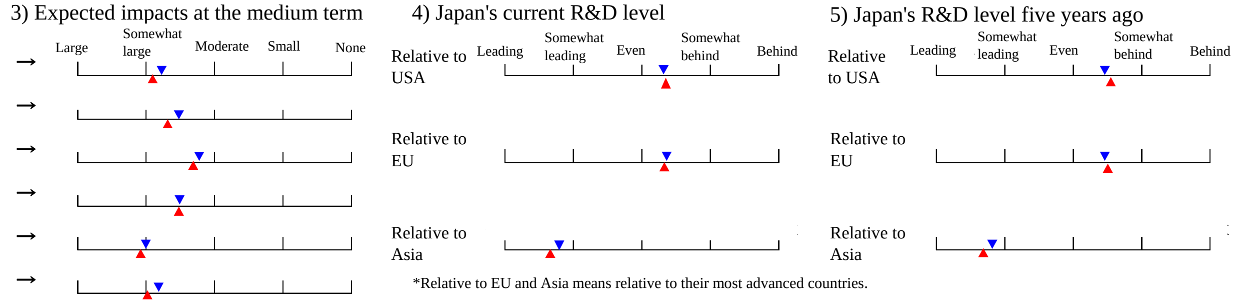
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

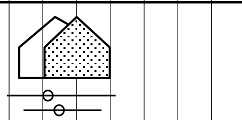
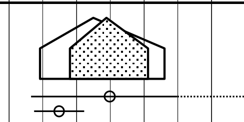
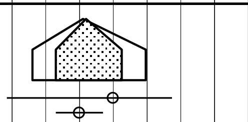
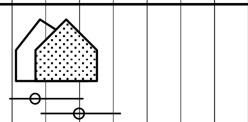
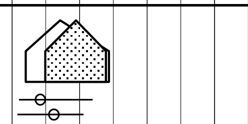
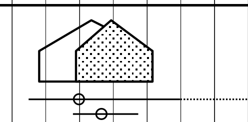
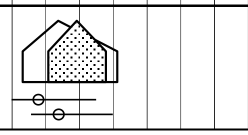
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life

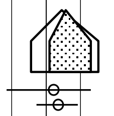
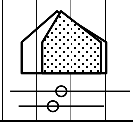
2. Questions regarding topics

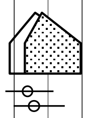
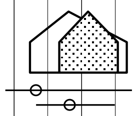
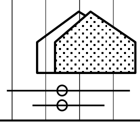
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Will not be realized (%)	Do not know (%)
20	Elucidation of the mechanism of the effect of acid rain on the flora and fauna and the ecosystem.	1	148	14	30	56	-	62	34	47	18	1	1	8
		2	130	6	28	66	-	63	30	63	7	0	1	2
		E	8	100	0	0	-	75	50	50	0	0	0	0
21	Technology for restoring the ecosystem and biodiversity of wetlands.	1	135	19	33	48	-	61	31	52	17	0	2	6
		2	123	13	34	53	-	60	24	69	7	0	0	2
		E	16	100	0	0	-	70	44	50	6	0	0	0
22	Technology for conserving and restoring the genetic diversity of endangered species.	1	101	8	37	55	-	61	31	53	15	1	4	9
		2	110	4	22	74	-	58	18	76	6	0	3	1
		E	4	100	0	0	-	63	25	75	0	0	0	0
23	Technology for ecologically identifying invasive foreign species.	1	107	14	31	55	-	69	45	40	13	2	1	8
		2	109	6	23	71	-	74	49	48	3	0	1	2
		E	7	100	0	0	-	86	71	29	0	0	0	0
24	Environmental monitoring technology based on high-precision satellite sensors and the Internet for vegetation mapping.	1	146	11	34	55	-	61	32	49	18	1	1	3
		2	134	8	25	67	-	56	20	66	13	1	0	1
		E	11	100	0	0	-	55	18	64	18	0	0	0
25	Quantitative elucidation of the effect of the flow structure on the tideland ecosystem structure and function.	1	117	19	25	56	-	64	35	52	11	2	3	9
		2	109	13	21	66	-	60	24	70	6	0	1	2
		E	14	100	0	0	-	79	57	43	0	0	0	0
26	Technology for controlling species inhibiting the conservation and restoration of the natural ecosystem.	1	103	12	32	56	-	59	24	63	12	1	9	14
		2	107	9	16	75	-	55	12	84	4	0	2	3
		E	10	100	0	0	-	72	44	56	0	0	0	0
27	Technology for addressing endocrine disruptors emitted from sewage into the rivers.	1	128	15	33	52	-	66	41	41	17	1	2	9
		2	121	13	30	57	-	70	45	48	7	0	1	3
		E	16	100	0	0	-	69	43	44	13	0	0	0

Time of technological realization: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
15	13	71	1	0	37	44	16	3	37	26	36	49	43	0	9	0																		
5	6	88	1	0	30	63	7	0	46	22	32	59	45	0	4	0																		
0	0	100	0	0	38	49	13	0	38	13	38	88	13	0	0	0																		
16	34	45	1	4	38	43	17	2	53	27	47	48	25	3	16	1						4	10	37	48	12	3	49	37	13	34	12	43	2
5	25	70	0	0	31	64	5	0	70	19	44	66	16	1	9	0						0	3	29	66	5	0	71	32	8	37	5	50	0
0	31	69	0	0	60	33	7	0	53	20	33	67	7	7	20	0						0	6	60	33	7	0	64	7	7	36	14	64	0
8	67	22	0	3	41	43	15	1	51	17	53	55	24	3	9	1						6	15	40	44	13	3	60	30	13	30	6	34	0
0	93	7	0	0	26	67	7	0	65	7	59	66	13	0	3	0						3	2	36	59	5	0	80	25	6	31	4	43	0
0	100	0	0	0	50	50	0	0	50	0	50	50	0	0	0	0						0	25	75	25	0	0	50	25	0	0	0	50	0
15	50	28	0	7	43	40	16	1	54	20	44	49	37	2	11	1						4	9	52	33	14	1	53	34	10	27	4	44	0
3	86	10	0	1	47	45	8	0	78	8	46	57	20	0	4	0						0	3	66	29	5	0	82	22	6	18	1	55	0
0	100	0	0	0	67	33	0	0	67	0	33	50	33	0	17	0						0	0	86	14	0	0	71	14	0	14	0	57	0
7	85	7	0	1	42	40	16	2	43	39	46	53	37	4	1	1						1	4	38	41	16	5	46	55	23	33	7	7	2
0	99	1	0	0	39	53	6	2	48	25	52	68	24	1	0	0						0	2	29	63	8	0	54	75	11	26	3	5	0
0	100	0	0	0	46	36	18	0	70	30	50	70	40	0	0	0						0	0	36	46	18	0	64	73	9	36	0	0	0
36	32	29	0	3	40	42	14	4	52	36	45	52	14	4	12	0						3	11	42	42	15	1	52	45	16	28	9	28	0
58	29	13	0	0	32	65	3	0	65	27	47	62	6	1	5	0						0	2	39	58	3	0	77	45	6	26	3	30	0
71	29	0	0	0	50	42	8	0	58	33	58	75	0	0	0	0						0	0	65	21	14	0	71	36	21	50	14	21	0
11	49	29	1	10	31	46	21	2	45	39	38	54	23	1	8	0						6	19	31	47	22	0	51	40	17	29	4	29	2
4	86	9	0	1	15	79	6	0	69	22	28	64	16	0	4	0						0	4	16	74	10	0	71	54	6	18	1	30	0
0	90	10	0	0	40	60	0	0	60	20	20	70	10	0	10	0						0	0	30	70	0	0	50	60	10	20	0	30	0
28	41	26	0	5	43	39	16	2	38	44	41	50	11	3	26	0						4	10	46	38	15	1	39	44	15	29	6	50	0
22	67	11	0	0	56	41	3	0	44	50	38	63	5	0	17	0						3	4	62	35	3	0	44	60	6	17	2	54	0
50	31	19	0	0	56	44	0	0	50	56	25	69	0	0	13	0						0	0	62	38	0	0	50	69	6	6	0	50	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
28	Establishment of a system for ensuring that development projects involve setting up targets concerning ecosystem conservation and restoration through a consensus-building process.	1	**119**	**14**	**29**	**57**	**-**	**73**	**51**	**39**	**8**	**2**			
		2	**114**	**11**	**27**	**62**	**-**	**80**	**63**	**32**	**5**	**0**			
		E	**12**	**100**	**0**	**0**	**-**	**86**	**73**	**27**	**0**	**0**			
29	Technology for removing dioxin and other POPs (Persistent Organic Pollutants) from ocean floor soil.	1	**120**	**12**	**32**	**56**	**-**	**67**	**42**	**42**	**15**	**1**		**3**	**12**
		2	**110**	**8**	**30**	**62**	**-**	**70**	**45**	**45**	**8**	**2**		**3**	**5**
		E	**9**	**100**	**0**	**0**	**-**	**72**	**44**	**56**	**0**	**0**		**0**	**0**
30	Technology for efficient revegetation in deserts.	1	**118**	**8**	**34**	**58**	**-**	**44**	**13**	**45**	**36**	**6**		**10**	**7**
		2	**117**	**5**	**28**	**67**	**-**	**43**	**5**	**61**	**31**	**3**		**3**	**3**
		E	**6**	**100**	**0**	**0**	**-**	**50**	**17**	**50**	**33**	**0**		**0**	**0**

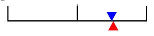
Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application			Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan (%)	USA (%)	EU (%)	Asia (%)	Other (%)	High (%)	Moderate (%)	Low (%)	None (%)	Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration (%)	Development of R&D infrastructure (%)	Expansion of R&D funding (%)	Internationalization of R&D activities (%)	Relaxation or elimination of relevant regulations (%)	Tightened or new regulations (%)	Other (%)	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	High (%)	Moderate (%)	Low (%)	None (%)	Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration (%)	Improvement of environment for business startups (%)	Support through taxation, subsidies, and procurement (%)	Relaxation or elimination of relevant regulations (%)	Tightened or new regulations (%)	Other (%)
																		4	8	53	38	8	1	43	31	5	24	11	62	0
																		1	3	77	20	3	0	62	28	5	13	4	73	0
																		0	0	75	25	0	0	33	25	17	8	8	75	0
48	27	19	0	6	43	39	15	3	37	48	40	56	12	4	21	0		5	17	48	41	9	2	36	44	18	37	8	42	0
83	11	6	0	0	58	33	7	2	36	59	30	67	4	0	13	0		5	5	65	27	5	3	36	70	8	23	1	45	1
78	11	11	0	0	44	56	0	0	11	78	11	67	11	0	11	0		11	0	45	44	0	11	38	88	0	25	0	38	0
30	36	12	9	13	21	43	31	5	50	37	36	39	52	1	2	1		10	12	24	42	30	4	53	48	26	30	6	7	5
35	59	3	2	1	9	69	19	3	70	28	25	41	57	0	1	0		3	4	13	66	19	2	76	55	11	26	1	3	0
50	50	0	0	0	0	67	33	0	83	67	50	67	50	0	0	0		0	0	40	40	20	0	80	80	20	40	0	0	0

IV. Environmental economic index

1. Questions regading therelevant area

1) Degree of expertise in the area

High Moderate Low



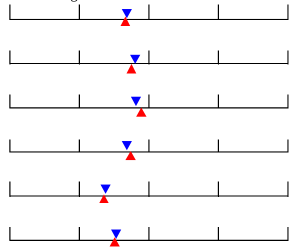
2) Current impacts

Large | Somewhat large | Moderate | Small | None

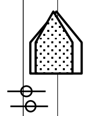
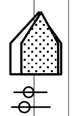
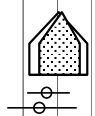
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

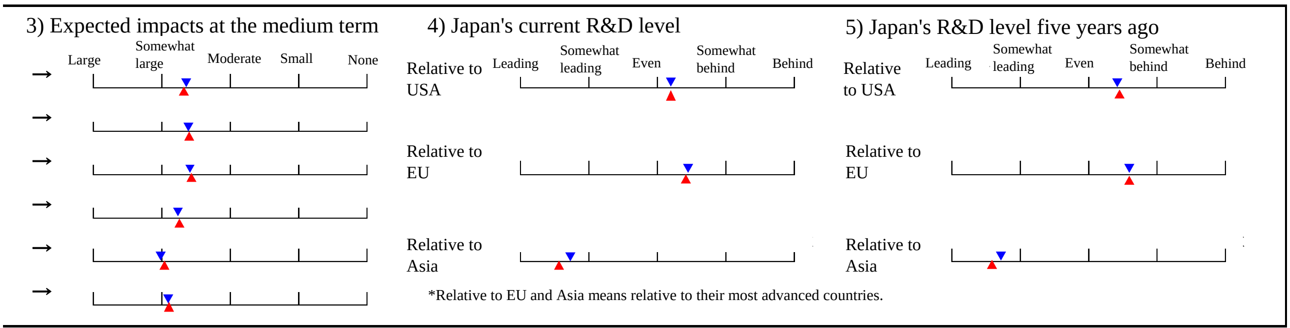
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

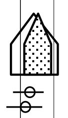
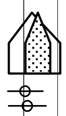
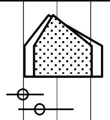
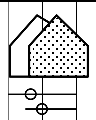
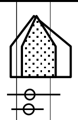
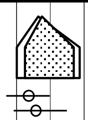
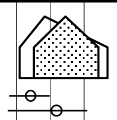
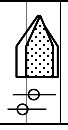
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
31	Development and standardization of socially approved tools for the risk assessment of chemical substances (including RoHS (Restriction of the Use of Hazardous Substances)-compliant alternatives).	1	112	16	28	56	-	74	50	44	6	0			
		2	110	11	26	63	-	82	65	34	1	0			
		E	12	100	0	0	-	92	83	17	0	0			
32	Establishment of the definition and calculation method of corporate environmental efficiency indicators.	1	119	16	23	61	-	59	25	60	14	1			
		2	116	9	26	65	-	56	15	80	5	0			
		E	11	100	0	0	-	66	36	55	9	0			
33	Methodology for tracing and identifying recycled materials (plastics and metals).	1	108	10	31	59	-	60	30	52	17	1		2	9
		2	100	8	17	75	-	56	17	72	10	1		2	1
		E	8	100	0	0	-	63	37	38	25	0		0	0
34	Technology for predicting and assessing global depletion of the resources that are used in Japan.	1	118	8	31	61	-	82	69	23	6	2		6	14
		2	114	5	25	70	-	93	85	15	0	0		2	4
		E	6	100	0	0	-	92	83	17	0	0		0	0
35	Social recognition of life cycle assessment (LCA) as an objective and quantitative tool.	1	146	21	34	45	-	67	39	53	7	1			
		2	130	16	33	51	-	60	22	73	5	0			
		E	21	100	0	0	-	68	38	57	5	0			
36	Pervasion of the standardized life cycle cost (LCC) assessment in the pricing of products and serivices.	1	132	17	29	54	-	67	42	45	12	1			
		2	122	13	28	59	-	62	28	64	7	1			
		E	16	100	0	0	-	67	44	44	6	6			
37	Technology for an efficient recovery of rare metals from molten fly ash as a domestic source of its sypply.	1	98	16	27	57	-	66	40	44	16	0		2	6
		2	93	10	18	72	-	65	35	56	8	1		0	2
		E	9	100	0	0	-	72	56	33	0	11		0	0
38	Publication of an environmental report by all listed companies.	1	139	20	31	49	-	55	24	52	22	2			
		2	128	13	29	58	-	55	17	68	14	1			
		E	17	100	0	0	-	57	29	47	18	6			

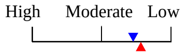


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application			Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
																		3	8	50	41	9	0	36	45	10	26	9	57	2
																		1	1	81	17	2	0	33	69	3	15	1	68	1
																		0	0	73	27	0	0	64	82	0	18	0	45	0
																		6	2	36	38	21	5	32	47	8	28	14	45	2
																		3	0	34	52	14	0	25	63	5	19	0	60	2
																		18	0	30	40	30	0	30	60	10	40	0	60	0
47	18	32	0	3	35	39	20	6	31	48	33	29	24	9	32	0		3	7	40	38	19	3	28	45	22	28	15	51	3
84	1	14	0	1	22	66	9	3	16	85	20	19	9	0	35	0		2	1	49	40	9	2	18	65	7	18	3	69	1
87	0	13	0	0	37	25	13	25	17	50	67	0	33	0	50	0		0	13	49	13	25	13	14	57	0	0	0	57	0
20	66	13	0	1	51	31	13	5	42	52	40	42	44	3	6	0		5	12	54	27	14	5	44	62	13	20	7	15	4
3	97	0	0	0	74	23	3	0	52	69	36	36	47	0	1	0		1	4	78	18	4	0	54	79	5	17	2	7	0
17	83	0	0	0	83	17	0	0	67	67	50	67	33	0	0	0		0	0	100	0	0	0	83	50	17	17	0	17	0
																		4	1	38	40	18	4	38	52	12	27	7	44	1
																		3	0	27	62	8	3	38	74	5	13	0	56	0
																		0	0	19	66	10	5	45	60	5	10	0	60	0
																		6	5	39	42	14	5	37	48	10	29	9	43	4
																		3	1	31	60	6	3	38	72	6	18	1	58	0
																		6	0	25	69	0	6	40	60	7	13	0	53	0
66	18	15	0	1	18	42	32	8	25	46	33	43	11	3	14	1		1	11	20	52	24	4	20	47	35	42	13	24	0
93	6	1	0	0	10	72	16	2	18	70	21	56	3	2	8	0		1	3	13	74	11	2	10	69	26	48	3	24	0
100	0	0	0	0	33	45	11	11	13	75	25	63	0	25	0	0		0	0	33	45	11	11	13	63	25	50	13	38	0
																		5	4	36	32	17	15	29	29	6	24	6	54	6
																		3	1	49	34	11	6	31	29	2	16	1	73	3
																		6	0	41	18	29	12	47	33	0	13	0	60	0

V. Lifestyle based on environment

1. Questions regading therelevant area

1) Degree of expertise in the area

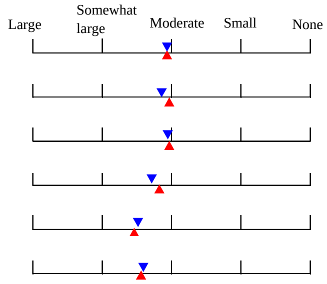


2) Current impacts

[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

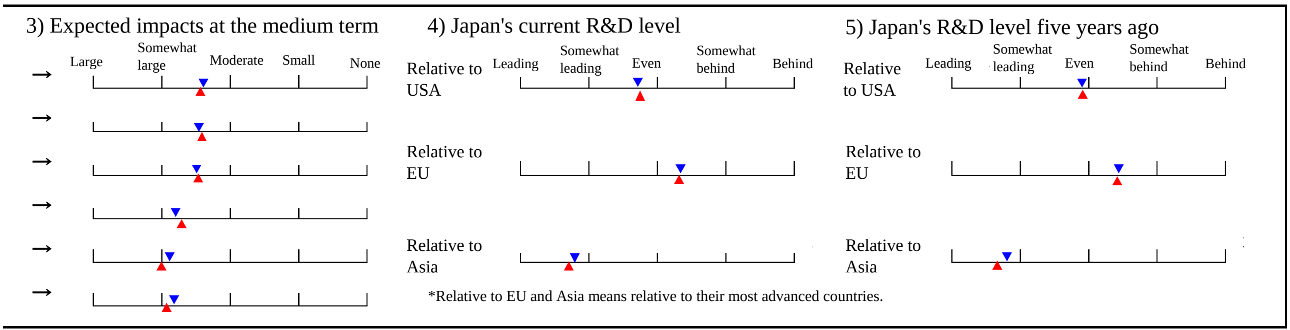
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

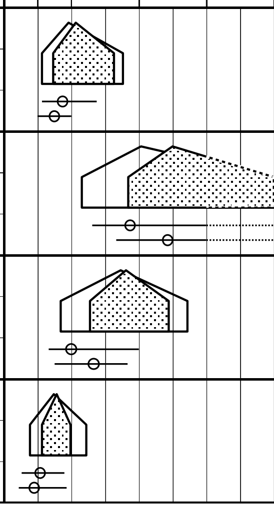
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
39	Use of virgin natural resources (non-recycled material) becomes taxable in Japan for global environmental conservation.	1	140	9	31	60	-	65	40	43	16	1								
		2	135	4	22	74	-	68	41	50	8	1								
		E	6	100	0	0	-	92	83	17	0	0								
40	Energy consumption per capita in Japan reduces by half.	1	154	15	30	55	-	77	61	31	5	3								
		2	141	13	24	63	-	92	85	13	2	0								
		E	19	100	0	0	-	92	84	16	0	0								
41	Most consumer durables are not purchased but leased.	1	126	11	28	61	-	54	24	48	23	5								
		2	128	8	17	75	-	52	14	69	15	2								
		E	10	100	0	0	-	63	30	60	10	0								
42	Introduction of an automobile tax based on CO2 emissions.	1	147	13	27	60	-	72	51	37	9	3								
		2	141	6	21	73	-	90	82	16	1	1								
		E	9	100	0	0	-	83	67	33	0	0								

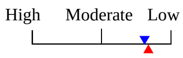


Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan (%)	USA	EU	Asia	Other	High (%)	Moderate	Low	None	Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know	High (%)	Moderate	Low	None	Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
																						14	13	65	24	7	4	10	27	11	31	10	77	2
																						11	5	85	10	2	3	7	19	5	28	4	86	0
																						33	0	100	0	0	0	40	20	0	40	0	60	0
																						26	16	61	26	8	5	21	33	16	36	11	64	8
																						31	6	87	11	1	1	16	33	8	39	5	79	1
																						11	5	76	18	0	6	44	50	13	38	19	56	0
																						22	19	30	37	19	14	15	26	33	39	19	46	2
																						27	7	25	51	17	7	6	16	29	44	8	68	0
																						30	10	67	11	11	11	13	25	13	38	13	50	0
																						8	9	73	18	4	5	6	25	8	31	9	82	2
																						2	1	92	6	1	1	4	22	3	29	2	88	0
																						0	0	89	11	0	0	22	33	11	44	0	22	0

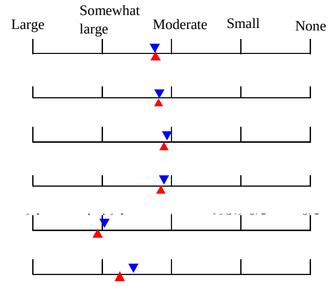
VI. Environmental disasters

1. Questions regading therelevant area

1) Degree of expertise in the area



2) Current impacts

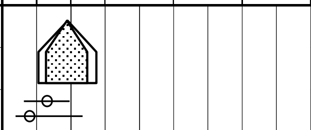
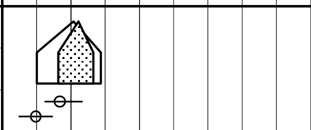
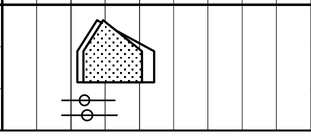


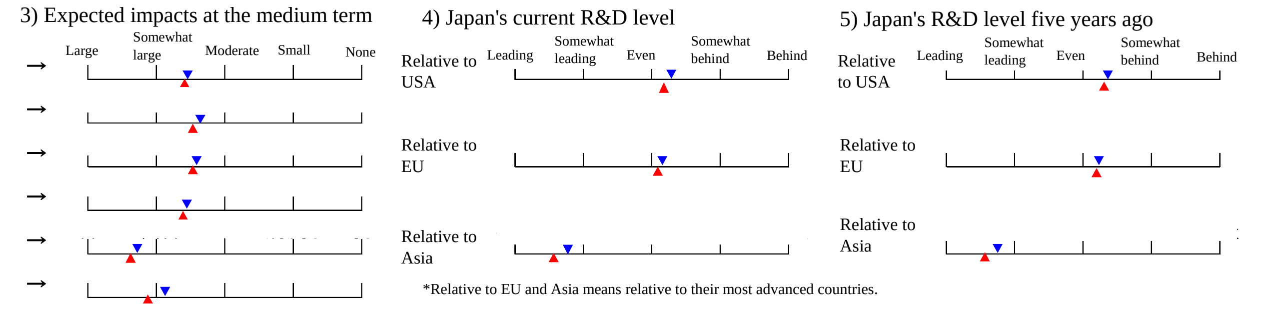
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

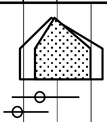
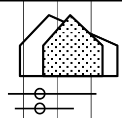
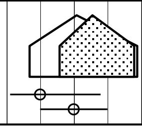
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
43	Technology for the early detection of and response to large-scale forest fires around the world.	1	**97**	**8**	**27**	**65**	-	**45**	**14**	**42**	**42**	**2**		**1**	**7**
		2	**111**	**5**	**19**	**76**	-	**48**	**10**	**63**	**26**	**1**		**3**	**2**
		E	**5**	**100**	**0**	**0**	-	**50**	**0**	**100**	**0**	**0**		**0**	**0**
44	Technology for minimizing the impacts of and restoring damage from large-scale industrial accidents.	1	**94**	**11**	**24**	**65**	-	**75**	**55**	**35**	**10**	**0**		**1**	**10**
		2	**107**	**4**	**16**	**80**	-	**90**	**81**	**18**	**1**	**0**		**1**	**5**
		E	**4**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**		**0**	**0**
45	Technology for forecasting abnormal weather disasters resulting from climate change.	1	**122**	**16**	**32**	**52**	-	**84**	**70**	**25**	**5**	**0**		**4**	**8**
		2	**122**	**13**	**23**	**64**	-	**94**	**87**	**13**	**0**	**0**		**3**	**3**
		E	**16**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**		**0**	**0**

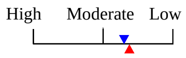


Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application							Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan (%)	USA	EU	Asia	Other	High (%)	Moderate	Low	None	Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know	High (%)	Moderate	Low	None	Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
3	88	6	0	3	29	40	26	5	41	33	40	30	49	1	2	2						2	9	26	43	25	6	47	42	16	24	5	11	11
1	98	1	0	0	22	63	11	4	53	26	45	32	52	0	1	0						3	2	20	68	9	3	65	59	5	23	1	7	0
0	100	0	0	0	20	60	20	0	60	40	20	20	20	0	0	0						0	0	20	80	0	0	60	40	20	20	0	0	0
23	58	18	0	1	44	39	14	3	37	49	30	31	20	1	20	0						1	11	41	43	14	2	38	45	11	25	6	39	0
10	88	2	0	0	66	30	4	0	37	77	29	25	12	1	12	0						0	5	51	47	2	0	42	72	8	20	1	46	0
0	100	0	0	0	50	50	0	0	0	75	0	0	0	25	25	0						0	0	75	25	0	0	25	75	25	50	0	25	0
19	67	13	0	1	62	28	8	2	58	37	52	59	39	0	3	1						6	5	54	30	13	3	58	54	17	23	6	10	8
7	87	6	0	0	85	14	1	0	73	24	45	63	36	0	1	0						3	4	80	18	2	0	86	59	7	19	0	3	0
31	56	13	0	0	94	6	0	0	81	38	50	56	50	0	0	0						0	0	87	13	0	0	81	69	19	19	0	6	0

VII. Water resources

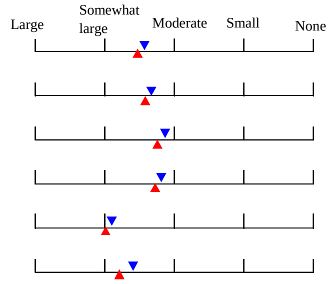
1. Questions regading therelevant area

1) Degree of expertise in the area

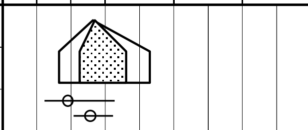
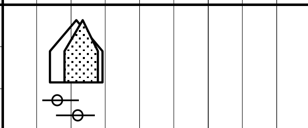
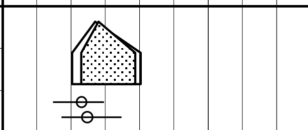
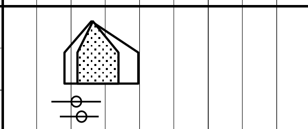
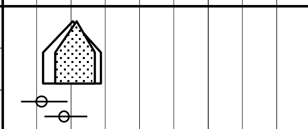
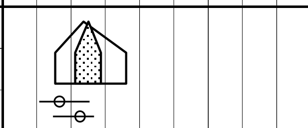
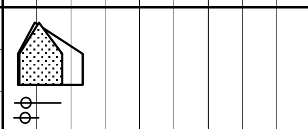
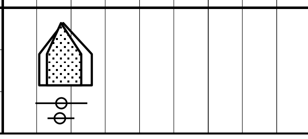


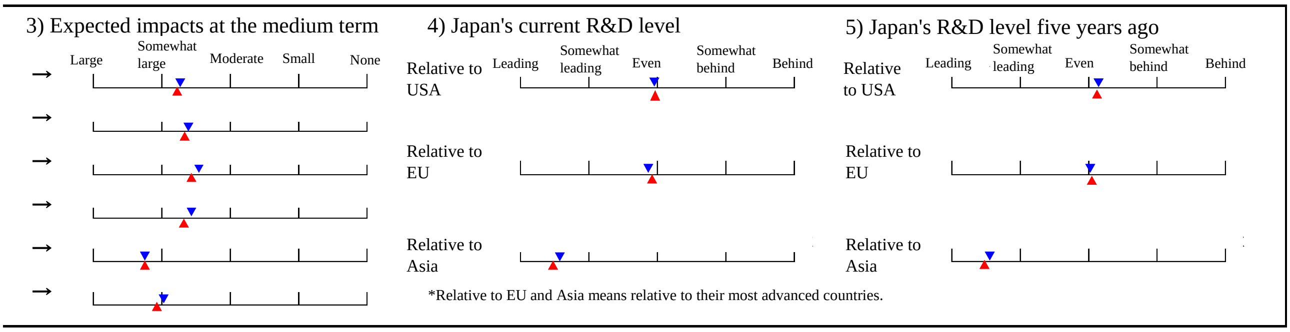
2) Current impacts

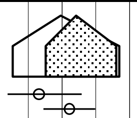
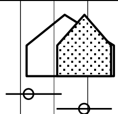
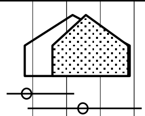
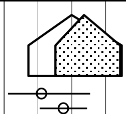
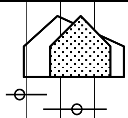
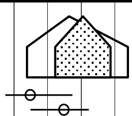
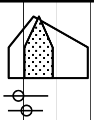
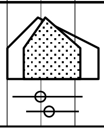
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

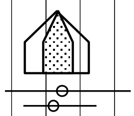


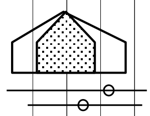
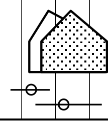
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
46	Global-scale observation of water use and water contaminants (data acquisition with a global 1-km mesh; including rivers, lakes and marshes, ground water, extraction, drainage, siltation in dams, urban pollution, industrial pollution, natural chemical substances).	1	128	20	38	42	-	68	44	41	14	1		3	5
		2	129	16	29	55	-	78	58	38	4	0		1	2
		E	21	100	0	0	-	80	62	33	5	0		0	0
47	Streamflow measurement and flood forecasts to prevent unexpected disasters by using satellite observation.	1	120	19	34	47	-	69	45	42	12	1		2	8
		2	120	16	25	59	-	81	63	34	3	0		2	3
		E	19	100	0	0	-	80	63	32	5	0		5	0
48	Groundwater observation from satellites (improvement of spatial resolution from a few hundreds to a few kilometers).	1	102	12	31	57	-	54	28	34	35	3		9	13
		2	106	9	22	69	-	49	11	60	29	0		7	5
		E	10	100	0	0	-	53	20	50	30	0		20	20
49	Construction of a hydrologic prediction model (including soil, snow/ice, and groundwater) for basins where there is poor ground observations.	1	107	21	31	48	-	56	29	44	22	5		3	10
		2	110	16	22	62	-	55	17	69	14	0		1	2
		E	18	100	0	0	-	71	44	50	6	0		0	0
50	Meso-scale (about 10-km mesh) precipitation simulation.	1	114	17	31	52	-	76	57	33	8	2		0	5
		2	110	13	31	56	-	85	72	22	6	0		0	2
		E	14	100	0	0	-	86	71	29	0	0		0	0
51	Integration of hydrology (basin water cycle) and meteorology on the Earth Simulator.	1	110	18	28	54	-	70	49	34	15	2		1	9
		2	110	11	24	65	-	81	67	25	8	0		5	2
		E	12	100	0	0	-	96	92	8	0	0		0	0
52	Technology for economically and practically desalinating seawater and purifying polluted water using reverse osmosis membrane or other methods.	1	128	20	27	53	-	59	31	46	21	2		0	5
		2	125	14	24	62	-	59	25	61	14	0		0	2
		E	18	100	0	0	-	65	33	61	6	0		0	0
53	Technology for identifying the groundwater pollution sources using isotopes.	1	104	12	33	55	-	54	24	47	26	3		1	7
		2	103	7	27	66	-	52	14	66	20	0		1	4
		E	7	100	0	0	-	68	43	43	14	0		0	0



Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
22	62	14	0	2	45	45	8	2	46	41	49	60	42	1	4	1		4	7	45	43	11	1	48	52	12	38	3	10	7
6	89	4	0	1	55	40	5	0	60	33	46	69	40	0	2	0		2	2	64	33	3	0	73	69	6	30	0	5	0
19	81	0	0	0	55	40	5	0	65	45	40	60	30	0	0	0		5	0	76	19	5	0	76	76	10	29	0	0	0
31	58	8	0	3	50	37	9	4	44	40	49	58	27	2	5	2		4	8	50	35	12	3	50	54	13	33	4	7	6
18	80	1	0	1	82	16	1	1	56	27	53	72	18	0	1	0		1	3	80	18	1	1	73	72	8	23	0	3	0
32	68	0	0	0	74	21	0	5	44	28	33	72	17	0	0	0		5	0	74	21	0	5	44	94	11	0	0	6	0
7	80	13	0	0	32	42	21	5	49	28	50	55	39	2	2	1		8	14	30	38	29	3	57	47	17	31	0	2	5
1	96	2	0	1	20	71	5	4	54	20	47	66	30	0	0	0		4	6	22	67	7	4	80	61	8	21	0	0	0
10	70	10	0	10	20	60	0	20	63	25	50	75	38	0	0	0		20	10	20	50	10	20	100	50	25	25	0	0	0
17	69	12	0	2	30	49	17	4	55	32	51	55	35	0	1	0		3	10	30	47	18	5	58	47	17	31	1	2	4
3	96	1	0	0	23	69	7	1	64	15	48	63	33	0	0	0		0	4	20	71	7	2	81	54	4	17	1	0	1
17	83	0	0	0	22	78	0	0	56	22	44	72	39	0	0	0		0	0	22	78	0	0	72	72	6	0	0	0	0
44	49	7	0	0	42	44	11	3	48	38	51	59	29	1	2	1		1	7	39	45	14	2	61	52	20	28	5	3	5
44	56	0	0	0	46	50	4	0	63	23	48	70	20	0	0	0		0	3	34	60	6	0	80	58	7	21	2	0	1
43	57	0	0	0	43	57	0	0	79	14	64	71	7	0	0	0		0	0	43	57	0	0	71	71	7	21	0	0	7
42	54	4	0	0	42	42	14	2	51	32	54	58	34	0	1	0		2	11	36	46	14	4	62	49	11	31	2	2	7
37	62	1	0	0	51	42	6	1	63	13	52	67	30	0	0	0		3	3	29	62	7	2	87	59	3	20	0	0	0
50	50	0	0	0	50	50	0	0	83	17	58	50	17	0	0	0		0	0	42	58	0	0	92	58	8	8	0	0	0
66	19	13	0	2	14	39	31	16	33	50	33	42	29	3	4	1		1	4	16	39	32	13	29	49	42	43	7	8	2
92	3	5	0	0	4	69	24	3	23	77	20	37	20	3	0	1		0	2	9	64	25	2	18	75	35	39	5	2	1
94	6	0	0	0	11	72	11	6	35	82	24	47	41	6	0	0		0	0	17	66	11	6	29	76	47	35	18	6	0
25	57	13	0	5	18	44	30	8	39	40	42	48	11	4	8	3		1	9	22	45	27	6	35	51	21	25	6	19	8
6	92	2	0	0	8	77	13	2	41	58	42	57	6	1	2	0		1	7	10	72	16	2	41	83	16	24	2	10	0
14	86	0	0	0	29	57	14	0	57	71	71	57	0	0	0	0		0	0	17	66	17	0	33	83	17	50	0	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
54	Technology for reclamation of salinized soils.	1	**94**	**11**	**28**	**61**	**-**	**44**	**12**	**43**	**42**	**3**							**2**	**11**
		2	**96**	**7**	**22**	**71**	**-**	**42**	**3**	**61**	**36**	**0**							**1**	**1**
		E	**7**	**100**	**0**	**0**	**-**	**43**	**0**	**71**	**29**	**0**							**0**	**0**
55	Social consensus building on the process for avoiding water conflicts associated with development.	1	**88**	**15**	**23**	**62**	**-**	**58**	**33**	**39**	**22**	**6**								
		2	**103**	**11**	**19**	**70**	**-**	**57**	**22**	**62**	**16**	**0**								
		E	**11**	**100**	**0**	**0**	**-**	**80**	**64**	**27**	**9**	**0**								

Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
21	**48**	**21**	**5**	**5**	**15**	**50**	**33**	**2**	**45**	**41**	**45**	**42**	**35**	**1**	**2**	**1**						**3**	**19**	**16**	**50**	**33**	**1**	**49**	**48**	**34**	**33**	**1**	**5**	**6**
6	**84**	**6**	**3**	**1**	**3**	**85**	**11**	**1**	**62**	**40**	**44**	**36**	**37**	**0**	**0**	**1**						**1**	**2**	**8**	**74**	**17**	**1**	**65**	**73**	**23**	**21**	**2**	**2**	**0**
0	**100**	**0**	**0**	**0**	**0**	**86**	**14**	**0**	**43**	**29**	**57**	**29**	**29**	**0**	**0**	**0**						**0**	**0**	**17**	**50**	**33**	**0**	**83**	**83**	**0**	**0**	**0**	**0**	**0**
																						**8**	**17**	**45**	**38**	**15**	**2**	**61**	**30**	**5**	**14**	**10**	**32**	**10**
																						2	**7**	**62**	**30**	**8**	**0**	**83**	**33**	**3**	**8**	**6**	**29**	**3**
																						9	**9**	**64**	**18**	**18**	**0**	**82**	**55**	**9**	**0**	**9**	**18**	**0**

9. Nanotechnology and materials field

9.1. Overview

(1) Overview of field

Nanotechnology is key science and technology for solving various problems in biology, information, the environment, and energy. In addition, the field is attractive as basic science that will bring unprecedented breakthroughs in nanometer-scale processing, molding, synthetic materials, and functions.

(2) The following points underlie the designation of important science and technology areas in the nanotechnology field.

- Historically, more than a few discoveries and inventions have been born from the serendipity of individual researchers, but at the other end of the spectrum, research with a goal (application) firmly in mind is also vital.
- Basic research is particularly important in the nanotechnology field, but at the same time, collaboration with industry must be further advanced. In addition, corporate laboratories need to address basic research, and they require further national government support to do so.
- As for technology areas, measuring technology, NEMS technology and other areas related to basics, fundamentals, and principles are particularly important. Expectations are high for the development of new industries such as NEMS and MEMS that are completely different from those that have supported precision processing until now.
- Regarding materials, needs-oriented research is important, but incubator and exploratory research has led to breakthroughs in areas such as fullerenes and carbon nanotubes as well.

(3) Policy proposals from the particulars of the area can be summarized as follows.

- Nanomaterials modeling simulation → human resources development
- Nano measurement and analysis technology → investment of human resources and funding in basic technology will be effective
- Nano processing, molding, and manufacturing technology → support for intellectual property rights, promotion of research exchange, and support for small and medium businesses
- Matter and materials origination, synthesis technology and process technology → collaboration and cooperation among multiple organizations
- New materials from nanolevel structure control → research to develop practical applications is essential
- Nano devices and sensors → university-centered research systems integrating industry
- NEMS technology → establishment of a joint-use center
- Environment and energy materials → advancement through effective use of nanomaterials
- Nanobiology → frameworks for organic collaboration among researchers
- Nanoscience for a safe and secure society → human resources development and accomplishment of international harmonization of relevant policies

(4) Promotion policies

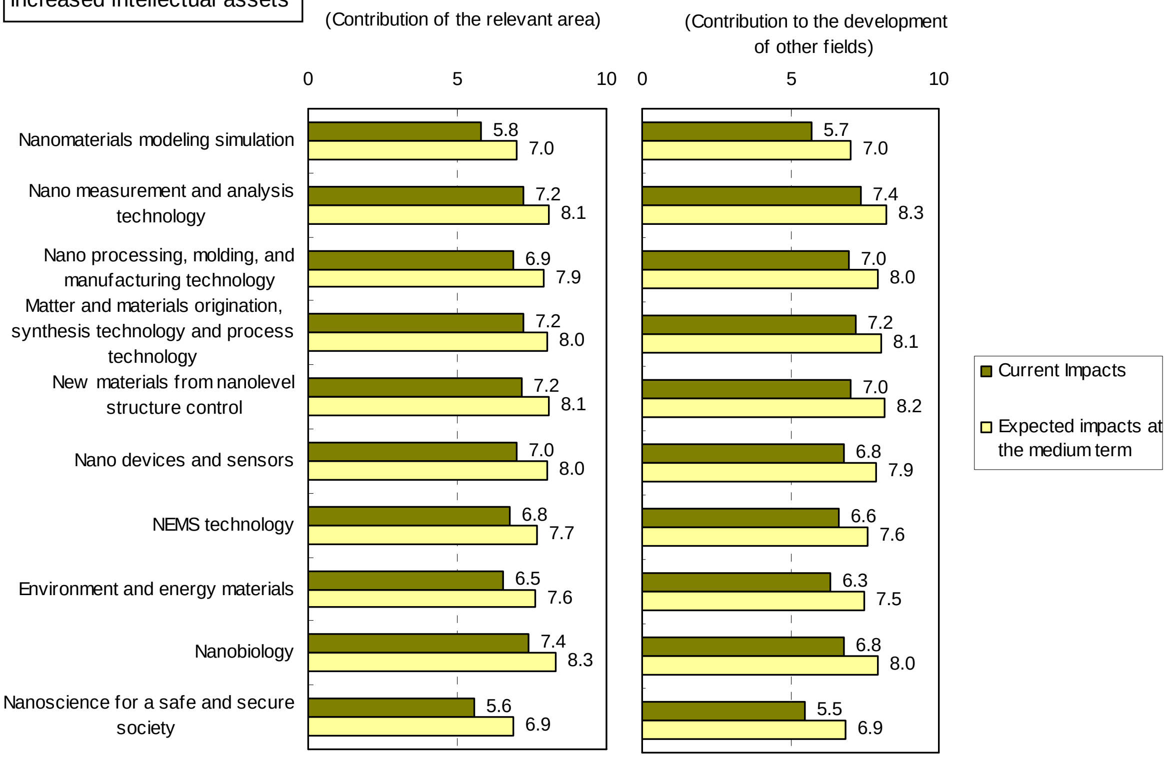
In the nanotechnology and materials field, many areas require much time from technological realization to social application. It is therefore vital that the national government develop a medium-term support system. Concretely, that vision must incorporate the creation of research infrastructure, including large-scale facilities, and human resources development and retention. It is essential that Japan lead the way in basic methods and principles and not fall behind. Investment and promotion policies to open new integrated science and technology fields based on nanotechnology and to increase Japan's strength in this already strong field are needed.

(KAWAI Tomoji)

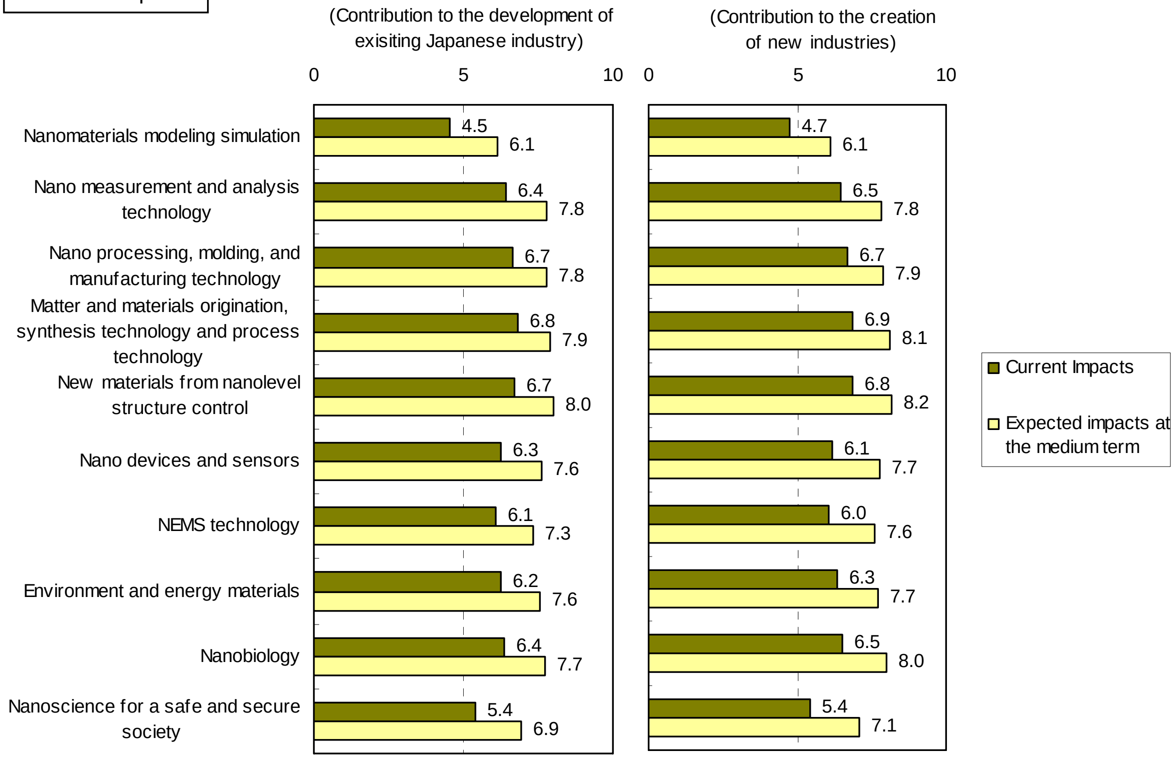
9.2. Main results

A. Impacts

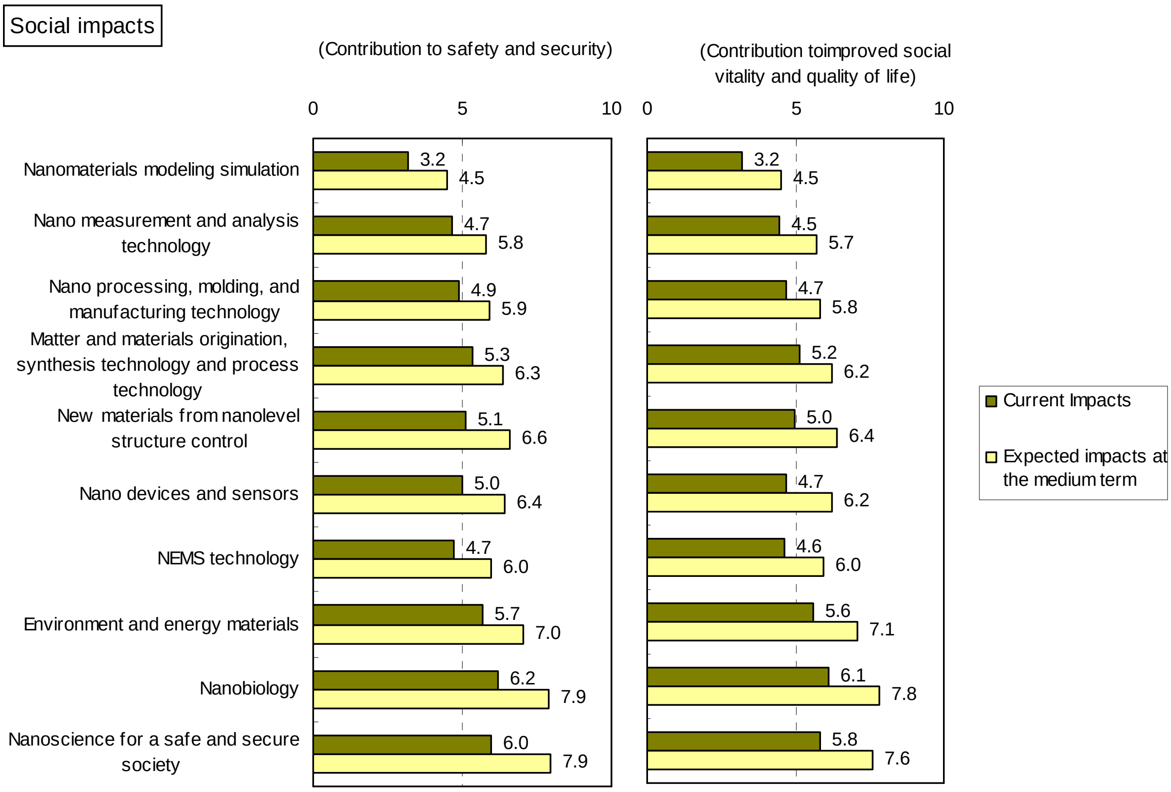
Increased intellectual assets



Economic impacts

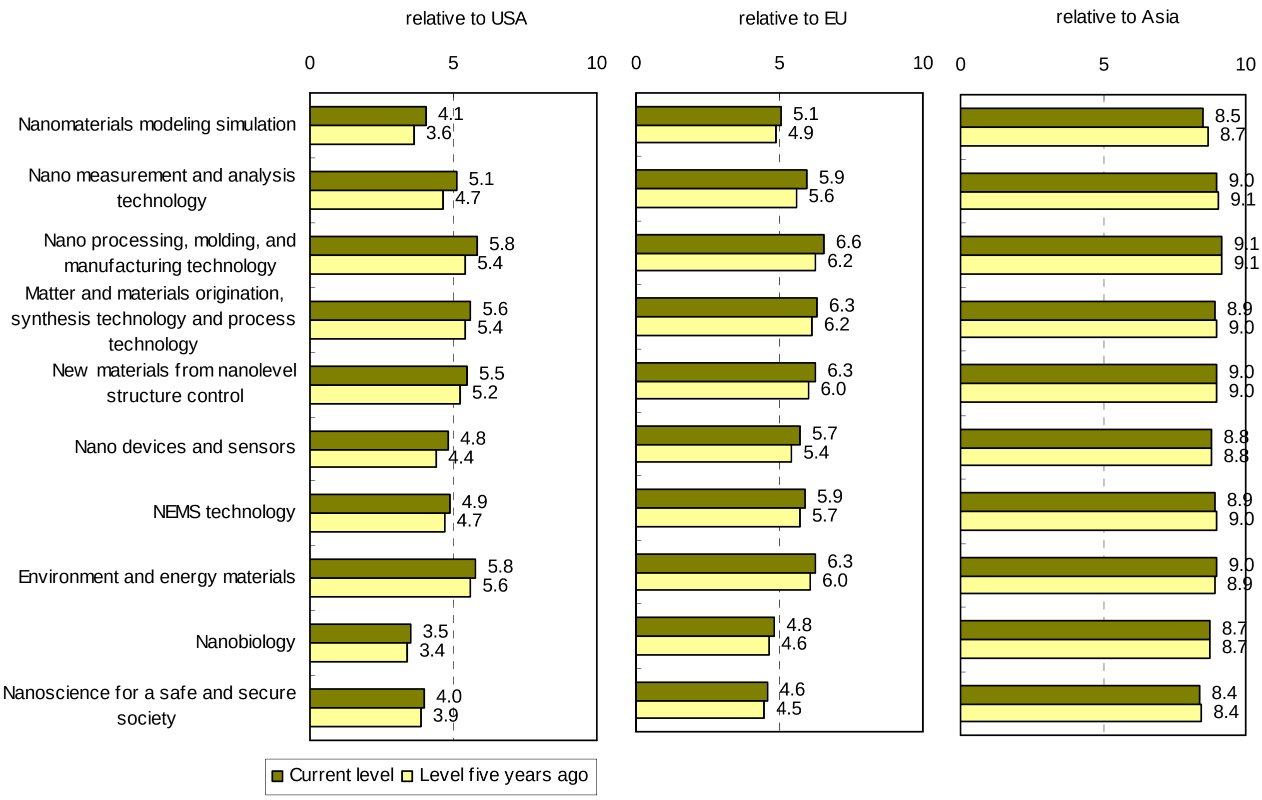


*Responses are indexed on a 10-point scale.



*Responses are indexed on a 10-point scale.

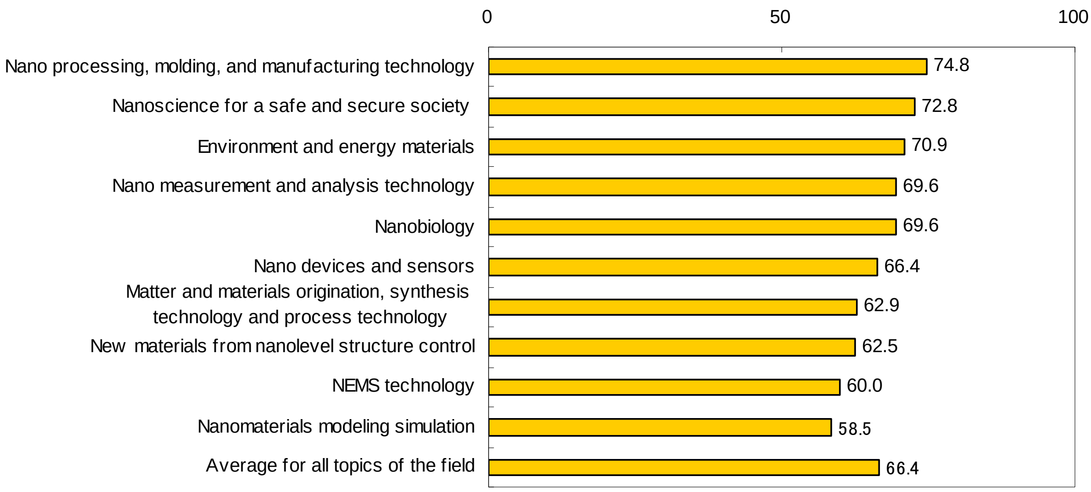
B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan

Average importance index by area



The most important 10 topics

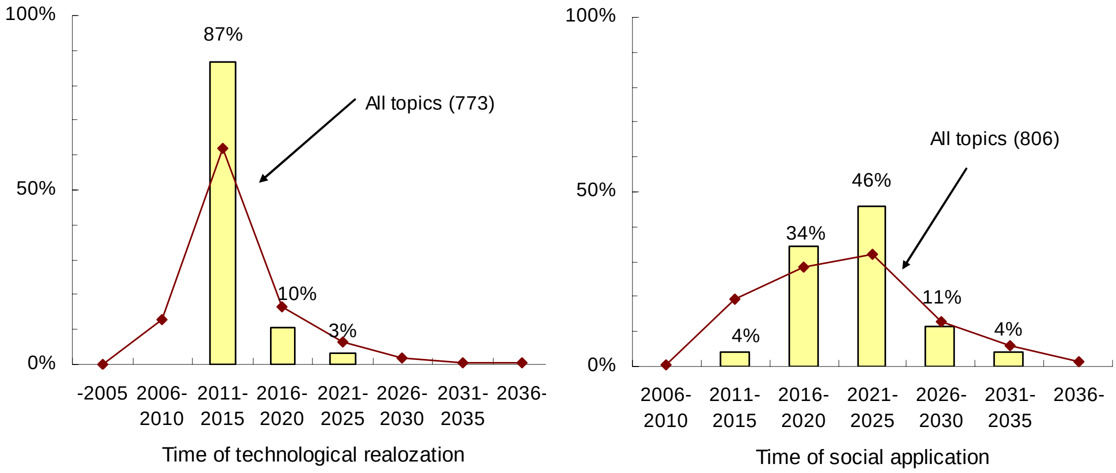
	Topic	Index	Year T*	Year S*
1	14: Production processing technology capable of controlling dimensions and shapes with single nanometer precision.	90	2013	2019
2	38: Large-area amorphous silicon solar cells with a conversion efficiency above 20 percent.	88	2012	2020
3	55: Hydrogen production processes through photocatalytic decomposition of water with sunlight	88	2013	2022
4	65: Biochip diagnostic systems that can accurately diagnose onset risk for cancer and other serious diseases and supply information for setting treatment within a very short time.	87	2012	2020
5	13: Three-dimensional packing technology at the nanometer scale.	84	2013	2020
6	62: Nanocarrier systems that deliver drugs and genes to target cells in the body and are directed by outside signals.	83	2013	2022
7	35: Superconductors with transfer points at room temperature and above.	83	2022	2033
8	16: Manufacture of materials with specified nanoscale structure and characteristics through self-organization.	82	2013	2021
9	08: Scanning probe analysis methods that enable fixed composition analysis and quantitative property measurement at the nanometer scale.	82	2012	2019
10	20: Macromolecule synthesis processes that use renewable resources in place of conventional petrochemical processing.	82	2013	2020

Year T: Time of technological realization Year S: Time of social application

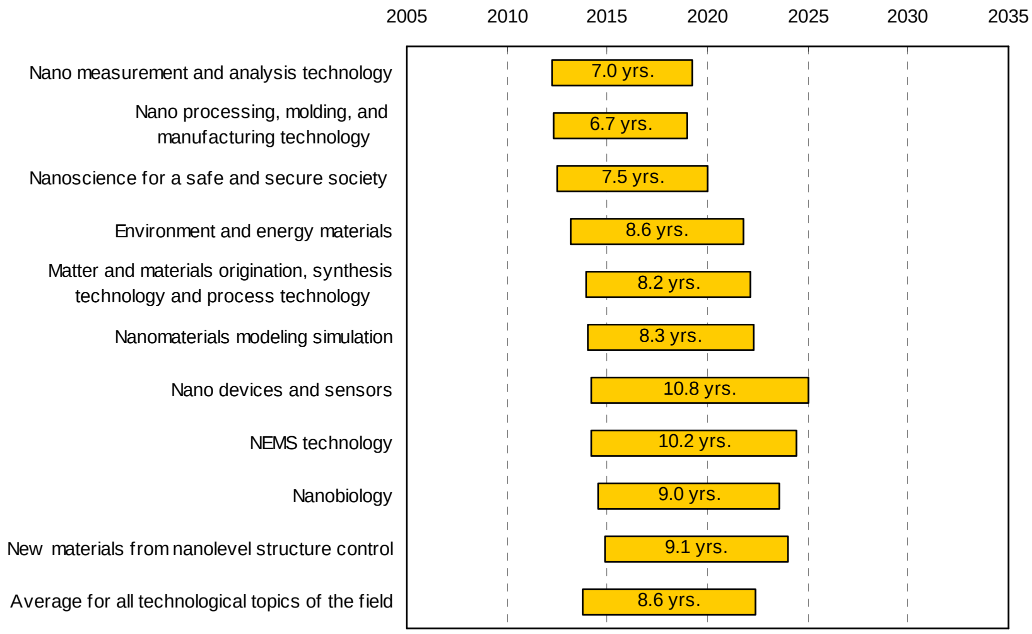
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

Topic	Year T*	Period*	Area
33: Macromolecule superconducting materials with transfer points above liquid nitrogen temperature.	2019	12	New materials from nanolevel structure control
44: Devices that utilize the switching functions of single molecules and atoms.	2017	12	Nano devices and sensors
45: Molecular devices and sensors that use protein or DNA as elements.	2014	12	Nano devices and sensors
49: NEMS that uses Brownian motion as its motive energy.	2015	12	NEMS technology
26: Artificial photosynthesis technology utilizing dendrimers.	2017	11	Matter and materials origination, synthesis technology and process technology
28: Technology to freely apply organic, inorganic, and metal materials at the nano level.	2015	11	Matter and materials origination, synthesis technology and process technology

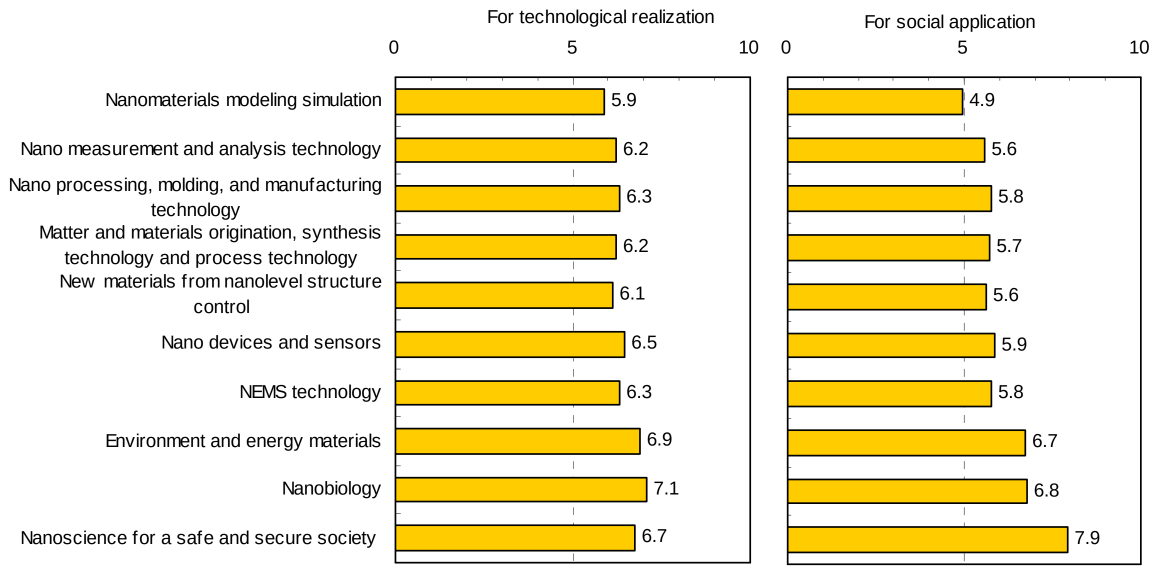
Topic	Year T*	Period*	Area
35: Superconductors with transfer points at room temperature and above.	2022	11	New materials from nanolevel structure control
43: Single-electron memory devices	2014	11	Nano devices and sensors
48: Technology that measures/controls spin polarization at the atomic and molecular levels.	2014	11	Nano devices and sensors
50: Nanosurgery manipulators (manipulators that directly manipulate, excise, join, and process biomolecules) for biomolecules.	2014	11	NEMS technology
64: Biocomputer devices utilizing cultured nerve cell networks.	2022	11	Nanobiology

Topic	Year T*	Period*	Area
12: Welding technology that does not degrade the performance of structural materials with outstanding strength, toughness, and fatigue characteristics.	2011	5	Nano processing, molding, and manufacturing technology
19: Organic macromolecules with luminous surfaces for lighting.	2011	5	Matter and materials origination, synthesis technology and process technology
05: Ultrahigh-resolution electron microscope (resolution of 0.05 nm) with aberration correction.	2012	6	Nano measurement and analysis technology
06: Technology to continuously observe and analyze individual atoms and molecules.	2012	6	Nano measurement and analysis technology
14: Production processing technology capable of controlling dimensions and shapes with single nanometer precision.	2013	6	Nano processing, molding, and manufacturing technology

*Year T: Time of technological realization Period: Period until social application (years)

E. Effective measures that should taken by government

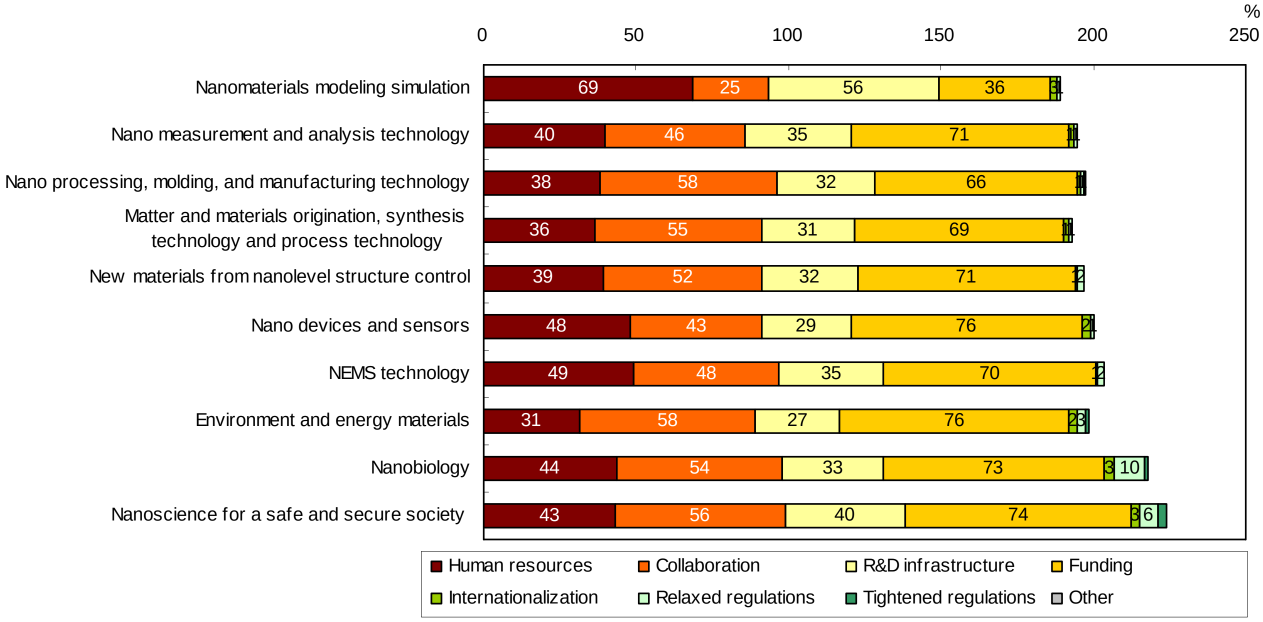
Necessity of government involvement



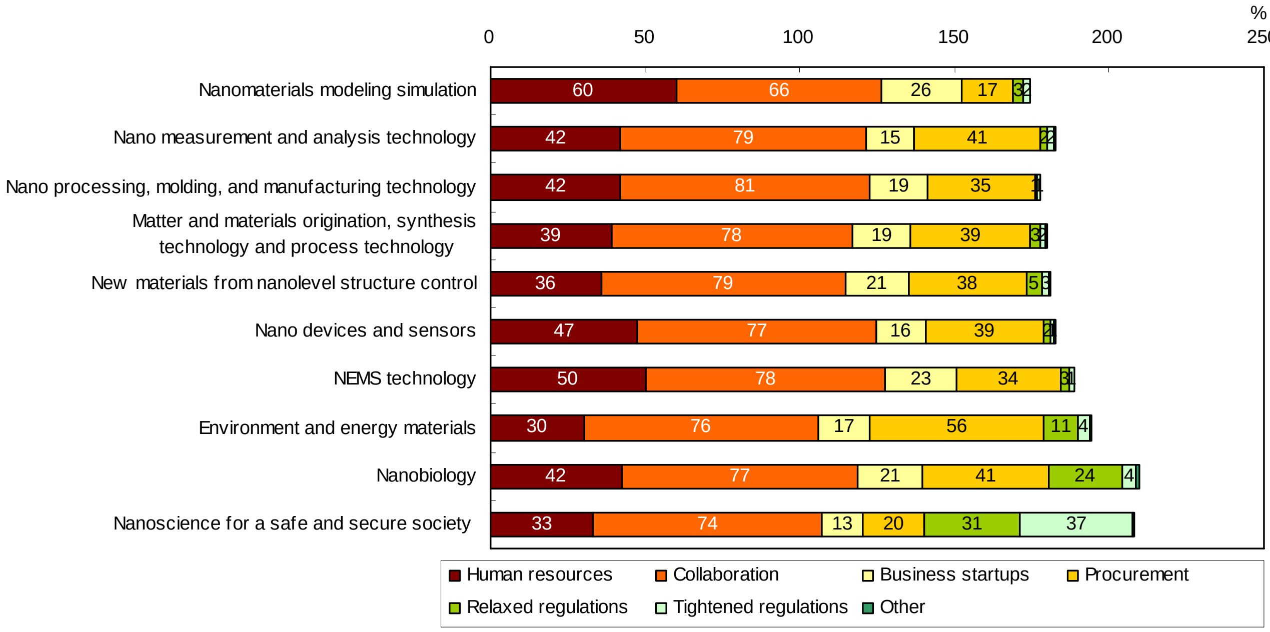
*Responses were indexed on a 10-point scale

Effective measures

For technological realization



For social applications



F. Time-line of topics

Technological realization

year	topic
2011	12: Welding technology that does not degrade the performance of structural materials with outstanding strength, toughness, and fatigue characteristics.
	19: Organic macromolecules with luminous surfaces for lighting.
2012	04: Technology for nondestructive inspection of fatigue in metal materials for in situ prediction of remaining life in light of usage conditions.
	05: Ultrahigh-resolution electron microscope (resolution of 0.05 nm) with aberration correction.
	06: Technology to continuously observe and analyze individual atoms and molecules.
	07: In situ observation technology for high-temperature reactions (near 1500° C).
	08: Scanning probe analysis methods that enable fixed composition analysis and quantitative property measurement at the nanometer scale.

year	topic
	10: Three-dimensional microscope techniques for cells and other soft samples (materials).
	15: Joining technology for ceramic and metal that can withstand thermal fatigue from repeated temperature changes of 500° C or more.
	17: Cheap and convenient nanometer-scale die-forming technology.
	24: Technology that uses gas phase coating to manufacture tools harder than diamond.
	29: Biomedical ceramics that function approximately the same as human bone.
	38: Large-area amorphous silicon solar cells with a conversion efficiency above 20 percent.
	42: Light and composite structure materials from carbon nanotubes.
	65: Biochip diagnostic systems that can accurately diagnose onset risk for cancer and other serious diseases and supply information for setting treatment within a very short time.
	69: Advanced authentication technology utilizing DNA tags.
2013	01: Technology to use simulation based on first-principle analysis to design nanomaterials with fixed (excellent) characteristics.
	09: Chip-type scanning probe analysis equipment.
	11: Three-dimensional fault imaging devices with a resolution on a several nanometer scale.
	13: Three-dimensional packing technology at the nanometer scale.
	14: Production processing technology capable of controlling dimensions and shapes with single nanometer precision.
	16: Manufacture of materials with specified nanoscale structure and characteristics through self-organization.
	20: Macromolecule synthesis processes that use renewable resources in place of conventional petrochemical processing.
	22: Manufacturing technology using nano structure control for ultra-plastic ceramics.
	23: Manufacturing technology for nanochips structured according to design.
	32: Lead-free ferroelectrics with a piezoelectric modulus equivalent to PZT (Pb [Zr, Ti] O3).
	37: Insulating materials with a dielectric constant of 1.3 or less for ultra-LSI.
	39: Organic and inorganic compound materials that express new functions or innovative properties through structures controlled at the nanometer level.
	46: Ultrahigh-speed optical switching devices with an order of femtosecond switching time.
	47: Devices and sensors manufactured with nanometer precision.
	54: Direct catalytic production of hydrogen from methane at low temperature
	55: Hydrogen production processes through photocatalytic decomposition of water with sunlight
	56: Production of iron by a new economical method with hydrogen as reductant instead of coke.
	58: Complete control of nanopores in separation membranes.
	59: Technology to predict three-dimensional structure from the primary sequence structure of proteins with about 30,000 molecules.
	62: Nanocarrier systems that deliver drugs and genes to target cells in the body and are directed by outside signals.
	63: Cell tissue sensors (biosensors composed of cells and tissue) used in place of animal experimentation.
	70: Virus detection technology utilizing protein chips with activity equivalent to that of life forms.
2014	03: Design of nano industrial materials utilizing mutilscale simulation through grid computing.
	18: Methods for protein synthesis with optional structures through in-vitro sequence control that does not use mRNA or tRNA.
	25: Technology to freely control the structure and characteristics of surfaces and interfaces at the atomic level.
	27: Precise polymerization processes that can voluntarily control at the molecular level stereoregularity, linkage structure, and molecule volume and distribution.
	34: Heat resistant alloys that can bear a load of 15 kgf/mm2 (about 150 MPa) for 1,000 hours at a high (atmospheric) temperature of 1200° C.
	40: Nanomaterials that show practical, meaningful stimulus response at necessary times and places.
	41: Semiconductor diamonds at a practical level.
	43: Single-electron memory devices
	45: Molecular devices and sensors that use protein or DNA as elements.
	48: Technology that measures/controls spin polarization at the atomic and molecular levels.

year	topic
	50: Nanosurgery manipulators (manipulators that directly manipulate, excise, join, and process biomolecules) for biomolecules.
	51: Mechanical switching elements that operate at 10 GHz and above and have outstanding ON/OFF characteristics.
	52: Multi-nanoprobe spectroscopic analysis, processing control, and operating technology that enables multi-sensing and multi-processing at the nanometer level of the functional structure of biomolecules such as nano semiconductor devices, molecular devices, nanomaterials, and DNA protein.
	53: Probe array-type sensor elements sensitive enough to detect single molecules.
	57: Catalytic fixation of carbon dioxide that will solve one of the global environmental problems.
	60: Actuators made from intelligent materials that can be utilized in medical devices for the in vivo use such as microsurgery.
2015	02: For dimensional materials, computer simulation technology and nonequilibrium nanomaterials databases that can strictly predict structure and properties in thermal equilibrium state when given elemental composition.
	28: Technology to freely apply organic, inorganic, and metal materials at the nano level.
	49: NEMS that uses Brownian motion as its motive energy.
	61: Hybrid-type artificial organs with self-organized tissue derived from stem cells.
2016	31: Macromolecule materials with conductivity and environment resistance equivalent to copper at room temperature.
	36: Anisotropic nanocomposite magnets with a (BH)max=400 kJ/m3(50.3 MGOe) or greater through nanometer-scale control of heterostructure.
2017	21: Technology to directly synthesize plastic form carbon dioxide gas and water, using light as an energy source.
	26: Artificial photosynthesis technology utilizing dendrimers.
	44: Devices that utilize the switching functions of single molecules and atoms.
2018	30: All-organic ferromagnets with a Curie point above room temperature.
2019	33: Macromolecule superconducting materials with transfer points above liquid nitrogen temperature.
2022	35: Superconductors with transfer points at room temperature and above.
	64: Biocomputer devices utilizing cultured nerve cell networks.

Social application

year	topic
2012	67: Establishment of safety standards for nanoparticles in consumer goods such as cosmetics and foods.
2013	66: Establishment of safety standards for DDS capsule materials and doses.
	68: Establishment of manufacturing standards for diagnostic DNA and protein chips.
2016	12: Welding technology that does not degrade the performance of structural materials with outstanding strength, toughness, and fatigue characteristics.
	19: Organic macromolecules with luminous surfaces for lighting.
2018	05: Ultrahigh-resolution electron microscope (resolution of 0.05 nm) with aberration correction.
	06: Technology to continuously observe and analyze individual atoms and molecules.
2019	04: Technology for nondestructive inspection of fatigue in metal materials for in situ prediction of remaining life in light of usage conditions.
	07: In situ observation technology for high-temperature reactions (near 1500° C).
	08: Scanning probe analysis methods that enable fixed composition analysis and quantitative property measurement at the nanometer scale.
	14: Production processing technology capable of controlling dimensions and shapes with single nanometer precision.
	15: Joining technology for ceramic and metal that can withstand thermal fatigue from repeated temperature changes of 500° C or more.
	17: Cheap and convenient nanometer-scale die-forming technology.
	24: Technology that uses gas phase coating to manufacture tools harder than diamond.
2020	09: Chip-type scanning probe analysis equipment.
	10: Three-dimensional microscope techniques for cells and other soft samples (materials).
	13: Three-dimensional packing technology at the nanometer scale.

year	topic
	20: Macromolecule synthesis processes that use renewable resources in place of conventional petrochemical processing.
	22: Manufacturing technology using nano structure control for ultra-plastic ceramics.
	29: Biomedical ceramics that function approximately the same as human bone.
	37: Insulating materials with a dielectric constant of 1.3 or less for ultra-LSI.
	38: Large-area amorphous silicon solar cells with a conversion efficiency above 20 percent.
	42: Light and composite structure materials from carbon nanotubes.
	65: Biochip diagnostic systems that can accurately diagnose onset risk for cancer and other serious diseases and supply information for setting treatment within a very short time.
	69: Advanced authentication technology utilizing DNA tags.
	70: Virus detection technology utilizing protein chips with activity equivalent to that of life forms.
2021	01: Technology to use simulation based on first-principle analysis to design nanomaterials with fixed (excellent) characteristics.
	11: Three-dimensional fault imaging devices with a resolution on a several nanometer scale.
	16: Manufacture of materials with specified nanoscale structure and characteristics through self-organization.
	18: Methods for protein synthesis with optional structures through in-vitro sequence control that does not use mRNA or tRNA.
	23: Manufacturing technology for nanochips structured according to design.
	54: Direct catalytic production of hydrogen from methane at low temperature
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	32: Lead-free ferroelectrics with a piezoelectric modulus equivalent to PZT (Pb [Zr, Ti] O3).
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	62: Nanocarrier systems that deliver drugs and genes to target cells in the body and are directed by outside signals.
	63: Cell tissue sensors (biosensors composed of cells and tissue) used in place of animal experimentation.
2023	25: Technology to freely control the structure and characteristics of surfaces and interfaces at the atomic level.
	27: Precise polymerization processes that can voluntarily control at the molecular level stereoregularity, linkage structure, and molecule volume and distribution.
	40: Nanomaterials that show practical, meaningful stimulus response at necessary times and places.
	46: Ultrahigh-speed optical switching devices with an order of femtosecond switching time.
	51: Mechanical switching elements that operate at 10 GHz and above and have outstanding ON/OFF characteristics.
	52: Multi-nanoprobe spectroscopic analysis, processing control, and operating technology that enables multi-sensing and multi-processing at the nanometer level of the functional structure of biomolecules such as nano semiconductor devices, molecular devices, nanomaterials, and DNA protein.
	57: Catalytic fixation of carbon dioxide that will solve one of the global environmental problems.
2024	02: For dimensional materials, computer simulation technology and nonequilibrium nanomaterials databases that can strictly predict structure and properties in thermal equilibrium state when given elemental composition.
	34: Heat resistant alloys that can bear a load of 15 kgf/mm2 (about 150 MPa) for 1,000 hours at a high (atmospheric) temperature of 1200° C.
	53: Probe array-type sensor elements sensitive enough to detect single molecules.
	61: Hybrid-type artificial organs with self-organized tissue derived from stem cells.
2025	36: Anisotropic nanocomposite magnets with a (BH)max=400 kJ/m3(50.3 MGOe) or greater through nanometer-scale control of heterostructure.

year	topic
	43: Single-electron memory devices
	48: Technology that measures/controls spin polarization at the atomic and molecular levels.
	50: Nanosurgery manipulators (manipulators that directly manipulate, excise, join, and process biomolecules) for biomolecules.
2026	21: Technology to directly synthesize plastic form carbon dioxide gas and water, using light as an energy source.
	28: Technology to freely apply organic, inorganic, and metal materials at the nano level.
	31: Macromolecule materials with conductivity and environment resistance equivalent to copper at room temperature.
	45: Molecular devices and sensors that use protein or DNA as elements.
2027	49: NEMS that uses Brownian motion as its motive energy.
2028	26: Artificial photosynthesis technology utilizing dendrimers.
	30: All-organic ferromagnets with a Curie point above room temperature.
2029	44: Devices that utilize the switching functions of single molecules and atoms.
2031	33: Macromolecule superconducting materials with transfer points above liquid nitrogen temperature.
2033	35: Superconductors with transfer points at room temperature and above.
	64: Biocomputer devices utilizing cultured nerve cell networks.

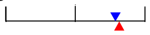
Appendix: Results of R1 and R2

I. Nanomaterials modeling simulation

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

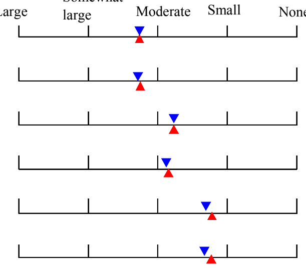


2) Current impacts

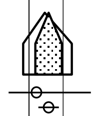
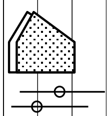
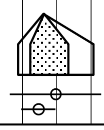
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

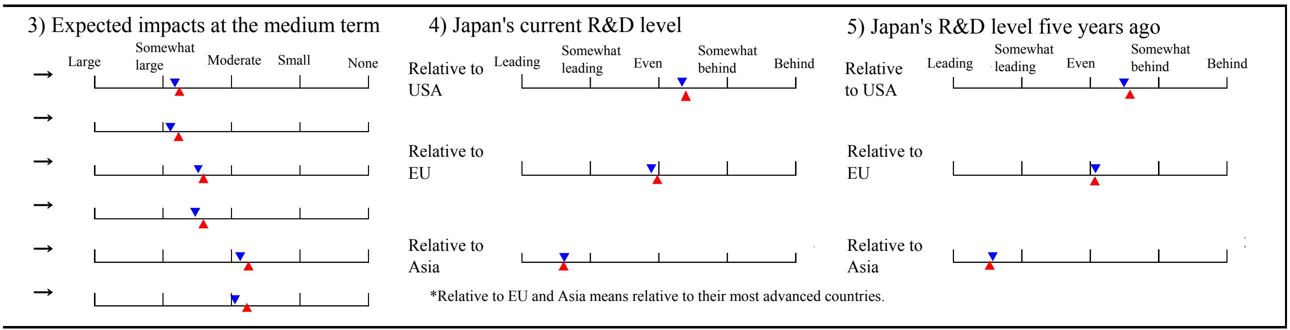
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

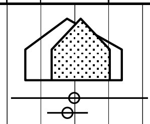
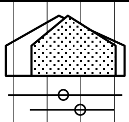
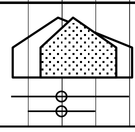
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High	Moderate	Low	None (%)	Importance to Japan: Index	High	Moderate	Low	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized	Do not know (%)
1	Technology to use simulation based on first-principle analysis to design nanomaterials with fixed (excellent) characteristics.	1	**142**	**8**	**27**	**65**	-	**68**	**42**	**47**	**11**	**0**		**4**	**8**
		2	**120**	**5**	**28**	**67**	-	**60**	**24**	**68**	**8**	**0**		**2**	**4**
		E	**6**	**100**	**0**	**0**	-	**92**	**83**	**17**	**0**	**0**		**0**	**0**
2	For dimensional materials, computer simulation technology and nonequilibrium nanomaterials databases that can strictly predict structure and properties in thermal equilibrium state when given elemental composition.	1	**125**	**7**	**17**	**76**	-	**66**	**38**	**51**	**11**	**0**		**3**	**16**
		2	**114**	**5**	**18**	**77**	-	**59**	**22**	**69**	**9**	**0**		**1**	**6**
		E	**6**	**100**	**0**	**0**	-	**92**	**83**	**17**	**0**	**0**		**0**	**0**
3	Design of nano industrial materials utilizing mutilscale simulation through grid computing.	1	**102**	**8**	**17**	**75**	-	**66**	**39**	**47**	**14**	**0**		**4**	**8**
		2	**101**	**4**	**8**	**88**	-	**57**	**18**	**73**	**9**	**0**		**1**	**6**
		E	**4**	**100**	**0**	**0**	-	**88**	**75**	**25**	**0**	**0**		**0**	**0**

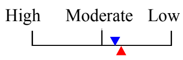


Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
14	78	8	0	0	30	37	25	8	53	32	46	35	9	2	0	0		4	10	20	29	34	17	51	54	28	24	9	2	1
2	96	2	0	0	14	52	29	5	70	21	54	38	3	1	0	0		2	4	6	36	50	8	62	63	26	17	3	2	0
0	100	0	0	0	33	67	0	0	67	17	67	67	0	0	0	0		0	0	17	83	0	0	83	50	33	33	0	0	0
12	74	13	0	1	27	45	19	9	53	40	47	38	7	1	0	0		4	16	19	36	27	18	47	60	31	22	7	1	2
0	94	5	0	1	12	55	28	5	69	27	58	33	3	1	0	0		1	7	6	46	38	10	56	70	26	17	3	2	0
0	83	17	0	0	17	66	17	0	67	33	50	33	0	0	0	0		0	0	17	66	17	0	67	67	17	33	0	0	0
8	84	8	0	0	29	46	17	8	52	37	48	36	11	2	0	0		3	11	17	40	28	15	46	56	30	23	6	1	1
2	95	2	0	1	12	62	21	5	67	26	57	38	2	1	0	0		1	7	5	53	35	7	62	66	26	16	3	2	0
0	100	0	0	0	50	50	0	0	50	50	25	75	0	0	0	0		0	0	25	75	0	0	50	25	25	75	0	0	0

II. Nano measurement and analysis technology

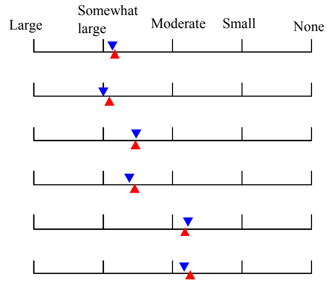
1. Questions regarding the relevant area

1) Degree of expertise in the area

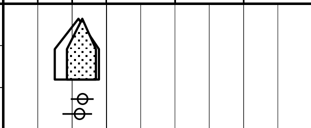
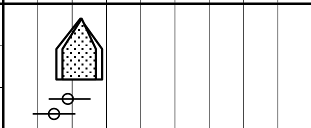
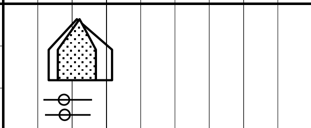
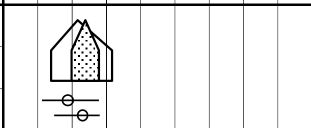
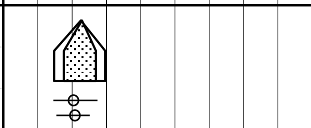
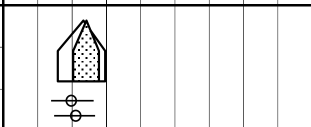
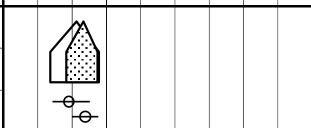
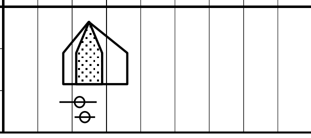


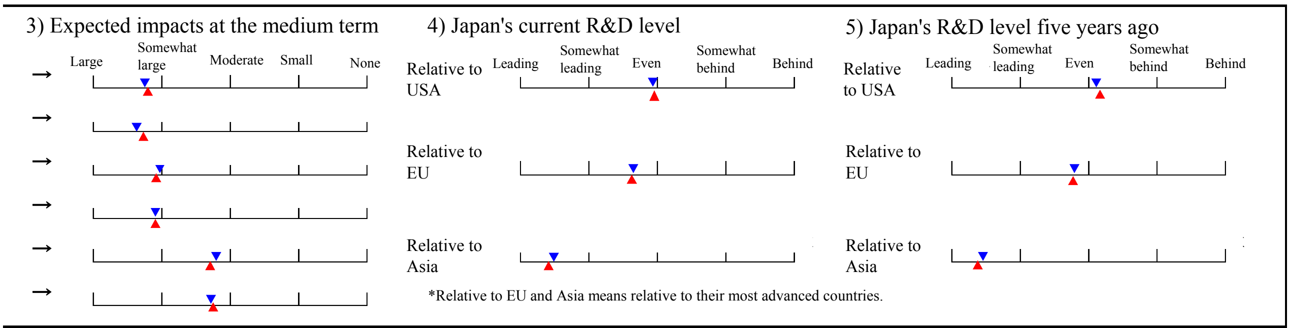
2) Current impacts

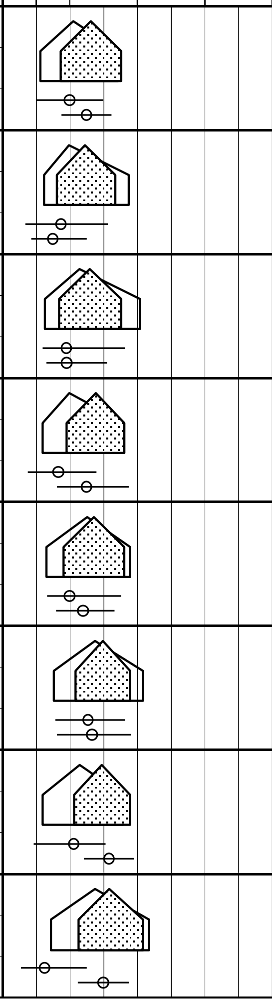
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
4	Technology for nondestructive inspection of fatigue in metal materials for in situ prediction of remaining life in light of usage conditions.	1	**105**	**4**	**29**	**67**	**-**	**68**	**39**	**53**	**8**	**0**		**1**	**9**
		2	**100**	**3**	**18**	**79**	**-**	**61**	**24**	**71**	**5**	**0**		**1**	**2**
		E	**3**	**100**	**0**	**0**	**-**	**83**	**67**	**33**	**0**	**0**		**0**	**0**
5	Ultrahigh-resolution electron microscope (resolution of 0.05 nm) with aberration correction.	1	**140**	**8**	**32**	**60**	**-**	**68**	**44**	**43**	**12**	**1**		**1**	**10**
		2	**127**	**6**	**24**	**70**	**-**	**64**	**32**	**60**	**8**	**0**		**0**	**4**
		E	**7**	**100**	**0**	**0**	**-**	**82**	**72**	**14**	**14**	**0**		**0**	**0**
6	Technology to continuously observe and analyze individual atoms and molecules.	1	**172**	**24**	**31**	**45**	**-**	**77**	**57**	**39**	**4**	**0**		**1**	**3**
		2	**142**	**18**	**28**	**54**	**-**	**80**	**62**	**36**	**2**	**0**		**0**	**1**
		E	**26**	**100**	**0**	**0**	**-**	**94**	**88**	**12**	**0**	**0**		**0**	**0**
7	In situ observation technology for high-temperature reactions (near 1500°C).	1	**112**	**13**	**25**	**62**	**-**	**57**	**28**	**43**	**28**	**1**		**1**	**7**
		2	**105**	**6**	**15**	**79**	**-**	**52**	**14**	**67**	**18**	**1**		**0**	**4**
		E	**6**	**100**	**0**	**0**	**-**	**63**	**33**	**50**	**17**	**0**		**0**	**0**
8	Scanning probe analysis methods that enable fixed composition analysis and quantitative property measurement at the nanometer scale.	1	**165**	**26**	**33**	**41**	**-**	**76**	**55**	**37**	**8**	**0**		**1**	**5**
		2	**133**	**23**	**27**	**50**	**-**	**82**	**66**	**32**	**2**	**0**		**0**	**2**
		E	**30**	**100**	**0**	**0**	**-**	**94**	**90**	**7**	**3**	**0**		**0**	**0**
9	Chip-type scanning probe analysis equipment.	1	**136**	**19**	**36**	**45**	**-**	**67**	**42**	**44**	**14**	**0**		**0**	**3**
		2	**124**	**13**	**23**	**64**	**-**	**64**	**33**	**57**	**10**	**0**		**0**	**2**
		E	**16**	**100**	**0**	**0**	**-**	**86**	**81**	**0**	**19**	**0**		**0**	**0**
10	Three-dimensional microscope techniques for cells and other soft samples (materials).	1	**123**	**13**	**31**	**56**	**-**	**78**	**59**	**37**	**3**	**1**		**0**	**4**
		2	**114**	**8**	**20**	**72**	**-**	**81**	**62**	**34**	**4**	**0**		**0**	**4**
		E	**9**	**100**	**0**	**0**	**-**	**94**	**89**	**11**	**0**	**0**		**0**	**0**
11	Three-dimensional fault imaging devices with a resolution on a several nanometer scale.	1	**122**	**7**	**32**	**61**	**-**	**73**	**49**	**44**	**7**	**0**		**0**	**4**
		2	**112**	**5**	**18**	**77**	**-**	**73**	**50**	**45**	**5**	**0**		**0**	**1**
		E	**6**	**100**	**0**	**0**	**-**	**92**	**83**	**17**	**0**	**0**		**0**	**0**





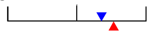
Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding technological realization — Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding social application — Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
43	52	5	0	0	21	50	22	7	31	46	32	50	4	2	2	1		1	9	20	46	24	10	35	60	22	29	4	8	0
46	53	0	0	1	12	74	12	2	35	63	32	58	1	2	0	0		1	1	5	71	18	6	42	84	13	26	4	5	1
100	0	0	0	0	33	67	0	0	33	100	67	33	0	0	0	0		0	0	0	67	33	0	33	100	0	33	33	0	0
65	27	6	0	2	17	45	26	12	28	30	36	63	8	2	0	1		3	10	11	39	33	17	39	51	18	49	4	0	0
87	12	1	0	0	7	64	25	4	27	36	37	74	0	1	0	0		0	2	2	56	36	6	32	80	10	47	3	2	1
86	14	0	0	0	28	29	14	29	40	80	20	60	0	20	0	0		0	0	0	71	0	29	60	80	20	40	0	20	0
31	59	9	0	1	27	41	21	11	42	30	40	63	8	1	0	1		3	6	14	39	31	16	44	58	22	36	5	0	0
19	80	1	0	0	12	64	21	3	45	38	40	75	1	1	0	0		0	1	4	59	32	5	48	79	16	40	2	2	1
40	56	4	0	0	19	54	19	8	67	46	67	75	4	4	0	0		0	0	8	68	12	12	65	74	26	43	4	4	0
35	53	8	0	4	11	47	33	9	29	33	35	53	9	1	0	2		1	12	8	34	43	15	36	53	18	40	5	1	1
17	78	0	2	3	7	62	28	3	36	41	33	70	2	2	0	0		0	3	4	42	49	5	38	76	11	46	2	2	1
20	80	0	0	0	17	49	17	17	60	60	20	100	0	0	0	0		0	0	17	49	17	17	60	100	20	40	0	0	0
30	57	12	0	1	26	44	23	7	44	34	37	65	10	1	0	0		1	6	14	43	31	12	46	56	20	40	3	1	0
16	82	2	0	0	10	71	17	2	46	42	33	73	2	1	0	0		0	1	3	69	21	7	44	76	16	45	2	2	1
28	65	7	0	0	33	51	13	3	59	55	52	72	3	3	0	0		0	0	10	73	7	10	58	81	38	46	4	4	0
26	59	14	0	1	21	46	25	8	32	40	36	57	5	1	0	1		1	4	13	44	32	11	42	57	27	35	4	0	1
12	82	5	1	0	8	77	13	2	34	53	34	72	1	1	0	0		0	0	2	68	24	6	37	79	18	42	2	2	1
7	73	20	0	0	31	50	13	6	27	47	53	73	0	7	0	0		0	0	7	79	7	7	36	79	43	43	0	7	0
31	61	7	0	1	33	41	18	8	46	44	43	64	12	1	0	1		1	6	21	46	24	9	54	59	23	41	5	1	0
15	84	1	0	0	15	69	11	5	53	49	35	73	4	1	0	0		0	1	8	71	17	4	52	81	21	35	1	2	1
44	56	0	0	0	22	56	11	11	63	38	38	88	0	13	0	0		0	0	33	67	0	0	44	33	56	44	0	11	0
31	57	10	0	2	30	47	20	3	41	43	41	60	9	3	1	2		0	7	25	40	26	9	47	58	26	50	6	0	0
12	87	1	0	0	10	75	11	4	43	46	38	75	1	1	0	0		0	1	4	74	18	4	44	80	19	44	2	2	1
33	67	0	0	0	33	33	17	17	60	40	40	80	0	20	0	0		0	0	50	50	0	0	33	33	67	33	0	17	0

III. Nano processing, molding, and manufacturing technology

1. Questions regarding the relevant area

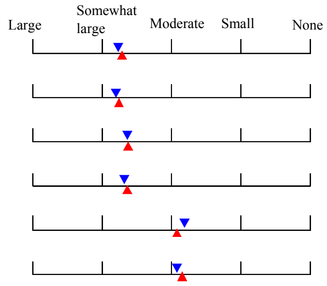
1) Degree of expertise in the area

High Moderate Low



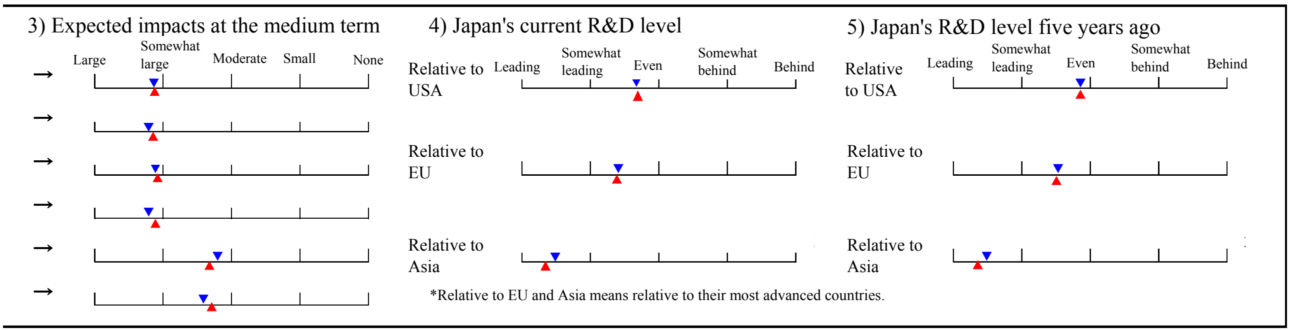
2) Current impacts

		Large / Somewhat large / Moderate / Small / None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

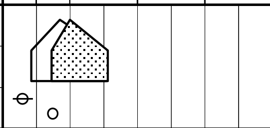
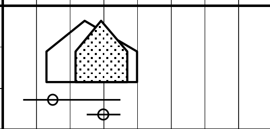
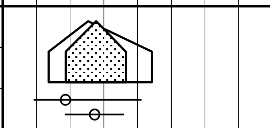
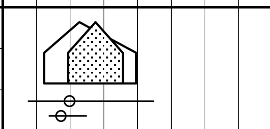
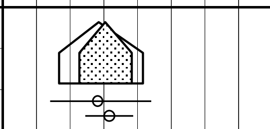
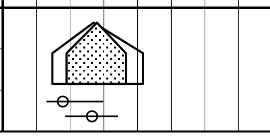


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
12	Welding technology that does not degrade the performance of structural materials with outstanding strength, toughness, and fatigue characteristics.	1	70	9	27	64	-	64	34	55	10	1		2	9
		2	82	1	17	82	-	55	15	75	9	1		0	3
		E	1	100	0	0	-	100	100	0	0	0		0	0
13	Three-dimensional packing technology at the nanometer scale.	1	128	16	38	46	-	78	58	38	4	0		0	3
		2	113	8	39	53	-	84	69	30	1	0		0	1
		E	9	100	0	0	-	94	89	11	0	0		0	0
14	Production processing technology capable of controlling dimensions and shapes with single nanometer precision.	1	111	14	36	50	-	80	62	31	7	0		1	3
		2	104	7	26	67	-	90	81	18	1	0		0	1
		E	7	100	0	0	-	100	100	0	0	0		0	0
15	Joining technology for ceramic and metal that can withstand thermal fatigue from repeated temperature changes of 500°C or more.	1	80	8	25	67	-	63	33	54	12	1		0	12
		2	85	4	15	81	-	56	16	78	5	1		0	4
		E	3	100	0	0	-	100	100	0	0	0		0	0
16	Manufacture of materials with specified nanoscale structure and characteristics through self-organization.	1	163	23	33	44	-	75	55	37	8	0		1	3
		2	143	17	32	51	-	82	66	32	2	0		0	1
		E	24	100	0	0	-	96	92	8	0	0		0	0
17	Cheap and convenient nanometer-scale die-forming technology.	1	119	18	32	50	-	73	51	39	9	1		1	3
		2	105	13	26	61	-	81	64	32	4	0		0	2
		E	14	100	0	0	-	93	86	14	0	0		0	0



*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
64	29	5	0	2	8	54	29	9	41	49	32	46	5	2	0	2		2	11	11	41	35	13	40	53	25	36	7	2	0
89	11	0	0	0	2	70	19	9	39	70	22	51	3	1	0	0		0	4	5	56	30	9	40	77	15	32	1	1	0
100	0	0	0	0	100	0	0	0	0	0	0	100	0	0	0	0		0	0	100	0	0	0	0	100	0	0	0	0	0
42	53	5	0	0	30	46	21	3	42	45	43	60	11	2	1	0		0	4	26	44	24	6	41	68	34	39	5	1	0
38	61	1	0	0	17	68	14	1	46	46	38	73	0	2	0	0		0	2	9	66	20	5	47	82	18	33	0	1	0
33	67	0	0	0	22	78	0	0	44	33	44	67	0	0	0	0		0	0	22	56	22	0	56	89	11	22	0	0	0
62	32	5	1	0	32	46	18	4	44	49	46	59	8	2	1	0		2	4	30	39	25	6	47	65	35	39	6	1	0
88	11	1	0	0	10	71	17	2	35	57	33	72	0	1	0	1		0	2	8	65	21	6	42	82	22	38	0	1	0
100	0	0	0	0	29	71	0	0	29	43	29	71	0	0	0	0		0	0	29	57	14	0	29	86	14	29	0	0	0
51	46	3	0	0	20	47	27	6	39	45	39	42	3	1	0	1		0	15	17	37	38	8	43	55	20	35	5	0	0
67	33	0	0	0	7	69	19	5	33	65	30	65	1	1	0	0		0	4	10	46	37	7	35	83	14	34	1	1	0
33	67	0	0	0	100	0	0	0	33	33	67	100	0	0	0	0		0	0	100	0	0	0	33	100	0	33	0	0	0
39	53	7	0	1	31	41	21	7	44	49	40	65	6	1	0	0		2	6	21	45	23	11	48	63	34	39	5	0	0
26	73	1	0	0	21	65	11	3	42	55	34	71	1	1	0	0		0	1	11	68	15	6	48	81	22	34	1	1	0
39	61	0	0	0	38	58	4	0	42	46	33	75	0	4	0	0		0	0	29	58	13	0	48	74	13	43	0	0	0
51	44	5	0	0	27	47	20	6	42	47	43	57	6	1	0	0		2	5	23	44	22	11	44	57	38	42	4	1	0
72	28	0	0	0	15	65	19	1	36	54	35	66	2	1	0	0		0	3	11	65	19	5	39	79	23	38	0	1	0
71	29	0	0	0	29	71	0	0	21	50	36	71	0	0	0	0		0	0	36	64	0	0	21	86	21	36	0	0	0

IV. Matter and materials origination, synthesis technology and process technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

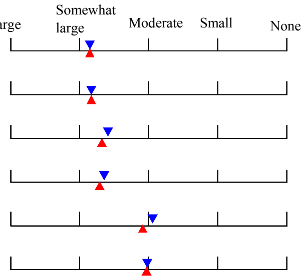
High Moderate Low

2) Current impacts

[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

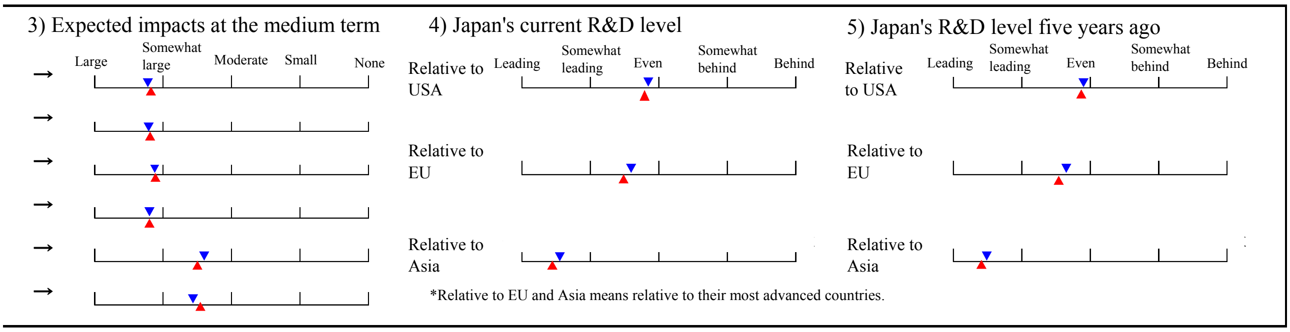
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life

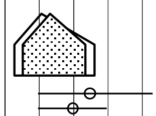
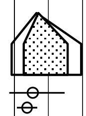
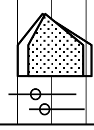


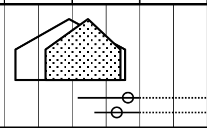
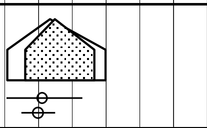
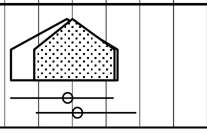
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
18	Methods for protein synthesis with optional structures through in-vitro sequence control that does not use mRNA or tRNA.	1	78	8	26	66	-	66	36	55	9	0		3	5
		2	82	4	15	81	-	59	21	74	5	0		0	4
		E	3	100	0	0	-	75	67	0	33	0		0	0
19	Organic macromolecules with luminous surfaces for lighting.	1	127	12	22	66	-	69	42	51	7	0		0	1
		2	110	5	27	68	-	65	33	61	5	1		0	1
		E	5	100	0	0	-	90	80	20	0	0		0	0
20	Macromolecule synthesis processes that use renewable resources in place of conventional petrochemical processing.	1	104	15	32	53	-	74	54	37	9	0		2	1
		2	102	11	25	64	-	82	66	31	3	0		3	2
		E	11	100	0	0	-	80	70	10	20	0		27	0
21	Technology to directly synthesize plastic form carbon dioxide gas and water, using light as an energy source.	1	98	13	27	60	-	69	48	35	16	1		5	9
		2	102	7	24	69	-	75	54	40	5	1		4	7
		E	7	100	0	0	-	61	43	29	14	14		43	0
22	Manufacturing technology using nano structure control for ultra-plastic ceramics.	1	96	19	21	60	-	61	33	45	22	0		0	9
		2	94	3	16	81	-	54	13	77	10	0		1	3
		E	3	100	0	0	-	67	33	67	0	0		0	0
23	Manufacturing technology for nanochips structured according to design.	1	139	19	29	52	-	63	36	45	18	1		1	3
		2	120	8	25	67	-	56	18	71	10	1		0	0
		E	9	100	0	0	-	75	56	33	11	0		0	0
24	Technology that uses gas phase coating to manufacture tools harder than diamond.	1	94	11	29	60	-	56	24	54	21	1		6	9
		2	95	2	24	74	-	52	12	74	14	0		2	4
		E	2	100	0	0	-	38	0	50	50	0		0	0
25	Technology to freely control the structure and characteristics of surfaces and interfaces at the atomic level.	1	144	22	33	45	-	69	42	50	8	0		2	4
		2	129	19	29	52	-	65	32	63	5	1		1	2
		E	24	100	0	0	-	82	67	29	4	0		0	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
16	80	4	0	0	29	49	19	3	35	39	31	61	13	7	0	0		3	8	15	57	19	9	35	53	30	38	17	3	0
4	96	0	0	0	10	71	15	4	41	49	24	64	5	3	0	0		0	3	5	76	14	5	40	75	19	37	5	1	0
33	67	0	0	0	34	33	0	33	0	0	0	100	0	0	0	0		0	0	34	33	33	0	67	33	33	67	0	0	0
65	30	2	3	0	19	52	19	10	30	57	33	65	6	4	1	0		2	2	11	38	38	13	26	54	39	40	13	4	0
86	11	3	0	0	8	69	15	8	26	70	26	62	0	1	0	0		0	1	6	54	30	10	24	80	28	45	2	1	0
100	0	0	0	0	60	40	0	0	20	100	0	40	0	0	0	0		0	0	20	60	20	0	20	80	40	60	20	0	0
41	46	12	0	1	35	44	15	6	33	56	40	59	7	5	2	1		3	2	29	44	22	5	30	57	36	51	16	11	1
35	60	5	0	0	26	62	10	2	27	64	32	68	3	1	1	0		3	1	17	69	10	4	25	84	18	51	8	3	0
60	30	10	0	0	27	27	37	9	10	40	40	60	20	0	0	0		27	0	28	18	27	27	13	88	25	50	13	0	0
32	47	15	0	6	30	38	20	12	31	44	48	56	9	5	1	0		8	13	21	39	27	13	35	52	33	40	15	9	1
25	69	5	0	1	22	63	13	2	31	44	44	69	2	1	0	0		3	6	17	66	13	4	37	72	17	47	6	1	1
66	17	17	0	0	28	29	29	14	0	17	0	67	17	0	0	0		43	0	28	29	14	29	20	40	0	20	0	0	20
64	28	7	0	1	15	58	20	7	35	47	33	60	4	2	1	1		0	11	12	44	36	8	34	59	28	41	5	1	1
90	10	0	0	0	1	80	18	1	35	62	28	69	0	1	0	0		0	4	2	69	23	6	36	77	21	47	1	2	1
100	0	0	0	0	0	100	0	0	0	33	33	100	0	0	0	0		0	0	0	100	0	0	0	100	0	67	0	0	0
55	45	0	0	0	24	41	27	8	39	58	38	63	5	2	0	0		4	10	18	37	29	16	38	57	37	39	6	2	1
78	22	0	0	0	5	71	21	3	35	67	31	70	1	1	0	0		0	1	3	66	23	8	37	77	23	43	2	2	1
78	22	0	0	0	33	45	11	11	13	63	25	75	0	0	0	0		0	0	11	67	11	11	25	63	25	38	0	0	0
63	28	6	0	3	12	47	30	11	33	45	29	56	4	3	1	1		1	10	9	38	38	15	34	50	35	40	7	3	0
91	9	0	0	0	3	67	26	4	34	60	20	71	0	1	0	0		1	4	2	53	35	10	31	81	27	36	2	2	1
100	0	0	0	0	0	50	0	50	100	100	0	100	0	0	0	0		0	0	0	50	0	50	100	100	0	100	0	0	0
28	61	10	0	1	29	43	21	7	41	40	41	69	5	2	1	0		1	7	15	40	30	15	47	53	29	37	5	2	0
18	82	0	0	0	13	68	14	5	43	41	35	73	2	1	0	0		2	1	6	60	25	9	48	78	14	29	2	2	1
33	67	0	0	0	38	45	17	0	42	29	38	67	0	4	0	0		0	0	21	49	13	17	40	65	15	35	0	5	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan					Time of technological realization		
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized	Do not know
				(%)					(%)					(%)	
26	Artificial photosynthesis technology utilizing dendrimers.	1	**100**	**14**	**20**	**66**	**-**	**52**	**25**	**37**	**35**	**3**		**8**	**14**
		2	**97**	**6**	**23**	**71**	**-**	**47**	**10**	**57**	**32**	**1**		**3**	**7**
		E	**6**	**100**	**0**	**0**	**-**	**50**	**17**	**66**	**0**	**17**		**33**	**0**
27	Precise polymerization processes that can voluntarily control at the molecular level stereoregularity, linkage structure, and molecule volume and distribution.	1	**107**	**18**	**24**	**58**	**-**	**64**	**37**	**46**	**16**	**1**		**4**	**5**
		2	**107**	**7**	**18**	**75**	**-**	**57**	**18**	**75**	**7**	**0**		**1**	**1**
		E	**7**	**100**	**0**	**0**	**-**	**64**	**29**	**71**	**0**	**0**		**14**	**0**
28	Technology to freely apply organic, inorganic, and metal materials at the nano level.	1	**148**	**20**	**28**	**52**	**-**	**76**	**56**	**38**	**6**	**0**		**1**	**6**
		2	**127**	**17**	**27**	**56**	**-**	**78**	**58**	**39**	**3**	**0**		**1**	**2**
		E	**22**	**100**	**0**	**0**	**-**	**95**	**91**	**9**	**0**	**0**		**0**	**0**

Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't																Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
45	48	6	0	1	18	45	22	15	46	36	43	58	3	4	1	0						11	19	12	43	29	16	46	42	26	33	11	4	0
43	57	0	0	0	7	66	22	5	51	35	30	67	0	1	0	0						5	7	4	64	24	8	60	64	10	23	2	1	0
67	33	0	0	0	0	83	0	17	40	40	20	80	0	0	0	0						33	0	17	66	0	17	40	40	0	60	0	0	0
48	42	10	0	0	21	43	25	11	40	45	42	60	4	4	1	0						4	9	12	42	32	14	43	53	31	40	7	2	0
66	34	0	0	0	10	71	15	4	34	57	29	70	0	1	0	0						1	1	7	63	25	5	47	84	16	35	1	1	0
100	0	0	0	0	14	58	14	14	17	67	17	50	0	0	0	0						14	0	0	43	43	14	33	50	67	33	0	0	0
39	52	8	0	1	34	42	17	7	44	48	46	71	8	2	1	0						1	7	20	46	23	11	48	54	33	37	6	3	0
26	74	0	0	0	18	68	11	3	44	53	38	75	1	1	0	0						1	2	9	69	15	7	48	82	14	37	2	2	1
41	59	0	0	0	36	64	0	0	41	45	41	82	0	0	0	0						0	0	32	49	14	5	29	76	10	48	5	5	5

V. New materials from nanolevel structure control

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

2) Current impacts

Large / Somewhat large / Moderate / Small / None

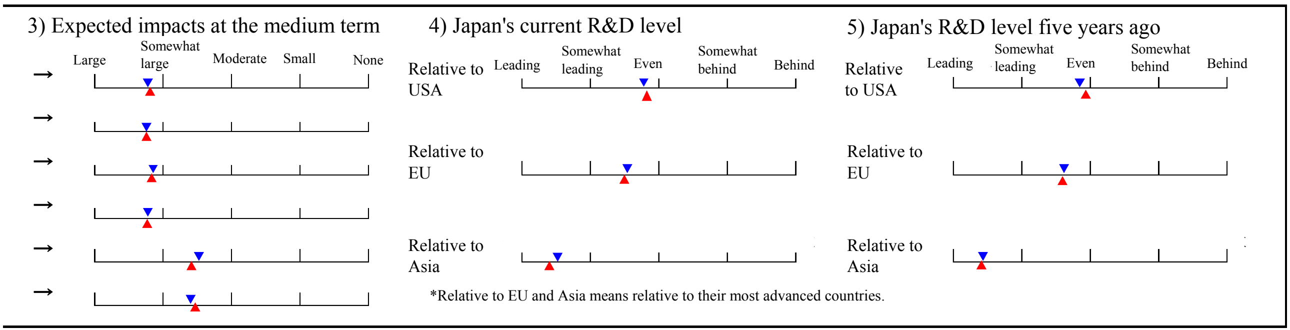
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

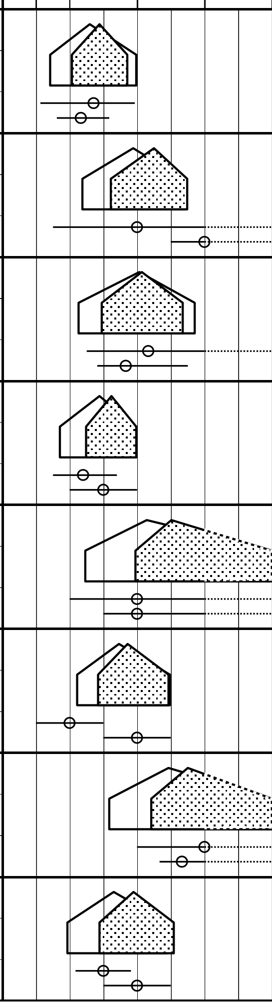
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

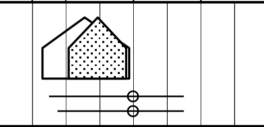
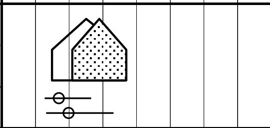
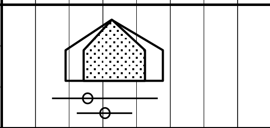
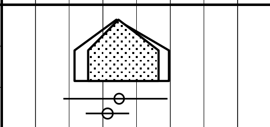
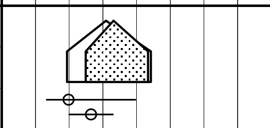
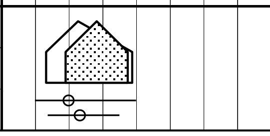
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
29	Biomedical ceramics that function approximately the same as human bone.	1	121	15	20	65	-	66	38	50	12	0		0	0
		2	106	5	18	77	-	61	24	72	4	0		0	2
		E	5	100	0	0	-	90	80	20	0	0		0	0
30	All-organic ferromagnets with a Curie point above room temperature.	1	83	7	25	68	-	57	27	50	22	1		5	14
		2	94	2	14	84	-	49	9	73	17	1		1	8
		E	2	100	0	0	-	100	100	0	0	0		0	0
31	Macromolecule materials with conductivity and environment resistance equivalent to copper at room temperature.	1	110	13	25	62	-	64	37	45	16	2		8	15
		2	105	6	22	72	-	58	21	71	7	1		5	5
		E	6	100	0	0	-	83	67	33	0	0		17	0
32	Lead-free ferroelectrics with a piezoelectric modulus equivalent to PZT (Pb [Zr, Ti] O3).	1	90	12	28	60	-	63	37	42	19	2		2	5
		2	94	4	22	74	-	53	16	67	16	1		0	0
		E	4	100	0	0	-	69	50	25	25	0		0	0
33	Macromolecule superconducting materials with transfer points above liquid nitrogen temperature.	1	104	13	21	66	-	61	34	46	16	4		10	19
		2	102	4	20	76	-	53	17	65	16	2		7	8
		E	4	100	0	0	-	69	50	25	25	0		25	25
34	Heat resistant alloys that can bear a load of 15 kgf/mm2 (about 150 MPa) for 1,000 hours at a high (atmospheric) temperature of 1200°C.	1	65	8	28	64	-	58	26	54	18	2		0	5
		2	74	3	20	77	-	53	14	74	11	1		0	4
		E	2	100	0	0	-	100	100	0	0	0		0	0
35	Superconductors with transfer points at room temperature and above.	1	108	16	22	62	-	79	65	23	10	2		11	27
		2	106	8	17	75	-	83	69	23	8	0		7	13
		E	8	100	0	0	-	91	87	0	13	0		13	38
36	Anisotropic nanocomposite magnets with a (BH)max=400 kJ/m3(50.3 MGOe) or greater through nanometer-scale control of heterostructure.	1	71	8	30	62	-	63	37	41	22	0		3	11
		2	76	3	12	85	-	58	21	70	9	0		0	4
		E	2	100	0	0	-	75	50	50	0	0		0	0



Countries at the leading edge (%)					Regarding technological realization													Time of social application							Regarding social application										
					Necessity of gov't involvement (%)				Effective measures that should be taken by gov't (%)													(%)		Necessity of gov't involvement (%)				Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
52	41	7	0	0	23	56	15	6	31	51	31	64	6	15	8	1						1	0	20	53	22	5	36	47	26	38	40	12	1
77	23	0	0	0	6	79	13	2	27	59	24	70	0	9	1	0						0	2	4	77	16	3	32	69	20	39	35	4	1
80	20	0	0	0	0	100	0	0	100	50	75	50	0	25	0	0						0	0	20	80	0	0	100	60	60	60	60	20	20
36	53	10	0	1	15	54	24	7	36	41	45	62	3	1	0	0						4	16	7	48	30	15	39	59	41	38	7	2	2
19	79	2	0	0	3	68	26	3	37	43	42	69	0	1	0	0						3	7	1	63	30	6	37	77	23	33	0	2	0
100	0	0	0	0	0	50	50	0	100	0	0	50	0	0	0	0						0	0	0	0	100	0	0	100	50	0	0	0	0
39	56	5	0	0	21	44	26	9	41	47	36	64	5	1	0	1						8	16	9	50	29	12	35	57	32	35	8	5	1
21	77	2	0	0	6	68	23	3	40	53	31	71	0	1	0	0						5	5	2	69	21	8	34	80	20	36	1	1	0
66	17	17	0	0	33	33	17	17	40	60	20	80	0	0	0	0						17	0	17	33	33	17	40	80	40	40	0	0	0
51	44	5	0	0	18	48	29	5	39	39	38	58	4	4	1	1						2	5	14	41	35	10	33	47	29	36	11	11	3
64	36	0	0	0	2	75	21	2	33	55	28	70	1	2	1	0						0	0	3	58	31	8	33	80	17	37	0	2	0
50	50	0	0	0	0	75	25	0	25	75	25	75	0	0	0	0						0	0	0	50	50	0	25	100	0	0	0	0	0
37	56	5	0	2	21	49	19	11	38	37	42	57	8	2	0	0						11	18	12	44	27	17	37	53	33	32	12	3	3
18	80	1	0	1	7	67	21	5	37	43	34	68	2	1	0	0						7	10	3	61	28	8	39	79	19	30	0	1	0
25	50	25	0	0	0	25	75	0	25	0	25	75	25	0	0	0						25	25	0	25	75	0	0	75	50	0	0	0	0
41	48	11	0	0	19	56	17	8	35	46	48	59	6	2	2	0						2	5	16	51	21	12	32	50	32	32	18	6	4
35	64	1	0	0	7	78	14	1	33	51	35	78	1	1	0	0						0	3	8	74	14	4	31	85	19	37	1	1	0
0	100	0	0	0	50	50	0	0	100	100	50	100	0	0	0	0						0	0	50	50	0	0	50	100	0	50	0	0	0
47	42	9	0	2	32	38	20	10	42	29	49	58	11	1	0	2						7	32	23	32	29	16	38	51	28	40	11	4	1
63	36	1	0	0	15	57	21	7	53	26	45	69	2	1	0	0						9	15	13	48	26	13	50	68	19	41	2	2	0
62	25	13	0	0	25	37	25	13	57	29	43	86	14	0	0	0						13	38	25	25	37	13	86	57	29	43	0	0	0
61	27	10	0	2	17	46	25	12	44	35	42	58	11	2	0	0						3	9	11	40	32	17	41	48	33	37	13	6	2
92	8	0	0	0	7	66	24	3	53	37	36	67	0	1	0	0						0	4	7	55	33	5	46	84	13	30	0	1	0
100	0	0	0	0	50	0	50	0	50	100	50	50	0	0	0	0						0	0	50	0	50	0	50	100	50	50	0	0	0



No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Degree of expertise: Moderate (%)	Degree of expertise: Low (%)	Degree of expertise: None (%)	Importance to Japan: Index	Importance to Japan: High (%)	Importance to Japan: Moderate (%)	Importance to Japan: Low (%)	Importance to Japan: None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
37	Insulating materials with a dielectric constant of 1.3 or less for ultra-LSI.	1	**91**	**10**	**32**	**58**	**-**	**74**	**54**	**37**	**8**	**1**		**2**	**7**
		2	**90**	**9**	**22**	**69**	**-**	**82**	**67**	**29**	**3**	**1**		**1**	**0**
		E	**8**	**100**	**0**	**0**	**-**	**81**	**62**	**38**	**0**	**0**		**13**	**0**
38	Large-area amorphous silicon solar cells with a conversion efficiency above 20 percent.	1	**118**	**14**	**27**	**59**	**-**	**84**	**71**	**23**	**5**	**1**		**10**	**4**
		2	**104**	**8**	**25**	**67**	**-**	**88**	**78**	**18**	**3**	**1**		**5**	**1**
		E	**8**	**100**	**0**	**0**	**-**	**78**	**62**	**25**	**13**	**0**		**0**	**0**
39	Organic and inorganic compound materials that express new functions or innovative properties through structures controlled at the nanometer level.	1	**142**	**27**	**25**	**48**	**-**	**70**	**45**	**48**	**7**	**0**		**0**	**6**
		2	**133**	**18**	**28**	**54**	**-**	**67**	**37**	**59**	**4**	**0**		**0**	**2**
		E	**24**	**100**	**0**	**0**	**-**	**85**	**70**	**30**	**0**	**0**		**0**	**0**
40	Nanomaterials that show practical, meaningful stimulus response at necessary times and places.	1	**129**	**18**	**30**	**52**	**-**	**65**	**36**	**51**	**12**	**1**		**1**	**7**
		2	**117**	**15**	**30**	**55**	**-**	**60**	**25**	**68**	**6**	**1**		**0**	**2**
		E	**17**	**100**	**0**	**0**	**-**	**83**	**69**	**25**	**6**	**0**		**0**	**0**
41	Semiconductor diamonds at a practical level.	1	**94**	**9**	**30**	**61**	**-**	**59**	**28**	**52**	**20**	**0**		**2**	**5**
		2	**88**	**5**	**19**	**76**	**-**	**53**	**14**	**69**	**17**	**0**		**0**	**2**
		E	**4**	**100**	**0**	**0**	**-**	**63**	**25**	**75**	**0**	**0**		**0**	**0**
42	Light and composite structure materials from carbon nanotubes.	1	**113**	**14**	**32**	**54**	**-**	**61**	**30**	**52**	**18**	**0**		**1**	**2**
		2	**110**	**6**	**29**	**65**	**-**	**55**	**16**	**72**	**12**	**0**		**0**	**0**
		E	**7**	**100**	**0**	**0**	**-**	**57**	**29**	**42**	**29**	**0**		**0**	**0**

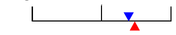
Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
49	49	1	0	1	27	43	19	11	35	52	37	61	13	3	0	1						1	5	22	32	31	15	33	65	28	39	9	4	0
67	33	0	0	0	9	69	20	2	30	64	28	76	2	1	0	1						1	0	7	58	26	9	26	86	15	45	1	3	1
100	0	0	0	0	38	49	13	0	25	63	50	63	13	0	0	13						14	0	13	74	0	13	14	71	29	29	0	0	14
88	11	1	0	0	36	42	14	8	30	60	32	68	10	5	4	0						7	7	28	42	22	8	28	46	28	52	20	15	0
100	0	0	0	0	23	56	16	5	29	67	24	76	1	1	0	0						5	1	21	53	21	5	26	65	24	66	12	7	0
100	0	0	0	0	36	38	13	13	57	57	43	71	0	0	0	0						0	0	36	13	38	13	14	57	29	71	14	14	0
43	49	6	0	2	31	46	18	5	46	42	42	65	8	3	1	1						1	10	20	46	22	12	50	59	33	32	8	3	0
39	59	1	1	0	14	72	12	2	54	51	33	75	2	1	0	0						0	2	7	66	22	5	47	81	23	31	3	2	2
54	46	0	0	0	33	63	4	0	54	54	38	75	8	0	0	0						0	0	21	62	17	0	50	79	21	46	17	4	4
50	43	5	0	2	28	44	22	6	48	44	36	63	8	5	2	2						3	9	18	49	20	13	45	63	29	36	14	5	0
62	37	1	0	0	12	76	11	1	51	51	30	72	2	1	0	0						0	2	8	70	20	2	40	78	25	30	6	2	2
71	29	0	0	0	35	59	6	0	41	65	29	82	0	0	0	0						0	0	25	62	13	0	38	81	31	25	6	0	0
58	34	8	0	1	22	51	20	7	47	53	30	62	9	3	1	0						2	5	14	46	26	14	47	64	36	38	7	3	1
90	9	1	0	0	3	69	26	2	39	60	24	69	0	1	0	0						1	0	2	61	29	8	36	88	20	33	4	4	1
100	0	0	0	0	25	50	25	0	100	50	50	75	0	0	0	0						0	0	34	33	0	33	50	100	50	50	0	0	0
71	27	0	2	0	24	39	30	7	38	57	38	59	5	3	0	2						1	2	14	45	30	11	37	60	39	37	12	4	1
88	11	1	0	0	4	66	29	1	33	71	29	65	0	1	0	0						0	0	3	66	27	4	27	80	33	40	5	2	1
57	43	0	0	0	14	57	29	0	29	71	29	57	0	0	0	0						0	0	14	57	29	0	29	71	14	43	0	0	0

VI. Nano devices and sensors

1. Questions regarding the relevant area

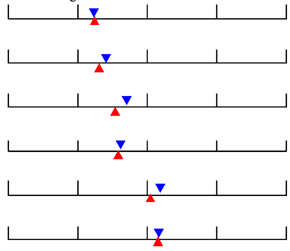
1) Degree of expertise in the area

High Moderate Low

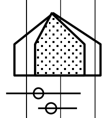
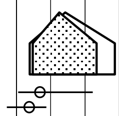
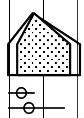
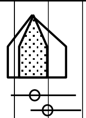
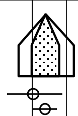
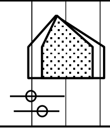


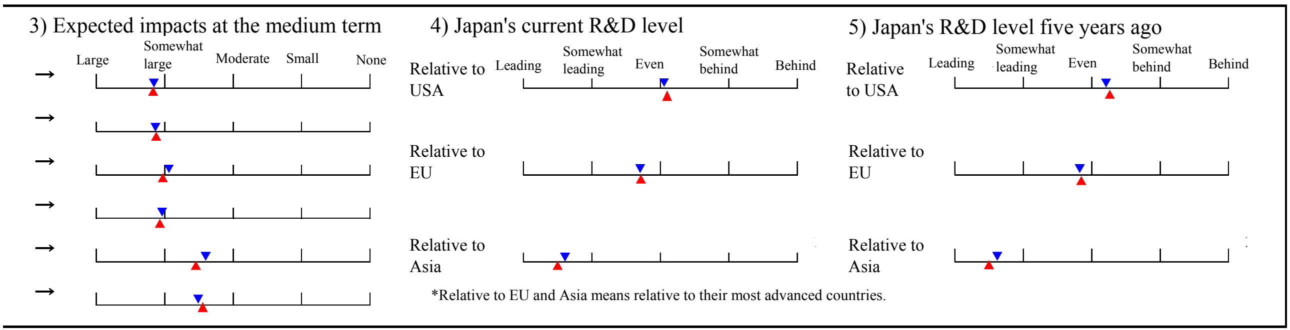
2) Current impacts

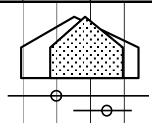
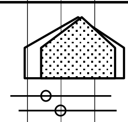
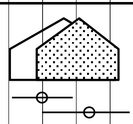
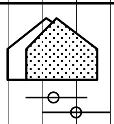
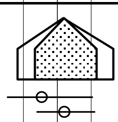
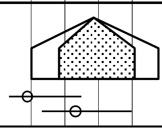
Large | Somewhat large | Moderate | Small | None

[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
43	Single-electron memory devices	1	104	17	25	58	-	68	42	47	9	2		6	8
		2	100	6	31	63	-	60	27	62	8	3		7	0
		E	6	100	0	0	-	29	0	50	17	33		40	0
44	Devices that utilize the switching functions of single molecules and atoms.	1	118	17	29	54	-	71	47	43	8	2		3	9
		2	111	9	29	62	-	68	43	47	7	3		3	3
		E	10	100	0	0	-	90	80	20	0	0		0	0
45	Molecular devices and sensors that use protein or DNA as elements.	1	124	16	27	57	-	69	44	44	11	1		1	4
		2	119	10	24	66	-	70	41	55	3	1		0	2
		E	12	100	0	0	-	96	92	8	0	0		0	0
46	Ultrahigh-speed optical switching devices with an order of femtosecond switching time.	1	93	12	32	56	-	70	45	47	7	1		0	7
		2	93	3	30	67	-	62	29	63	7	1		0	0
		E	3	100	0	0	-	33	0	67	0	33		0	0
47	Devices and sensors manufactured with nanometer precision.	1	123	23	31	46	-	75	54	38	8	0		0	4
		2	115	13	37	50	-	80	62	33	4	1		0	0
		E	15	100	0	0	-	90	80	20	0	0		0	0
48	Technology that measures/controls spin polarization at the atomic and molecular levels.	1	90	14	17	69	-	62	33	48	19	0		1	9
		2	95	6	20	74	-	59	22	69	9	0		0	2
		E	6	100	0	0	-	75	50	50	0	0		0	0



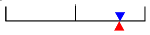
Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
42	48	10	0	0	22	53	17	8	49	47	35	65	15	2	1	0		6	13	16	43	25	16	44	58	25	39	9	4	0
42	57	1	0	0	11	65	18	6	52	44	28	73	3	1	0	0		8	1	6	57	25	12	48	81	15	30	0	1	0
80	20	0	0	0	0	20	40	40	33	33	33	67	0	0	0	0		40	0	0	20	20	60	0	50	50	0	0	0	0
23	70	6	0	1	30	45	18	7	50	36	41	65	11	3	0	0		4	15	21	37	29	13	42	58	18	38	10	2	0
11	88	0	1	0	16	65	16	3	60	33	37	77	4	1	0	0		5	2	9	63	21	7	51	78	13	38	1	1	0
10	90	0	0	0	30	60	10	0	70	30	50	80	0	0	0	0		0	0	20	60	10	10	88	75	13	50	0	0	0
24	72	4	0	0	34	46	17	3	44	49	33	68	11	4	1	0		1	8	24	41	29	6	42	56	32	37	15	3	0
7	93	0	0	0	20	69	10	1	43	50	30	72	0	2	0	0		0	2	13	69	14	4	48	82	20	32	5	1	0
17	83	0	0	0	42	50	8	0	67	42	25	83	0	0	0	0		0	0	33	50	17	0	75	67	25	58	0	0	0
38	59	2	0	1	26	52	17	5	35	43	30	69	8	1	0	0		0	8	23	44	25	8	37	67	26	39	7	4	1
24	75	1	0	0	7	76	16	1	34	51	21	78	3	1	0	0		0	0	5	70	19	6	36	81	15	43	1	1	0
100	0	0	0	0	0	0	100	0	50	50	0	50	0	0	0	0		0	0	0	50	50	0	0	50	100	0	0	0	0
33	58	7	1	1	36	46	16	2	44	48	39	70	10	2	0	0		0	5	32	36	24	8	46	58	28	42	5	2	0
16	83	1	0	0	18	68	14	0	44	53	27	77	2	1	0	0		0	1	12	65	18	5	41	81	21	46	3	2	1
27	73	0	0	0	40	47	13	0	60	60	47	80	0	0	0	0		0	0	41	33	13	13	54	77	23	46	8	0	0
38	55	7	0	0	23	49	24	4	48	37	33	66	10	1	0	0		1	16	18	38	35	9	51	44	22	47	6	1	0
12	87	1	0	0	9	74	16	1	55	30	33	78	2	1	0	0		0	3	8	63	25	4	60	62	11	44	1	1	0
17	83	0	0	0	17	49	17	17	40	20	60	80	0	0	0	0		0	0	17	49	17	17	80	60	20	20	0	0	0

VII. NEMS technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

High　Moderate　Low



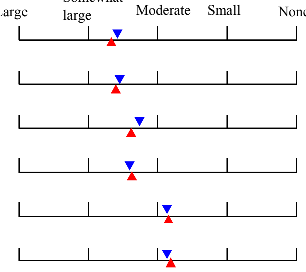
2) Current impacts

Large　Somewhat large　Moderate　Small　None

[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

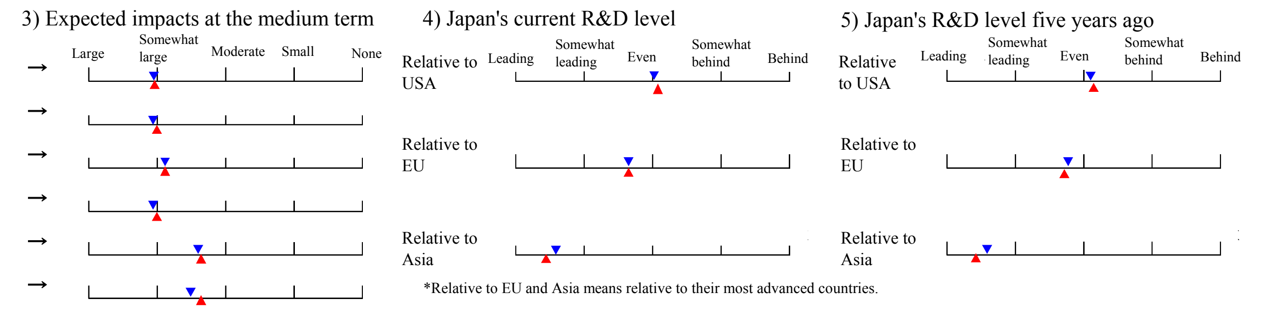
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

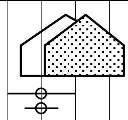
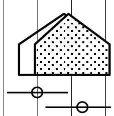
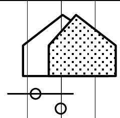
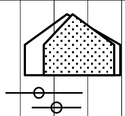
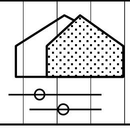
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
49	NEMS that uses Brownian motion as its motive energy.	1	70	7	21	72	-	52	22	47	27	4							6	12
		2	75	4	11	85	-	48	11	62	24	3							3	11
		E	3	100	0	0	-	50	0	100	0	0							0	0
50	Nanosurgery manipulators (manipulators that directly manipulate, excise, join, and process biomolecules) for biomolecules.	1	84	11	29	60	-	66	43	39	16	2							2	7
		2	90	7	18	75	-	74	52	40	8	0							0	7
		E	6	100	0	0	-	100	100	0	0	0							0	0
51	Mechanical switching elements that operate at 10 GHz and above and have outstanding ON/OFF characteristics.	1	71	13	27	60	-	57	28	44	27	1							1	15
		2	80	1	24	75	-	52	15	67	14	4							3	4
		E	1	100	0	0	-	100	100	0	0	0							0	0
52	Multi-nanoprobe spectroscopic analysis, processing control, and operating technology that enables multi-sensing and multi-processing at the nanometer level of the functional structure of biomolecules such as nano semiconductor devices, molecular devices,	1	124	15	29	56	-	69	45	43	11	1							1	7
		2	114	14	19	67	-	70	44	50	5	1							0	2
		E	16	100	0	0	-	100	100	0	0	0							0	0
53	Probe array-type sensor elements sensitive enough to detect single molecules.	1	104	14	25	61	-	65	37	50	12	1							2	10
		2	102	11	17	72	-	55	16	74	10	0							1	5
		E	11	100	0	0	-	75	55	36	9	0							9	0

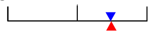


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
25	62	6	2	5	21	50	19	10	49	39	47	49	4	4	0	0		5	14	11	50	28	11	44	54	30	30	11	2	2
8	91	1	0	0	8	67	24	1	63	29	39	61	0	3	0	0		3	11	3	63	28	6	53	75	16	28	1	1	1
67	33	0	0	0	67	33	0	0	100	67	33	100	0	0	0	0		0	33	33	67	0	0	100	67	67	100	0	0	0
31	60	6	0	3	31	39	26	4	45	45	47	66	5	9	0	0		1	10	24	37	32	7	44	56	30	32	23	4	1
11	89	0	0	0	18	61	20	1	53	43	40	70	0	3	0	0		0	8	11	66	20	3	55	78	27	30	10	1	0
67	33	0	0	0	67	0	33	0	67	50	50	100	0	17	0	0		0	17	34	33	33	0	67	67	67	83	33	0	0
41	54	5	0	0	17	53	25	5	32	50	39	65	3	2	0	0		1	16	13	43	33	11	36	59	32	41	5	2	0
19	78	3	0	0	6	68	23	3	36	57	27	72	0	1	0	0		1	4	5	61	26	8	39	79	23	32	0	1	0
100	0	0	0	0	100	0	0	0	100	100	100	100	0	0	0	0		0	0	100	0	0	0	100	100	100	100	0	0	0
30	60	10	0	0	32	50	16	2	45	50	46	69	8	4	0	0		1	9	18	45	30	7	47	54	42	45	12	1	0
12	87	1	0	0	17	69	14	0	46	59	37	74	2	1	0	0		0	3	10	67	19	4	52	81	25	43	2	1	0
31	69	0	0	0	56	38	6	0	75	75	56	100	0	0	0	0		0	0	19	68	13	0	75	81	56	69	6	0	0
16	66	17	0	1	26	54	18	2	41	47	39	63	7	3	0	0		2	11	20	46	25	9	42	57	32	39	12	4	1
6	87	7	0	0	11	71	17	1	46	51	31	70	1	2	1	0		1	5	7	66	22	5	52	74	24	35	1	1	0
9	55	36	0	0	46	36	18	0	73	55	45	100	0	0	0	0		9	0	36	46	9	9	80	70	70	60	0	0	0

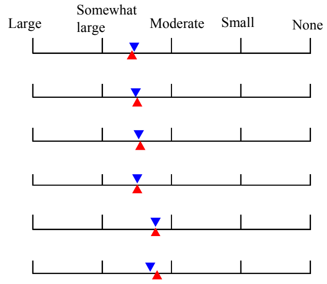
VIII. Environment and energy materials

1. Questions regarding the relevant area

1) Degree of expertise in the area

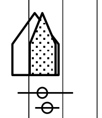
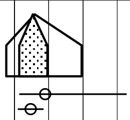
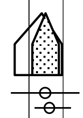
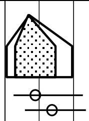
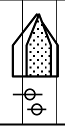


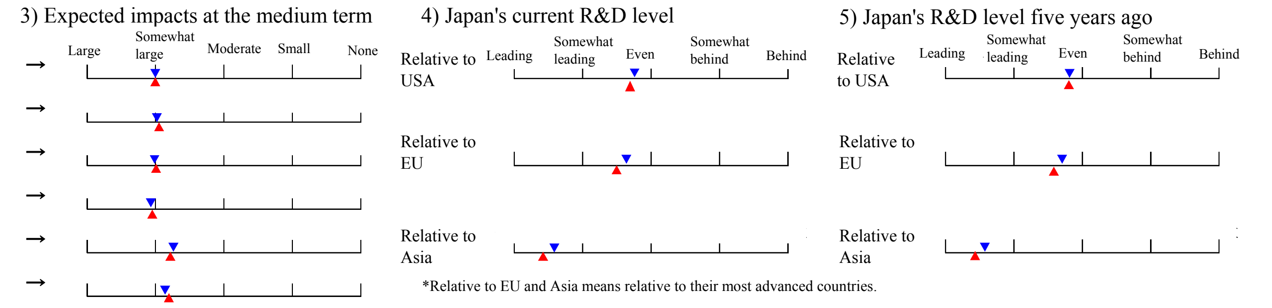
2) Current impacts



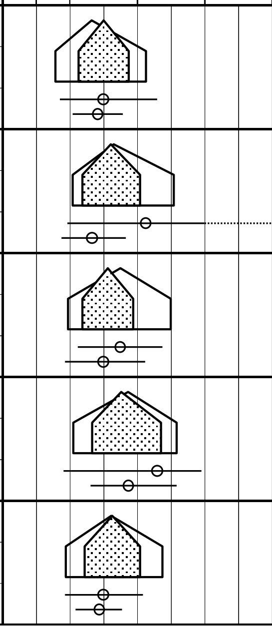
Category	Item
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
54	Direct catalytic production of hydrogen from methane at low temperature	1	92	21	24	55	-	71	49	39	11	1		2	4
		2	97	11	27	62	-	81	67	27	5	1		1	1
		E	11	100	0	0	-	86	82	9	0	9		9	0
55	Hydrogen production processes through photocatalytic decomposition of water with sunlight	1	104	20	18	62	-	76	57	31	12	0		1	5
		2	110	13	22	65	-	88	77	18	4	1		1	4
		E	14	100	0	0	-	89	79	21	0	0		7	7
56	Production of iron by a new economical method with hydrogen as reductant instead of coke.	1	67	12	18	70	-	57	26	56	13	5		3	8
		2	77	9	10	81	-	53	12	77	11	0		0	1
		E	7	100	0	0	-	68	43	43	14	0		0	0
57	Catalytic fixation of carbon dioxide that will solve one of the global environmental problems.	1	102	17	24	59	-	70	47	43	6	4		3	9
		2	99	11	16	73	-	77	59	33	5	3		2	3
		E	11	100	0	0	-	70	64	9	9	18		9	0
58	Complete control of nanopores in separation membranes.	1	109	14	28	58	-	57	25	56	18	1		0	5
		2	103	11	25	64	-	55	15	77	8	0		0	2
		E	11	100	0	0	-	82	64	36	0	0		0	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
51	42	5	1	1	36	49	10	5	31	41	41	67	8	8	4	0						3	8	33	41	18	8	39	51	29	45	25	8	1
75	23	1	1	0	25	67	6	2	31	57	36	79	1	3	1	0						1	3	21	66	9	4	29	75	19	55	17	3	1
82	9	0	9	0	55	36	9	0	36	64	18	45	9	0	0	0						9	9	55	36	9	0	36	55	9	64	9	0	9
70	23	7	0	0	42	40	14	4	37	45	39	68	9	5	3	0						4	9	39	41	15	5	34	47	30	54	22	11	1
93	4	3	0	0	39	48	11	2	32	56	26	79	2	4	1	0						2	5	28	58	11	3	28	69	17	65	15	5	0
93	0	7	0	0	65	14	21	0	36	43	14	57	7	0	0	0						7	7	46	31	23	0	38	54	15	46	8	8	0
63	31	4	0	2	25	51	13	11	37	55	29	55	10	10	8	0						7	8	21	52	16	11	46	52	24	38	18	6	2
92	8	0	0	0	12	66	19	3	27	66	23	70	3	3	1	0						0	1	12	71	12	5	35	74	14	49	7	4	0
100	0	0	0	0	0	71	29	0	14	29	29	43	29	0	0	0						0	0	14	72	14	0	29	57	0	43	14	0	0
52	34	13	0	1	41	41	11	7	41	41	34	64	10	7	8	0						6	14	39	39	14	8	36	51	29	42	16	16	0
91	8	1	0	0	38	51	7	4	39	54	25	77	4	3	3	0						2	3	38	49	8	5	32	80	16	58	10	4	1
91	0	9	0	0	36	46	9	9	30	50	20	60	20	0	0	0						9	9	27	46	18	9	30	60	0	40	10	0	10
52	40	6	0	2	21	50	18	11	31	52	42	63	9	3	1	0						0	7	17	49	19	15	33	58	30	49	11	5	0
80	20	0	0	0	5	81	12	2	27	57	26	73	2	1	0	0						0	3	6	75	15	4	26	80	17	55	5	3	1
91	9	0	0	0	9	91	0	0	18	55	18	55	0	0	0	0						0	0	18	82	0	0	9	73	0	55	0	0	0

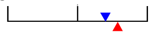


IX. Nanobiology

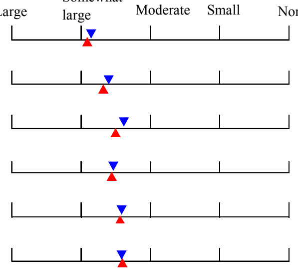
1. Questions regarding the relevant area

1) Degree of expertise in the area

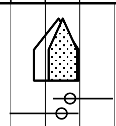
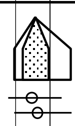
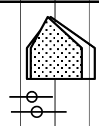
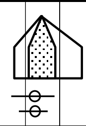
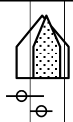
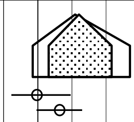
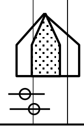
High Moderate Low

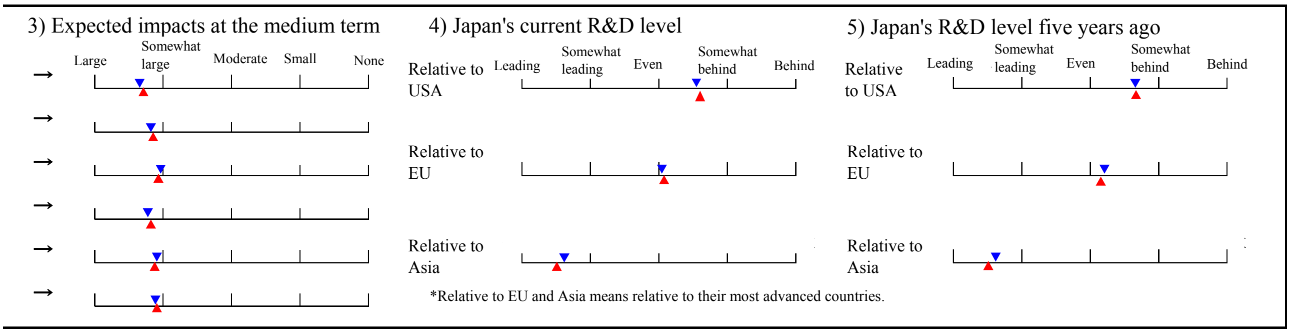


2) Current impacts

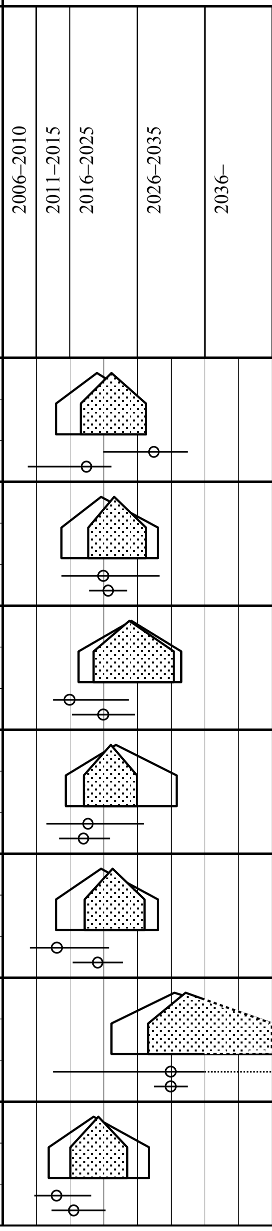
		Large / Somewhat large / Moderate / Small / None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
59	Technology to predict three-dimensional structure from the primary sequence structure of proteins with about 30,000 molecules.	1	88	9	24	67	-	63	34	52	14	0		0	7
		2	92	4	18	78	-	56	16	76	8	0		0	0
		E	4	100	0	0	-	75	50	50	0	0		0	0
60	Actuators made from intelligent materials that can be utilized in medical devices for the in vivo use such as microsurgery.	1	105	12	27	61	-	68	40	50	10	0		0	3
		2	99	8	29	63	-	66	34	63	3	0		0	1
		E	8	100	0	0	-	81	62	38	0	0		0	0
61	Hybrid-type artificial organs with self-organized tissue derived from stem cells.	1	101	18	27	55	-	71	47	45	8	0		0	6
		2	100	13	19	68	-	76	54	43	3	0		0	2
		E	13	100	0	0	-	96	92	8	0	0		0	0
62	Nanocarrier systems that deliver drugs and genes to target cells in the body and are directed by outside signals.	1	116	33	22	45	-	74	52	41	7	0		1	1
		2	115	17	27	56	-	83	68	28	4	0		0	0
		E	20	100	0	0	-	98	95	5	0	0		0	0
63	Cell tissue sensors (biosensors composed of cells and tissue) used in place of animal experimentation.	1	90	17	27	56	-	65	40	39	21	0		2	2
		2	97	9	23	68	-	68	41	47	12	0		0	0
		E	9	100	0	0	-	94	89	11	0	0		0	0
64	Biocomputer devices utilizing cultured nerve cell networks.	1	81	10	20	70	-	51	19	48	29	4		9	8
		2	85	5	9	86	-	51	14	62	23	1		5	4
		E	4	100	0	0	-	75	50	50	0	0		0	0
65	Biochip diagnostic systems that can accurately diagnose onset risk for cancer and other serious diseases and supply information for setting treatment within a very short time.	1	115	20	19	61	-	81	63	32	5	0		0	2
		2	106	14	19	67	-	87	76	20	4	0		0	2
		E	15	100	0	0	-	100	100	0	0	0		0	0



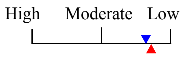
Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (%): Will not be applied	Do not know	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
17	78	4	0	1	24	57	13	6	37	36	44	63	8	5	1	0	0	8	17	52	18	13	42	53	29	40	10	1	0
4	95	1	0	0	12	72	13	3	44	35	42	70	1	3	1	0	0	1	9	69	16	6	44	76	19	42	0	1	0
0	100	0	0	0	50	50	0	0	75	25	50	100	0	0	0	0	0	25	50	50	0	0	75	25	50	75	0	0	0
32	64	3	0	1	29	54	16	1	39	48	38	68	7	17	2	0	0	4	19	56	22	3	40	52	31	41	27	10	1
18	82	0	0	0	16	75	8	1	32	62	28	78	0	9	1	0	0	1	13	74	11	2	39	82	18	43	18	1	0
38	62	0	0	0	50	50	0	0	63	50	63	100	0	13	0	0	0	0	38	49	13	0	63	88	50	50	38	0	0
23	75	1	0	1	44	43	12	1	43	47	42	64	10	25	8	0	4	8	41	45	13	1	36	48	32	39	39	17	0
11	89	0	0	0	41	49	8	2	50	60	36	74	1	19	1	0	0	1	35	51	13	1	40	77	26	37	36	11	1
46	54	0	0	0	92	8	0	0	77	54	62	77	0	46	0	0	0	0	69	31	0	0	46	77	46	31	38	8	0
33	64	3	0	0	41	45	11	3	42	55	42	66	9	21	4	0	2	2	37	45	15	3	32	52	33	41	49	13	0
17	82	1	0	0	34	52	13	1	39	60	29	79	5	16	1	0	0	0	32	55	12	1	34	75	21	42	49	5	2
32	68	0	0	0	70	25	5	0	35	50	25	100	0	20	0	0	0	0	74	26	0	0	32	74	16	47	58	0	5
17	76	6	0	1	34	45	19	2	38	49	37	67	14	17	2	0	0	4	31	43	22	4	38	49	28	37	36	16	1
5	95	0	0	0	23	65	11	1	41	55	26	72	4	10	1	0	0	0	17	66	16	1	41	74	20	38	25	3	1
44	56	0	0	0	89	11	0	0	67	56	33	89	0	11	0	0	0	0	56	44	0	0	56	67	22	44	11	0	0
7	88	4	0	1	18	46	27	9	47	41	47	59	10	9	0	0	7	11	17	51	23	9	48	48	18	36	22	4	1
0	98	1	1	0	10	69	17	4	55	40	36	65	5	1	0	0	10	5	8	68	18	6	58	77	12	36	4	3	0
0	100	0	0	0	25	75	0	0	75	50	50	50	25	0	0	0	0	0	25	75	0	0	75	75	25	50	0	0	0
16	80	2	0	2	48	38	13	1	39	55	40	64	11	14	7	0	0	2	40	43	15	2	35	51	39	44	41	14	1
7	93	0	0	0	59	31	9	1	47	67	35	71	4	12	2	0	0	2	41	49	8	2	40	75	30	47	36	7	1
20	80	0	0	0	73	27	0	0	67	60	33	87	0	7	0	0	0	0	67	33	0	0	40	80	47	40	33	7	0



X. Nanoscience for a safe and secure society

1. Questions regarding the relevant area

1) Degree of expertise in the area

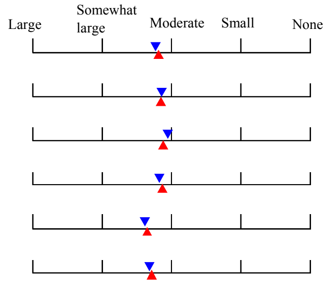


2) Current impacts

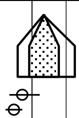
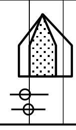
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

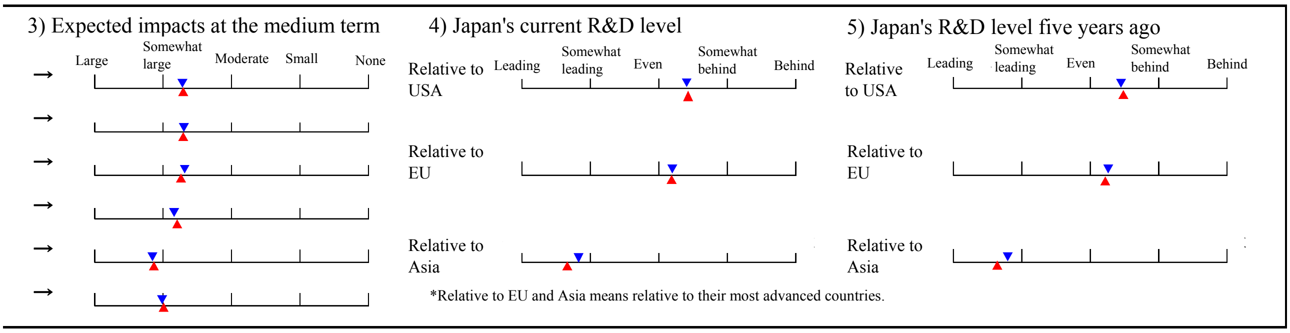
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High	Moderate	Low	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know (%)
66	Establishment of safety standards for DDS capsule materials and doses.	1	**90**	**14**	**21**	**65**	-	**72**	**52**	**34**	**13**	**1**								
		2	**94**	**4**	**16**	**80**	-	**82**	**67**	**26**	**6**	**1**								
		E	**4**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**								
67	Establishment of safety standards for nanoparticles in consumer goods such as cosmetics and foods.	1	**105**	**10**	**20**	**70**	-	**68**	**45**	**39**	**16**	**0**								
		2	**100**	**3**	**20**	**77**	-	**73**	**52**	**37**	**10**	**1**								
		E	**3**	**100**	**0**	**0**	-	**83**	**67**	**33**	**0**	**0**								
68	Establishment of manufacturing standards for diagnostic DNA and protein chips.	1	**93**	**14**	**15**	**71**	-	**71**	**51**	**33**	**14**	**2**								
		2	**96**	**3**	**19**	**78**	-	**76**	**59**	**31**	**8**	**2**								
		E	**3**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**								
69	Advanced authentication technology utilizing DNA tags.	1	**83**	**5**	**20**	**75**	-	**59**	**35**	**35**	**26**	**4**							**3**	**3**
		2	**92**	**3**	**15**	**82**	-	**61**	**28**	**62**	**8**	**2**							**0**	**1**
		E	**3**	**100**	**0**	**0**	-	**83**	**67**	**33**	**0**	**0**							**0**	**0**
70	Virus detection technology utilizing protein chips with activity equivalent to that of life forms.	1	**79**	**11**	**18**	**71**	-	**67**	**43**	**43**	**13**	**1**							**0**	**5**
		2	**91**	**9**	**15**	**76**	-	**72**	**47**	**49**	**3**	**1**							**0**	**0**
		E	**8**	**100**	**0**	**0**	-	**94**	**87**	**13**	**0**	**0**							**0**	**0**



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application					(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
																						0	1	60	32	8	0	31	46	19	16	41	46	0
																						0	1	74	19	7	0	32	68	10	10	44	48	0
																						0	0	100	0	0	0	0	67	33	0	100	0	0
																						1	3	51	32	16	1	32	43	17	16	37	49	2
																						0	0	64	28	7	1	30	70	6	11	34	49	1
																						0	0	50	50	0	0	50	50	0	0	50	0	0
																						0	5	56	23	16	5	36	49	17	25	35	49	1
																						0	0	70	19	10	1	33	73	8	13	34	48	0
																						0	0	100	0	0	0	50	100	0	50	0	50	0
4	91	1	0	4	27	40	25	8	43	42	45	49	9	9	12	0						3	4	32	39	22	7	38	45	25	34	31	32	3
0	100	0	0	0	15	67	17	1	45	56	42	69	4	7	4	0						0	1	20	66	13	1	33	80	20	28	23	22	0
0	100	0	0	0	34	33	33	0	33	100	33	67	0	0	0	0						0	0	34	33	33	0	33	100	0	33	0	33	0
7	86	3	0	4	34	39	19	8	37	49	40	59	9	9	7	0						1	5	33	45	19	3	36	45	29	33	28	25	1
1	98	1	0	0	24	62	13	1	41	55	38	79	2	5	2	0						0	1	20	69	10	1	37	80	21	36	20	17	0
14	86	0	0	0	75	25	0	0	63	63	50	88	0	0	0	0						0	13	38	62	0	0	63	63	38	50	0	0	0

10. Manufacturing field

10.1. Overview

(1) Background

Japan, of course, is a country built on trade, importing raw materials, processing them, and exporting them to other countries. Skilled manufacturing is Japan's lifeblood. In the past, there was a time when simply manufacturing products was the goal, but as society progressed and manufacturing technology evolved, products that are durable, have outstanding design, or provide other added value have come to be demanded. It is no longer easy to stay ahead of China and other relatively low wage countries simply by manufacturing products.

Shifting the focus inside Japan, the existing trend towards an aging society with a low birthrate is accelerating, and future labor shortages are a concern. Many issues related to how to compensate for a labor shortage expected to reach 2 million workers by 2020 must be examined, from increasing the roles of women and the elderly while further saving labor with robot technology to accepting workers from overseas. Furthermore, considering the shift of young people away from manufacturing jobs, education system reform that points out the satisfaction of skilled manufacturing work should also be examined.

(2) The designation process and its meaning and importance

First, we will describe the characteristics of this analysis. Although the process for designating individual topics based on the study framework was the same as that of the 7th Science and Technology Foresight Survey, in the framework we set the terms with the "category" of manufacturing process on the horizontal axis and "relationship" to "purpose" on the vertical axis. In addition, within the framework, we set the area by bundling the individual topics. This resulted in setting the following 9 areas (with "other individual foresight topics" added to make 10).

1. "Manufacturing technology utilizing advanced information technology"
2. "Manufacturing technology using virtual design"
3. "Manufacturing technology for high-value added products"
4. "Nano-machining/micromachining technology"
5. "Recycling-oriented manufacturing technology with a low environmental load"
6. "Human and robot participation in manufacturing"
7. "Manufacturing technology in special environments"
8. "Advanced manufacturing technology for social infrastructure"
9. "Surface modification and interface control technology"
10. "Other individual foresight topics"

The first main point is that individual topics bundled as "information" in the previous survey are scattered in 5 different areas this time. "Manufacturing technology utilizing advanced information technology" is characterized by OS technology for manufacturing, remote control, on-demand manufacturing, and so on. "Manufacturing technology using virtual design" is characterized by research and development based on virtual spaces, etc. "Manufacturing technology for high-value added products" is characterized by tailor-made manufacturing and so on through high-mix, low-volume production with forecasting the need. "Nano-machining/micromachining technology" is characterized by ultra-precision processing technology, net shape processing technology, and so on. "Human and robot participation in manufacturing" is characterized by upgrading robot technology through work and cognitive support.

Next, looking at "environment" and "energy," which were individual topics in the previous survey, we concentrated most of these in one area, "recycling-oriented manufacturing technology with a low environmental load," while "biology" and "welfare" were assigned to suitable areas. A further difference from the previous survey is the handling of manufacturing technology for heavy structures as "advanced manufacturing technology for social infrastructure." This manufacturing technology for steel, shipping, buildings, and other heavy structures is positioned as important infrastructure technology to maintain and build a safe and secure society. In addition, as "other" topics, we set individual educational topics such as technical education programs related to skilled manufacturing and elementary and middle school education emphasizing math and science.

(3) Results and policies

We will briefly summarize the expected current and medium-term impacts and Japan's research and development from the questionnaire survey results. First, the largest expected impacts either currently or in the medium term (2015–2025) are the contributions of "nano-machining/ micromachining technology" to increased intellectual assets and to the creation of new industries or businesses and the contribution of "recycling-oriented manufacturing technology with a low environmental load " to safe and secure society. In addition to the two areas above, medium-term expectations are high for areas such as "human and robot participation in manufacturing." The largest increase in expectations from the current time to the medium term is in "manufacturing technology in special environments" such as zero gravity environment. Fields with which manufacturing technology should collaborate over the coming 5 to 10 years are first, "information and communications" and second, "nanotechnology and materials." Underlying this is the extreme importance of their relationships with the manufacturing field.

Next, looking at Japan's R&D level, in areas related to information technology (IT), which was indicated as a field for collaboration over the coming 5 to 10 years, responses putting Japan behind the USA stood out ("manufacturing technology using virtual design" and "manufacturing technology utilizing advanced information technology"). Looking at the time axis, long-term fields, with which government should naturally be involved, are seen as suitable, but for manufacturing, the short-term topic of active government involvement in collaboration with the information sector is also seen as desirable.

In addition, the degree of importance index is calculated in the questionnaire survey as the degree of importance to Japan. According to this index, above-mentioned areas such as "recycling-oriented manufacturing technology with a low environmental load," "nano-machining/ micromachining technology," "manufacturing technology using virtual design," and "manufacturing technology utilizing advanced information technology" are among the leaders. Moreover, we note that three topics listed as "other" received high scores. They are "Implementation of a new elementary and secondary education scheme that emphasizes science and mathematics to make Japan a world leader in science and technology (topic no.59)," "A technological education program that ensures the handing down of expertise and craftsmanship by establishing technology for converting implicit knowledge on manufacturing and manufacturing technique (e.g. basic techniques and skills, know-how, experience) into explicit knowledge (topic no. 56)," and "Promotion of human resources mobility that is promoted across industry, academia, and government, leading to a greater number of joint or collaboration projects, and consequently bringing about innovations in manufacturing technology. (topic no. 58)."

In addition to the above, the subcommittee discussed issues that should be addressed, and government support based on the questionnaire survey results. The main points reached were as follows.

For "manufacturing technology utilizing advanced information technology," passing on the skills of experienced workers; for "manufacturing technology using virtual design," software development; for "manufacturing technology for high-value added products," response to the hollowing out of industrial technology accompanying overseas expansion; for "nano-machining/ micromachining technology," tax measures and other responses to intensifying global competition; for "humans and robot participation in manufacturing," research on programming for complex human work; for " recycling-oriented manufacturing technology with a low environmental load," research and development and tax measures for non-fossil energy; for "manufacturing technology in special environments," continuation of basic research; for "advanced manufacturing technology for social infrastructure," development of joining techniques for heavy structures and so on; and for "surface modification and interface control technology," interfacial control research a s basic research on nano- and micro-fabrication.

Finally, as policies to promote science and technology fields (policy proposals), the following can be offered for the manufacturing field.

(1) From the short-term perspective of the coming 5 to 10 years, collaboration with the information sector (IT) is important for the manufacturing field. A total of 5 areas are named ("manufacturing technology utilizing advanced information technology," "manufacturing technology using virtual design," "manufacturing technology for high-value added products," "nano-machining/micromachining technology," and "humans and robot participation in manufacturing"), but support is especially needed for the areas trailing the USA ("manufacturing technology using virtual design" and "manufacturing technology utilizing advanced information technology") and the area related to nanotechnology ("nano-machining/micromachining technology").

(2) Outside the information field, "recycling-oriented manufacturing technology with a low environmental load" is considered important in the manufacturing field. This area is characterized by a high necessity of government involvement for both time of technological realization and time of social application. In addition, it is positioned as a short-term field in terms of time of technological realization, but looking at the field with which it should collaborate, "energy and resources," measures with a long-term perspective beyond 2016 are important, necessitating both short- and long-term initiatives.

(3) A large majority of answers in the manufacturing field indicated expectations for government involvement and support through strengthened industry-academia-government and interdisciplinary collaboration, expanded funding, and so on. In concrete terms, promotion of research and development by industry consortiums and the creation of centers by universities and public agencies were named as means of strengthening such collaboration. In addition, support through taxation, subsidies, and procurement was named as a concrete means of government involvement.

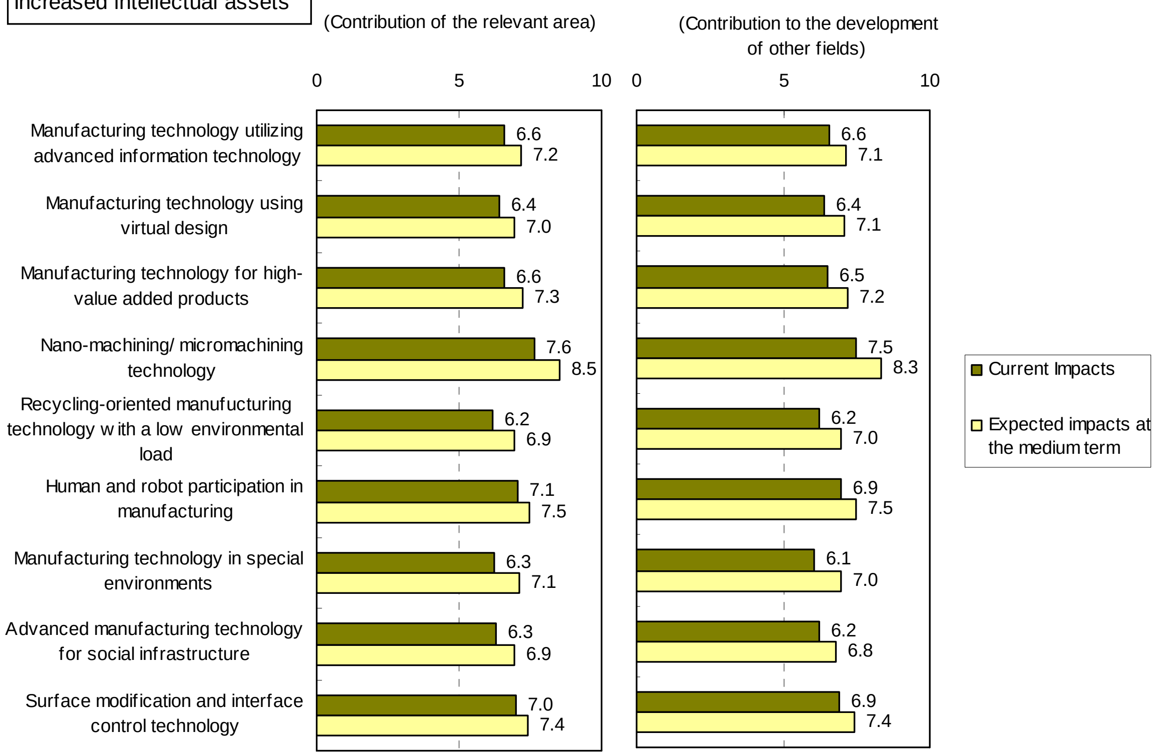
(4) The importance of education reform such as "implementation of a new elementary and secondary education scheme that emphasizes science and mathematics" and "development of an education program for handing down expertise" in order to develop outstanding human resources was pointed out. Active government support of this aspect is expected.

(KOBAYASHI Toshio and HIRAMATSU Kaneo)

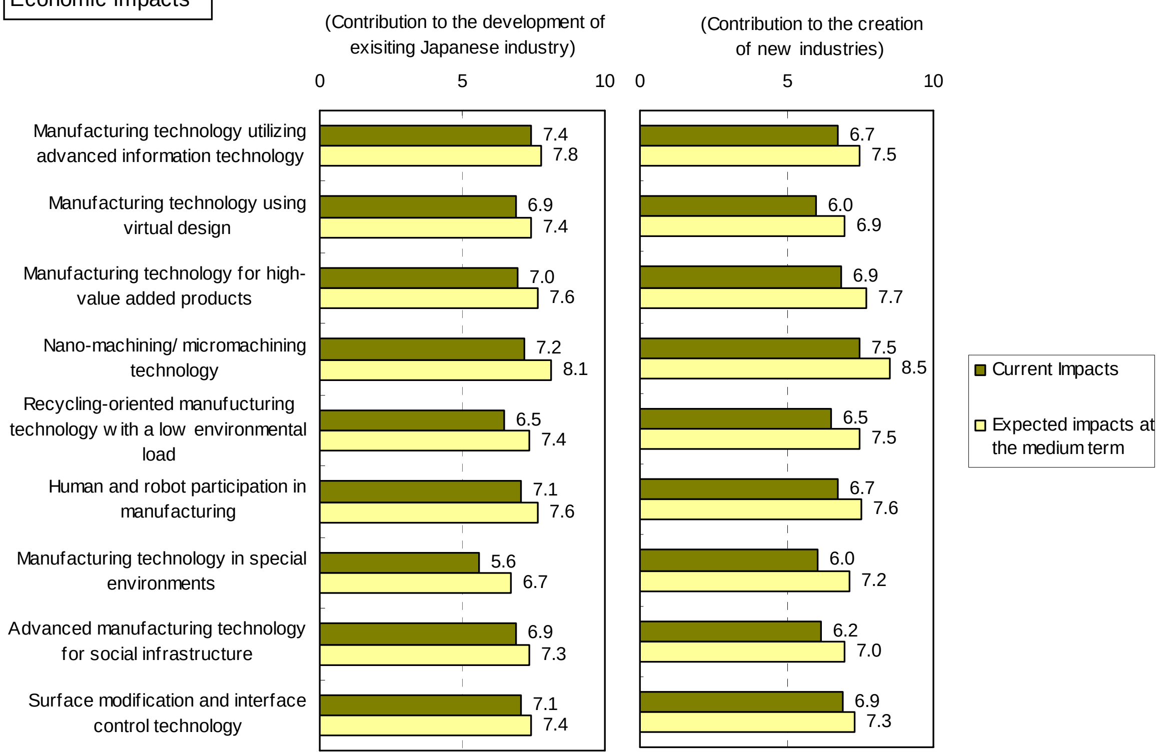
10.2. Main results

A. Impacts

Increased intellectual assets

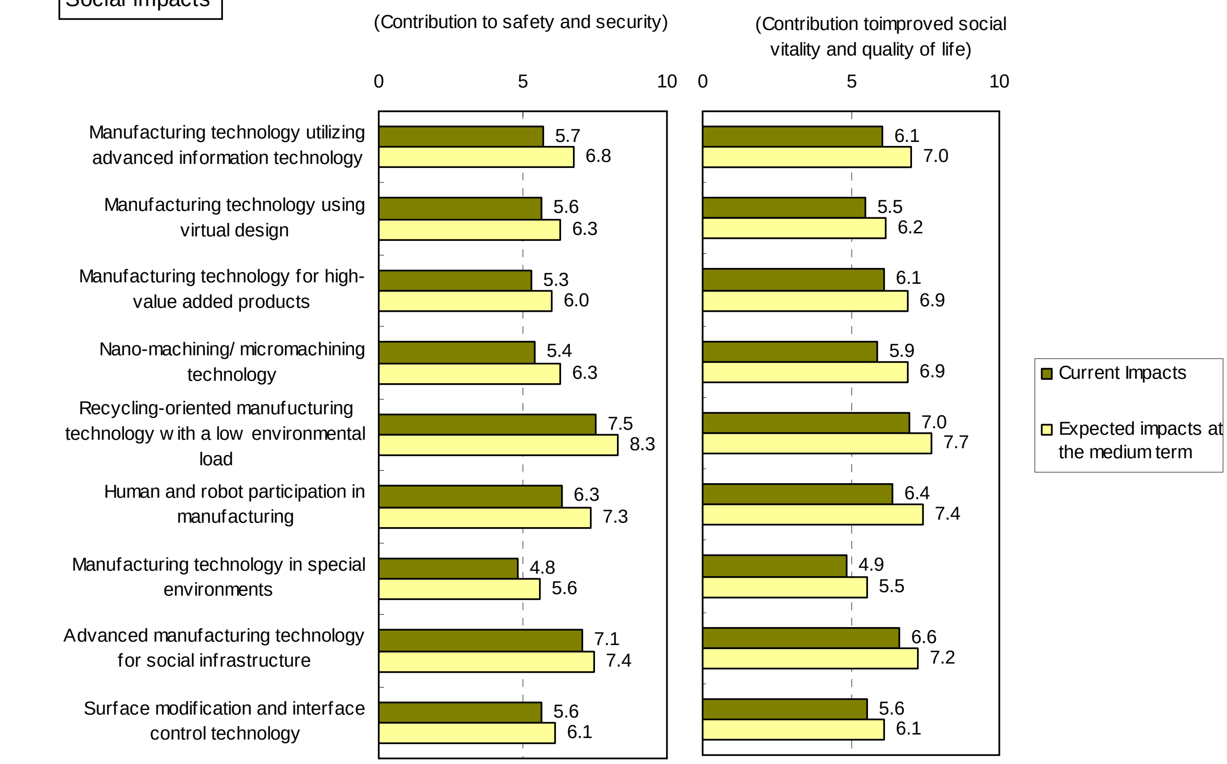


Economic impacts



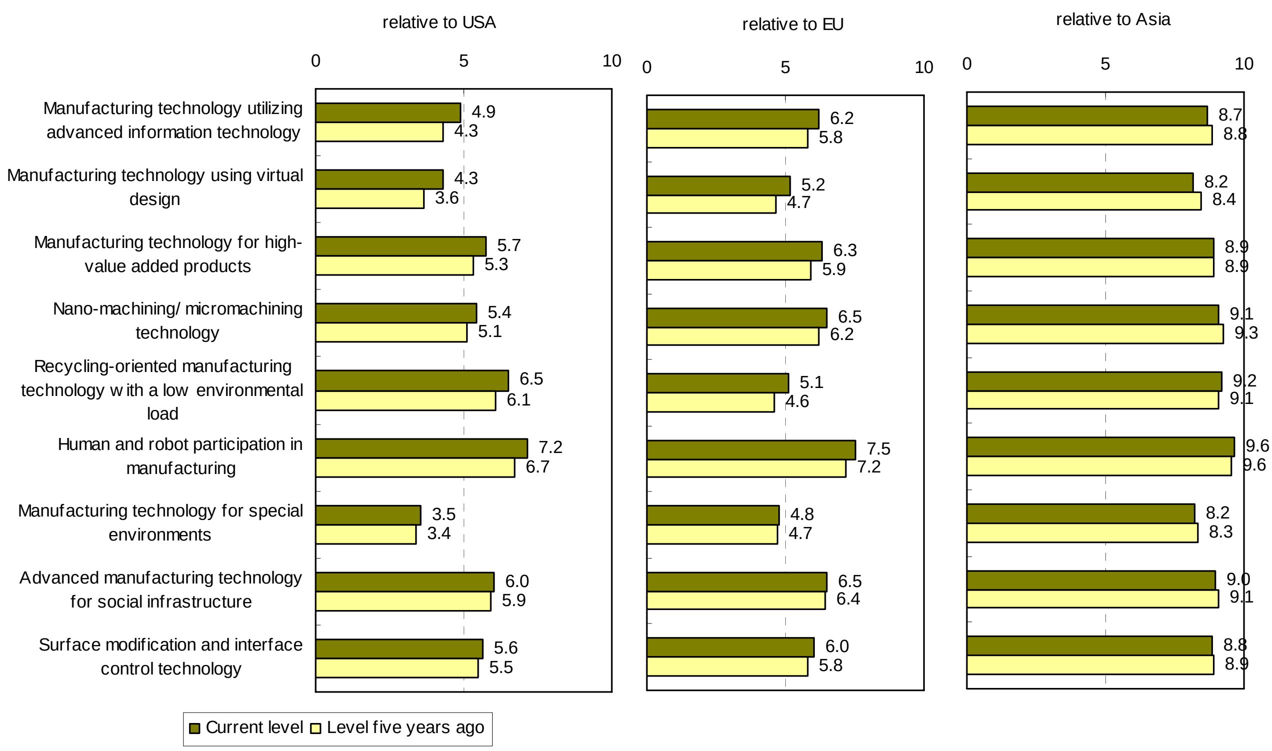
*Responses are indexed on a 10-point scale.

Social impacts



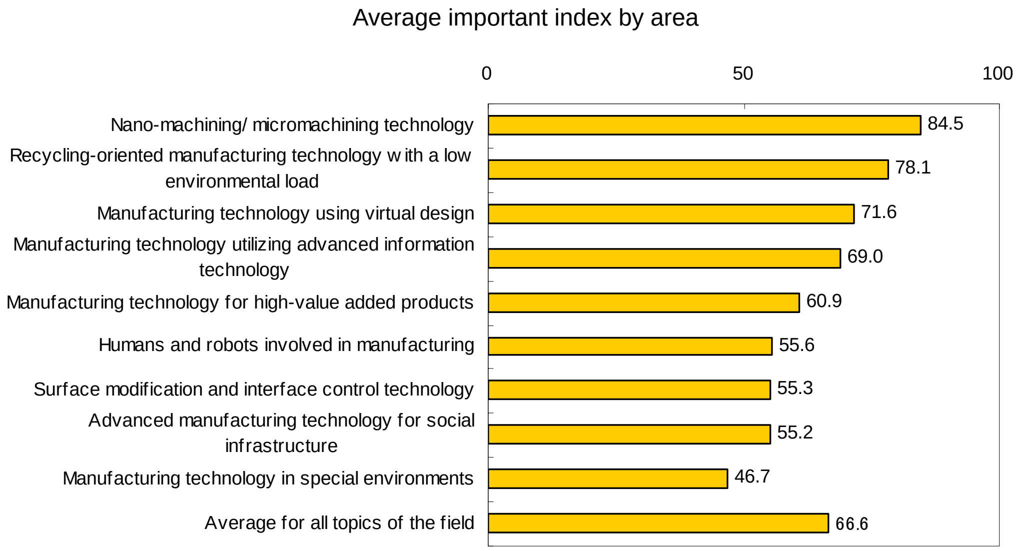
*Responses are indexed on a 10-point scale

B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan



The most important 10 topics

	Topic	Index	Year T*	Year S*
1	27: Widespread use of production processes using low CO_2 emitting energy sources such as non-fossil energy (wind, geothermal, photovoltaic, solar heat, waste heat, etc.), cogeneration systems, stationary fuel-cell systems etc..	95	2014	2023
2	59: Implementation of a new elementary and secondary education scheme that emphasizes science and mathematics to make Japan a world leader in science and technology.	95		2013
3	56: A technical education program that ensures the handing down of expertise and craftsmanship by establishing technology for converting implicit knowledge on manufacturing and manufacturing technique (e.g. basic techniques and skills, know-how, experience) into explicit knowledge.	94	2013	2019
4	58: Promotion of human resources mobility that is promoted across industry, academia, and government, leading to a greater number of joint or collaboration projects, and consequently bringing about innovations in manufacturing technology.	93		2013
5	28: Manufacturers' responsibility for collecting and disposing of discarded products is defined by law, and recycling systems in which more than 90% of used material is thermal- or material-recycled become widespread. Design for recycle/disassemble technology, easy assemble & disassemble production technology , selective collection system technology etc. enable it to achieve.	91	2013	2021
6	17: Super high precision process technology (for processing, analyzing, testing, and in-situ monitoring) at the angstrom level achieved through advances in beam technology (ion, electron, laser, etc.), machine control technology, and sensor technology.	91	2012	2018
7	25: An "inverse" manufacturing system that combines "arterial" (production) and "venous" (disposal) activities in which the production system (design→produce→use→scrap) and the resources recycling system (collect→disassemble/sort→reuse→produce) are integrated.	90	2013	2021
8	18: Packaging technology at the few micron level for achieving super-small wearable equipment for use anywhere, anytime by a combination of optoelectronics, microelectronics, and micromachinery.	89	2013	2021
9	07: An advanced virtual manufacturing system and its operation system to support optimization, efficiency improvement, license application, and other processes of production activities such as design, development, manufacture, operation, maintenance, and disposal.	87	2012	2018

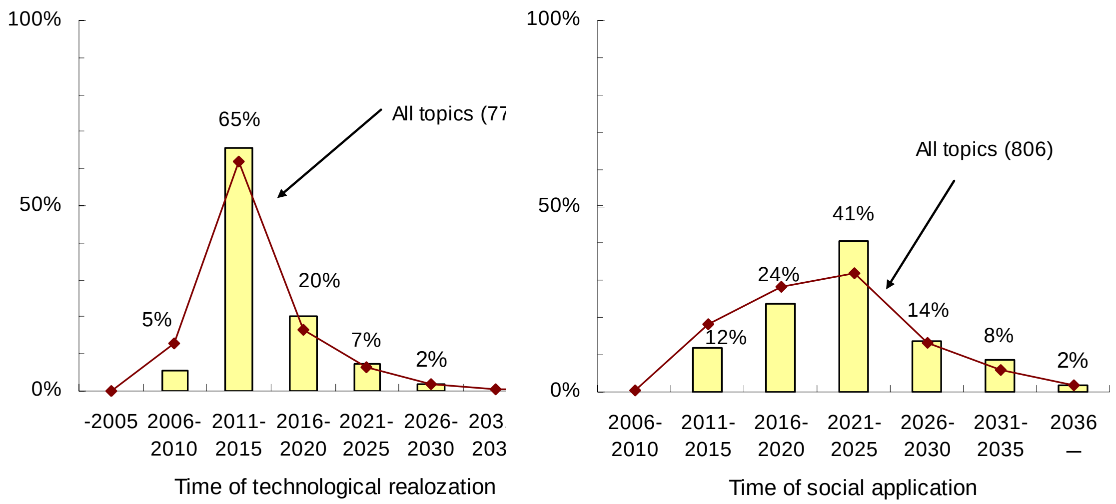
	Topic	Index	Year T*	Year S*
10	02: A support system that explicitly shows experts' decision-making process, skills, and know-how for reuse and leaning by non-experts.	87	2012	2018

*Year T: Time of technological realization Year S: Time of social application

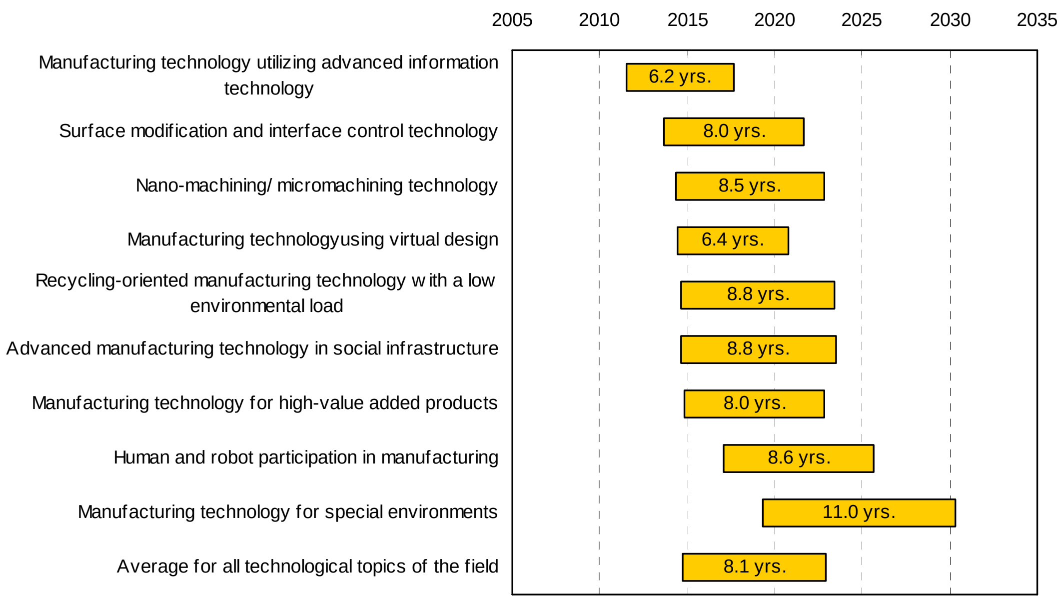
Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

Topic	Year T*	Period*	Area
43: An efficient manufacturing process that uses or mimics microorganism functions.	2017	12	Manufacturing technology in special environments
20: Technology for manufacturing high-value added products by using the bottom-up approach (self-organization) for supermolecular structure control at the nano level.	2016	11	Nano-machining/ micromachining technology

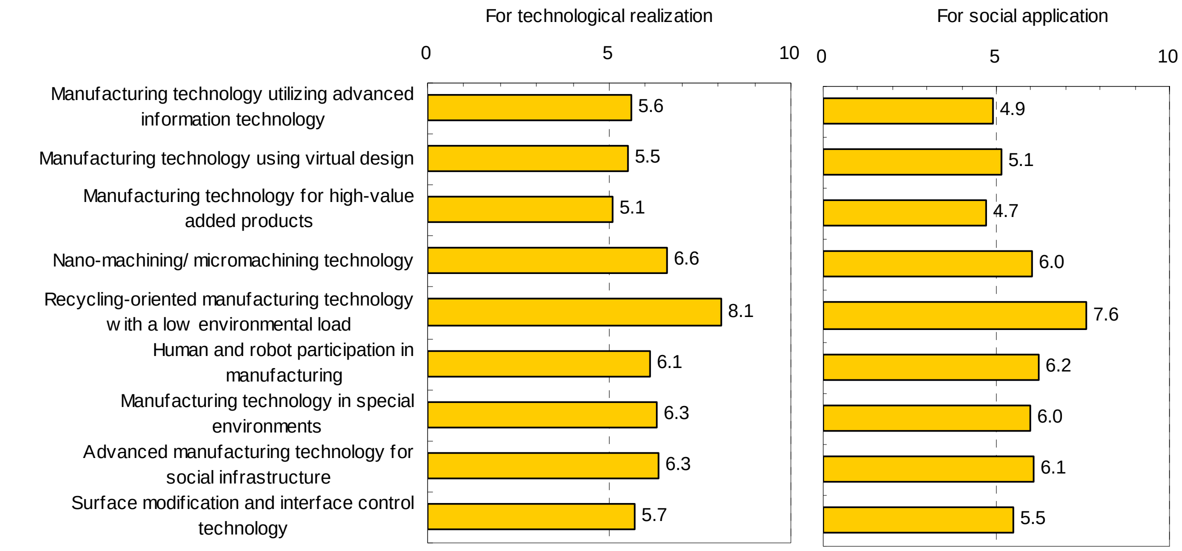
Topic	Year T*	Period*	Area
36: Manufacturing and process design technologies resulting from the discovery of new laws based on life science.	2023	11	Human and robot participation in manufacturing
42: Manufacturing process technology that utilizes gravity-free, minimal gravity, or other special environments.	2020	11	Manufacturing technology in special environments
49: Technology for desert revegetation and food production in desert areas to help avoid food crises resulting from population growth.	2018	11	Advanced manufacturing technology for social infrastructure

Topic	Year T*	Period*	Area
09: Construction of a life cycle assessment (LCA) database of the materials used for a product and technology for performing LCA of a designed product based on such a database.	2011	4	Manufacturing technology using virtual design
04: A lifetime tracking system for industrial products in which each component of manufactured products contains an IC chip that stores identification information (e.g. manufacturer, materials, components, changes in performance/properties, user).	2008	5	Manufacturing technology utilizing advanced information technology
05: Technology for remotely maintaining and inspecting equipment and facilities with advanced, complex functionality.	2009	5	Manufacturing technology utilizing advanced information technology
06: Japan's original manufacturing software for supporting autonomous adaptability, large variety small volume production, and short delivery time.	2010	5	Manufacturing technology utilizing advanced information technology
02: A support system that explicitly shows experts' decision-making process, skills, and know-how for reuse and leaning by non-experts.	2012	6	Manufacturing technology utilizing advanced information technology
07: An advanced virtual manufacturing system and its operation system to support optimization, efficiency improvement, license application, and other processes of production activities such as design, development, manufacture, operation, maintenance, and disposal.	2012	6	Manufacturing technology using virtual design
08: Digital mock-up technology with which, for the aim of shortening the design and R&D periods and reinforcing product competitiveness, all product evaluation parameters including strength, performance, reliability, environment-friendliness, and productivity can be assessed.	2012	6	Manufacturing technology using virtual design
11: High-speed mold making technology for producing (and finishing) a prototype mold according to a 3D image within 10 minutes.	2012	6	Manufacturing technology using virtual design
16: Technology for forming and machining a one-off product without using a mold.	2012	6	Manufacturing technology for high- value added products
17: Super high precision process technology (for processing, analyzing, testing, and in-situ monitoring) at the angstrom level achieved through advances in beam technology (ion, electron, laser, etc.), machine control technology, and sensor technology.	2012	6	Nano-machining/ micromachining technology
32: Technology for using robots in dangerous or hazardous work in manufacturing processes to ensure human operators' safety.	2011	6	Human and robot participation in manufacturing
51: Technology for forming super-hard thin film (e.g. diamond thin film) on a complex surface to be applied to the sliding surface of bearings and special tools.	2012	6	Surface modification and interfacial control technology
56: A technical education program that ensures the handing down of expertise and craftsmanship by establishing technology for converting implicit knowledge on manufacturing and manufacturing technique (e.g. basic techniques and skills, know-how, experience) into explicit knowledge.	2013	6	-

*Year T: Time of technological realization Period: Period until social application (years)

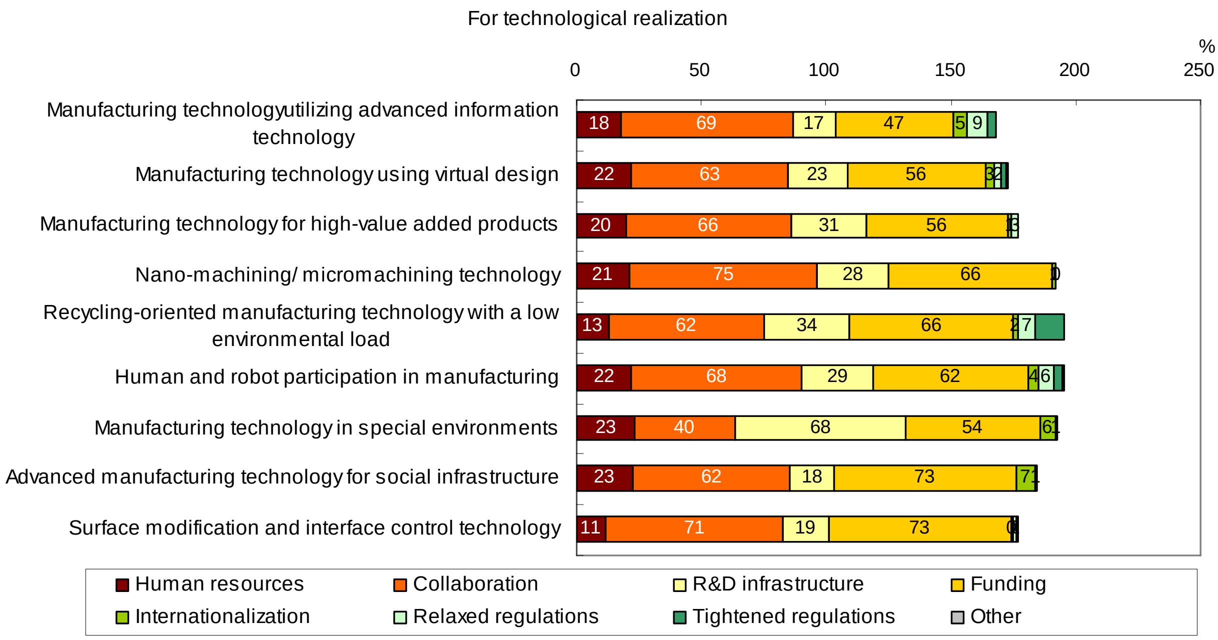
E. Effective measures that should taken by government

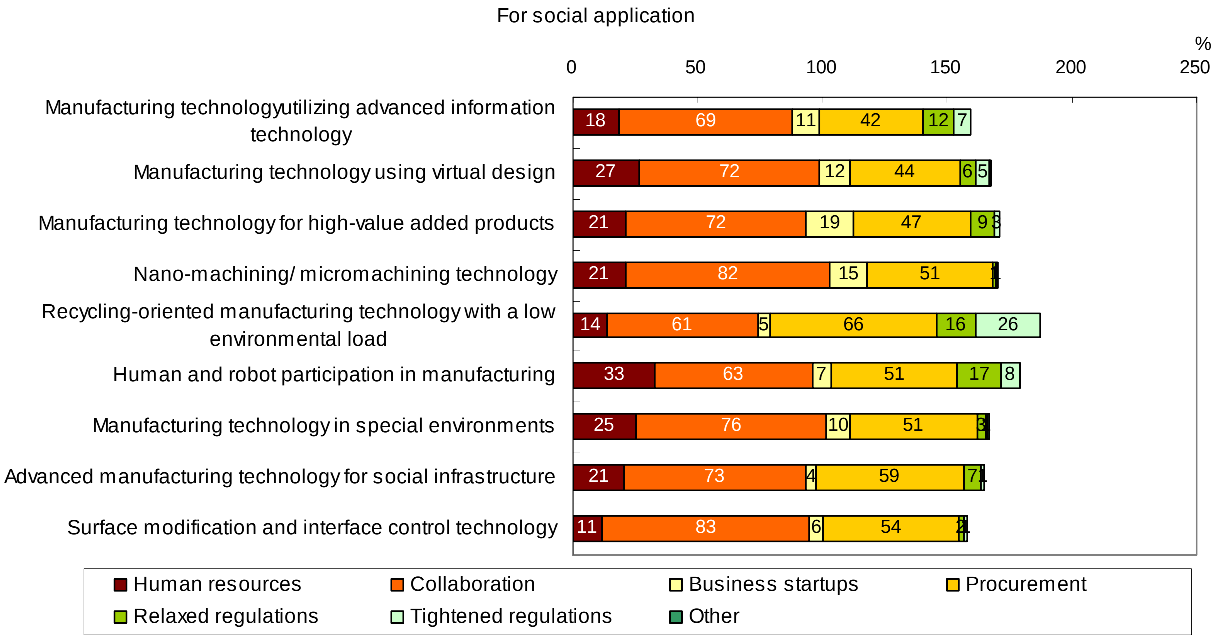
Necessity of government involvement



*Responses were indexed on a 10-point scale

Effective measures





F. Time-line of topics

Technological realization

Year	topic
2008	04: A lifetime tracking system for industrial products in which each component of manufactured products contains an IC chip that stores identification information (e.g. manufacturer, materials, components, changes in performance/properties, user).
2009	05: Technology for remotely maintaining and inspecting equipment and facilities with advanced, complex functionality.
2010	06: Japan's original manufacturing software for supporting autonomous adaptability, large variety small volume production, and short delivery time.
2011	09: Construction of a life cycle assessment (LCA) database of the materials used for a product and technology for performing LCA of a designed product based on such a database.
	32: Technology for using robots in dangerous or hazardous work in manufacturing processes to ensure human operators' safety.
2012	02: A support system that explicitly shows experts' decision-making process, skills, and know-how for reuse and leaning by non-experts.
	07: An advanced virtual manufacturing system and its operation system to support optimization, efficiency improvement, license application, and other processes of production activities such as design, development, manufacture, operation, maintenance, and disposal.
	08: Digital mock-up technology with which, for the aim of shortening the design and R&D periods and reinforcing product competitiveness, all product evaluation parameters including strength, performance, reliability, environment-friendliness, and productivity can be assessed.
	11: High-speed mold making technology for producing (and finishing) a prototype mold according to a 3D image within 10 minutes.
	14: A reconfigurable manufacturing system in which production volume can be quickly and flexibly adjusted to each of many different products.
	16: Technology for forming and machining a one-off product without using a mold.
	17: Super high precision process technology (for processing, analyzing, testing, and in-situ monitoring) at the angstrom level achieved through advances in beam technology (ion, electron, laser, etc.), machine control technology, and sensor technology.
	31: Digitization and advanced industrial robots reshape the job market and the employment practices in the manufacturing sector.
	33: A system that issues an alert when a possibility of human error is detected through real-time analysis of human behavior across the shop floor.
	51: Technology for forming super-hard thin film (e.g. diamond thin film) on a complex surface to be applied to the sliding surface of bearings and special tools.
2013	15: On-demand manufacturing technology for pharmaceutical drugs and chemicals based on microreactors.

Year	topic
	18: Packaging technology at the few micron level for achieving super-small wearable equipment for use anywhere, anytime by a combination of optoelectronics, microelectronics, and micromachinery.
	19: Technology for net shape forming with an accuracy of around ±1 μm through casting、sintering, and plastic working.
	25: An "inverse" manufacturing system that combines "arterial" (production) and "venous" (disposal) activities in which the production system (design→produce→use→scrap) and the resources recycling system (collect→disassemble/sort→reuse→produce) are integrated.
	28: Manufacturers' responsibility for collecting and disposing of discarded products is defined by law, and recycling systems in which more than 90% of used material is thermal- or material-recycled become widespread. Design for recycle/disassemble technology, easy assemble & disassemble production technology , selective collection system technology etc. enable it to achieve.
	30: Technology that achieves energy and space savings through a major plant downsizing (1/2 to 1/10 of current size) or a dramatic improvement in plant serviceability by introducing modules in workflows, recombining modules, and constructing module-to-module communications systems.
	37: An operator support system that creates work environments friendly to all workers including women, the elderly, and the disabled.
	46: Technology for bonding dissimilar materials (e.g., composite material and steel) in heavy structures.
	53: Proliferation of dry processing technology with which no lubricant or processing fluid is necessary for machining and plastic working.
	56: A technical education program that ensures the handing down of expertise and craftsmanship by establishing technology for converting implicit knowledge on manufacturing and manufacturing technique (e.g. basic techniques and skills, know-how, experience) into explicit knowledge.
2014	03: An autonomous adaptive system with high flexibility, safety, and serviceability in which networked machines and devices adjust to the system's internal and external environments.
	21: Technology that allows manufacturing processes to practically use the measurement of length, displacement, and surface roughness down to the angstrom level and the time measurement down to the femtosecond level.
	26: Assessment technology on the potential damage and risk associated with industrial parks and individual companies and production facilities, even assuming local impacts of chain-reaction and/or complex accidents.
	27: Widespread use of production processes using low CO2 emitting energy sources such as non-fossil energy (wind, geothermal, photovoltaic, solar heat, waste heat, etc.), cogeneration systems, stationary fuel-cell systems etc..
	44: Technology for manufacturing heavy structures such as large equipment, buildings, and vessels by using light-weight, high-strength composite materials instead of conventional steel materials.
	45: High-strength, high-durability bonding technologies, such as plastic bonding, that can substitute for welding in heavy structures.
	48: Technology for construction of vessels, bridges, thermal power plants and other large structures with no need for modification and maintenance, by simulating and accurately predicting deformations by gravity, temperature, heat input in bonding, and residual stress in steel, and incorporating the results into the initial design.
	50: Technology for dramatically (three or more times longer than current level) extending the life of production facilities through innovations in material surface properties.
	54: Machine element technology that allows significant regulation of holding stiffness and damping properties through the use of functional materials such as electroviscous fluid.
	55: Micromachining/ultra micromachining technology that can change material's surface properties, such as wettability and optical quality, according to the aim of the machine element.
2015	23: Optimizing technology on energy usage in a production process by means of large-scale energy storage system (superconductivity technology, a flywheel, a capacitor, etc.).
	39: Manufacturing technology based on robots that can adapt to change in the operational environment with real-time 3D image processing and force control functions.
	47: Low-deformation/-distortion (1/1000 of conventional level) bonding technology based on liquid-phase or solid-state diffusion that can substitute for conventional hot-melt bonding in heavy structures.
	52: Self-lubricating machine elements become commercially available, widely eliminating the need for lubricating the processing machines.
2016	01: Technology that allows machine to improve performance autonomously through the use of intelligent materials and parts whose properties adapt to the external environment and of systems incorporating such elements.

Year	topic
	20: Technology for manufacturing high-value added products by using the bottom-up approach (self-organization) for supermolecular structure control at the nano level.
	24: A low-entropy eco-factory taking everything into consideration of impacts on ecosystems including whole product life from birth to disposal.
2017	12: Technology for making customized products for which distinctive characteristics (e.g. physical constitution, sensibilities, five senses, stress, genetic information) of individuals are measured, analyzed and used for product design.
	43: An efficient manufacturing process that uses or mimics microorganism functions.
2018	22: Manufacturing technology for achieving innovative functions and properties through nanoscale manipulation and control of atoms and molecules or through control of materials structure or arrangement.
	49: Technology for desert revegetation and food production in desert areas to help avoid food crises resulting from population growth.
2019	29: Product/material manufacturing technology and system technology that achieve safety, cleanness, high energy efficiency, and high cost effectiveness based on natural and biological mechanisms.
	35: A common global language (including software) to express manufacturing information and knowledge is established, resulting in an interface technology through which communications (including intentions) between humans, machines, and information systems can be conducted accurately across different cultures and languages.
2020	13: Simulation technology for detecting and embodying values in need among people before specific needs are formulated.
	42: Manufacturing process technology that utilizes gravity-free, minimal gravity, or other special environments.
2021	38: Production system technology based on robots with s elf-repair capability.
	41: Manufacturing process technology that utilizes functions of microorganisms inhabiting ultrahigh pressure, high pH, or other extreme environments.
2023	36: Manufacturing and process design technologies resulting from the discovery of new laws based on life science.
2025	10: A design/development support technology that can detect human brain waves to express thoughts of humans on a computer.
2028	40: Technology for controlling robots in human-robot cooperative tasks using high-accuracy detection of human brain waves.

Social application

Year	topic
2013	04: A lifetime tracking system for industrial products in which each component of manufactured products contains an IC chip that stores identification information (e.g. manufacturer, materials, components, changes in performance/properties, user).
	57: University and higher-education systems in which students can choose freely from broad production-related technical fields (materials, design, information, electronics, mechanical, and analysis/assessment technologies, quality engineering, business administration, etc.) and earn credits.
	58: Promotion of human resources mobility that is promoted across industry, academia, and government, leading to a greater number of joint or collaboration projects, and consequently bringing about innovations in manufacturing technology.
	59: Implementation of a new elementary and secondary education scheme that emphasizes science and mathematics to make Japan a world leader in science and technology.
2014	05: Technology for remotely maintaining and inspecting equipment and facilities with advanced, complex functionality.
2015	06: Japan's original manufacturing software for supporting autonomous adaptability, large variety small volume production, and short delivery time.
	09: Construction of a life cycle assessment (LCA) database of the materials used for a product and technology for performing LCA of a designed product based on such a database.
2017	32: Technology for using robots in dangerous or hazardous work in manufacturing processes to ensure human operators' safety.
2018	02: A support system that explicitly shows experts' decision-making process, skills, and know-how for reuse and leaning by non-experts.
	07: An advanced virtual manufacturing system and its operation system to support optimization, efficiency improvement, license application, and other processes of production activities such as design, development, manufacture, operation, maintenance, and disposal.

Year	topic
	08: Digital mock-up technology with which, for the aim of shortening the design and R&D periods and reinforcing product competitiveness, all product evaluation parameters including strength, performance, reliability, environment-friendliness, and productivity can be assessed.
	11: High-speed mold making technology for producing (and finishing) a prototype mold according to a 3D image within 10 minutes.
	16: Technology for forming and machining a one-off product without using a mold.
	17: Super high precision process technology (for processing, analyzing, testing, and in-situ monitoring) at the angstrom level achieved through advances in beam technology (ion, electron, laser, etc.), machine control technology, and sensor technology.
	51: Technology for forming super-hard thin film (e.g. diamond thin film) on a complex surface to be applied to the sliding surface of bearings and special tools.
2019	14: A reconfigurable manufacturing system in which production volume can be quickly and flexibly adjusted to each of many different products.
	31: Digitization and advanced industrial robots reshape the job market and the employment practices in the manufacturing sector.
	56: A technical education program that ensures the handing down of expertise and craftsmanship by establishing technology for converting implicit knowledge on manufacturing and manufacturing technique (e.g. basic techniques and skills, know-how, experience) into explicit knowledge.
2020	19: Technology for net shape forming with an accuracy of around ±1 μm through casting、sintering, and plastic working.
	33: A system that issues an alert when a possibility of human error is detected through real-time analysis of human behavior across the shop floor.
	37: An operator support system that creates work environments friendly to all workers including women, the elderly, and the disabled.
2021	15: On-demand manufacturing technology for pharmaceutical drugs and chemicals based on microreactors.
	18: Packaging technology at the few micron level for achieving super-small wearable equipment for use anywhere, anytime by a combination of optoelectronics, microelectronics, and micromachinery.
	25: An "inverse" manufacturing system that combines "arterial" (production) and "venous" (disposal) activities in which the production system (design→produce→use→scrap) and the resources recycling system (collect→disassemble/sort→reuse→produce) are integrated.
	28: Manufacturers' responsibility for collecting and disposing of discarded products is defined by law, and recycling systems in which more than 90% of used material is thermal- or material-recycled become widespread. Design for recycle/disassemble technology, easy assemble & disassemble production technology , selective collection system technology etc. enable it to achieve.
	30: Technology that achieves energy and space savings through a major plant downsizing (1/2 to 1/10 of current size) or a dramatic improvement in plant serviceability by introducing modules in workflows, recombining modules, and constructing module-to-module communications systems.
	34: In the manufacturing sector, women account for 50% of researchers and engineers.
	53: Proliferation of dry processing technology with which no lubricant or processing fluid is necessary for machining and plastic working.
2022	03: An autonomous adaptive system with high flexibility, safety, and serviceability in which networked machines and devices adjust to the system's internal and external environments.
	44: Technology for manufacturing heavy structures such as large equipment, buildings, and vessels by using light-weight, high-strength composite materials instead of conventional steel materials.
	45: High-strength, high-durability bonding technologies, such as plastic bonding, that can substitute for welding in heavy structures.
	46: Technology for bonding dissimilar materials (e.g., composite material and steel) in heavy structures.
	48: Technology for construction of vessels, bridges, thermal power plants and other large structures with no need for modification and maintenance, by simulating and accurately predicting deformations by gravity, temperature, heat input in bonding, and residual stress in steel, and incorporating the results into the initial design.
	54: Machine element technology that allows significant regulation of holding stiffness and damping properties through the use of functional materials such as electroviscous fluid.
	55: Micromachining/ultra micromachining technology that can change material's surface properties, such as wettability and optical quality, according to the aim of the machine element.
2023	21: Technology that allows manufacturing processes to practically use the measurement of length, displacement, and surface roughness down to the angstrom level and the time measurement down to the femtosecond level.

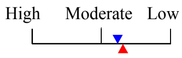
Year	topic
	26: Assessment technology on the potential damage and risk associated with industrial parks and individual companies and production facilities, even assuming local impacts of chain-reaction and/or complex accidents.
	27: Widespread use of production processes using low CO2 emitting energy sources such as non-fossil energy (wind, geothermal, photovoltaic, solar heat, waste heat, etc.), cogeneration systems, stationary fuel-cell systems etc..
	50: Technology for dramatically (three or more times longer than current level) extending the life of production facilities through innovations in material surface properties.
2024	01: Technology that allows machine to improve performance autonomously through the use of intelligent materials and parts whose properties adapt to the external environment and of systems incorporating such elements.
	23: Optimizing technology on energy usage in a production process by means of large-scale energy storage system (superconductivity technology, a flywheel, a capacitor, etc.).
	39: Manufacturing technology based on robots that can adapt to change in the operational environment with real-time 3D image processing and force control functions.
	47: Low-deformation/-distortion (1/1000 of conventional level) bonding technology based on liquid-phase or solid-state diffusion that can substitute for conventional hot-melt bonding in heavy structures.
	52: Self-lubricating machine elements become commercially available, widely eliminating the need for lubricating the processing machines.
2025	24: A low-entropy eco-factory taking everything into consideration of impacts on ecosystems including whole product life from birth to disposal.
2027	12: Technology for making customized products for which distinctive characteristics (e.g. physical constitution, sensibilities, five senses, stress, genetic information) of individuals are measured, analyzed and used for product design.
	20: Technology for manufacturing high-value added products by using the bottom-up approach (self-organization) for supermolecular structure control at the nano level.
2028	22: Manufacturing technology for achieving innovative functions and properties through nanoscale manipulation and control of atoms and molecules or through control of materials structure or arrangement.
2029	13: Simulation technology for detecting and embodying values in need among people before specific needs are formulated.
	29: Product/material manufacturing technology and system technology that achieve safety, cleanness, high energy efficiency, and high cost effectiveness based on natural and biological mechanisms.
	35: A common global language (including software) to express manufacturing information and knowledge is established, resulting in an interface technology through which communications (including intentions) between humans, machines, and information systems can be conducted accurately across different cultures and languages.
	43: An efficient manufacturing process that uses or mimics microorganism functions.
	49: Technology for desert revegetation and food production in desert areas to help avoid food crises resulting from population growth.
2031	38: Production system technology based on robots with s elf-repair capability.
	41: Manufacturing process technology that utilizes functions of microorganisms inhabiting ultrahigh pressure, high pH, or other extreme environments.
	42: Manufacturing process technology that utilizes gravity-free, minimal gravity, or other special environments.
2034	36: Manufacturing and process design technologies resulting from the discovery of new laws based on life science.
2035	10: A design/development support technology that can detect human brain waves to express thoughts of humans on a computer.
2036-	40: Technology for controlling robots in human-robot cooperative tasks using high-accuracy detection of human brain waves.

Appendix: Results of R1 and R2

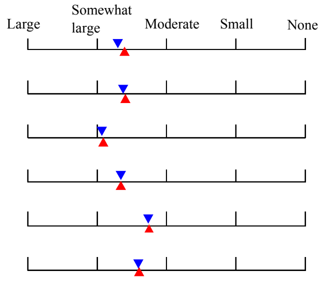
I. Manufacturing technology utilizing advanced information technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

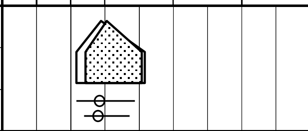
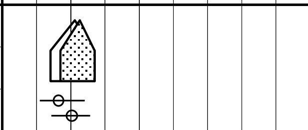
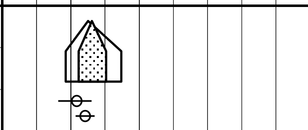
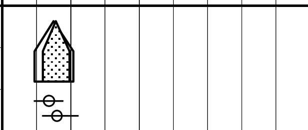
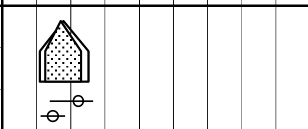
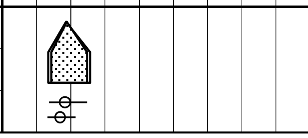


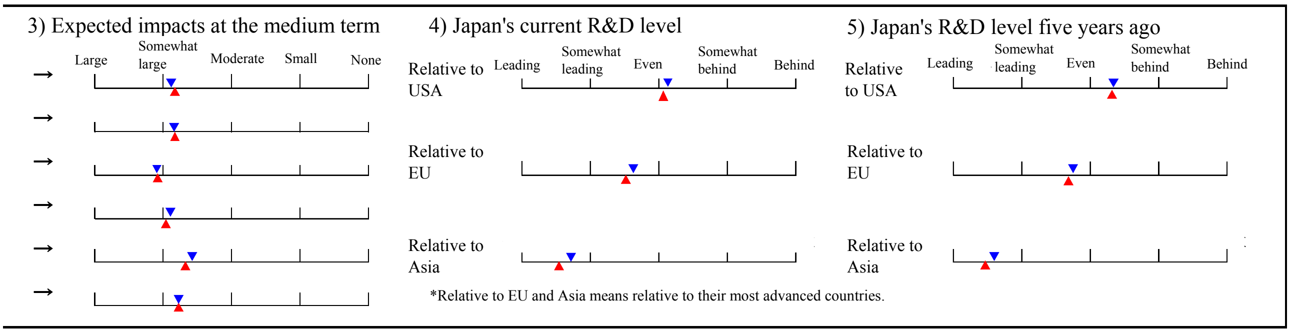
2) Current impacts

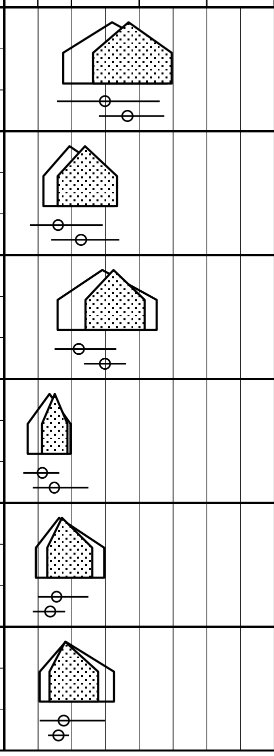


Impact type	Item
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
1	Technology that allows machine to improve performance autonomously through the use of intelligent materials and parts whose properties adapt to the external environment and of systems incorporating such elements.	1	127	9	31	60	-	68	40	52	8	0		2	7
		2	124	4	21	75	-	57	16	80	4	0		0	2
		E	5	100	0	0	-	90	80	20	0	0		0	0
2	A support system that explicitly shows experts' decision-making process, skills, and know-how for reuse and leaning by non-experts.	1	156	21	38	41	-	80	63	31	5	1		2	3
		2	139	12	31	57	-	87	74	25	1	0		1	2
		E	17	100	0	0	-	97	94	6	0	0		0	0
3	An autonomous adaptive system with high flexibility, safety, and serviceability in which networked machines and devices adjust to the system's internal and external environments.	1	131	16	36	48	-	71	45	49	6	0		0	3
		2	126	8	22	70	-	63	27	71	1	1		1	2
		E	10	100	0	0	-	75	50	50	0	0		0	0
4	A lifetime tracking system for industrial products in which each component of manufactured products contains an IC chip that stores identification information (e.g. manufacturer, materials, components, changes in performance/properties, user).	1	149	10	32	58	-	63	34	49	16	1		1	3
		2	139	5	25	70	-	64	29	67	4	0		0	0
		E	7	100	0	0	-	79	57	43	0	0		0	0
5	Technology for remotely maintaining and inspecting equipment and facilities with advanced, complex functionality.	1	141	12	27	61	-	60	30	51	18	1		0	3
		2	133	5	26	69	-	59	21	74	5	0		0	1
		E	7	100	0	0	-	61	29	57	14	0		0	0
6	Japan's original manufacturing software for supporting autonomous adaptability, large variety small volume production, and short delivery time.	1	139	19	25	56	-	75	53	39	8	0		1	2
		2	129	8	23	69	-	85	72	26	2	0		0	1
		E	10	100	0	0	-	94	89	11	0	0		0	0



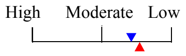


Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization: Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (%): Will not be applied	Do not know	Regarding social application: Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
36	53	10	0	1	19	46	29	6	28	51	39	48	3	6	2	0	1	10	18	29	38	15	28	40	25	35	15	2	1
15	84	1	0	0	3	66	27	4	17	60	26	56	1	2	0	0	0	3	2	24	69	5	21	68	15	41	7	2	0
40	60	0	0	0	20	60	0	20	25	75	75	50	0	0	0	0	0	0	20	20	40	20	50	100	50	25	0	0	0
48	38	14	0	0	24	41	25	10	43	54	28	44	7	1	1	1	2	5	20	34	28	18	43	44	18	38	6	4	2
76	22	2	0	0	14	67	15	4	42	70	14	47	2	2	0	0	1	3	10	53	30	7	50	67	9	41	1	1	0
70	24	6	0	0	41	53	0	6	50	75	25	69	6	0	0	0	0	6	12	70	12	6	56	69	13	56	0	0	0
37	54	9	0	0	16	46	31	7	22	50	34	46	8	11	0	1	0	5	13	41	36	10	23	54	19	35	15	6	0
20	79	1	0	0	5	71	20	4	16	73	19	53	3	3	0	0	1	1	3	54	40	3	15	77	9	42	9	0	0
20	70	10	0	0	30	60	0	10	44	56	44	67	22	11	0	0	0	0	20	60	10	10	33	56	22	56	33	0	0
52	38	9	0	1	24	36	27	13	11	44	19	31	26	25	20	1	1	5	27	32	27	14	15	36	19	36	31	35	2
81	15	4	0	0	14	60	23	3	6	68	9	28	19	24	16	0	0	0	17	50	29	4	5	56	12	43	26	35	1
71	0	29	0	0	43	43	14	0	0	43	29	86	43	14	0	0	0	0	43	29	14	14	0	50	33	50	33	50	0
33	59	8	0	0	13	30	46	11	17	48	33	40	9	18	4	1	1	4	9	31	47	13	19	53	12	34	31	12	0
17	82	1	0	0	3	40	52	5	6	67	18	46	3	14	2	1	0	1	3	32	59	6	4	72	5	38	28	2	0
29	71	0	0	0	0	43	43	14	0	83	33	50	0	0	0	0	0	0	0	14	72	14	0	100	0	67	0	0	0
64	33	2	0	1	19	30	39	12	33	57	26	49	7	10	1	0	1	1	17	28	40	15	31	50	27	41	15	2	2
82	18	0	0	0	6	38	51	5	19	75	17	55	2	6	1	0	0	1	5	24	64	7	16	75	18	44	3	0	0
89	11	0	0	0	20	50	30	0	30	60	20	70	0	0	0	0	0	0	20	50	30	0	0	80	50	50	0	0	0

II. Manufacturing technology using virtual design

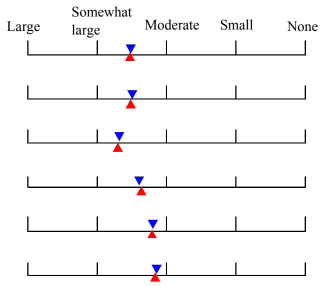
1. Questions regarding the relevant area

1) Degree of expertise in the area



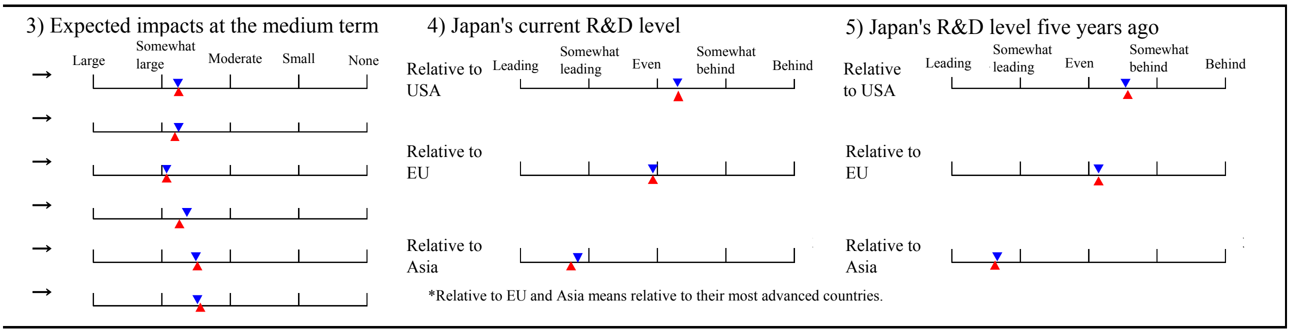
2) Current impacts

[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High	Moderate	Low	None (%)	Importance to Japan: Index	High	Moderate	Low	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know (%)
7	An advanced virtual manufacturing system and its operation system to support optimization, efficiency improvement, license application, and other processes of production activities such as design, development, manufacture, operation, maintenance, and disposal.	1	133	23	33	44	-	76	56	36	8	0							1	4
		2	129	14	26	60	-	87	74	25	1	0							0	1
		E	18	100	0	0	-	97	94	6	0	0							0	0
8	Digital mock-up technology with which, for the aim of shortening the design and R&D periods and reinforcing product competitiveness, all product evaluation parameters including strength, performance, reliability, environment-friendliness, and productivity can be assessed.	1	145	19	35	46	-	78	58	38	4	0							2	2
		2	132	8	29	63	-	84	69	31	0	0							0	1
		E	11	100	0	0	-	95	91	9	0	0							0	0
9	Construction of a life cycle assessment (LCA) database of the materials used for a product and technology for performing LCA of a designed product based on such a database.	1	142	6	29	65	-	68	41	47	11	1							1	4
		2	132	1	20	79	-	66	33	65	2	0							0	2
		E	1	100	0	0	-	100	100	0	0	0							0	0
10	A design/development support technology that can detect human brain waves to express thoughts of humans on a computer.	1	87	6	16	78	-	47	16	45	34	5							21	12
		2	106	0	6	94	-	41	5	51	41	3							16	6
		E																		
11	High-speed mold making technology for producing (and finishing) a prototype mold according to a 3D image within 10 minutes.	1	136	17	33	50	-	73	50	41	9	0							1	4
		2	132	8	28	64	-	80	62	36	2	0							0	2
		E	11	100	0	0	-	95	91	9	0	0							0	0



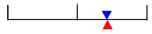
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application			Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
19	70	9	0	2	17	46	29	8	36	56	34	49	11	13	3	0		1	5	15	35	37	13	32	46	25	41	21	6	1
6	94	0	0	0	6	70	22	2	26	73	18	56	4	5	2	0		0	2	3	53	41	3	25	71	16	43	11	3	0
17	83	0	0	0	18	64	18	0	41	76	24	65	6	6	0	0		0	0	6	50	44	0	38	69	31	31	13	0	0
26	65	7	1	1	15	39	35	11	31	55	35	53	6	4	0	1		2	2	12	34	37	17	30	55	27	41	9	1	3
11	88	1	0	0	3	64	28	5	25	74	22	52	5	2	1	0		0	1	2	47	45	6	26	79	15	42	4	1	0
27	73	0	0	0	18	55	27	0	64	91	45	55	9	0	0	0		0	0	9	73	18	0	45	91	36	36	0	0	0
26	27	45	0	2	23	56	17	4	27	52	24	43	15	9	15	2		1	4	26	44	23	7	24	48	14	42	15	27	2
11	15	74	0	0	10	80	8	2	15	80	17	47	6	2	9	0		0	2	16	70	12	2	13	80	7	48	9	21	0
0	0	100	0	0	100	0	0	0	0	100	0	100	0	0	100	0		0	0	0	100	0	0	0	100	0	100	0	0	0
6	88	0	0	6	21	32	30	17	39	36	43	47	6	6	0	4		24	9	18	30	28	24	48	44	22	38	8	9	5
0	98	0	0	2	7	42	42	9	24	40	43	48	2	2	0	1		20	6	4	40	46	10	52	62	8	30	3	2	2
72	22	4	0	2	16	32	40	12	29	43	34	69	3	3	1	0		1	5	17	25	41	17	28	51	31	51	7	2	0
91	8	1	0	0	5	36	53	6	20	48	17	75	1	1	0	0		0	2	6	25	64	5	19	66	15	57	4	0	0
100	0	0	0	0	27	46	27	0	45	27	18	64	0	0	0	0		0	0	27	18	55	0	18	64	36	36	0	0	0

III. Manufacturing technology for high-value added products

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

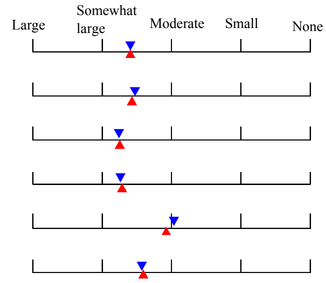


2) Current impacts

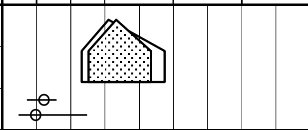
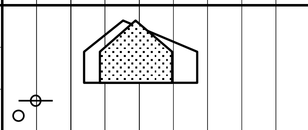
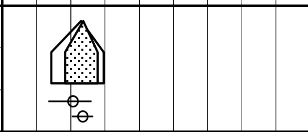
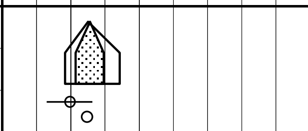
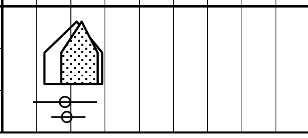
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

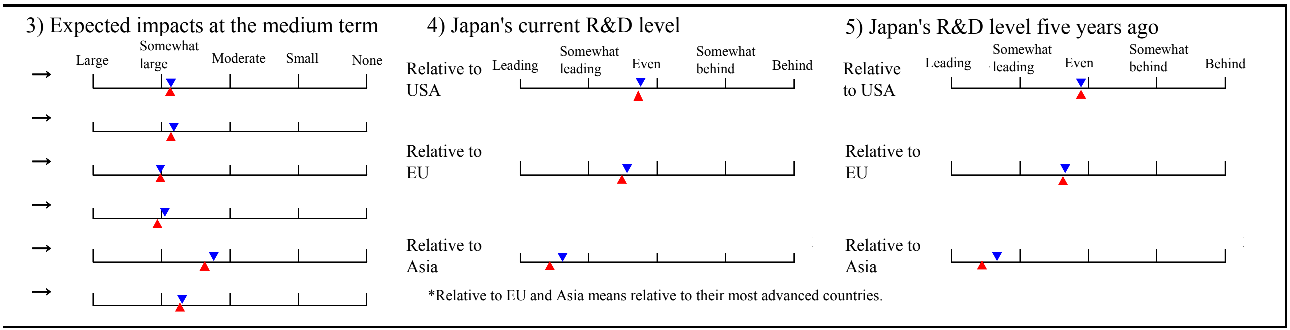
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
12	Technology for making customized products for which distinctive characteristics (e.g. physical constitution, sensibilities, five senses, stress, genetic information) of individuals are measured, analyzed and used for product design.	1	99	3	26	71	-	56	26	46	27	1		3	9
		2	111	2	13	85	-	51	11	73	16	0		2	2
		E	2	100	0	0	-	75	50	50	0	0		0	0
13	Simulation technology for detecting and embodying values in need among people before specific needs are formulated.	1	97	2	20	78	-	51	23	36	39	2		9	15
		2	109	1	7	92	-	44	8	51	41	0		5	6
		E	1	100	0	0	-	100	100	0	0	0		0	0
14	A reconfigurable manufacturing system in which production volume can be quickly and flexibly adjusted to each of many different products.	1	130	18	34	48	-	74	52	39	8	1		0	2
		2	128	8	25	67	-	85	70	28	2	0		0	1
		E	10	100	0	0	-	100	100	0	0	0		0	0
15	On-demand manufacturing technology for pharmaceutical drugs and chemicals based on microreactors.	1	81	10	21	69	-	67	40	50	9	1		0	9
		2	99	1	13	86	-	61	24	73	3	0		0	3
		E	1	100	0	0	-	100	100	0	0	0		0	0
16	Technology for forming and machining a one-off product without using a mold.	1	145	18	32	50	-	65	38	45	16	1		1	8
		2	134	8	31	61	-	63	28	67	5	0		0	1
		E	11	100	0	0	-	91	82	18	0	0		0	0



Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
24	61	8	0	7	16	41	32	11	25	47	44	45	8	7	7	1						4	12	14	36	36	14	31	45	27	37	18	14	0
8	91	1	0	0	5	55	36	4	17	63	37	52	3	3	2	0						2	4	5	41	49	5	22	74	16	40	12	7	0
100	0	0	0	0	0	0	100	0	50	100	0	0	0	0	0	0						0	0	0	0	100	0	50	100	0	0	0	0	0
8	78	6	0	8	8	33	44	15	37	41	37	36	4	4	3	3						5	19	9	24	47	20	30	48	19	29	10	7	3
2	97	0	0	1	4	29	60	7	29	60	37	42	2	2	0	0						8	7	3	23	64	10	37	73	11	32	4	2	0
0	100	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0						0	0	0	0	0	100	0	0	0	0	0	0	0
73	22	5	0	0	14	37	32	17	25	59	38	52	3	5	0	0						1	2	11	30	36	23	24	51	26	48	8	2	0
95	4	1	0	0	2	49	40	9	17	79	20	50	0	1	0	0						0	1	2	34	55	9	16	77	15	55	2	1	0
100	0	0	0	0	0	70	10	20	50	100	50	50	0	0	0	0						0	0	0	60	20	20	38	100	13	63	0	0	0
9	76	12	0	3	22	53	21	4	19	48	38	52	8	18	5	0						0	9	25	44	22	9	19	50	33	49	26	16	0
2	94	3	0	1	8	76	14	2	16	62	33	68	2	7	1	0						0	3	8	74	16	2	11	71	23	55	26	2	0
100	0	0	0	0	0	100	0	0	100	100	100	100	0	0	0	0						0	0	0	100	0	0	0	100	100	100	0	0	0
62	27	9	0	2	10	36	38	16	28	52	43	57	2	2	0	1						2	8	13	29	36	22	26	48	43	47	5	1	0
92	5	3	0	0	4	35	53	8	19	67	25	68	0	1	0	0						0	1	3	26	60	11	18	67	29	55	3	1	0
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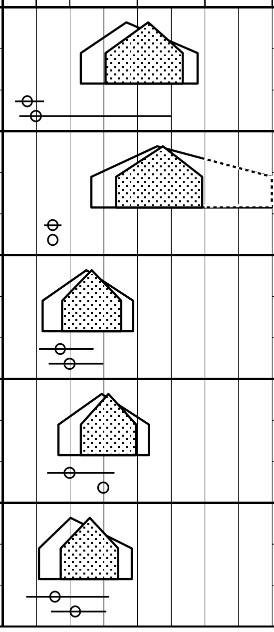
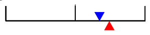


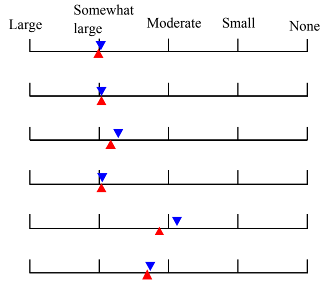
IV. Nano-machining/ micromachining technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

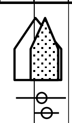
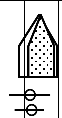
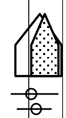
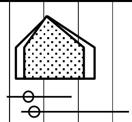
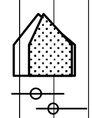
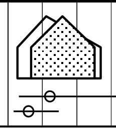


2) Current impacts



[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

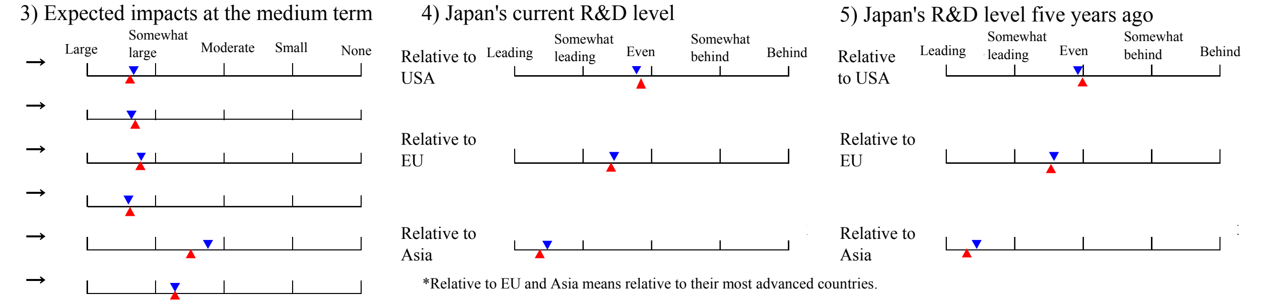
2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High	Moderate	Low	None (%)	Importance to Japan: Index	High	Moderate	Low	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know (%)
17	Super high precision process technology (for processing, analyzing, testing, and in-situ monitoring) at the angstrom level achieved through advances in beam technology (ion, electron, laser, etc.), machine control technology, and sensor technology.	1	106	22	34	44	-	82	65	33	2	0							0	2
		2	114	11	17	72	-	91	82	18	0	0							0	1
		E	13	100	0	0	-	100	100	0	0	0							0	0
18	Packaging technology at the few micron level for achieving super-small wearable equipment for use anywhere, anytime by a combination of optoelectronics, microelectronics, and micromachinery.	1	100	12	30	58	-	76	56	37	7	0							0	2
		2	112	8	13	79	-	89	78	22	0	0							0	1
		E	9	100	0	0	-	94	89	11	0	0							0	0
19	Technology for net shape forming with an accuracy of around ±1 μm through casting、sintering, and plastic working.	1	113	29	31	40	-	72	48	47	5	0							1	4
		2	120	18	28	54	-	76	52	48	0	0							0	1
		E	22	100	0	0	-	93	86	14	0	0							0	0
20	Technology for manufacturing high-value added products by using the bottom-up approach (self-organization) for supermolecular structure control at the nano level.	1	96	16	27	57	-	75	54	39	7	0							1	4
		2	105	6	18	76	-	82	66	32	2	0							2	3
		E	6	100	0	0	-	92	83	17	0	0							0	0
21	Technology that allows manufacturing processes to practically use the measurement of length, displacement, and surface roughness down to the angstrom level and the time measurement down to the femtosecond level.	1	111	22	17	61	-	72	49	39	12	0							0	7
		2	115	7	19	74	-	82	64	34	2	0							1	2
		E	8	100	0	0	-	88	75	25	0	0							0	0
22	Manufacturing technology for achieving innovative functions and properties through nanoscale manipulation and control of atoms and molecules or through control of materials structure or arrangement.	1	102	15	25	60	-	77	58	35	7	0							0	5
		2	116	6	19	75	-	87	73	26	1	0							0	3
		E	7	100	0	0	-	93	86	14	0	0							0	0

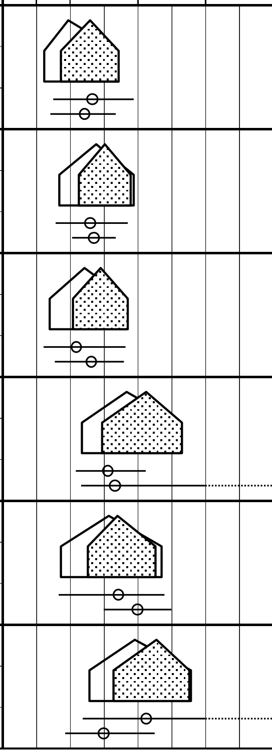
3) Expected impacts at the medium term

4) Japan's current R&D level

5) Japan's R&D level five years ago



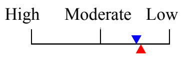
*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
50	37	11	1	1	33	46	17	4	27	62	37	61	3	1	0	0		0	3	24	44	21	11	21	64	24	39	5	4	0
73	26	1	0	0	15	73	11	1	15	74	25	62	1	0	0	0		0	1	11	66	21	2	16	83	15	46	4	1	0
67	33	0	0	0	54	46	0	0	15	77	54	69	0	0	0	0		0	0	38	54	8	0	23	85	23	69	0	0	0
45	50	5	0	0	31	48	19	2	32	59	41	61	5	2	0	0		0	3	24	43	26	7	25	63	28	44	9	6	0
26	74	0	0	0	9	81	10	0	17	74	25	67	2	0	0	0		0	1	5	72	22	1	17	83	13	47	1	1	0
25	75	0	0	0	50	50	0	0	38	63	63	63	13	0	0	0		0	0	33	56	11	0	22	67	44	78	0	0	0
76	10	12	0	2	18	47	27	8	33	60	37	63	3	1	0	0		1	6	19	36	29	16	30	60	24	48	3	2	0
91	3	6	0	0	9	71	17	3	25	73	23	68	1	1	0	0		0	2	5	64	25	6	22	78	13	53	1	1	0
91	0	9	0	0	24	71	0	5	45	70	30	70	0	0	0	0		0	0	18	54	23	5	24	90	5	43	5	5	0
34	56	9	0	1	26	53	16	5	40	59	36	68	5	2	0	0		2	6	26	40	18	16	34	68	25	51	1	0	0
10	89	1	0	0	9	79	10	2	30	74	28	68	3	1	0	0		2	4	8	70	18	4	27	84	16	52	0	0	0
0	83	17	0	0	50	50	0	0	33	83	50	50	0	0	0	0		0	0	50	33	17	0	17	100	17	33	0	0	0
44	39	17	0	0	23	44	24	9	28	58	44	54	4	2	0	0		0	8	21	38	21	20	28	65	22	45	6	1	0
60	38	2	0	0	11	74	11	4	16	84	31	62	0	0	0	0		1	3	4	67	25	4	18	84	14	48	1	1	0
87	13	0	0	0	62	38	0	0	50	88	75	50	0	0	0	0		0	0	50	25	25	0	38	75	13	38	13	13	0
31	62	6	0	1	34	50	13	3	32	63	46	58	4	1	0	0		1	7	32	40	16	12	31	71	22	49	5	1	0
8	91	1	0	0	18	75	6	1	22	75	39	69	0	0	0	0		0	3	13	72	12	3	27	78	18	59	0	0	0
50	33	17	0	0	100	0	0	0	29	57	29	86	0	0	0	0		0	0	86	0	14	0	29	57	29	71	0	0	0

V. Recycling-oriented manufacturing technology with a low environmental load

1. Questions regarding the relevant area

1) Degree of expertise in the area

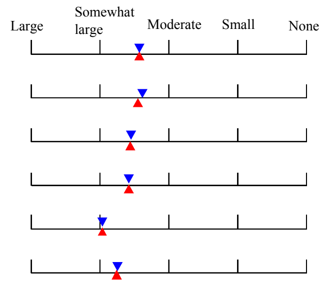


2) Current impacts

[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

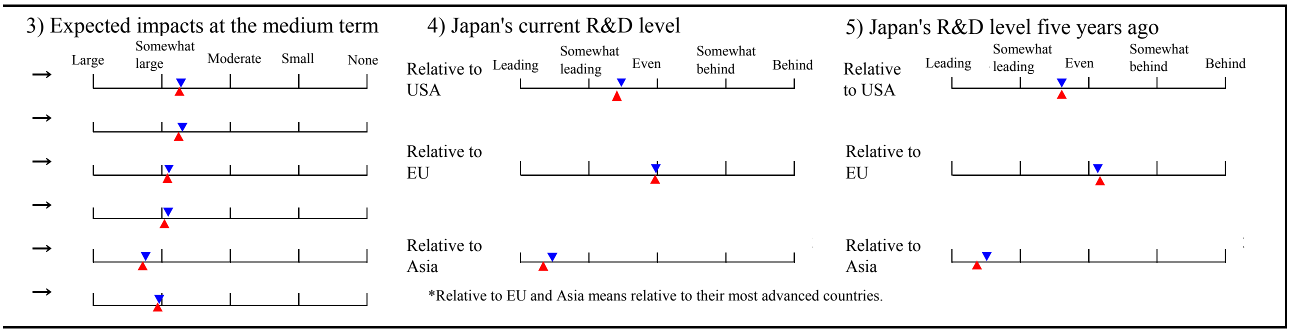
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life

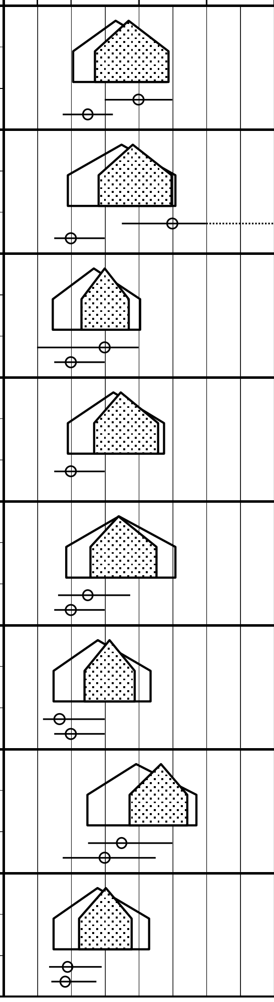


2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
23	Optimizing technology on energy usage in a production process by means of large-scale energy storage system (superconductivity technology, a flywheel, a capacitor, etc.).	1	102	3	25	72	-	70	46	40	14	0		2	7
		2	108	3	10	87	-	75	52	42	6	0		0	5
		E	3	100	0	0	-	100	100	0	0	0		0	0
24	A low-entropy eco-factory taking everything into consideration of impacts on ecosystems including whole product life from birth to disposal.	1	110	3	17	80	-	70	46	44	10	0		0	7
		2	114	2	10	88	-	75	51	48	1	0		0	2
		E	2	100	0	0	-	100	100	0	0	0		0	0
25	An "inverse" manufacturing system that combines "arterial" (production) and "venous" (disposal) activities in which the production system (design→produce→use→scrap) and the resources recycling system	1	132	7	36	57	-	79	61	35	4	0		1	4
		2	133	3	29	68	-	90	81	19	0	0		0	2
		E	4	100	0	0	-	100	100	0	0	0		0	0
26	Assessment technology on the potential damage and risk associated with industrial parks and individual companies and production facilities, even assuming local impacts of chain-reaction and/or complex accidents.	1	81	2	22	76	-	58	25	60	14	1		0	5
		2	94	0	7	93	-	56	14	83	3	0		0	3
		E													
27	Widespread use of production processes using low CO2 emitting energy sources such as non-fossil energy (wind, geothermal, photovoltaic, solar heat, waste heat, etc.), cogeneration systems, stationary fuel-cell systems etc..	1	128	8	27	65	-	85	71	25	4	0		3	4
		2	128	3	20	77	-	95	89	10	1	0		1	1
		E	4	100	0	0	-	100	100	0	0	0		0	0
28	Manufacturers' responsibility for collecting and disposing of discarded products is defined by law, and recycling systems in which more than 90% of used material is thermal- or material-recycled become widespread. Design for recycle/disassemble technology, easy assemble & disassemble production technology , selective collection system technology etc. enable it to achieve.	1	128	5	27	68	-	78	58	38	4	0		0	2
		2	123	5	18	77	-	91	83	17	0	0		0	1
		E	6	100	0	0	-	92	83	17	0	0		0	0
29	Product/material manufacturing technology and system technology that achieve safety, cleanness, high energy efficiency, and high cost effectiveness based on natural and biological mechanisms.	1	115	7	23	70	-	71	45	47	8	0		0	6
		2	119	3	14	83	-	67	35	64	1	0		0	5
		E	3	100	0	0	-	83	67	33	0	0		0	0
30	Technology that achieves energy and space savings through a major plant downsizing (1/2 to 1/10 of current size) or a dramatic improvement in plant serviceability by introducing modules in workflows, recombining modules, and constructing module-to-module communications systems.	1	120	9	31	60	-	71	47	45	8	0		0	1
		2	122	4	31	65	-	75	50	49	1	0		0	1
		E	5	100	0	0	-	90	80	20	0	0		0	0



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization: Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	Regarding social application: Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
47	30	22	0	1	44	39	14	3	21	42	44	58	7	14	5	1		2	9	32	46	18	4	22	41	18	52	32	13	2
75	17	8	0	0	60	33	6	1	10	46	43	76	0	7	4	0		1	4	27	65	7	1	12	55	11	75	22	7	0
67	33	0	0	0	100	0	0	0	33	100	67	67	0	0	0	0		0	0	33	67	0	0	33	100	0	33	33	0	0
31	14	54	0	1	44	43	12	1	21	42	44	44	9	10	23	1		1	7	37	50	11	2	21	50	13	47	21	34	1
12	0	88	0	0	45	52	3	0	11	53	50	70	3	3	13	0		0	1	18	81	1	0	11	66	4	63	9	30	0
100	0	0	0	0	100	0	0	0	50	100	50	50	0	0	0	0		0	0	50	50	0	0	50	100	0	0	0	0	0
47	7	46	0	0	43	45	9	3	15	46	44	48	10	18	26	1		0	5	41	47	9	3	17	44	16	48	25	43	0
43	0	57	0	0	43	52	4	1	9	59	34	67	2	9	20	0		0	1	38	60	1	1	10	58	3	70	14	40	0
75	0	25	0	0	75	0	0	25	33	67	33	100	0	0	0	0		0	0	75	0	0	25	33	67	0	67	0	0	0
18	44	37	0	1	48	37	11	4	19	49	45	38	8	14	14	1		0	4	36	51	10	3	27	42	16	35	22	35	1
2	61	37	0	0	60	40	0	0	11	70	48	37	1	3	16	0		0	2	27	72	1	0	16	79	2	45	8	36	0
46	14	40	0	0	63	30	3	4	20	53	39	62	10	24	16	0		2	4	54	36	5	5	18	35	19	65	39	32	0
61	2	37	0	0	88	9	1	2	10	67	25	73	5	19	10	0		0	2	81	17	0	2	10	43	6	81	40	23	0
75	0	25	0	0	100	0	0	0	25	50	50	100	25	25	0	0		0	0	100	0	0	0	25	50	0	100	50	25	0
35	5	60	0	0	59	31	7	3	20	47	33	48	13	20	41	1		0	3	60	32	6	2	16	38	15	49	26	58	2
13	0	87	0	0	85	12	3	0	10	61	23	67	5	11	28	0		0	1	86	13	1	0	9	46	4	65	19	62	1
33	0	67	0	0	83	0	17	0	33	67	33	33	17	17	33	0		0	0	83	0	17	0	33	50	17	67	50	50	0
26	36	35	0	3	22	56	18	4	35	50	44	55	11	5	5	2		1	9	23	52	18	7	35	51	17	52	18	15	0
17	46	36	0	1	8	86	3	3	25	69	30	70	2	1	3	0		0	5	9	80	8	3	25	68	4	66	9	6	0
67	33	0	0	0	67	33	0	0	33	100	67	33	0	0	0	0		0	0	67	0	33	0	67	67	0	0	0	0	0
72	17	9	0	2	13	50	27	10	23	52	36	49	8	9	4	2		0	3	14	43	30	13	29	50	18	49	19	11	1
96	2	1	0	1	4	76	15	5	15	74	19	65	1	4	0	0		0	2	5	70	18	7	16	71	6	66	5	3	0
100	0	0	0	0	50	50	0	0	25	100	50	50	25	0	0	0		0	0	40	40	20	0	20	100	20	40	0	0	0

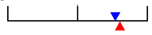


VI. Human and robot participation in manufacturing

1. Questions regarding the relevant area

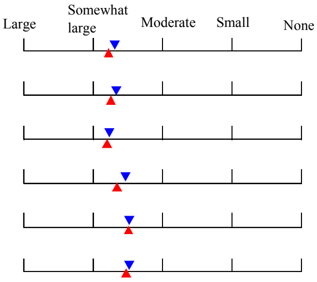
1) Degree of expertise in the area

High Moderate Low

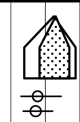
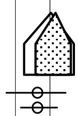
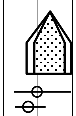
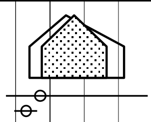
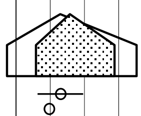
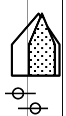
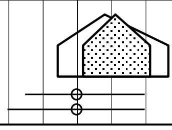


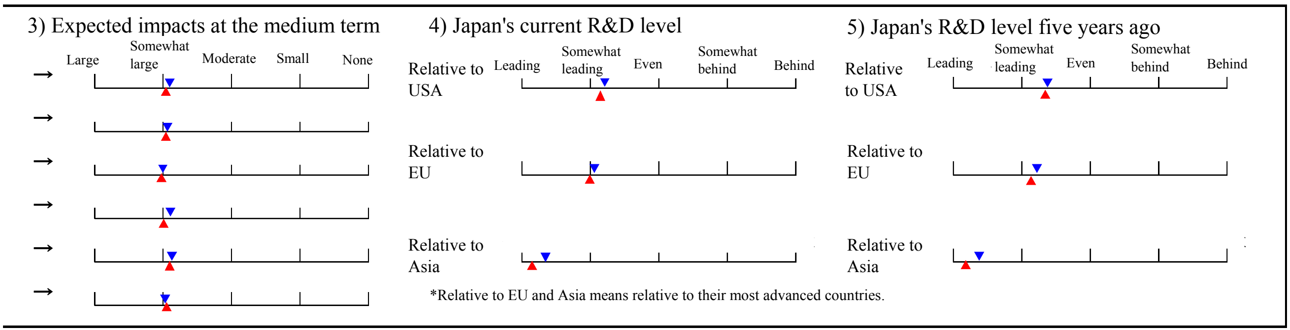
2) Current impacts

[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
31	Digitization and advanced industrial robots reshape the job market and the employment practices in the manufacturing sector.	1	136	8	32	60	-	65	39	47	13	1							2	7
		2	131	5	23	72	-	64	30	65	5	0							0	2
		E	6	100	0	0	-	92	83	17	0	0							0	0
32	Technology for using robots in dangerous or hazardous work in manufacturing processes to ensure human operators' safety.	1	142	8	26	66	-	67	40	50	9	1							1	4
		2	130	5	22	73	-	63	27	70	3	0							0	1
		E	6	100	0	0	-	79	66	17	17	0							0	0
33	A system that issues an alert when a possibility of human error is detected through real-time analysis of human behavior across the shop floor.	1	124	7	29	64	-	56	24	53	23	0							1	7
		2	122	2	23	75	-	55	11	86	3	0							0	1
		E	3	100	0	0	-	83	67	33	0	0							0	0
34	In the manufacturing sector, women account for 50% of researchers and engineers.	1	112	3	19	78	-	54	22	53	23	2								
		2	123	1	10	89	-	52	11	74	15	0								
		E	1	100	0	0	-	100	100	0	0	0								
35	A common global language (including software) to express manufacturing information and knowledge is established, resulting in an interface technology through which communications (including intentions) between humans, machines, and information systems can be conducted accurately across different cultures and languages.	1	107	8	17	75	-	59	29	53	14	4							8	10
		2	117	3	8	89	-	52	6	88	6	0							5	5
		E	4	100	0	0	-	63	25	75	0	0							0	0
36	Manufacturing and process design technologies resulting from the discovery of new laws based on life science.	1	90	4	22	74	-	55	23	53	21	3							6	16
		2	109	1	8	91	-	53	11	80	9	0							0	6
		E	1	100	0	0	-	100	100	0	0	0							0	0
37	An operator support system that creates work environments friendly to all workers including women, the elderly, and the disabled.	1	111	5	25	70	-	68	41	50	9	0							0	2
		2	119	3	9	88	-	66	33	66	1	0							0	2
		E	3	100	0	0	-	100	100	0	0	0							0	0
38	Production system technology based on robots with s elf-repair capability.	1	113	8	25	67	-	56	24	54	21	1							3	9
		2	108	4	19	77	-	53	8	87	5	0							1	1
		E	4	100	0	0	-	63	25	75	0	0							0	0



Countries at the leading edge					Regarding technological realization													Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't												Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 2011–2015 2016–2025 2026–2035 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
80	19	1	0	0	18	39	27	16	25	58	27	39	9	20	11	4		4	8	15	44	24	17	30	47	17	44	30	17	2
97	3	0	0	0	6	61	28	5	15	79	16	52	0	15	4	0		0	3	6	68	21	5	20	66	7	54	23	6	0
100	0	0	0	0	17	33	33	17	20	80	20	60	0	0	0	0		0	0	17	50	33	0	33	83	33	33	0	0	0
70	24	5	0	1	14	52	20	14	22	57	30	56	7	13	13	1		0	6	16	45	25	14	21	51	18	58	24	21	1
90	9	1	0	0	6	76	16	2	14	75	19	60	0	12	10	0		0	2	9	72	17	2	13	66	6	68	18	10	0
67	33	0	0	0	17	33	33	17	0	100	40	40	0	20	0	0		0	0	33	33	17	17	0	80	20	20	20	20	0
50	37	11	0	2	9	43	34	14	29	48	39	53	6	7	8	2		2	7	12	39	31	18	26	52	13	47	14	13	2
85	15	0	0	0	2	71	24	3	16	68	23	68	0	5	4	0		1	1	4	66	27	3	19	74	5	57	9	6	1
100	0	0	0	0	0	33	67	0	0	100	33	67	0	0	0	0		0	0	0	67	33	0	33	67	0	33	0	33	0
																		20	15	30	36	12	22	59	11	11	26	43	30	4
																		12	8	20	66	5	9	80	5	1	21	56	19	0
																		0	0	0	100	0	0	0	0	0	0	100	0	0
15	66	15	0	4	23	42	22	13	34	47	43	37	34	8	1	2		9	12	17	51	19	13	40	51	23	47	17	6	3
3	95	1	0	1	6	81	10	3	28	77	41	40	21	3	1	1		6	5	3	85	9	3	38	75	13	46	11	2	0
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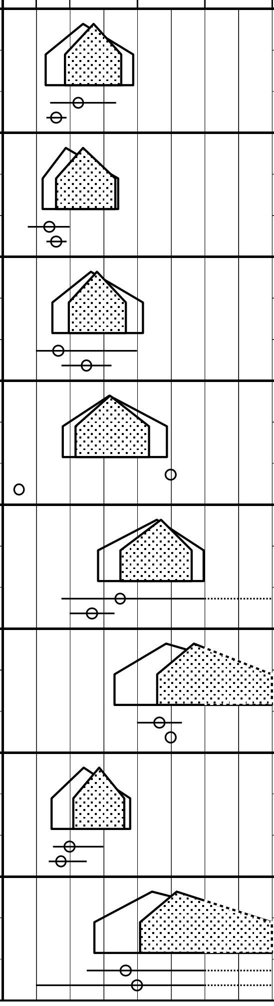
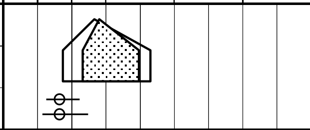
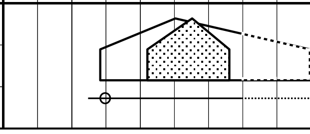
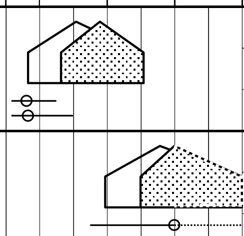
10	75	11	0	4	23	45	19	13	43	49	47	49	16	7	7	1		10	17	22	53	12	13	47	54	24	39	12	15	0
1	99	0	0	0	8	78	11	3	40	64	43	59	9	1	0	0		3	9	9	78	10	3	50	77	10	41	8	7	0
0	100	0	0	0	0	100	0	0	0	100	100	100	0	0	0	0		0	0	0	100	0	0	100	100	100	100	0	0	0
30	29	41	0	0	39	47	9	5	30	46	30	53	5	22	20	2		0	2	44	40	11	5	29	32	14	63	35	28	1
20	12	68	0	0	38	58	1	3	33	59	24	65	1	15	15	0		0	2	50	46	1	3	30	32	4	73	34	22	0
67	33	0	0	0	67	33	0	0	33	67	33	33	0	33	33	0		0	0	67	33	0	0	33	33	33	67	0	0	0
56	33	7	0	4	11	47	32	10	24	52	35	57	4	5	2	3		4	11	12	46	29	13	26	55	23	43	13	5	1
84	16	0	0	0	2	74	20	4	15	69	25	72	2	2	0	0		1	4	2	71	23	4	18	82	10	51	6	2	0
75	25	0	0	0	25	50	25	0	50	50	50	50	0	0	0	0		0	0	25	50	25	0	75	50	50	25	0	0	0



No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Degree of expertise: Moderate (%)	Degree of expertise: Low (%)	Degree of expertise: None (%)	Importance to Japan: Index	Importance to Japan: High (%)	Importance to Japan: Moderate (%)	Importance to Japan: Low (%)	Importance to Japan: None (%)	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
39	Manufacturing technology based on robots that can adapt to change in the operational environment with real-time 3D image processing and force control functions.	1	**114**	**12**	**21**	**67**	**-**	**61**	**31**	**54**	**13**	**2**		**3**	**5**
		2	**110**	**5**	**12**	**83**	**-**	**54**	**9**	**87**	**4**	**0**		**1**	**2**
		E	**6**	**100**	**0**	**0**	**-**	**92**	**83**	**17**	**0**	**0**		**0**	**0**
40	Technology for controlling robots in human-robot cooperative tasks using high-accuracy detection of human brain waves.	1	**90**	**8**	**13**	**79**	**-**	**53**	**24**	**43**	**28**	**5**		**13**	**7**
		2	**99**	**0**	**7**	**93**	**-**	**46**	**3**	**78**	**17**	**2**		**14**	**6**
		E													

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
60	**33**	**4**	**0**	**3**	**11**	**55**	**26**	**8**	**24**	**54**	**36**	**68**	**4**	**7**	**1**	**1**						**5**	**5**	**14**	**46**	**26**	**14**	**24**	**59**	**29**	**43**	**9**	**2**	**0**
85	**15**	**0**	**0**	**0**	**3**	**74**	**18**	**5**	**16**	**70**	**21**	**73**	**1**	**1**	**0**	**0**						**1**	**3**	**4**	**72**	**18**	**6**	**21**	**79**	**12**	**58**	**2**	**0**	**0**
100	**0**	**0**	**0**	**0**	**17**	**49**	**17**	**17**	**40**	**80**	**40**	**40**	**0**	**0**	**0**	**0**						**0**	**0**	**33**	**17**	**33**	**17**	**80**	**60**	**20**	**20**	**0**	**0**	**0**
28	**64**	**5**	**0**	**3**	**14**	**43**	**33**	**10**	**30**	**43**	**46**	**48**	**4**	**8**	**4**	**4**						**14**	**10**	**14**	**38**	**33**	**15**	**40**	**58**	**19**	**37**	**10**	**7**	**1**
4	**96**	**0**	**0**	**0**	**2**	**69**	**23**	**6**	**24**	**50**	**47**	**73**	**1**	**3**	**0**	**0**						**19**	**6**	**3**	**63**	**28**	**6**	**38**	**76**	**8**	**37**	**8**	**4**	**1**

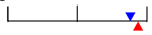


VII. Manufacturing technology in special environments

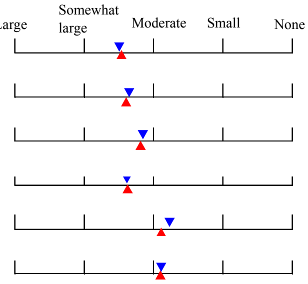
1. Questions regarding the relevant area

1) Degree of expertise in the area

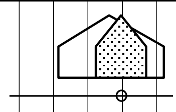
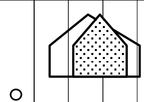
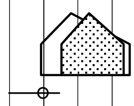
High Moderate Low

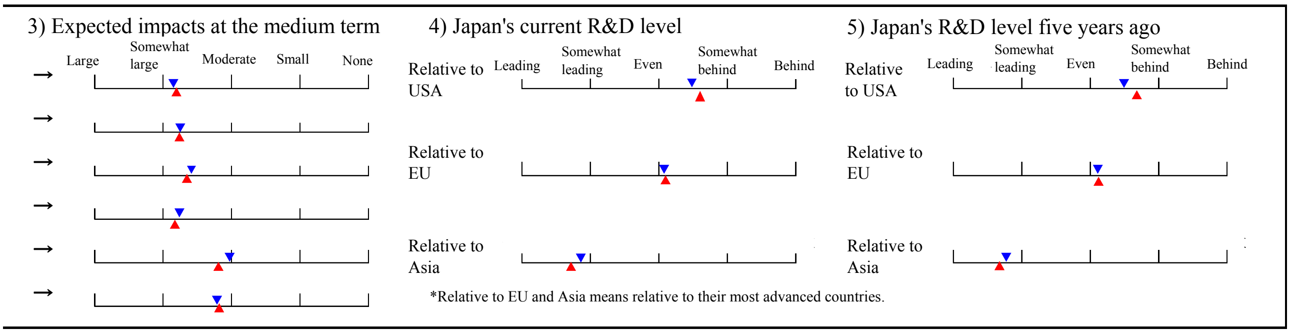


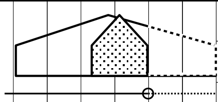
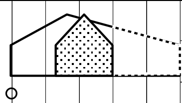
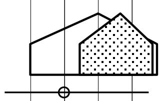
2) Current impacts

		Large / Somewhat large / Moderate / Small / None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
41	Manufacturing process technology that utilizes functions of microorganisms inhabiting ultrahigh pressure, high pH, or other extreme environments.	1	52	6	19	75	-	50	12	67	19	2		2	19
		2	82	0	5	95	-	47	1	86	11	2		0	5
		E		100	0	0	-	0	100	0	0	0		0	0
42	Manufacturing process technology that utilizes gravity-free, minimal gravity, or other special environments.	1	80	1	11	88	-	49	15	53	29	3		3	10
		2	97	0	5	95	-	43	3	68	26	3		5	4
		E													
43	An efficient manufacturing process that uses or mimics microorganism functions.	1	63	8	17	75	-	59	27	55	16	2		2	13
		2	96	0	6	94	-	50	7	81	10	2		0	4
		E		100	0	0	-	0	100	0	0	0		0	0

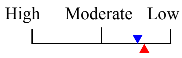


Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
19	71	6	0	4	21	44	25	10	33	37	52	43	2	4	4	0		2	19	15	49	23	13	32	59	20	50	14	9	0
3	97	0	0	0	4	74	19	3	29	38	71	45	3	0	0	0		0	6	3	75	17	5	27	77	9	53	1	0	0
100	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0		0	0	100	0	0	0	0	0	0	0	0	0	0
8	87	4	0	1	24	52	20	4	29	47	51	53	21	3	4	1		3	16	18	45	29	8	30	70	26	48	4	4	0
0	99	1	0	0	13	73	12	2	16	38	64	60	11	0	0	0		4	10	6	71	20	3	23	77	9	48	1	0	1
30	57	9	0	4	19	50	21	10	27	47	51	51	7	11	4	0		3	13	15	49	20	16	28	56	26	52	18	10	0
7	92	0	0	1	5	82	12	1	25	46	70	57	3	2	0	0		1	6	2	81	14	3	25	75	11	52	8	2	0
100	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0		0	0	100	0	0	0	0	0	0	0	0	0	0

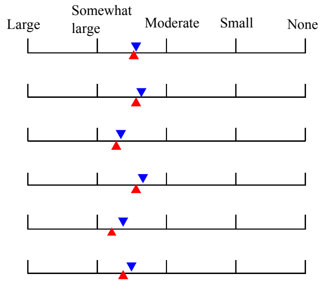
VIII. Advanced manufacturing technology for social infrastructure

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts



[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

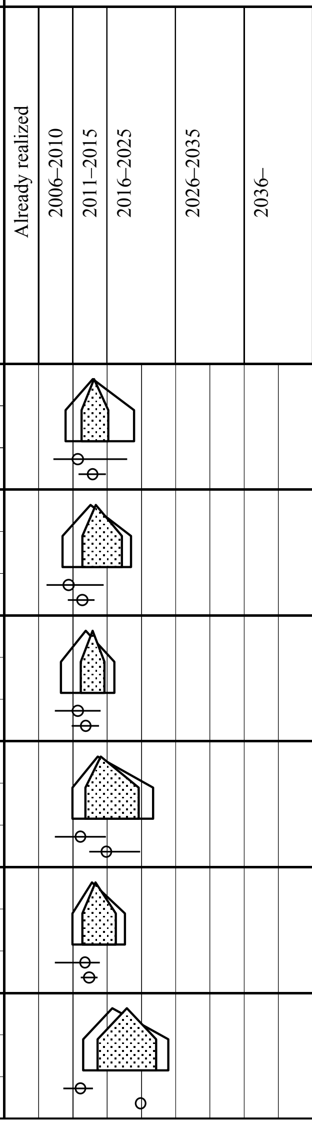
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

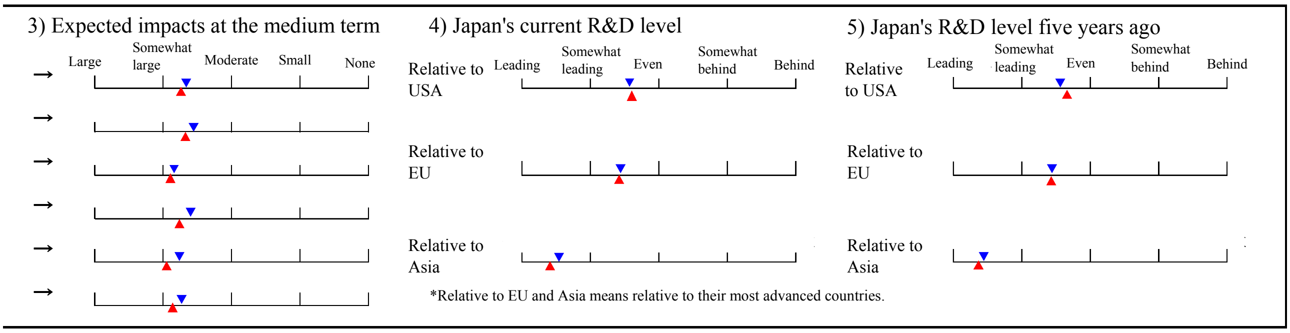
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

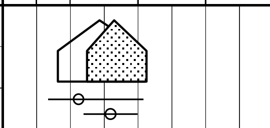
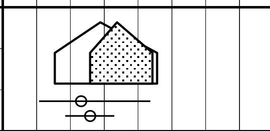
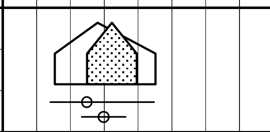
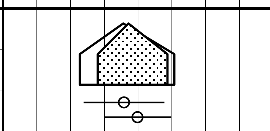
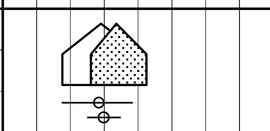
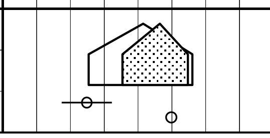
2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate	Low	None	Will not be realized (%)	Do not know
44	Technology for manufacturing heavy structures such as large equipment, buildings, and vessels by using light-weight, high-strength composite materials instead of conventional steel materials.	1	104	17	30	53	-	65	36	55	8	1	5	8
		2	106	8	28	64	-	60	21	75	4	0	2	1
		E	9	100	0	0	-	89	78	22	0	0	0	0
45	High-strength, high-durability bonding technologies, such as plastic bonding, that can substitute for welding in heavy structures.	1	97	16	27	57	-	55	20	61	18	1	4	6
		2	104	8	21	71	-	54	11	83	6	0	0	1
		E	8	100	0	0	-	79	57	43	0	0	0	0
46	Technology for bonding dissimilar materials (e.g., composite material and steel) in heavy structures.	1	96	18	27	55	-	59	27	57	15	1	2	6
		2	103	9	18	73	-	56	14	81	5	0	1	1
		E	9	100	0	0	-	89	78	22	0	0	0	0
47	Low-deformation/-distortion (1/1000 of conventional level) bonding technology based on liquid-phase or solid-state diffusion that can substitute for conventional hot-melt bonding in heavy structures.	1	80	18	34	48	-	59	25	61	13	1	1	9
		2	95	8	17	75	-	53	9	86	5	0	0	2
		E	8	100	0	0	-	69	38	62	0	0	0	14
48	Technology for construction of vessels, bridges, thermal power plants and other large structures with no need for modification and maintenance, by simulating and accurately predicting deformations by gravity, temperature, heat input in bonding, and residual stress in steel, and incorporating the results into the initial design.	1	87	17	23	60	-	60	29	52	18	1	1	8
		2	97	6	14	80	-	56	13	86	1	0	0	1
		E	6	100	0	0	-	75	50	50	0	0	0	0
49	Technology for desert revegetation and food production in desert areas to help avoid food crises resulting from population growth.	1	63	5	11	84	-	60	33	45	17	5	0	10
		2	88	1	0	99	-	53	11	78	11	0	0	1
		E	1	100	0	0	-	50	0	100	0	0	0	0

Time of technological realization





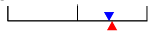
Countries at the leading edge: Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied	Do not know	Regarding social application — Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
65	29	5	0	1	16	50	27	7	22	54	33	65	6	16	6	2		4	9	16	47	29	8	23	51	14	49	34	11	3
92	7	1	0	0	8	73	17	2	15	67	17	72	2	4	0	0		2	1	5	71	22	2	16	71	3	53	16	5	0
87	13	0	0	0	45	44	11	0	33	78	33	67	0	0	0	0		0	0	22	67	0	11	38	75	0	50	25	0	0
48	28	23	0	1	13	42	34	11	29	56	30	67	4	11	2	0		3	7	11	38	38	13	19	59	16	51	21	6	1
87	8	5	0	0	4	77	17	2	20	72	17	72	1	0	0	0		0	1	3	66	28	3	13	74	2	57	7	0	0
100	0	0	0	0	13	62	25	0	50	100	0	63	0	0	0	0		0	0	14	58	14	14	33	83	0	33	0	0	0
44	38	17	0	1	13	42	35	10	31	61	30	66	4	7	2	0		1	8	11	40	34	15	22	61	21	48	18	6	0
78	20	2	0	0	5	75	18	2	20	71	17	73	1	0	0	0		1	1	5	66	26	3	19	71	3	60	7	0	0
87	13	0	0	0	22	67	11	0	44	78	0	67	0	0	0	0		0	0	33	56	0	11	38	63	0	50	0	0	0
54	24	19	0	3	13	48	33	6	30	58	36	62	3	4	3	0		1	8	13	44	31	12	22	60	21	47	18	9	0
89	10	1	0	0	4	78	17	1	17	70	22	66	1	0	0	0		0	2	3	75	20	2	15	81	3	54	4	1	0
100	0	0	0	0	13	62	25	0	13	88	25	63	0	0	0	0		0	14	13	61	13	13	43	86	0	43	0	0	0
50	42	7	0	1	16	41	33	10	32	53	34	64	8	5	4	3		1	8	16	38	31	15	28	59	23	46	13	8	0
76	23	1	0	0	5	79	15	1	16	67	20	74	1	1	0	0		0	1	3	75	19	3	16	81	8	56	4	1	0
100	0	0	0	0	33	50	17	0	33	83	50	67	0	0	0	0		0	0	17	66	0	17	40	80	20	60	0	0	0
27	43	18	7	5	39	43	10	8	40	33	33	56	46	9	4	0		0	10	33	51	9	7	43	55	19	58	13	8	4
16	81	3	0	0	22	75	1	2	49	27	16	80	37	0	0	0		0	1	18	78	3	1	44	59	5	76	3	0	0
100	0	0	0	0	0	100	0	0	100	100	0	100	100	0	0	0		0	0	0	100	0	0	100	100	0	100	0	0	0

IX. Surface modification and interface control technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

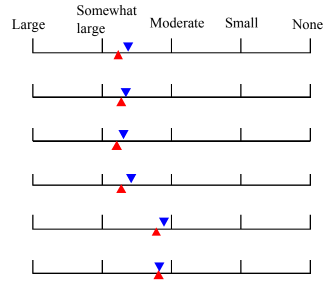


2) Current impacts

[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

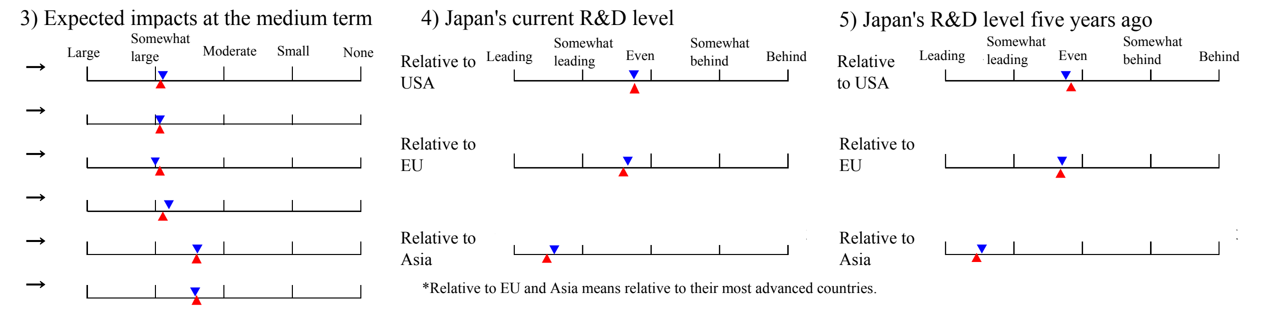
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



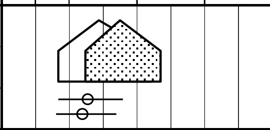
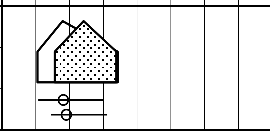
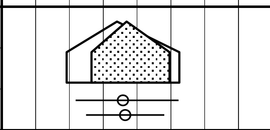
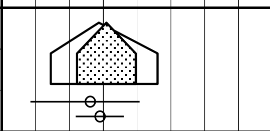
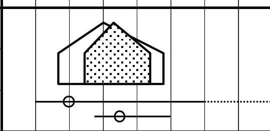
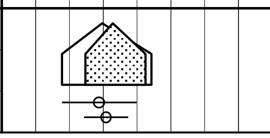
2. Questions regarding toipcs

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization	Will not be realized (%)	Do not know (%)
50	Technology for dramatically (three or more times longer than current level) extending the life of production facilities through innovations in material surface properties.	1	114	17	28	55	-	61	29	59	12	0		3	6
		2	121	8	22	70	-	55	13	82	5	0		0	2
		E	10	100	0	0	-	75	50	50	0	0		0	0
51	Technology for forming super-hard thin film (e.g. diamond thin film) on a complex surface to be applied to the sliding surface of bearings and special tools.	1	116	16	29	55	-	60	28	58	14	0		0	3
		2	121	9	19	72	-	56	14	83	3	0		0	1
		E	11	100	0	0	-	73	45	55	0	0		0	0
52	Self-lubricating machine elements become commercially available, widely eliminating the need for lubricating the processing machines.	1	111	14	30	56	-	59	28	52	20	0		7	6
		2	120	7	23	70	-	54	12	82	6	0		2	3
		E	8	100	0	0	-	75	50	50	0	0		13	0
53	Proliferation of dry processing technology with which no lubricant or processing fluid is necessary for machining and plastic working.	1	115	29	23	48	-	60	28	53	19	0		4	4
		2	120	17	26	58	-	59	21	73	6	0		3	3
		E	20	100	0	0	-	73	45	55	0	0		10	0
54	Machine element technology that allows significant regulation of holding stiffness and damping properties through the use of functional materials such as electroviscous fluid.	1	91	10	31	59	-	50	14	59	26	1		0	1
		2	104	7	20	73	-	51	6	85	9	0		0	2
		E	7	100	0	0	-	64	29	71	0	0		0	0
55	Micromachining/ultra micromachining technology that can change material's surface properties, such as wettability and optical quality, according to the aim of the machine element.	1	91	22	30	48	-	65	33	59	8	0		0	4
		2	109	12	21	67	-	56	15	81	3	1		0	2
		E	13	100	0	0	-	69	38	62	0	0		0	0

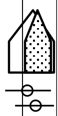
Time of technological realization columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–

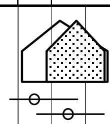
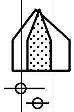
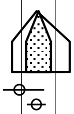
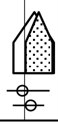


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
54	36	10	0	0	16	43	24	17	24	59	37	56	5	2	1	0
90	8	2	0	0	3	74	17	6	12	75	20	71	0	2	1	0
70	10	20	0	0	20	80	0	0	20	50	40	90	0	0	0	0
62	25	12	1	0	15	35	32	18	21	55	32	60	5	2	1	0
92	6	2	0	0	4	65	26	5	11	66	17	79	0	3	1	0
91	0	9	0	0	27	73	0	0	18	36	27	100	0	0	0	0
62	25	13	0	0	13	38	30	19	24	56	34	51	3	3	2	1
91	6	3	0	0	3	62	30	5	9	71	17	68	0	2	1	0
74	13	13	0	0	13	61	13	13	14	43	29	100	0	0	0	0
57	17	25	0	1	11	40	30	19	29	52	32	52	9	4	5	1
90	2	8	0	0	4	65	27	4	15	73	18	71	2	2	2	0
75	0	25	0	0	16	63	16	5	22	67	17	89	11	0	6	0
50	36	14	0	0	10	41	30	19	22	51	33	56	8	1	1	1
80	17	3	0	0	2	69	26	3	9	67	20	74	0	1	0	0
86	0	14	0	0	0	57	43	0	14	57	29	71	0	0	0	0
50	36	14	0	0	20	44	19	17	24	55	36	67	3	1	1	0
82	13	5	0	0	5	77	14	4	12	72	23	75	0	1	0	0
77	23	0	0	0	23	77	0	0	31	62	46	85	0	0	0	0

Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
			High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
	2	7	11	42	24	23	20	64	22	47	5	1	0
	0	3	3	70	18	9	10	86	6	52	4	1	0
	0	0	30	50	20	0	30	80	10	30	0	0	0
	0	4	10	38	25	27	24	60	23	48	4	2	1
	0	1	3	62	25	10	9	85	9	52	3	1	0
	0	0	27	55	18	0	27	91	0	18	0	0	0
	8	7	10	36	29	25	27	54	19	46	6	4	1
	3	4	3	59	29	9	10	78	4	56	2	2	0
	13	0	25	37	25	13	29	100	0	29	0	0	0
	4	4	11	39	27	23	27	53	18	48	7	9	0
	3	3	3	61	29	7	13	79	2	55	3	5	0
	11	0	11	63	21	5	17	83	0	44	0	0	0
	1	2	7	44	27	22	24	72	16	40	3	1	0
	1	2	2	67	25	6	12	82	4	55	1	0	0
	0	0	0	33	50	17	20	80	0	40	0	0	0
	0	3	16	44	17	23	29	66	24	43	4	1	1
	1	3	5	76	12	7	13	88	10	54	1	0	0
	0	0	23	69	8	0	38	92	23	54	0	0	0

Questions regardig other topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
56	A technical education program that ensures the handing down of expertise and craftsmanship by establishing technology for converting implicit knowledge on manufacturing and manufacturing technique (e.g. basic techniques and skills, know-how, experience) into explicit knowledge.	1	157	17	36	47	-	81	65	29	6	0							5	8
		2	141	10	33	57	-	94	87	13	0	0							2	2
		E	14	100	0	0	-	96	93	7	0	0							7	0
57	University and higher-education systems in which students can choose freely from broad production-related technical fields (materials, design, information, electronics, mechanical, and analysis/assessment technologies, quality engineering, business administration, etc.) and earn credits.	1	139	20	30	50	-	72	49	44	6	1								
		2	136	12	24	64	-	82	65	33	2	0								
		E	16	100	0	0	-	91	81	19	0	0								
58	Promotion of human resources mobility that is promoted across industry, academia, and government, leading to a greater number of joint or collaboration projects, and consequently bringing about innovations in manufacturing technology.	1	156	15	38	47	-	81	63	32	5	0								
		2	139	9	35	56	-	93	86	14	0	0								
		E	12	100	0	0	-	100	100	0	0	0								
59	Implementation of a new elementary and secondary education scheme that emphasizes science and mathematics to make Japan a world leader in science and technology.	1	150	16	23	61	-	88	77	19	4	0								
		2	142	6	22	72	-	95	89	9	1	1								
		E	9	100	0	0	-	100	100	0	0	0								

Countries at the leading edge					Regarding technological realization													Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't												Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
60	**22**	**18**	**0**	**0**	**37**	**37**	**18**	**8**	**64**	**55**	**36**	**40**	**5**	**4**	**1**	**0**		**3**	**7**	**37**	**36**	**18**	**9**	**67**	**60**	**12**	**39**	**10**	**5**	**1**
87	**8**	**5**	**0**	**0**	**39**	**50**	**7**	**4**	**79**	**57**	**24**	**44**	**1**	**0**	**1**	**0**		**2**	**4**	**43**	**45**	**6**	**6**	**81**	**68**	**2**	**38**	**2**	**1**	**0**
79	**21**	**0**	**0**	**0**	**54**	**23**	**23**	**0**	**54**	**62**	**31**	**46**	**0**	**0**	**0**	**0**		**7**	**0**	**57**	**14**	**29**	**0**	**93**	**71**	**0**	**50**	**0**	**0**	**0**
																		**2**	**8**	**50**	**37**	**10**	**3**	**56**	**51**	**6**	**20**	**38**	**17**	**3**
																		0	**1**	**81**	**13**	**5**	**1**	**76**	**63**	**0**	**14**	**31**	**3**	**1**
																		0	**0**	**68**	**19**	**13**	**0**	**75**	**69**	**0**	**25**	**25**	**0**	**0**
																		**0**	**7**	**61**	**30**	**7**	**2**	**57**	**75**	**8**	**27**	**42**	**14**	**1**
																		0	**1**	**83**	**12**	**4**	**1**	**66**	**81**	**0**	**18**	**36**	**2**	**1**
																		0	**0**	**84**	**0**	**8**	**8**	**82**	**91**	**0**	**18**	**73**	**0**	**0**
																		**1**	**7**	**78**	**17**	**3**	**2**	**76**	**42**	**4**	**25**	**35**	**19**	**4**
																		0	**1**	**94**	**4**	**1**	**1**	**91**	**44**	**0**	**20**	**28**	**4**	**1**
																		0	**0**	**89**	**11**	**0**	**0**	**89**	**44**	**0**	**11**	**56**	**0**	**0**

11. Industrial infrastructure field

11.1. Overview

This survey was the first to cover the field of industrial infrastructure. In addition, this was the first use of the current method for establishing areas. “Areas” and “topics” in industrial infrastructure were established as follows.

First, for the field of industrial infrastructure, we envisioned the Japanese economy over the long term of 30 to 50 years and established the question of what sort of industrial infrastructure will be necessary in order to promote corporate activity in Japan and overseas activities of Japanese corporations effectively. At that time, we identified in detail the unresolved problems in Japan that form major broad-based barriers to corporate activities.

Next, we examined how technology would be specified as a means of solving such problems. Industrial infrastructure technology is not necessarily as clear as technology in natural science. In particular, industrial infrastructure itself is developed by technology, and emphasizing the point that it is inseparable from the corporations, governments, and other social systems that adopt it, we included management technology as "technology." Furthermore, we established "topics" in the form of questions for the selected technologies. We used these topics as the basis to categorize the “areas”.

The 10 areas were classified as follows. First, we turned our attention to the geographical and population elements that are natural elements upon which corporate activity is predicated. These are reflected in Area 1, "optimization of industrial infrastructure through regional dispersion and concentration" and Area 6, "human resources management." Second, we identified knowledge management, human resources management, risk management, financial management, environmental management, and so on, as corporate management technologies. These are included in various appropriate areas. Third, we reflected the governance of corporate activity in Area 3, and corporations and market competition in Area 7. Fourth, we established Area 4, "public-sector governance and management," to target central and local government, and nonprofit organization in a sector where numerous issues must be resolved. Based on awareness that low productivity and stagnant quality in Japan's service industries and service sector are issues that need to be resolved, we addressed them as Area 8. Finally, anticipating the development of new industries centered on the arts, culture, and leisure, we named that as an independent area. Although policy is an important element of industrial infrastructure, we reflect this in individual topics rather than in an independent area. Each of the 10 areas thus arranged is a basic condition of corporate management and is vital to Japan's industrial infrastructure. The areas are also closely related to one another.

We bore the following points in mind while establishing as a topic the proper form of promotion measures for this kind of technology. First, government-led funding supply and the introduction of special projects are insufficient to realize these industrial infrastructure technologies. More refined promotion measures are necessary. Methods that are based on consideration of the individual conditions of the entities developing and utilizing the technologies, which are inseparable from corporations, government, and social systems, and that are coordinated by the relevant entities are necessary. For example, in order to realize industrial or research clusters in regional areas, various policies must be combined, and refined methods to achieve the concentration of corporations and research institutions are necessary.

Second, government or political leadership is still essential. Government leadership is vital to regional decentralization of industrial infrastructure, corporate governance, education, technology policy, and so on. In public-sector management, it is the action of government itself that is at issue.

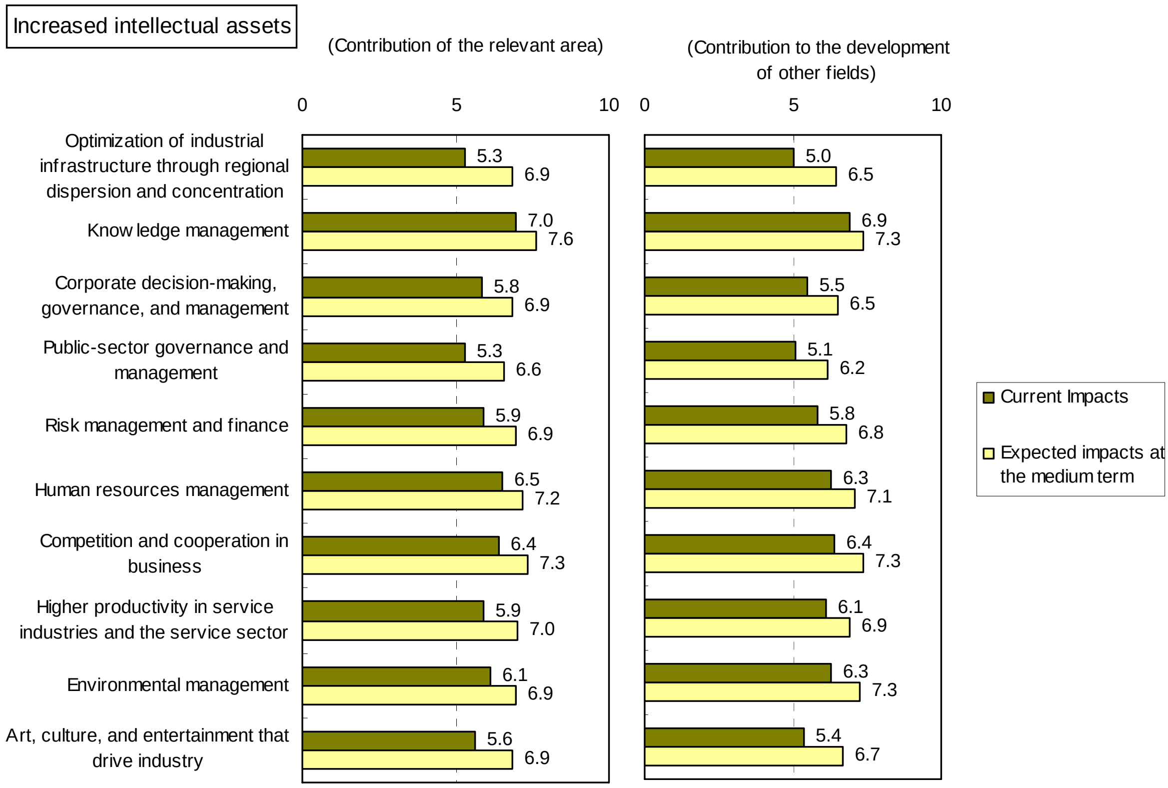
Third is the importance of human resources development. In particular, advanced training at the university and graduate school level of human resources who can develop and disseminate such technologies is vital. At the same time, however, the division between science and humanities education forms a barrier, and a proper form of education to integrate them is necessary. As measures towards this end, the fusion of science and the humanities education at the department level and the implementation of multiple majors and degrees at the graduate school level are important. For example, education in risk management or financial technology clearly requires integration of the sciences and the humanities.

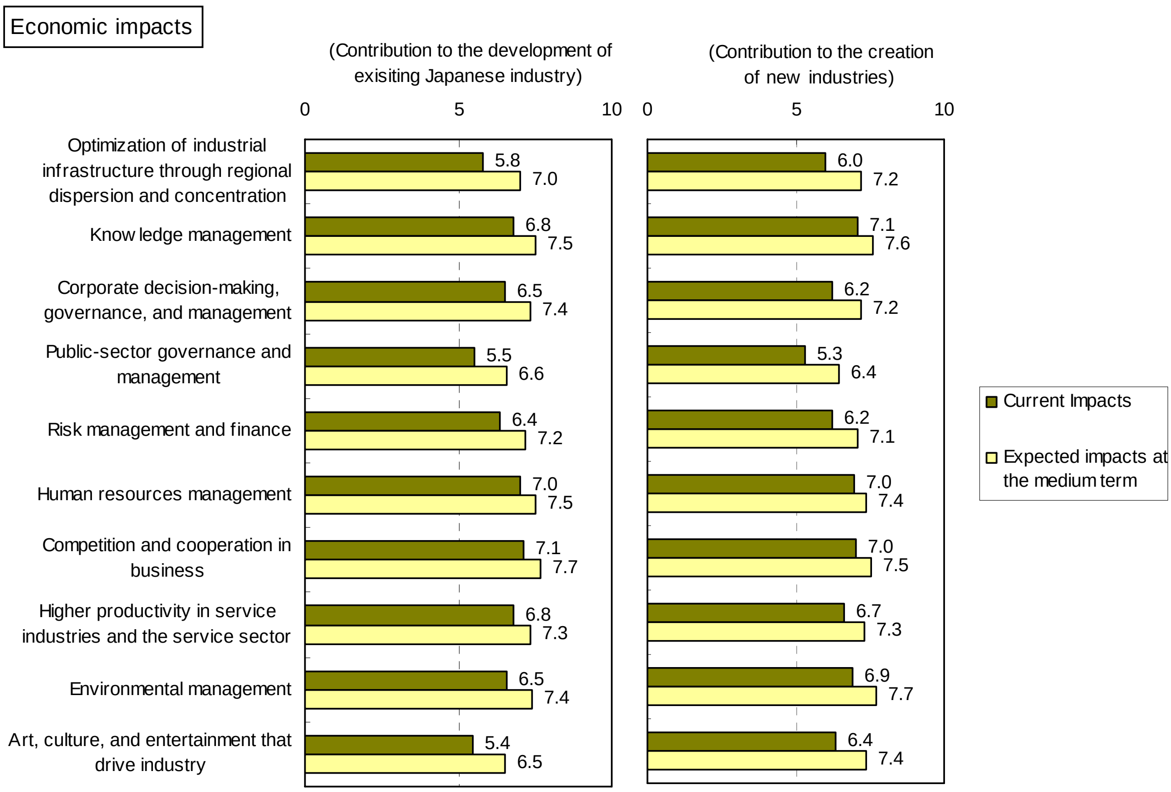
Fourth, the proper form of research and development funding is an issue. Direct distribution of research funding alone is insufficient. The question is how to form a system in Japan that can distinguish between early-stage and middle-stage corporate technical development and effectively allocate funds.

(ANEGAWA Tomofumi)

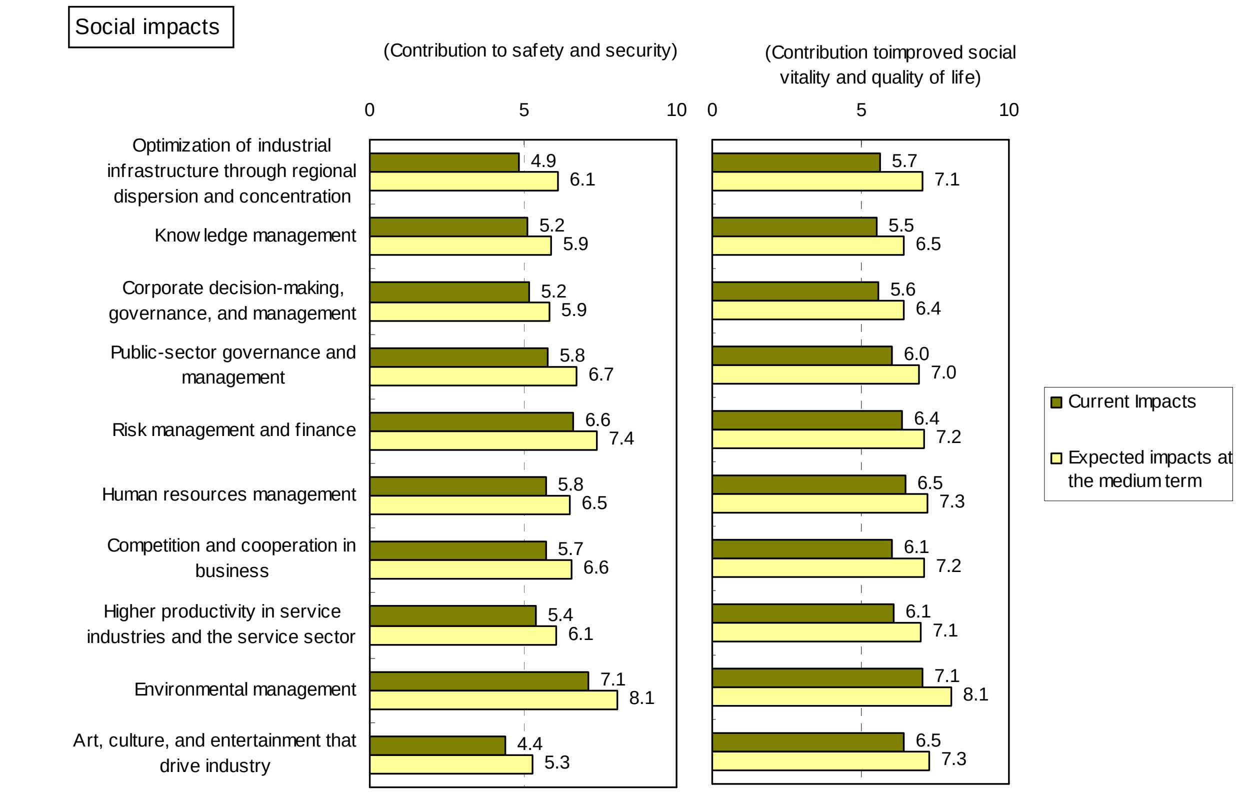
11.2. Main results

A. Impacts

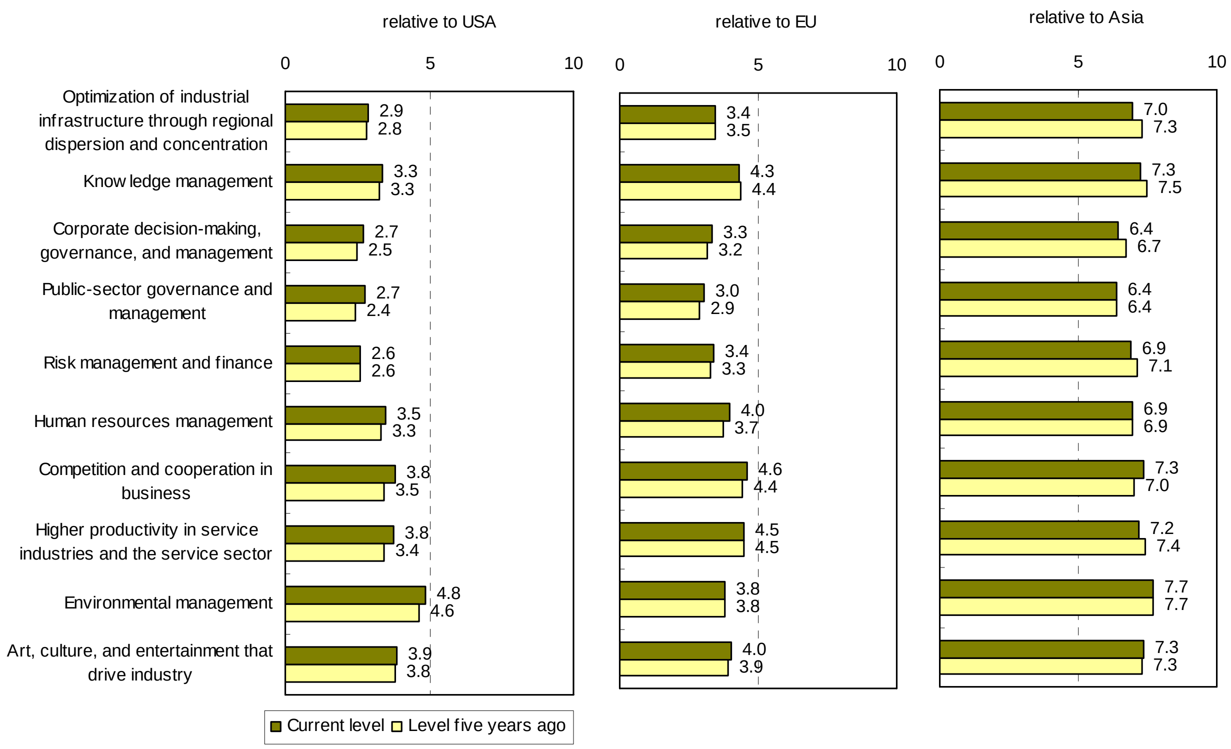




*Responses are indexed on a 10-point scale.

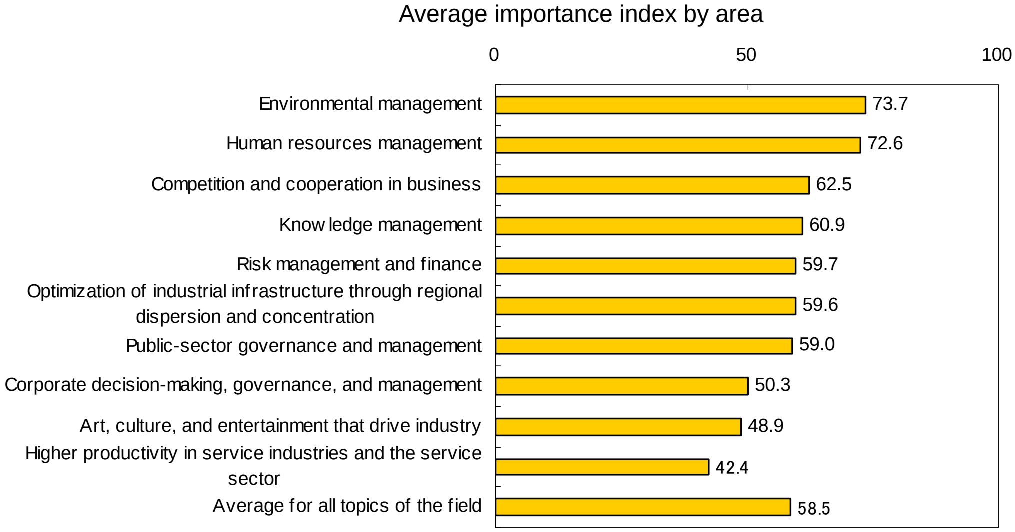


B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan



The most important 10 topics

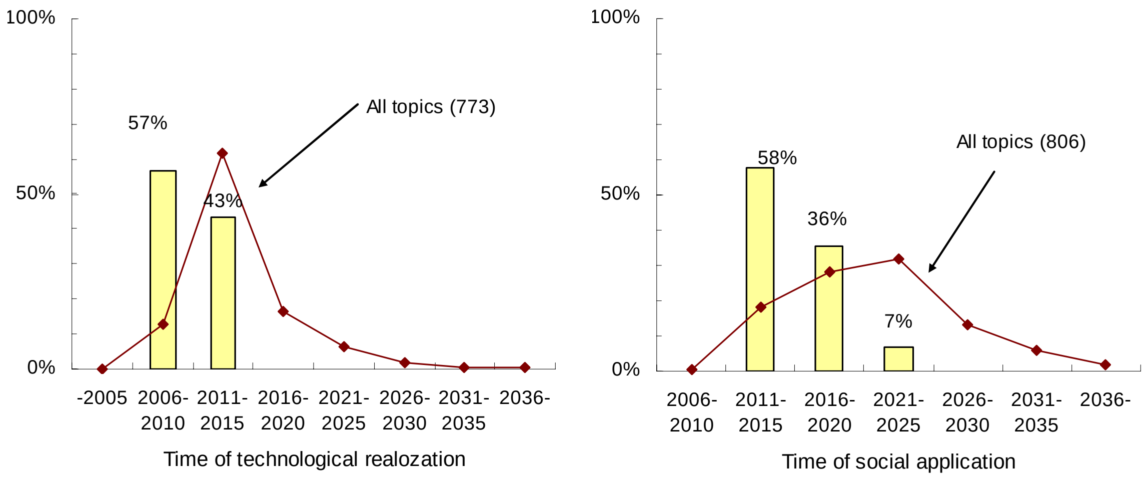
	Topic	Index	Year T*	Year S*
1	36: A social environment that encourages women to balance work and marriage, childbearing, and childrearing (e.g. 30% of listed companies set up day care centers) becomes a reality in Japan to promote the utilization of female human resources.	90	-	2014
2	39: In Japan, for easier job changes, corporate pensions become "portable" so that the pension funds deposited under the pension program of the previous employer can be transferred to the new employer's pension program when a worker changes jobs.	90	-	2013
3	51: Over half of Japan's listed companies adopt management schemes that emphasize corporate social responsibility as the fundamental business policy.	86	-	2011
4	04: Facilitation of international business operations based on international standards, as a result of international standardization of the laws governing commercial activities, transactions, taxing, competition, and intellectual property rights in the international context.	82	-	2016
5	38: Reeducation/retraining programs for "capacity building among the existing workforce," or for improving specialized skills and productivity among part-time and temporary workers, are widely implemented in Japan.	80	-	2013
6	27: Financial and other economic policies become more specific and capable of controlling inflation and deflation, contributing to a major reduction of economic fluctuations.	77	-	2021
7	34: In Japan, securities markets where relatively small, unlisted companies can raise small funds that range from a few tens to hundreds of millions of yen are formed.	76	-	2013
8	44: Consumer-oriented systems for privacy information management and protection are implemented to ensure that consumers' personal information is made accessible only to the entities authorized by the consumers and reuse by any other entities is blocked.	75	2009	2014
9	09: Methods of assessing and utilizing the database, knowledge base, and knowledge network (a social network in which people with knowledge are known and accessible) built within an organization are established and made widely available.	74	2009	2014
10	25: Japan's government sector moves toward e-government and, combined with established technologies for personal authentication and personal information protection, begins to provide online public services in areas such as tax accounting and payment, pensions, health insurance, welfare, and other formalities.	73	2008	2014

Year T: Time of technological realization   Year S: Time of social application

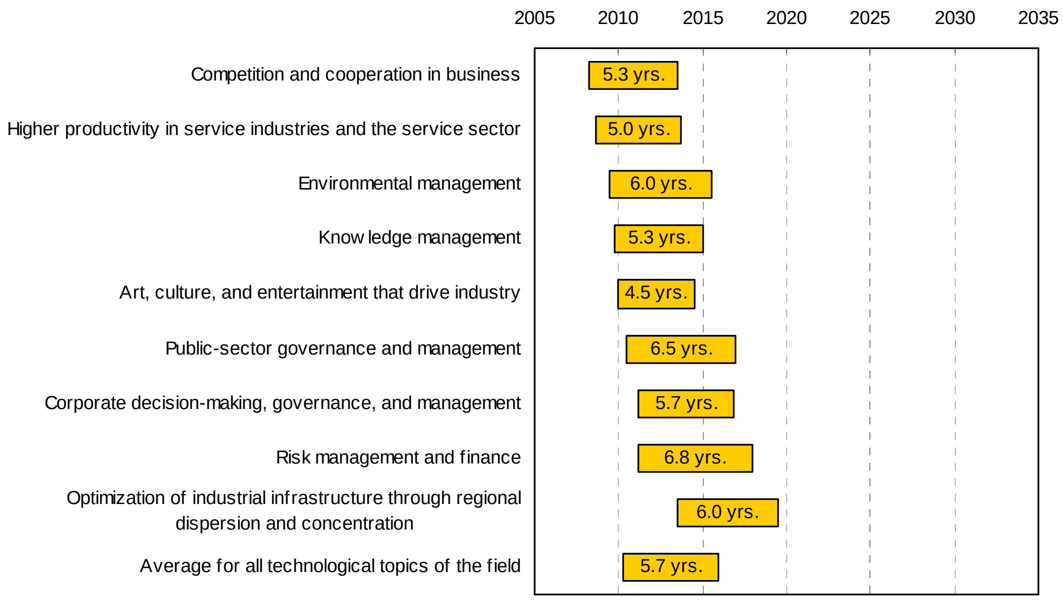
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

Topic	Year T*	Period*	Area
31: In Japan, advances in the behavioral scientific analysis of the strategy building process in the public and corporate sectors lead to the ability to promptly and effectively make decisions under competitive circumstances.	2012	8	Risk management and finance
18: Efficient monitoring and incentive systems applicable internally to companies are developed to allow a significant delegation of authority, resulting in a 50% increase in labor productivity from the current levels.	2013	7	Corporate decision-making, governance, and management
26: In Japan, technology for integrated risk management is developed to enhance the risk management capacity across the public sector, and this enables society to scan and identify risks, evaluate risk impacts, and rank risks by priority. As a result, assuming the desirable social state, a consistent framework within which protections against risks are proposed, adopted, and implemented is established.	2013	7	Public-sector governance and management

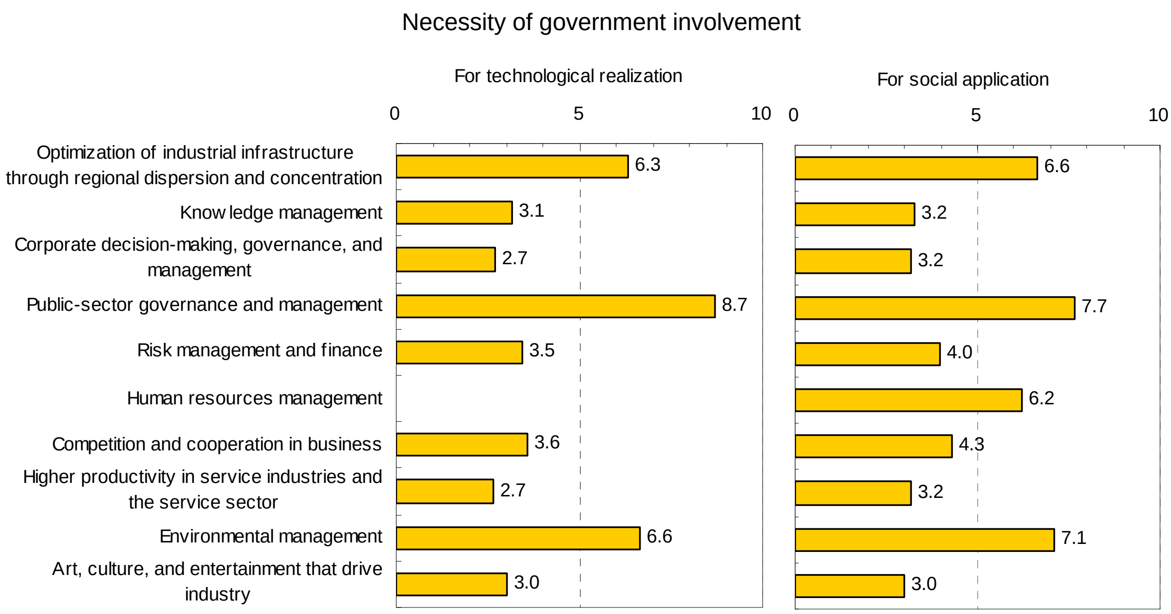
Topic	Year T*	Period*	Area
30: A rapid increase in the amount of data available to companies and advances in data analysis technology result in better prediction technologies that allow companies to evaluate diverse risks. To take advantage of these technologies, scenario planning and other tools are developed, enabling risk control that can reduce fluctuations in operating profits by half.	2011	7	Risk management and finance
32: Common, universal systems for evaluating and controlling project risks are established.	2012	7	Risk management and finance
33: As fusion between insurance and capital markets progresses, a risk control method called alternative risk transfer (ART) advances in structure. Thus, various risks of companies and individuals are diversified and transferred to investors on a large scale to achieve integrated risk management.	2012	7	Risk management and finance
54: Demand-side management programs are widely and effectively introduced to Japan's traffic, electricity, and communications infrastructures to reduce hourly and seasonal fluctuations in demand and thus to cut excessive capital investment.	2010	7	Environmental management

Topic	Year T*	Period*	Area
15: Efficient optimization of resources allocation, scheduling, etc. becomes possible, contributing to corporate cost reduction.	2009	4	Corporate decision-making, governance, and management
55: Advances in research on comfort/discomfort, likes/dislikes, and other sensibilities that people feel as a result of consuming goods and services lead to the establishment of methods by which consumer sensibilities are directly analyzed, measured, and assessed, so that the results are used for R&D, sales, and marketing of goods and services.	2012	4	Art, culture, and entertainment that drive industry
07: As with the case of open source software, diverse goods and services, regardless of price, are developed, produced, sold, and supported primarily by consumers to meet their needs.	2009	5	Knowledge management
08: For diverse goods and services, technology standardization and module-based research and development practices intensify, resulting in improved efficiency in overall R&D for any goods and services.	2009	5	Knowledge management
09: Methods of assessing and utilizing the database, knowledge base, and knowledge network (a social network in which people with knowledge are known and accessible) built within an organization are established and made widely available.	2009	5	Knowledge management
13: Widespread use of electronic money and the like allows micropayments (transactions smaller than ¥500) to be made at zero or negligible cost.	2008	5	Corporate decision-making, governance, and management
29: To reduce market risks arising from the fluctuation of currency values and international commodity (e.g. energy) prices, major Japanese companies (over 30% of those listed) measure and control risk amounts daily by identifying in advance the risk factors.	2009	5	Risk management and finance
42: Over 50% of the Japanese companies implement enterprise resource planning (ERP) systems and successfully improve demand forecasting, logistic systems, contracting forms, etc., enabling real-time order transactions and consequently, a significant reduction in inventory in the production/distribution system.	2008	5	Competition and cooperation in business
43: The establishment of flexible manufacturing technology allows over 50% of the listed manufacturers to replace conventional mass-production processes with fully individualized, made-to-order production processes.	2009	5	Competition and cooperation in business
44: Consumer-oriented systems for privacy information management and protection are implemented to ensure that consumers' personal information is made accessible only to the entities authorized by the consumers and reuse by any other entities is blocked.	2009	5	Competition and cooperation in business
46: Robots and information systems that can substitute as service personnel at checkout counters and the storefront become widely available.	2009	5	Higher productivity in service industries and the service sector

Topic	Year T*	Period*	Area
47: Ordering and other business transactions are mostly conducted over mobile phones through voice input alone.	2008	5	Higher productivity in service industries and the service sector
49: In TV and other broadcasting media, advertising material can be adapted to individual viewers.	2009	5	Higher productivity in service industries and the service sector
52: Environmental accounting (a method of evaluating a company's contribution to environmental conservation and sustainable development) or its extensions are widely adopted.	2009	5	Environmental management
58: In such fields as art, theater, cinema, music, and literature, there are artistic activities whose viability is threatened due to a very small consumer population. Such small-scale artistic activities can be made economically viable not by increasing the number of consumers, but by reducing access costs through the development of a system that allows existing consumers to enjoy, or obtain reproductions of, such activities over the Internet or other communications means at far lower cost.	2008	5	Art, culture, and entertainment that drive industry

*Year T: Time of technological realization Period: Period until social application (years)

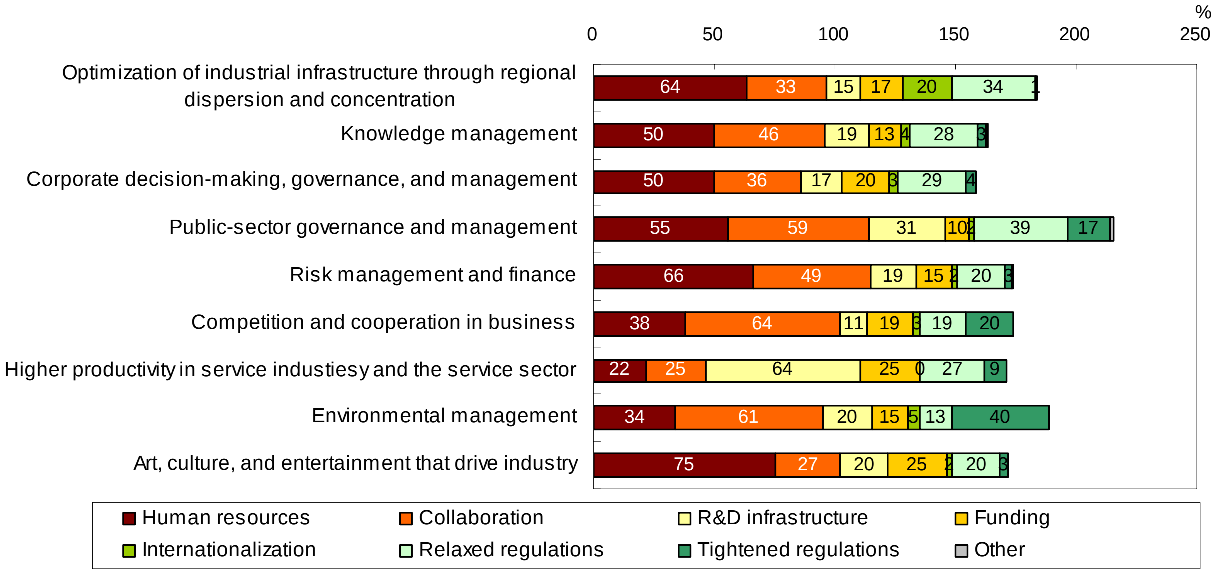
E. Effective measures that should taken by government



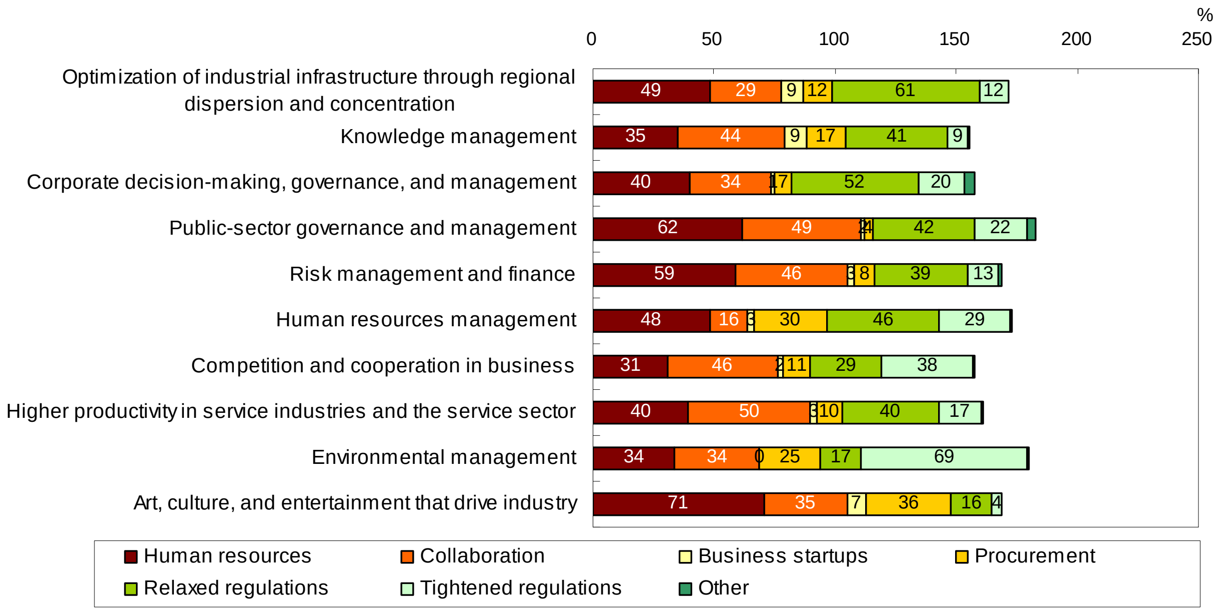
*Responses were indexed on a 10-point scale

Effective measures

For technological realization



For social application



F. Time-line of topics

Technological realization

year	topic
2007	45: Intelligent tags designed for product identification, quality control, and product tracking become widely available.
2008	13: Widespread use of electronic money and the like allows micropayments (transactions smaller than ¥500) to be made at zero or negligible cost.
	25: Japan's government sector moves toward e-government and, combined with established technologies for personal authentication and personal information protection, begins to provide online public services in areas such as tax accounting and payment, pensions, health insurance, welfare, and other formalities.
	42: Over 50% of the Japanese companies implement enterprise resource planning (ERP) systems and successfully improve demand forecasting, logistic systems, contracting forms, etc., enabling real-time order transactions and consequently, a significant reduction in inventory in the production/distribution system.

year	topic
	47: Ordering and other business transactions are mostly conducted over mobile phones through voice input alone.
	58: In such fields as art, theater, cinema, music, and literature, there are artistic activities whose viability is threatened due to a very small consumer population. Such small-scale artistic activities can be made economically viable not by increasing the number of consumers, but by reducing access costs through the development of a system that allows existing consumers to enjoy, or obtain reproductions of, such activities over the Internet or other communications means at far lower cost.
2009	07: As with the case of open source software, diverse goods and services, regardless of price, are developed, produced, sold, and supported primarily by consumers to meet their needs.
	08: For diverse goods and services, technology standardization and module-based research and development practices intensify, resulting in improved efficiency in overall R&D for any goods and services.
	09: Methods of assessing and utilizing the database, knowledge base, and knowledge network (a social network in which people with knowledge are known and accessible) built within an organization are established and made widely available.
	15: Efficient optimization of resources allocation, scheduling, etc. becomes possible, contributing to corporate cost reduction.
	29: To reduce market risks arising from the fluctuation of currency values and international commodity (e.g. energy) prices, major Japanese companies (over 30% of those listed) measure and control risk amounts daily by identifying in advance the risk factors.
	43: The establishment of flexible manufacturing technology allows over 50% of the listed manufacturers to replace conventional mass-production processes with fully individualized, made-to-order production processes.
	44: Consumer-oriented systems for privacy information management and protection are implemented to ensure that consumers' personal information is made accessible only to the entities authorized by the consumers and reuse by any other entities is blocked.
	46: Robots and information systems that can substitute as service personnel at checkout counters and the storefront become widely available.
	49: In TV and other broadcasting media, advertising material can be adapted to individual viewers.
	52: Environmental accounting (a method of evaluating a company's contribution to environmental conservation and sustainable development) or its extensions are widely adopted.
2010	54: Demand-side management programs are widely and effectively introduced to Japan's traffic, electricity, and communications infrastructures to reduce hourly and seasonal fluctuations in demand and thus to cut excessive capital investment.
2011	30: A rapid increase in the amount of data available to companies and advances in data analysis technology result in better prediction technologies that allow companies to evaluate diverse risks. To take advantage of these technologies, scenario planning and other tools are developed, enabling risk control that can reduce fluctuations in operating profits by half.
2012	10: In the area of R&D project management, methods of planning, performing, controlling, and assessing research projects are established, enabling an average 50% increase in labor productivity in R&D.
	21: Competition, negotiation, and coordination are analyzed further by game theory. The results are commonly applied to real-world policy-making and corporate decision-making, causing a significant change in such practices, and to institutional design in the public sector (e.g. competition policy, industrial policy) and the corporate sector (e.g. corporate strategy).
	22: In marketing surveys, there is a general shift from the traditional analysis focusing on individuals and individual variables to an approach in which interpersonal relationships are considered as "social networks" or an approach in which each person is analyzed from the viewpoint of "individual relationships."
	31: In Japan, advances in the behavioral scientific analysis of the strategy building process in the public and corporate sectors lead to the ability to promptly and effectively make decisions under competitive circumstances.
	32: Common, universal systems for evaluating and controlling project risks are established.
	33: As fusion between insurance and capital markets progresses, a risk control method called alternative risk transfer (ART) advances in structure. Thus, various risks of companies and individuals are diversified and transferred to investors on a large scale to achieve integrated risk management.
	55: Advances in research on comfort/discomfort, likes/dislikes, and other sensibilities that people feel as a result of consuming goods and services lead to the establishment of methods by which consumer sensibilities are directly analyzed, measured, and assessed, so that the results are used for R&D, sales, and marketing of goods and services.
2013	03: A research and development system for developing information, medical, financial, and other technologies that meet the demands of people in developing countries, rather than developed countries.

year	topic
	18: Efficient monitoring and incentive systems applicable internally to companies are developed to allow a significant delegation of authority, resulting in a 50% increase in labor productivity from the current levels.
	19: Through research in experimental economics and other fields, personal mind and consciousness are analyzed, resulting in the predictability of decision-making. This achievement is applied to designing structures such as business organizations and markets and to companies developing products and technologies.
	26: In Japan, technology for integrated risk management is developed to enhance the risk management capacity across the public sector, and this enables society to scan and identify risks, evaluate risk impacts, and rank risks by priority. As a result, assuming the desirable social state, a consistent framework within which protections against risks are proposed, adopted, and implemented is established.
2014	02: Social network theory and other theories on social relationships and organization are developed to create new types of methods for financing and risk management. As a result, both OECD countries and developing countries implement local policies or development policies that emphasize social assets such as local communities and mutual trust.

Social application

year	topic
2011	51: Over half of Japan's listed companies adopt management schemes that emphasize corporate social responsibility as the fundamental business policy.
2013	06: It becomes the standard business practice for listed companies that operations such as product development and strategy building are conducted under independent projects in which individuals or freelancers can participate without having to belong to any company.
	13: Widespread use of electronic money and the like allows micropayments (transactions smaller than ¥500) to be made at zero or negligible cost.
	14: Under a system that requires the listed companies to quantitatively assess their operational risks and publish the results periodically, efficiently reducing numerically expressed risks through the construction of an optimal business portfolio becomes a common practice among major Japanese companies.
	15: Efficient optimization of resources allocation, scheduling, etc. becomes possible, contributing to corporate cost reduction.
	20: A rise in shareholder awareness of corporate ownership in Japan results in Japanese shareholders coming to exercise their rights as extensively as U.S. shareholders.
	34: In Japan, securities markets where relatively small, unlisted companies can raise small funds that range from a few tens to hundreds of millions of yen are formed.
	38: Reeducation/retraining programs for "capacity building among the existing workforce," or for improving specialized skills and productivity among part-time and temporary workers, are widely implemented in Japan.
	39: In Japan, for easier job changes, corporate pensions become "portable" so that the pension funds deposited under the pension program of the previous employer can be transferred to the new employer's pension program when a worker changes jobs.
	42: Over 50% of the Japanese companies implement enterprise resource planning (ERP) systems and successfully improve demand forecasting, logistic systems, contracting forms, etc., enabling real-time order transactions and consequently, a significant reduction in inventory in the production/distribution system.
	45: Intelligent tags designed for product identification, quality control, and product tracking become widely available.
	47: Ordering and other business transactions are mostly conducted over mobile phones through voice input alone.
	48: In Japan, methods by which system requirements can be clearly defined for any organization in the public or corporate sector are established, resulting in efficient management of IT investment and prompt construction of the required IT environment.
	58: In such fields as art, theater, cinema, music, and literature, there are artistic activities whose viability is threatened due to a very small consumer population. Such small-scale artistic activities can be made economically viable not by increasing the number of consumers, but by reducing access costs through the development of a system that allows existing consumers to enjoy, or obtain reproductions of, such activities over the Internet or other communications means at far lower cost.
2014	07: As with the case of open source software, diverse goods and services, regardless of price, are developed, produced, sold, and supported primarily by consumers to meet their needs.
	08: For diverse goods and services, technology standardization and module-based research and development practices intensify, resulting in improved efficiency in overall R&D for any goods and services.
	09: Methods of assessing and utilizing the database, knowledge base, and knowledge network (a social network in which people with knowledge are known and accessible) built within an organization are established and made widely available.

year	topic
	11: A system for trading corporate databases and knowledge bases within and across corporate boundaries is built, allowing the wide and active trading of such knowledge based on economic incentives.
	12: It becomes a common approach to accelerating new discoveries and new technical developments that technical problems of companies and industries are widely publicized for a public call for solutions or for a contest in which proposed solutions are examined.
	25: Japan's government sector moves toward e-government and, combined with established technologies for personal authentication and personal information protection, begins to provide online public services in areas such as tax accounting and payment, pensions, health insurance, welfare, and other formalities.
	29: To reduce market risks arising from the fluctuation of currency values and international commodity (e.g. energy) prices, major Japanese companies (over 30% of those listed) measure and control risk amounts daily by identifying in advance the risk factors.
	36: A social environment that encourages women to balance work and marriage, childbearing, and childrearing (e.g. 30% of listed companies set up day care centers) becomes a reality in Japan to promote the utilization of female human resources.
	40: In Japan, employment contracts that clearly relate personal motivation to compensation, together with human resources evaluation methods that enable such contracts, penetrate. As a result, higher mobility in human resources and a 2% or more annual increase in labor productivity are achieved, consequently improving the quality of services provided by companies for consumers.
	43: The establishment of flexible manufacturing technology allows over 50% of the listed manufacturers to replace conventional mass-production processes with fully individualized, made-to-order production processes.
	44: Consumer-oriented systems for privacy information management and protection are implemented to ensure that consumers' personal information is made accessible only to the entities authorized by the consumers and reuse by any other entities is blocked.
	46: Robots and information systems that can substitute as service personnel at checkout counters and the storefront become widely available.
	49: In TV and other broadcasting media, advertising material can be adapted to individual viewers.
	50: Effective usage of IT is defined for the public and corporate sectors, allowing IT investment to contribute to an annual increase of 2% or more in total factor productivity. This solves "the productivity paradox," a proposition that investing in IT does not necessarily improve productivity in the entire economy.
	52: Environmental accounting (a method of evaluating a company's contribution to environmental conservation and sustainable development) or its extensions are widely adopted.
	53: In Japan, the notion of the national trust is expanded, and legislation is developed so as to promote funding from individuals and corporations for conserving and enhancing the natural environment, public property, and the living environment. As a result, diverse public values come to be protected through many different approaches.
	56: The concept of developing goods and services for not meeting specific needs, but for use in entertainment, art, and cultural activities becomes the mainstream in many industries and drives technological development.
	57: Universities, companies, and local governments establish mechanisms for promoting personal hobby activities regarding entertainment, art, and culture, and for linking them to academic or technological advances.
2015	01: Through political incentives and corporate decisions to promote IT, advanced traffic systems, and the decentralization of industry, the medium and long-term (5-year) growth rate of added values (GDP) produced in Japan's non-metropolitan areas exceeds the equivalent rate in its metropolitan areas.
	59: Universities become the center of the theoretical analysis of art, theater, cinema, music, literature, and other artistic and cultural activities, and play an important role in nurturing artists who initiate new artistic activities and supporting such activities.
2016	04: Facilitation of international business operations based on international standards, as a result of international standardization of the laws governing commercial activities, transactions, taxing, competition, and intellectual property rights in the international context.
	05: In many parts of Japan, local currencies that are, unlike the national currency, valid only within a specific geographic area become available and are used for solving environmental problems, promoting local economy, and encouraging community activities.
	16: In companies in Asia, Latin America, and Continental Europe, unique corporate governance models which are dissimilar to the shareholder-oriented one in the U.S. and the U.K. emerge and find certain acceptance.
	41: Japan-based major multinational companies of which half the sales are generated overseas introduce foreign labor to over one-third of their key managerial and specialist positions.
	55: Advances in research on comfort/discomfort, likes/dislikes, and other sensibilities that people feel as a result of consuming goods and services lead to the establishment of methods by which consumer sensibilities are directly analyzed, measured, and assessed, so that the results are used for R&D, sales, and marketing of goods and services.

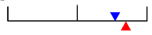
year	topic
2017	17: A new form of corporation in which non-shareholder stakeholders (employees, consumers, etc.) assume shareholder-like corporate ownership and are granted the right to claim residual profits becomes widespread.
	54: Demand-side management programs are widely and effectively introduced to Japan's traffic, electricity, and communications infrastructures to reduce hourly and seasonal fluctuations in demand and thus to cut excessive capital investment.
2018	10: In the area of R&D project management, methods of planning, performing, controlling, and assessing research projects are established, enabling an average 50% increase in labor productivity in R&D.
	21: Competition, negotiation, and coordination are analyzed further by game theory. The results are commonly applied to real-world policy-making and corporate decision-making, causing a significant change in such practices, and to institutional design in the public sector (e.g. competition policy, industrial policy) and the corporate sector (e.g. corporate strategy).
	22: In marketing surveys, there is a general shift from the traditional analysis focusing on individuals and individual variables to an approach in which interpersonal relationships are considered as "social networks" or an approach in which each person is analyzed from the viewpoint of "individual relationships."
	30: A rapid increase in the amount of data available to companies and advances in data analysis technology result in better prediction technologies that allow companies to evaluate diverse risks. To take advantage of these technologies, scenario planning and other tools are developed, enabling risk control that can reduce fluctuations in operating profits by half.
2019	03: A research and development system for developing information, medical, financial, and other technologies that meet the demands of people in developing countries, rather than developed countries.
	19: Through research in experimental economics and other fields, personal mind and consciousness are analyzed, resulting in the predictability of decision-making. This achievement is applied to designing structures such as business organizations and markets and to companies developing products and technologies.
	32: Common, universal systems for evaluating and controlling project risks are established.
	33: As fusion between insurance and capital markets progresses, a risk control method called alternative risk transfer (ART) advances in structure. Thus, various risks of companies and individuals are diversified and transferred to investors on a large scale to achieve integrated risk management.
	35: Because of a major increase in the volume of highly specialized knowledge required for senior management and a higher demand for highly specialized professionals, MBA holders come to account for 25% of the top executives of Japan's listed companies.
	37: In Japan's listed companies, women account for 20% of senior-level managers.
2020	02: Social network theory and other theories on social relationships and organization are developed to create new types of methods for financing and risk management. As a result, both OECD countries and developing countries implement local policies or development policies that emphasize social assets such as local communities and mutual trust.
	18: Efficient monitoring and incentive systems applicable internally to companies are developed to allow a significant delegation of authority, resulting in a 50% increase in labor productivity from the current levels.
	26: In Japan, technology for integrated risk management is developed to enhance the risk management capacity across the public sector, and this enables society to scan and identify risks, evaluate risk impacts, and rank risks by priority. As a result, assuming the desirable social state, a consistent framework within which protections against risks are proposed, adopted, and implemented is established.
	31: In Japan, advances in the behavioral scientific analysis of the strategy building process in the public and corporate sectors lead to the ability to promptly and effectively make decisions under competitive circumstances.
2021	24: Non-monetary accounting methods, which use physical units as well as monetary units, are established, and multidimensional performance evaluation systems based on them come into wide use for evaluation of the public sector, the environment, and social capital such as human relationships.
	27: Financial and other economic policies become more specific and capable of controlling inflation and deflation, contributing to a major reduction of economic fluctuations.
2022	23: Global governance is established as a result of the construction of organizations and schemes for "monitoring," "controlling," and "coordinating" activities of companies, consumers, and individuals within a common framework for governance across national boundaries.
2023	28: In Japan, methods of evaluating personal contribution to a local society or non-profit organization (NPO) are developed, so that the evaluation results are used by government or NPOs in designing the personal roles.

Appendix: Results of R1 and R2

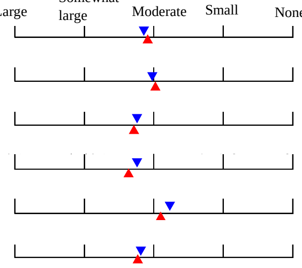
I. Optimization of industrial infrastructure through regional dispersion and concentration

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Currenrt impacts

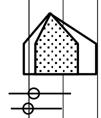
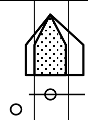


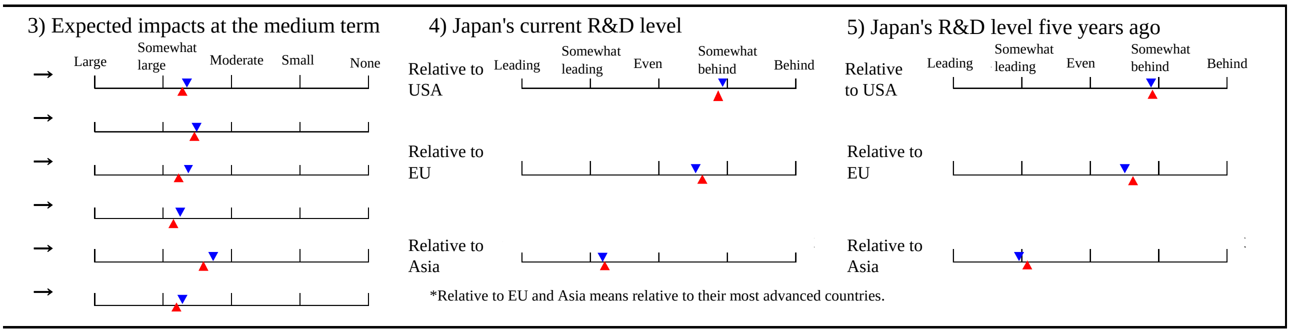
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

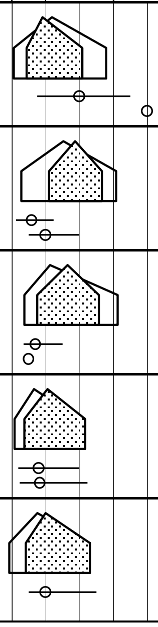
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
1	Through political incentives and corporate decisions to promote IT, advanced traffic systems, and the decentralization of industry, the medium and long-term (5-year) growth rate of added values (GDP) produced in Japan's non-metropolitan areas exceeds the equivalent rate in its metropolitan areas.	1	73	12	30	58	-	67	43	42	15	0								
		2	64	2	17	81	-	63	29	65	6	0								
		E	1	100	0	0	-	50	0	100	0	0								
2	Social network theory and other theories on social relationships and organization are developed to create new types of methods for financing and risk management. As a result, both OECD countries and developing countries implement local policies or development policies that emphasize social assets such as local communities and mutual trust.	1	72	18	31	51	-	64	38	44	18	0							8	17
		2	61	8	28	64	-	58	23	64	13	0							8	7
		E	5	100	0	0	-	70	40	60	0	0							0	0
3	A research and development system for developing information, medical, financial, and other technologies that meet the demands of people in developing countries, rather than developed countries.	1	71	11	31	58	-	57	26	49	25	0							4	18
		2	60	3	20	77	-	57	19	69	12	0							5	9
		E	2	100	0	0	-	75	50	50	0	0							0	50
4	Facilitation of international business operations based on international standards, as a result of international standardization of the laws governing commercial activities, transactions, taxing, competition, and intellectual property rights in the international context.	1	80	18	33	49	-	78	58	37	5	0								
		2	65	11	28	61	-	82	66	29	5	0								
		E	7	100	0	0	-	86	71	29	0	0								
5	In many parts of Japan, local currencies that are, unlike the national currency, valid only within a specific geographic area become available and are used for solving environmental problems, promoting local economy, and encouraging community activities.	1	75	12	23	65	-	45	16	35	45	4								
		2	61	3	16	81	-	39	7	35	58	0								
		E	2	100	0	0	-	25	0	0	100	0								



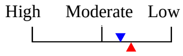
Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
																		23	20	39	41	17	3	38	33	30	33	48	10	2
																		18	16	26	54	18	2	33	30	28	21	72	5	0
																		0	0	0	100	0	0	0	100	0	100	100	100	0
3	41	54	1	1	30	38	24	8	42	34	22	18	18	37	3	2		8	14	25	48	21	6	43	32	13	25	49	6	4
2	28	70	0	0	12	68	17	3	61	38	14	5	13	46	2	0		8	15	12	70	13	5	58	33	5	11	67	4	0
0	25	75	0	0	25	75	0	0	75	50	50	25	50	50	25	0		0	0	20	60	20	0	60	60	0	20	60	40	0
6	63	24	4	3	33	33	27	7	48	33	22	25	36	25	2	0		3	21	27	42	27	4	58	34	13	21	28	9	3
4	74	18	0	4	16	65	14	5	67	28	15	30	28	22	0	0		2	17	9	72	16	3	75	36	4	16	34	0	0
0	50	50	0	0	0	50	50	0	100	100	100	100	100	50	0	0		0	50	0	100	0	0	100	100	0	100	100	0	0
																		3	8	64	26	9	1	44	34	10	12	45	34	5
																		2	13	76	19	5	0	53	39	3	5	61	27	0
																		0	0	86	14	0	0	43	43	0	0	71	29	0
																		18	19	25	25	31	19	34	12	12	12	63	24	5
																		10	13	15	28	44	13	25	9	6	6	72	25	0
																		100	0	0	0	50	50	0	0	0	0	100	0	0



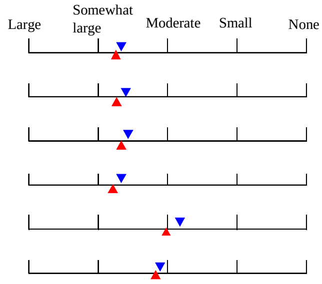
II. Knowledge management

1. Questions regarding the relevant area

1) Degree of expertise in the area

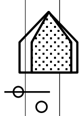
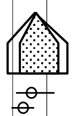
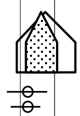
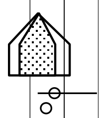


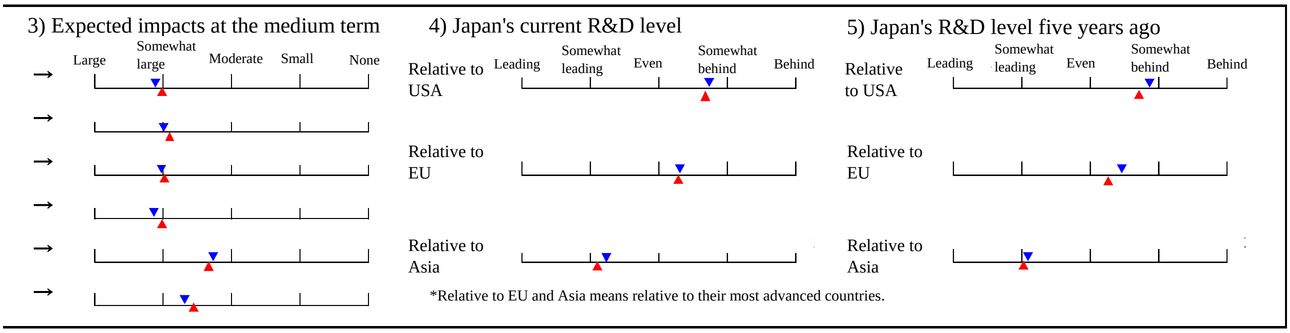
2) Current impacts



[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
6	It becomes the standard business practice for listed companies that operations such as product development and strategy building are conducted under independent projects in which individuals or freelancers can participate without having to belong to any company.	1	87	25	45	30	-	58	29	46	23	2			
		2	68	9	43	48	-	52	16	60	24	0			
		E	6	100	0	0	-	71	50	33	17	0			
7	As with the case of open source software, diverse goods and services, regardless of price, are developed, produced, sold, and supported primarily by consumers to meet their needs.	1	88	15	41	44	-	57	26	48	26	0		5	10
		2	67	3	31	66	-	47	11	57	30	2		5	8
		E	2	100	0	0	-	38	0	50	50	0		0	50
8	For diverse goods and services, technology standardization and module-based research and development practices intensify, resulting in improved efficiency in overall R&D for any goods and services.	1	82	16	40	44	-	69	46	41	11	2		4	10
		2	67	9	30	61	-	71	47	42	11	0		0	8
		E	6	100	0	0	-	88	83	0	17	0		0	33
9	Methods of assessing and utilizing the database, knowledge base, and knowledge network (a social network in which people with knowledge are known and accessible) built within an organization are established and made widely available.	1	86	22	38	40	-	71	50	35	15	0		1	13
		2	66	8	33	59	-	74	53	36	11	0		0	8
		E	5	100	0	0	-	85	80	0	20	0		0	40
10	In the area of R&D project management, methods of planning, performing, controlling, and assessing research projects are established, enabling an average 50% increase in labor productivity in R&D.	1	78	13	49	38	-	68	42	49	6	3		4	13
		2	67	4	40	56	-	72	47	48	3	2		2	14
		E	3	100	0	0	-	67	67	0	0	33		0	67
11	A system for trading corporate databases and knowledge bases within and across corporate boundaries is built, allowing the wide and active trading of such knowledge based on economic incentives.	1	83	17	47	36	-	63	39	40	17	4			
		2	67	9	42	49	-	61	29	57	12	2			
		E	6	100	0	0	-	79	66	17	17	0			
12	It becomes a common approach to accelerating new discoveries and new technical developments that technical problems of companies and industries are widely publicized for a public call for solutions or for a contest in which proposed solutions are examined.	1	73	10	36	54	-	60	33	43	23	1			
		2	64	3	23	74	-	49	10	69	19	2			
		E	2	100	0	0	-	63	50	0	50	0			



Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application			Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
																		17	17	8	19	30	43	28	17	26	36	55	17	2
																		9	12	2	15	36	47	37	23	9	23	66	3	6
																		0	33	0	17	33	50	0	33	33	67	67	0	0
5	68	23	0	4	12	18	37	33	35	28	28	28	12	51	11	0		6	14	7	25	37	31	36	25	29	32	53	12	0
0	92	6	2	0	2	11	58	29	57	26	15	13	0	61	4	0		4	10	0	17	62	21	39	22	18	18	65	6	0
0	100	0	0	0	0	0	50	50	0	0	0	0	0	100	0	0		0	50	0	50	0	50	0	0	0	0	0	100	0
13	75	8	0	4	16	24	30	30	29	41	30	25	20	27	0	4		3	16	10	28	34	28	21	42	30	28	33	5	2
6	89	3	2	0	2	24	44	30	33	57	22	20	9	22	4	0		0	13	2	18	62	18	21	64	9	15	34	6	0
0	100	0	0	0	0	17	17	66	50	0	0	100	0	50	0	0		0	33	0	34	33	33	25	75	0	25	50	0	0
10	82	7	0	1	12	24	33	31	37	41	31	31	10	24	2	3		0	16	11	31	34	24	33	43	25	33	29	10	5
2	95	3	0	0	6	18	50	26	48	58	17	6	2	15	2	4		0	11	5	17	58	20	31	63	12	13	23	8	0
0	100	0	0	0	0	20	0	80	100	0	0	0	0	0	0	0		0	40	0	0	20	80	100	0	0	0	0	0	0
10	81	9	0	0	14	18	38	30	49	38	32	32	11	21	2	2		3	17	10	25	34	31	55	35	22	24	24	2	2
2	96	2	0	0	2	14	58	26	63	42	21	15	4	15	2	0		2	15	5	20	52	23	64	48	2	8	20	4	0
0	100	0	0	0	0	0	33	67	0	0	0	100	0	0	0	0		0	67	0	0	33	67	0	100	0	0	0	0	0
																		10	13	11	24	41	24	26	33	16	22	40	29	3
																		3	13	3	14	63	20	22	31	4	8	55	25	0
																		0	33	17	0	33	50	0	0	0	0	33	67	0
																		7	15	17	25	32	26	37	50	25	46	33	17	4
																		8	14	3	19	53	25	30	57	11	32	28	9	2
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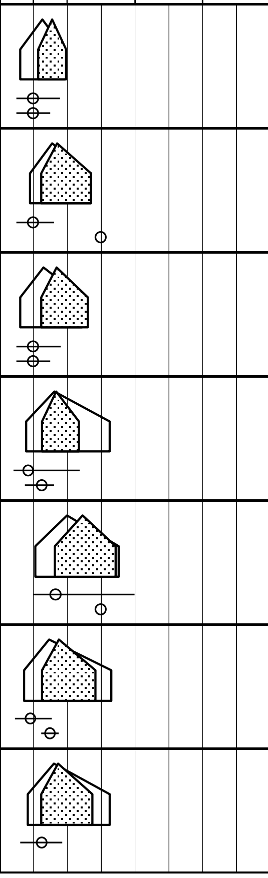
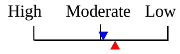


III. Corporate decision-making, governance, and management

1. Questions regarding the relevant area

1) Degree of expertise in the area

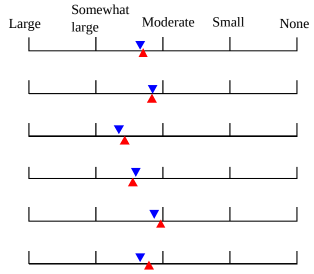


2) Current impacts

[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

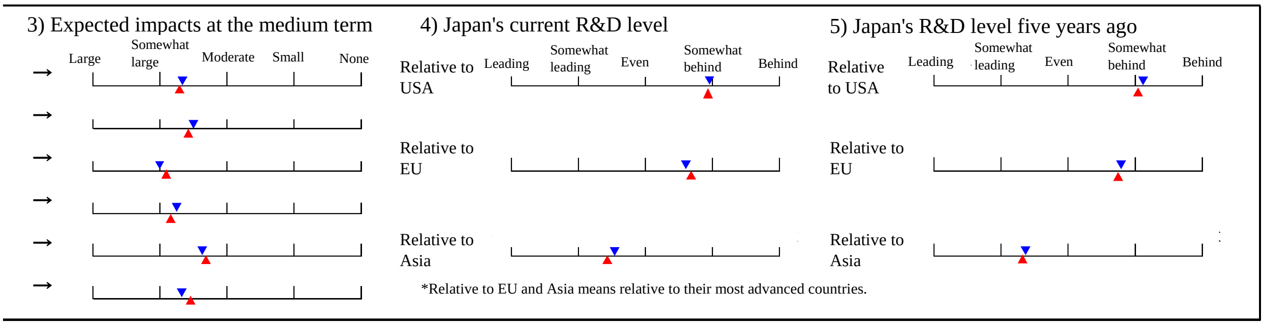
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

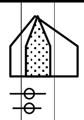
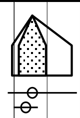
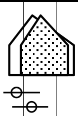
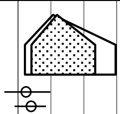
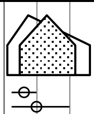
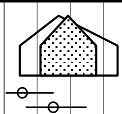
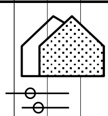
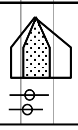
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



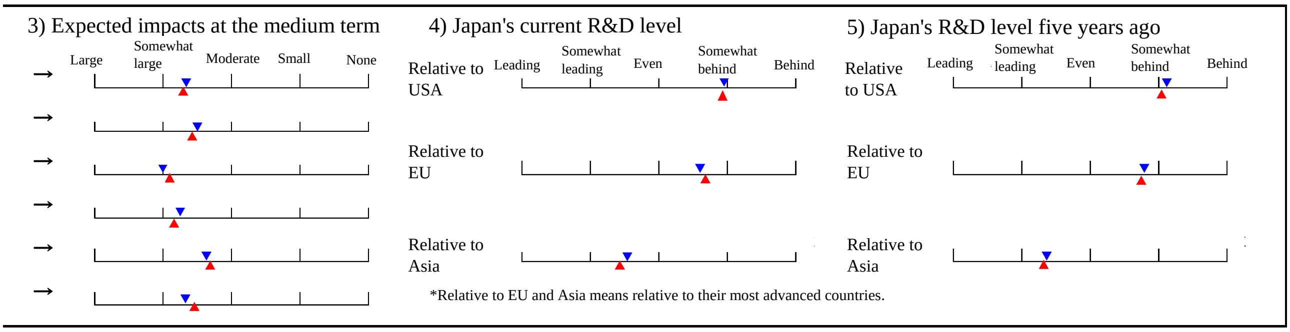
2. Questions regarding topics

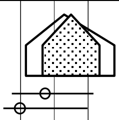
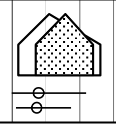
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
13	Widespread use of electronic money and the like allows micropayments (transactions smaller than ¥500) to be made at zero or negligible cost.	1	87	10	31	59	-	45	11	47	40	2		2	6
		2	70	4	20	76	-	41	6	45	49	0		0	3
		E	3	100	0	0	-	42	0	67	33	0		0	0
14	Under a system that requires the listed companies to quantitatively assess their operational risks and publish the results periodically, efficiently reducing numerically expressed risks through the construction of an optimal business portfolio becomes a common practice among major Japanese companies.	1	95	28	36	36	-	60	31	49	20	0			
		2	76	24	30	46	-	58	22	67	11	0			
		E	18	100	0	0	-	67	39	50	11	0			
15	Efficient optimization of resources allocation, scheduling, etc. becomes possible, contributing to corporate cost reduction.	1	87	24	33	43	-	55	26	42	31	1		5	15
		2	71	13	34	53	-	51	13	66	20	1		0	10
		E	9	100	0	0	-	75	56	33	11	0		0	11
16	In companies in Asia, Latin America, and Continental Europe, unique corporate governance models which are dissimilar to the shareholder-oriented one in the U.S. and the U.K. emerge and find certain acceptance.	1	90	27	32	41	-	58	33	40	18	9			
		2	71	20	28	52	-	57	26	54	17	3			
		E	14	100	0	0	-	68	50	29	14	7			
17	A new form of corporation in which non-shareholder stakeholders (employees, consumers, etc.) assume shareholder-like corporate ownership and are granted the right to claim residual profits becomes widespread.	1	89	30	28	42	-	51	28	33	28	11			
		2	71	20	28	52	-	51	19	52	26	3			
		E	14	100	0	0	-	59	36	36	21	7			
18	Efficient monitoring and incentive systems applicable internally to companies are developed to allow a significant delegation of authority, resulting in a 50% increase in labor productivity from the current levels.	1	91	25	40	35	-	64	38	42	20	0		12	19
		2	72	15	38	47	-	58	20	73	6	1		7	14
		E	11	100	0	0	-	70	40	60	0	0		9	18
19	Through research in experimental economics and other fields, personal mind and consciousness are analyzed, resulting in the predictability of decision-making. This achievement is applied to designing structures such as business organizations and markets and to companies developing products and technologies.	1	84	21	30	49	-	52	25	38	33	4		19	15
		2	72	13	33	54	-	44	7	58	34	1		13	10
		E	9	100	0	0	-	64	33	56	11	0		0	11
20	A rise in shareholder awareness of corporate ownership in Japan results in Japanese shareholders coming to exercise their rights as extensively as U.S. shareholders.	1	95	31	32	37	-	56	27	48	22	3			
		2	74	19	40	41	-	52	13	73	13	1			
		E	14	100	0	0	-	70	43	50	7	0			



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
19	50	25	5	1	15	28	35	22	18	23	23	12	14	55	26	0		4	6	23	28	33	16	15	21	15	18	64	36	1
13	78	9	0	0	9	36	46	9	15	32	20	3	3	72	15	0		1	3	12	43	39	6	13	25	5	10	84	20	0
0	67	33	0	0	34	33	33	0	33	33	0	0	33	67	0	0		0	0	50	50	0	0	0	0	0	50	50	0	0
																		8	11	17	26	33	24	32	31	11	16	34	45	5
																		5	8	11	30	43	16	38	27	2	2	33	48	2
																		11	0	22	34	33	11	44	25	0	0	13	56	0
11	83	5	0	1	5	13	39	43	45	28	21	36	6	26	0	2		3	18	4	15	34	47	37	34	17	29	32	5	2
4	96	0	0	0	0	13	41	46	65	27	16	27	3	14	3	0		0	14	3	13	41	43	50	45	0	13	37	5	3
0	100	0	0	0	0	11	56	33	67	50	50	33	0	0	0	0		0	11	11	11	56	22	33	67	0	33	33	17	17
																		19	24	16	15	29	40	31	22	6	8	49	27	14
																		11	14	3	26	33	38	38	31	0	5	71	19	5
																		21	0	7	21	29	43	13	38	0	0	75	75	0
																		30	24	17	25	22	36	22	14	2	16	65	41	6
																		23	16	6	25	35	34	21	14	0	9	72	49	2
																		43	14	14	21	21	44	25	25	0	13	63	75	0
6	76	10	2	6	6	19	34	41	38	25	15	19	15	44	13	8		12	24	8	15	29	48	33	21	7	19	65	14	7
1	96	1	1	1	0	13	43	44	61	22	8	3	0	47	3	0		4	24	3	13	36	48	46	26	0	9	71	14	6
0	91	0	9	0	0	9	36	55	20	20	20	0	0	60	0	0		0	20	0	9	18	73	0	50	0	50	50	0	50
5	91	3	0	1	9	16	38	37	38	34	32	46	6	16	2	0		14	19	6	13	34	47	46	51	12	29	24	10	0
0	99	1	0	0	4	9	49	38	43	28	23	48	5	10	3	3		7	15	4	9	45	42	49	46	3	15	28	5	5
0	100	0	0	0	25	0	25	50	25	25	25	75	0	0	25	0		0	11	22	0	22	56	25	25	0	50	0	25	0
																		13	9	14	23	31	32	18	11	8	2	62	38	8
																		8	5	7	21	39	33	17	8	0	2	77	29	2
																		7	0	29	14	43	14	17	0	0	0	83	50	8

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High	Moderate	Low	None (%)	Importance to Japan: Index	High	Moderate	Low	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know (%)
21	Competition, negotiation, and coordination are analyzed further by game theory. The results are commonly applied to real-world policy-making and corporate decision-making, causing a significant change in such practices, and to institutional design in the public sector (e.g. competition policy, industrial policy) and the corporate sector (e.g. corporate strategy).	1	**90**	**17**	**42**	**41**	**-**	**51**	**22**	**40**	**36**	**2**							**12**	**15**
		2	**70**	**9**	**45**	**46**	**-**	**46**	**9**	**61**	**26**	**4**							**6**	**13**
		E	**6**	**100**	**0**	**0**	**-**	**58**	**34**	**33**	**33**	**0**							**0**	**17**
22	In marketing surveys, there is a general shift from the traditional analysis focusing on individuals and individual variables to an approach in which interpersonal relationships are considered as "social networks" or an approach in which each person is analyzed from the viewpoint of "individual relationships."	1	**82**	**24**	**27**	**49**	**-**	**47**	**19**	**38**	**38**	**5**							**3**	**21**
		2	**66**	**18**	**15**	**67**	**-**	**45**	**6**	**61**	**31**	**2**							**3**	**15**
		E	**12**	**100**	**0**	**0**	**-**	**56**	**25**	**50**	**25**	**0**							**0**	**17**

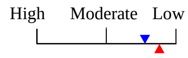


Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
2	91	6	0	1	6	26	31	37	40	40	35	33	6	17	2	8		16	20	6	23	29	42	50	54	11	13	30	7	7
0	100	0	0	0	1	15	44	40	54	56	29	17	2	15	0	0		7	19	0	18	41	41	63	55	5	3	23	3	8
0	100	0	0	0	0	50	50	0	67	83	33	17	0	0	0	0		33	33	0	50	50	0	83	50	17	0	0	0	17
6	83	8	0	3	6	14	31	49	38	43	23	35	10	23	0	3		5	18	4	14	31	51	45	50	8	13	26	3	3
3	94	3	0	0	0	6	38	56	64	50	4	21	7	14	0	0		2	17	2	8	38	52	63	63	0	3	23	3	3
9	82	9	0	0	0	17	17	66	75	75	0	25	0	0	0	0		0	17	0	17	25	58	60	80	0	0	0	20	0

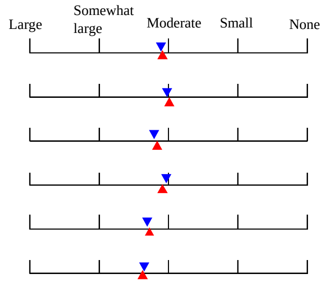
IV. Public-sector governance and management

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

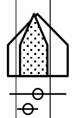
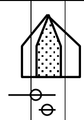


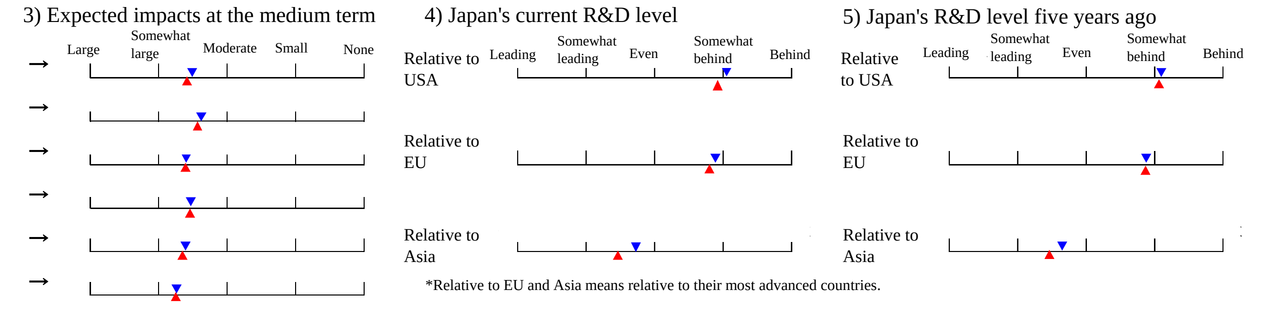
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

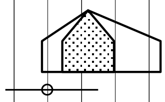
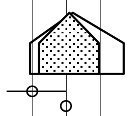
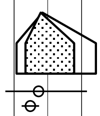
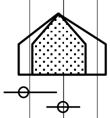
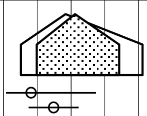
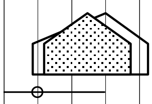
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
23	Global governance is established as a result of the construction of organizations and schemes for "monitoring," "controlling," and "coordinating" activities of companies, consumers, and individuals within a common framework for governance across national boundaries.	1	66	14	26	60	-	58	31	42	25	2								
		2	57	5	14	81	-	50	9	73	18	0								
		E	3	100	0	0	-	42	0	67	33	0								
24	Non-monetary accounting methods, which use physical units as well as monetary units, are established, and multidimensional performance evaluation systems based on them come into wide use for evaluation of the public sector, the environment, and social capital such as human relationships.	1	59	14	22	64	-	54	26	42	29	3								
		2	56	5	16	79	-	52	13	71	16	0								
		E	3	100	0	0	-	42	0	67	33	0								
25	Japan's government sector moves toward e-government and, combined with established technologies for personal authentication and personal information protection, begins to provide online public services in areas such as tax accounting and payment, pensions, health insurance, welfare, and other formalities.	1	78	13	24	63	-	72	50	40	10	0							0	6
		2	63	8	21	71	-	73	51	41	6	2							0	3
		E	5	100	0	0	-	70	40	60	0	0							0	0
26	In Japan, technology for integrated risk management is developed to enhance the risk management capacity across the public sector, and this enables society to scan and identify risks, evaluate risk impacts, and rank risks by priority. As a result, assuming the desirable social state, a consistent framework within which protections against risks are proposed, adopted, and implemented is established.	1	64	14	33	53	-	66	41	41	16	2							8	17
		2	57	9	14	77	-	61	28	59	11	2							2	15
		E	5	100	0	0	-	60	20	80	0	0							20	40
27	Financial and other economic policies become more specific and capable of controlling inflation and deflation, contributing to a major reduction of economic fluctuations.	1	76	18	34	48	-	72	55	26	16	3								
		2	62	10	23	67	-	77	59	31	10	0								
		E	6	100	0	0	-	88	83	0	17	0								
28	In Japan, methods of evaluating personal contribution to a local society or non-profit organization (NPO) are developed, so that the evaluation results are used by government or NPOs in designing the personal roles.	1	58	10	29	61	-	50	25	34	30	11								
		2	56	4	20	76	-	41	7	53	29	11								
		E	2	100	0	0	-	13	0	0	50	50								



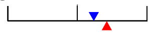
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
																		15	21	44	29	17	10	45	46	9	11	39	23	7
																		9	23	55	30	11	4	53	49	2	4	45	18	4
																		33	67	67	33	0	0	67	33	0	0	67	0	0
																		7	22	39	36	16	9	44	48	2	18	38	38	8
																		4	17	42	44	9	5	60	60	2	4	37	23	6
																		0	67	0	100	0	0	100	100	0	0	67	33	0
7	61	27	4	1	72	19	6	3	36	41	38	23	7	50	36	4		3	8	70	25	4	1	45	43	14	20	51	46	3
3	87	8	0	2	78	13	2	7	48	59	25	9	2	50	23	2		2	3	77	17	3	3	60	37	5	4	68	44	2
0	60	40	0	0	80	20	0	0	80	80	40	0	0	80	20	0		0	0	80	20	0	0	100	40	0	0	100	60	0
0	78	17	0	5	53	28	11	8	44	45	40	22	9	29	22	2		7	20	50	33	10	7	56	47	9	23	33	32	2
0	94	4	0	2	68	24	4	4	63	59	37	12	2	27	12	2		5	13	69	22	7	2	67	56	0	4	31	19	2
0	80	20	0	0	40	60	0	0	100	40	40	0	0	20	0	0		20	40	60	40	0	0	80	60	0	0	40	20	0
																		36	30	51	30	7	12	47	53	5	13	22	17	8
																		28	18	66	26	3	5	61	54	0	2	19	9	7
																		17	33	67	33	0	0	83	50	0	0	17	0	0
																		25	23	25	27	27	21	59	43	5	23	45	20	7
																		17	13	17	31	30	22	69	38	0	7	50	17	2
																		50	50	0	0	50	50	100	100	0	0	100	0	0

V. Risk management and finance

1. Questions regarding the relevant area

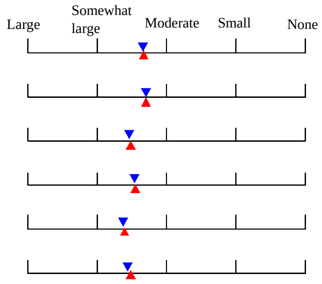
1) Degree of expertise in the area

High Moderate Low



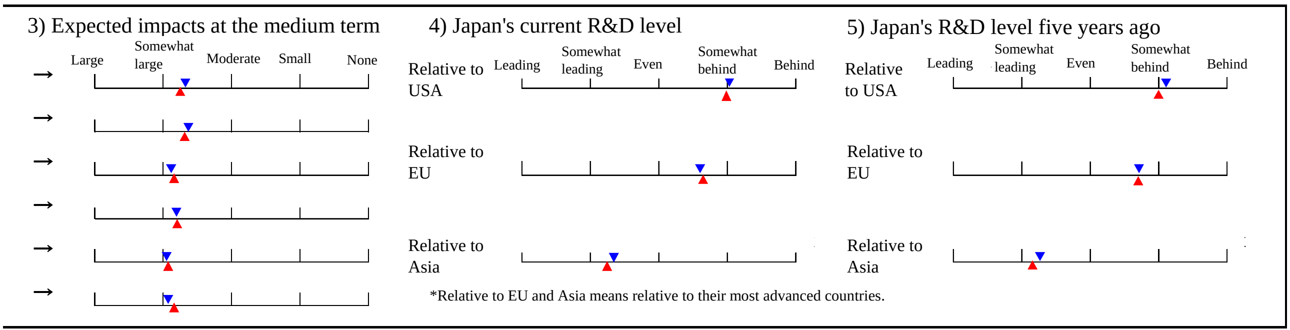
2) Current impacts

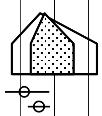
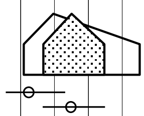
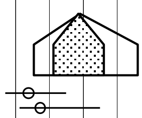
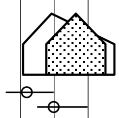
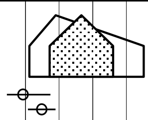
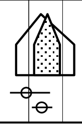
		Large / Somewhat large / Moderate / Small / None
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
29	To reduce market risks arising from the fluctuation of currency values and international commodity (e.g. energy) prices, major Japanese companies (over 30% of those listed) measure and control risk amounts daily by identifying in advance the risk factors.	1	78	33	26	41	-	64	35	53	9	3							4	10
		2	70	19	24	57	-	64	30	67	3	0							3	6
		E	13	100	0	0	-	83	69	23	8	0							8	0
30	A rapid increase in the amount of data available to companies and advances in data analysis technology result in better prediction technologies that allow companies to evaluate diverse risks. To take advantage of these technologies, scenario planning and other tools are developed, enabling risk control that can reduce fluctuations in operating profits by half.	1	84	26	30	44	-	57	29	45	24	2							18	12
		2	74	14	32	54	-	55	15	75	10	0							14	10
		E	10	100	0	0	-	60	30	50	20	0							10	10
31	In Japan, advances in the behavioral scientific analysis of the strategy building process in the public and corporate sectors lead to the ability to promptly and effectively make decisions under competitive circumstances.	1	77	23	43	34	-	63	34	52	13	1							4	14
		2	68	9	40	51	-	56	15	81	4	0							4	6
		E	6	100	0	0	-	75	50	50	0	0							17	0
32	Common, universal systems for evaluating and controlling project risks are established.	1	76	24	28	48	-	60	32	47	20	1							7	11
		2	69	7	29	64	-	53	13	71	16	0							3	9
		E	5	100	0	0	-	55	20	60	20	0							0	20
33	As fusion between insurance and capital markets progresses, a risk control method called alternative risk transfer (ART) advances in structure. Thus, various risks of companies and individuals are diversified and transferred to investors on a large scale to achieve integrated risk management.	1	63	27	32	41	-	63	37	45	16	2							2	8
		2	65	15	26	59	-	54	14	75	11	0							0	6
		E	10	100	0	0	-	68	40	50	10	0							0	0
34	In Japan, securities markets where relatively small, unlisted companies can raise small funds that range from a few tens to hundreds of millions of yen are formed.	1	75	29	31	40	-	72	50	38	12	0								
		2	67	12	36	52	-	76	56	37	7	0								
		E	8	100	0	0	-	75	62	13	25	0								

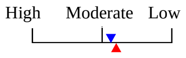


Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
1	92	7	0	0	19	21	38	22	44	41	32	27	22	31	8	2		3	12	17	24	35	24	45	50	7	21	30	16	4
0	99	1	0	0	7	10	61	22	63	52	17	12	6	23	2	2		4	9	3	29	45	23	63	59	2	6	31	11	2
0	100	0	0	0	17	33	33	17	70	40	30	10	20	30	0	0		8	0	8	46	23	23	70	50	0	0	40	40	0
1	91	4	0	4	10	19	46	25	46	39	36	33	16	21	5	0		20	16	10	21	42	27	54	47	7	22	22	10	3
0	100	0	0	0	4	10	61	25	68	51	25	21	2	17	0	0		14	10	1	14	61	24	67	55	2	13	22	5	2
0	100	0	0	0	10	20	40	30	71	57	29	0	14	14	0	0		10	10	0	30	50	20	63	38	0	25	25	13	0
0	91	6	0	3	21	20	35	24	55	40	38	33	10	17	5	5		8	18	16	26	33	25	66	47	7	16	24	5	9
0	100	0	0	0	8	20	50	22	73	51	16	18	0	14	2	0		7	6	4	25	47	24	77	54	0	4	19	0	2
0	100	0	0	0	0	17	66	17	100	80	20	0	0	0	0	0		17	0	0	17	50	33	100	75	0	0	0	0	0
1	94	4	0	1	16	22	33	29	50	37	35	21	19	25	6	4		11	11	9	27	27	37	51	49	11	21	30	11	9
0	93	5	2	0	3	20	51	26	67	43	16	16	0	14	6	0		7	7	3	16	50	31	70	54	2	9	24	4	2
0	100	0	0	0	0	20	60	20	75	50	0	0	0	25	50	0		0	20	0	20	60	20	75	50	0	0	50	0	0
0	89	9	2	0	18	26	37	19	57	39	33	27	12	37	16	0		3	13	23	13	41	23	54	38	8	23	44	23	10
0	97	3	0	0	7	15	60	18	58	48	20	10	2	32	4	0		5	8	2	28	53	17	53	42	0	4	57	17	0
0	89	11	0	0	11	11	67	11	63	38	25	0	13	50	13	0		0	0	0	50	40	10	44	33	0	0	56	22	0
																		3	21	33	38	19	10	29	17	29	32	65	41	3
																		1	6	27	48	16	9	25	13	11	13	79	38	0
																		13	13	0	50	25	25	17	0	17	0	67	50	0

VI. Human resources management
(relationship among education, competition, and cooperation)

1. Questions regarding the relevant area

1) Degree of expertise in the area

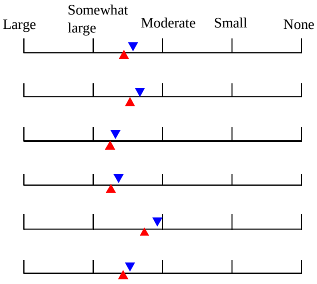


2) Current impacts

[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

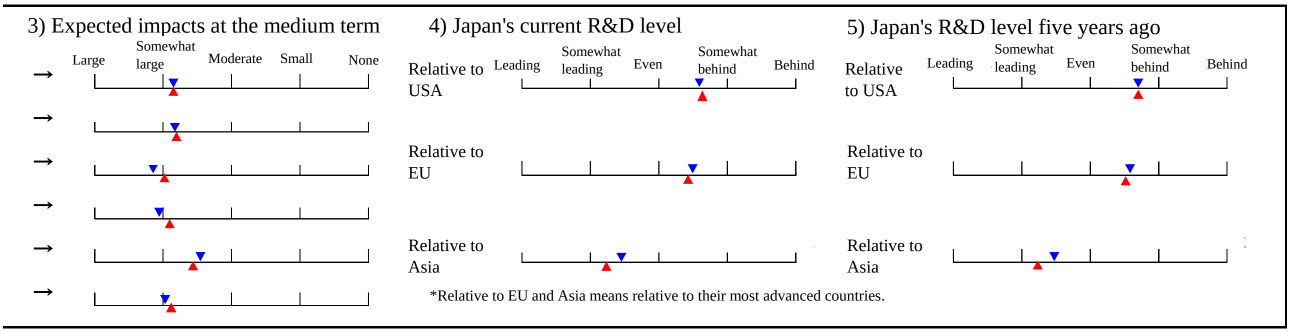
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

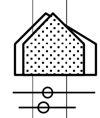
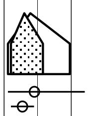
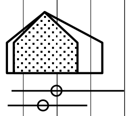
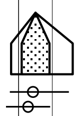
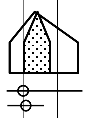
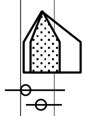
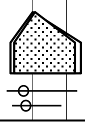
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (%): Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
35	Because of a major increase in the volume of highly specialized knowledge required for senior management and a higher demand for highly specialized professionals, MBA holders come to account for 25% of the top executives of Japan's listed companies.	1	93	39	27	34	-	55	31	35	26	8								
		2	78	24	40	36	-	52	20	51	28	1								
		E	19	100	0	0	-	72	50	39	11	0								
36	A social environment that encourages women to balance work and marriage, childbearing, and childrearing (e.g. 30% of listed companies set up day care centers) becomes a reality in Japan to promote the utilization of female human resources.	1	87	25	34	41	-	82	66	32	2	0								
		2	74	15	35	50	-	90	81	18	1	0								
		E	11	100	0	0	-	95	91	9	0	0								
37	In Japan's listed companies, women account for 20% of senior-level managers.	1	87	26	32	42	-	60	30	52	18	0								
		2	72	19	32	49	-	65	34	59	7	0								
		E	14	100	0	0	-	70	43	50	7	0								
38	Reeducation/retraining programs for "capacity building among the existing workforce," or for improving specialized skills and productivity among part-time and temporary workers, are widely implemented in Japan.	1	85	29	32	39	-	71	49	38	9	4								
		2	72	18	36	46	-	80	62	34	4	0								
		E	13	100	0	0	-	88	77	23	0	0								
39	In Japan, for easier job changes, corporate pensions become "portable" so that the pension funds deposited under the pension program of the previous employer can be transferred to the new employer's pension program when a worker changes jobs.	1	86	31	34	35	-	80	64	29	7	0								
		2	74	19	42	39	-	90	82	14	4	0								
		E	14	100	0	0	-	88	79	14	7	0								
40	In Japan, employment contracts that clearly relate personal motivation to compensation, together with human resources evaluation methods that enable such contracts, penetrate. As a result, higher mobility in human resources and a 2% or more annual increase in labor productivity are achieved, consequently improving the quality of services provided by companies for consumers.	1	90	29	38	33	-	67	41	45	14	0								
		2	73	22	45	33	-	69	42	51	6	1								
		E	16	100	0	0	-	78	63	31	0	6								
41	Japan-based major multinational companies of which half the sales are generated overseas introduce foreign labor to over one-third of their key managerial and specialist positions.	1	84	23	36	41	-	64	37	48	14	1								
		2	71	18	38	44	-	62	29	62	9	0								
		E	13	100	0	0	-	71	46	46	8	0								



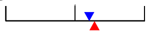
Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
																		12	13	8	26	29	37	79	39	9	30	20	7	7
																		10	13	5	14	36	45	90	30	3	15	15	3	0
																		0	11	16	11	32	41	90	40	10	10	0	0	0
																		7	11	53	40	7	0	32	24	12	60	39	42	2
																		0	5	78	18	1	3	26	20	3	70	42	38	0
																		0	0	82	18	0	0	30	40	10	60	70	30	0
																		7	14	22	29	27	22	57	12	5	29	22	32	6
																		3	6	30	37	15	18	63	11	2	30	29	38	0
																		0	7	36	43	14	7	75	0	0	25	42	42	0
																		6	7	40	37	18	5	56	29	16	52	34	27	1
																		1	4	65	21	11	3	56	15	6	67	23	17	2
																		0	0	77	15	8	0	67	42	0	67	42	33	0
																		1	6	60	33	6	1	14	16	6	31	55	58	4
																		0	3	83	10	3	4	9	9	1	12	68	68	0
																		0	0	86	7	0	7	8	17	0	25	67	75	0
																		8	12	25	21	26	28	38	28	13	26	49	36	5
																		4	5	21	25	30	24	38	15	4	12	67	35	0
																		6	6	25	25	31	19	25	17	0	8	83	42	0
																		11	13	13	14	32	41	51	20	8	20	59	16	4
																		1	7	9	23	44	24	57	9	0	6	81	8	2
																		0	0	8	38	46	8	75	25	0	0	83	8	0

VII. Competition and cooperation in business

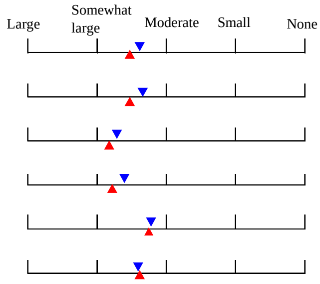
1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

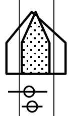
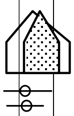
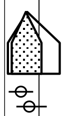
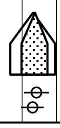


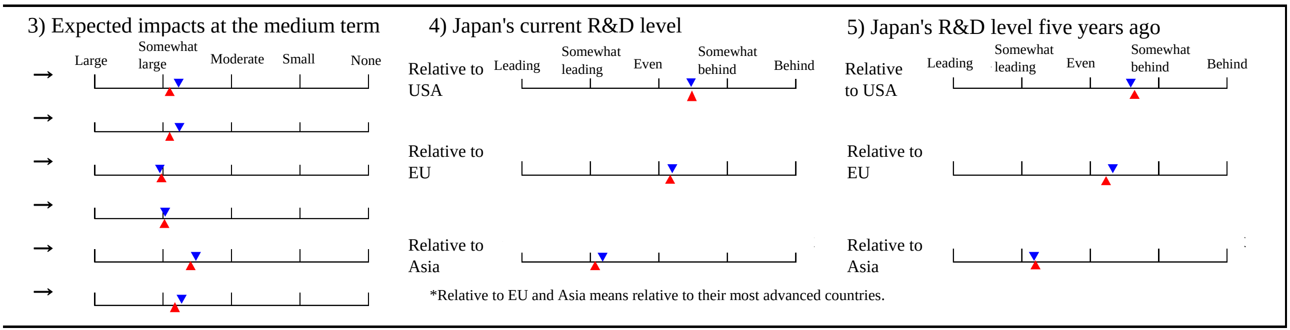
2) Current impacts

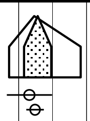
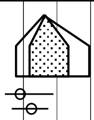
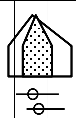
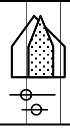


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
42	Over 50% of the Japanese companies implement enterprise resource planning (ERP) systems and successfully improve demand forecasting, logistic systems, contracting forms, etc., enabling real-time order transactions and consequently, a significant reduction in inventory in the production/distribution system.	1	83	24	35	41	-	63	34	52	13	1							5	5
		2	67	10	43	47	-	59	22	69	9	0							3	3
		E	7	100	0	0	-	61	29	57	14	0							14	0
43	The establishment of flexible manufacturing technology allows over 50% of the listed manufacturers to replace conventional mass-production processes with fully individualized, made-to-order production processes.	1	78	24	36	40	-	59	32	42	25	1							5	8
		2	65	14	40	46	-	53	15	67	18	0							5	3
		E	9	100	0	0	-	61	33	45	22	0							11	0
44	Consumer-oriented systems for privacy information management and protection are implemented to ensure that consumers' personal information is made accessible only to the entities authorized by the consumers and reuse by any other entities is blocked.	1	86	17	30	53	-	71	49	37	14	0							4	8
		2	69	6	32	62	-	75	51	44	5	0							3	4
		E	4	100	0	0	-	88	75	25	0	0							25	0
45	Intelligent tags designed for product identification, quality control, and product tracking become widely available.	1	77	19	35	46	-	68	40	51	9	0							0	6
		2	67	12	31	57	-	64	31	63	6	0							0	3
		E	8	100	0	0	-	88	75	25	0	0							0	0

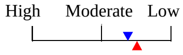


Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
26	69	5	0	0	9	13	41	37	48	60	19	25	8	35	6	0		5	9	9	18	39	34	36	42	17	32	43	19	0
11	89	0	0	0	0	9	48	43	46	86	5	5	0	30	3	0		3	4	0	14	45	41	31	56	3	13	54	8	0
0	100	0	0	0	0	14	57	29	80	80	0	0	0	40	20	0		14	0	0	14	43	43	75	75	0	25	75	25	0
49	43	8	0	0	9	9	42	40	47	44	27	42	11	16	0	2		11	12	7	12	40	41	43	43	16	20	25	9	2
73	25	2	0	0	0	6	42	52	55	58	6	26	6	10	0	0		6	9	2	6	43	49	66	56	0	9	16	0	0
78	22	0	0	0	0	11	33	56	100	75	25	0	0	0	0	0		11	0	0	11	33	56	100	75	0	25	0	0	0
6	75	18	0	1	35	25	30	10	31	41	28	33	12	27	44	0		4	12	40	27	27	6	27	31	15	23	27	65	1
2	90	8	0	0	40	24	27	9	28	45	14	21	3	14	60	0		1	7	56	27	12	5	14	21	2	6	16	87	2
0	50	50	0	0	25	25	50	0	50	50	25	0	0	0	25	0		25	0	75	25	0	0	25	25	0	0	25	75	25
42	53	4	0	1	17	26	43	14	25	44	25	34	16	34	20	3		3	8	23	27	38	12	28	41	16	33	41	45	3
51	49	0	0	0	3	30	47	20	23	67	19	25	2	21	15	0		2	5	12	34	45	9	14	49	3	17	31	56	2
62	38	0	0	0	0	50	50	0	13	75	50	38	0	25	13	0		13	0	25	37	38	0	13	75	0	25	38	63	13

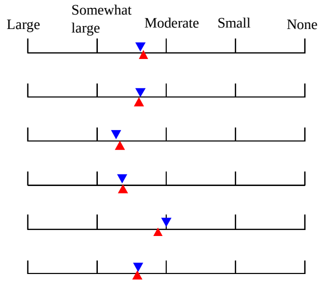
VIII. Higher productivity in service industries and the service sector

1. Questions regarding the relevant area

1) Degree of expertise in the area

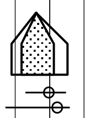
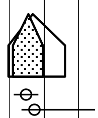
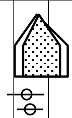


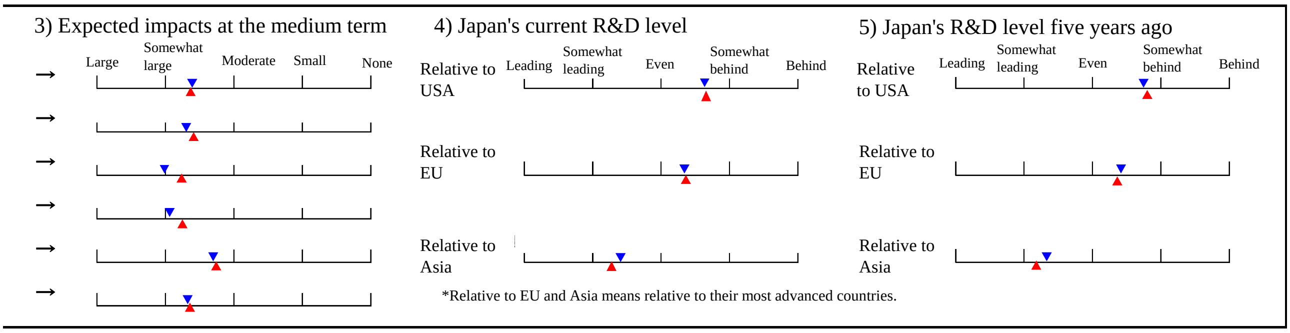
2) Current impacts

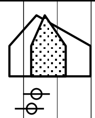
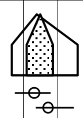
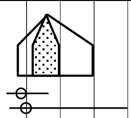
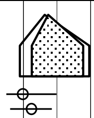
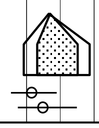


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
46	Robots and information systems that can substitute as service personnel at checkout counters and the storefront become widely available.	1	68	12	29	59	-	46	16	37	44	3		9	6
		2	61	5	13	82	-	38	5	36	59	0		2	5
		E	3	100	0	0	-	75	67	0	33	0		0	0
47	Ordering and other business transactions are mostly conducted over mobile phones through voice input alone.	1	70	11	31	58	-	44	12	43	40	5		2	8
		2	60	5	12	83	-	39	3	46	49	2		3	5
		E	3	100	0	0	-	33	0	33	67	0		0	0
48	In Japan, methods by which system requirements can be clearly defined for any organization in the public or corporate sector are established, resulting in efficient management of IT investment and prompt construction of the required IT environment.	1	71	21	28	51	-	59	30	46	23	1			
		2	60	7	20	73	-	50	8	77	15	0			
		E	4	100	0	0	-	69	50	25	25	0			
49	In TV and other broadcasting media, advertising material can be adapted to individual viewers.	1	63	16	24	60	-	39	8	39	45	8		6	10
		2	61	10	16	74	-	32	2	27	68	3		0	12
		E	6	100	0	0	-	42	17	17	66	0		0	0
50	Effective usage of IT is defined for the public and corporate sectors, allowing IT investment to contribute to an annual increase of 2% or more in total factor productivity. This solves "the productivity paradox," a proposition that investing in IT does not necessarily improve productivity in the entire economy.	1	68	15	37	48	-	61	31	51	18	0			
		2	59	5	25	70	-	53	14	74	10	2			
		E	3	100	0	0	-	75	67	0	33	0			

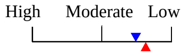


Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
57	37	6	0	0	16	13	41	30	30	32	59	43	2	27	11	0		15	12	15	17	43	25	37	35	20	39	31	16	4
83	15	2	0	0	2	8	53	37	22	30	68	24	0	30	8	0		3	8	5	7	59	29	31	40	2	33	40	12	2
67	33	0	0	0	0	0	100	0	50	50	50	0	0	100	50	0		0	0	33	0	67	0	33	33	0	33	100	33	0
53	40	3	2	2	12	15	47	26	35	33	50	33	6	31	19	0		5	11	11	17	52	20	30	32	16	22	34	40	0
84	12	2	0	2	2	5	67	26	26	26	60	24	0	21	7	0		5	10	5	9	65	21	24	36	4	4	42	38	0
100	0	0	0	0	0	0	100	0	67	33	33	0	0	67	33	0		0	0	33	0	67	0	33	0	0	0	33	67	0
																		4	13	18	25	38	19	44	44	17	31	31	15	2
																		2	15	5	12	62	21	63	63	2	11	30	2	0
																		0	0	25	25	50	0	75	50	0	25	75	25	0
20	75	2	0	3	10	20	40	30	29	31	38	31	2	31	21	0		10	8	16	20	46	18	22	38	14	10	38	38	6
15	83	0	0	2	0	12	59	29	17	20	63	27	0	29	12	0		3	8	7	5	66	22	13	49	4	0	56	36	0
33	67	0	0	0	0	20	60	20	50	50	50	50	0	25	50	0		17	0	40	0	60	0	40	0	0	0	100	60	0
																		6	15	15	29	33	23	53	55	18	25	37	10	6
																		3	15	3	17	51	29	66	63	0	2	32	0	2
																		0	0	0	33	67	0	67	67	0	0	0	0	0

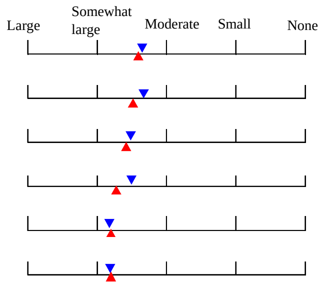
IX. Environmental management

1. Questions regarding the relevant area

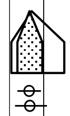
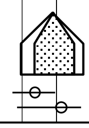
1) Degree of expertise in the area

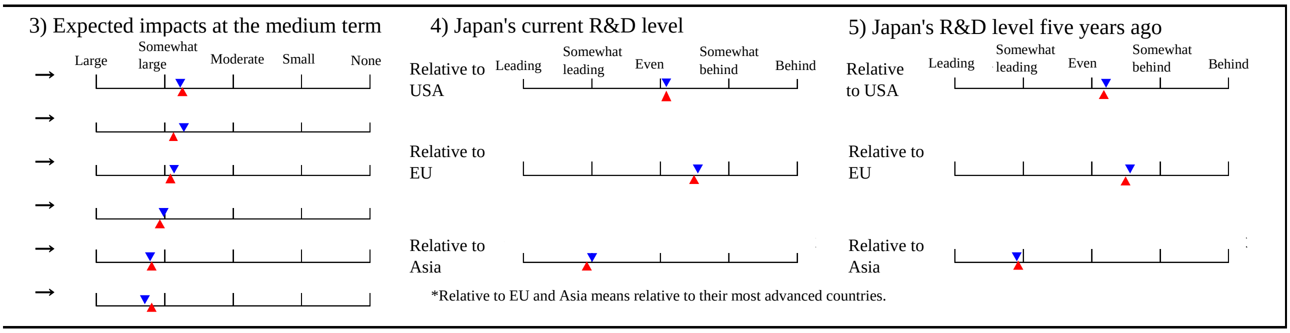


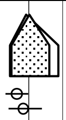
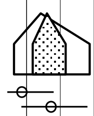
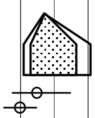
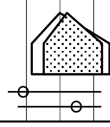
2) Current impacts

[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
51	Over half of Japan's listed companies adopt management schemes that emphasize corporate social responsibility as the fundamental business policy.	1	92	25	40	35	-	77	58	32	10	0			
		2	69	17	44	39	-	86	75	18	7	0			
		E	12	100	0	0	-	96	92	8	0	0			
52	Environmental accounting (a method of evaluating a company's contribution to environmental conservation and sustainable development) or its extensions are widely adopted.	1	82	17	37	46	-	67	39	51	10	0		4	4
		2	69	10	36	54	-	66	34	60	6	0		0	3
		E	7	100	0	0	-	86	71	29	0	0		0	0
53	In Japan, the notion of the national trust is expanded, and legislation is developed so as to promote funding from individuals and corporations for conserving and enhancing the natural environment, public property, and the living environment. As a result, diverse public values come to be protected through many different approaches.	1	66	14	24	62	-	70	46	40	14	0			
		2	63	3	16	81	-	71	47	43	10	0			
		E	2	100	0	0	-	100	100	0	0	0			
54	Demand-side management programs are widely and effectively introduced to Japan's traffic, electricity, and communications infrastructures to reduce hourly and seasonal fluctuations in demand and thus to cut excessive capital investment.	1	72	19	17	64	-	68	42	44	14	0		4	7
		2	62	11	13	76	-	72	47	48	5	0		3	5
		E	7	100	0	0	-	68	43	43	14	0		0	0



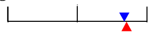
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
																		2	4	33	26	25	16	37	32	7	23	18	66	3
																		0	0	37	22	26	15	36	41	0	12	10	72	0
																		0	0	33	25	17	25	44	78	0	22	0	67	0
9	26	65	0	0	33	38	21	8	39	42	27	28	28	21	46	1		5	8	36	33	22	9	44	37	11	30	29	63	1
3	3	94	0	0	35	50	12	3	35	59	11	8	10	8	60	0		0	0	43	42	12	3	43	37	0	17	10	79	0
0	0	100	0	0	43	57	0	0	43	71	0	0	0	0	57	0		0	0	57	43	0	0	29	43	0	14	14	100	0
																		3	21	53	32	13	2	34	29	8	34	29	68	3
																		0	6	61	32	5	2	33	16	0	26	18	75	2
																		0	0	100	0	0	0	100	0	0	50	0	100	0
30	35	32	0	3	29	34	20	17	33	38	34	31	10	19	28	2		8	13	31	38	18	13	33	33	9	40	34	45	5
34	44	20	0	2	22	48	20	10	33	63	30	22	0	19	20	0		3	7	19	60	14	7	24	44	0	45	29	47	2
57	43	0	0	0	29	14	43	14	33	67	17	0	0	17	17	0		14	0	14	58	14	14	50	0	0	33	33	33	0

X. Art, culture, and entertainment that drive industry

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



2) Current impacts

[Increased intellectual assets] Contribution of the relevant area itself to increased intellectual assets

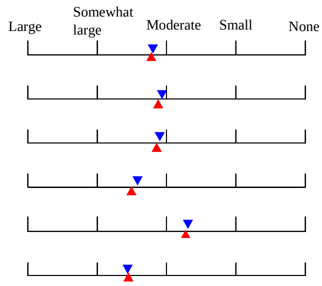
Contribution to the development of other fields

[Economic impacts] Contribution to the development of existing Japanese industry

Contribution to the creation of new industries or businesses

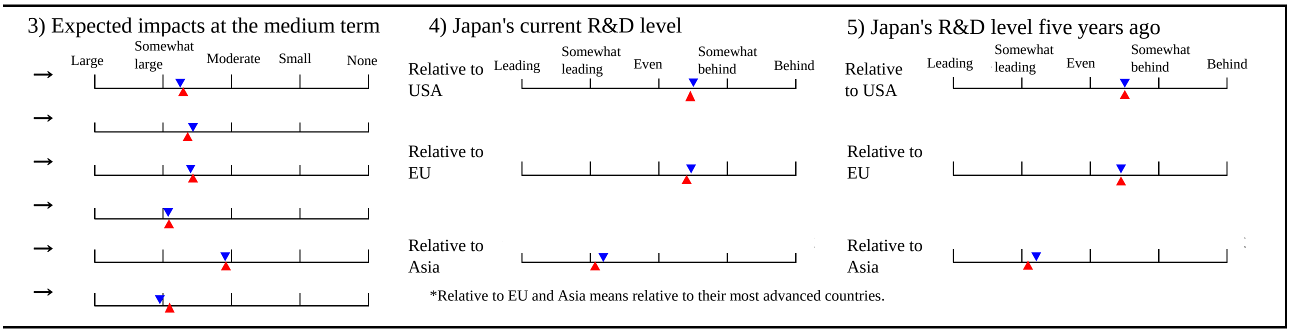
[Social impacts] Contribution to safety and security

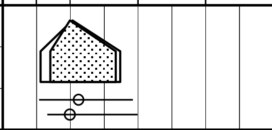
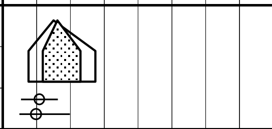
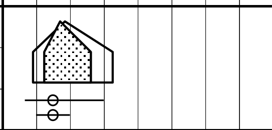
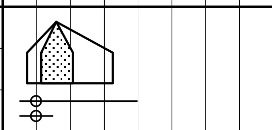
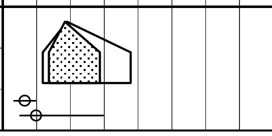
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
55	Advances in research on comfort/discomfort, likes/dislikes, and other sensibilities that people feel as a result of consuming goods and services lead to the establishment of methods by which consumer sensibilities are directly analyzed, measured, and assessed, so that the results are used for R&D, sales, and marketing of goods and services.	1	68	22	21	57	-	55	25	46	29	0		6	12
		2	62	16	19	65	-	49	12	60	28	0		5	8
		E	10	100	0	0	-	53	20	50	30	0		10	0
56	The concept of developing goods and services for not meeting specific needs, but for use in entertainment, art, and cultural activities becomes the mainstream in many industries and drives technological development.	1	71	17	18	65	-	55	21	55	24	0			
		2	63	8	17	75	-	50	12	66	22	0			
		E	5	100	0	0	-	75	60	20	20	0			
57	Universities, companies, and local governments establish mechanisms for promoting personal hobby activities regarding entertainment, art, and culture, and for linking them to academic or technological advances.	1	70	13	21	66	-	51	19	50	31	0			
		2	65	6	12	82	-	54	15	70	15	0			
		E	4	100	0	0	-	69	50	25	25	0			
58	In such fields as art, theater, cinema, music, and literature, there are artistic activities whose viability is threatened due to a very small consumer population. Such small-scale artistic activities can be made economically viable not by increasing the number of consumers, but by reducing access costs through the development of a system that allows existing consumers to enjoy, or obtain reproductions of, such activities over the Internet or other communications means at far lower cost.	1	68	13	25	62	-	51	19	47	34	0		1	9
		2	63	5	10	85	-	46	8	59	33	0		5	6
		E	3	100	0	0	-	42	0	67	33	0		0	0
59	Universities become the center of the theoretical analysis of art, theater, cinema, music, literature, and other artistic and cultural activities, and play an important role in nurturing artists who initiate new artistic activities and supporting such activities.	1	63	8	22	70	-	46	13	47	40	0			
		2	64	3	9	88	-	45	8	57	35	0			
		E	2	100	0	0	-	38	0	50	50	0			



Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't involvement: High (%)	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
11	80	3	0	6	6	14	53	27	42	40	38	47	4	9	2	0		8	15	6	14	46	34	42	37	28	28	14	7	0
9	85	4	0	2	2	9	56	33	69	44	31	44	0	5	0	0		6	6	2	3	53	42	74	56	6	21	9	6	0
22	78	0	0	0	11	0	78	11	88	25	38	38	0	0	0	0		10	10	11	0	56	33	83	50	17	50	0	0	0
																		1	16	6	19	43	32	47	30	32	32	32	11	0
																		2	11	2	10	46	42	86	31	17	17	14	0	0
																		0	20	20	0	40	40	100	33	33	67	0	0	0
																		3	12	6	25	49	20	53	45	18	33	24	10	2
																		2	10	2	16	52	30	66	52	2	27	16	5	0
																		0	0	0	50	50	0	50	25	0	25	25	25	0
9	63	20	3	5	18	22	42	18	49	23	23	23	17	28	13	2		6	13	15	24	42	19	39	22	26	48	37	22	0
4	81	11	2	2	5	12	63	20	81	11	9	6	4	34	6	0		5	8	5	15	64	16	53	14	8	69	29	10	0
0	67	33	0	0	0	0	67	33	100	0	0	0	0	0	0	0		0	33	33	0	67	0	50	0	0	50	0	0	0
																		12	13	14	31	41	14	65	29	8	37	18	8	4
																		5	16	7	20	58	15	75	19	4	44	13	0	0
																		0	0	0	50	50	0	100	0	0	0	0	0	0

12. Social infrastructure field

12.1. Overview

The social infrastructure field combines the "cities, construction, and civil engineering" and "transportation" fields of the previous analysis, surveying 97 topics in 14 areas.

Of the 155 respondents, about 56 percent envision society 30 years from now as "a society driven by environmental technology." This is a slightly idealistic environmentally-orientated society in which "compact cities will be distributed around the country based on environmental policy… urban transportation will be handled by public transportation and dissemination of fuel-cell automobiles will progress," but one that is not that far from realization. On the other hand, 38 percent envision a "world market" society, in other words, a realistic society that confirms the status quo with "concentrations of people and capital in a few major urban areas as economic competition and population decline advance… railways and automobiles forming the core type of transportation around major cities… automobiles as the main form in suburbs." In addition, 90 percent of respondents envision private-sector corporations playing an expanded role in the social infrastructure field. These are all matters that are often spoken of in recent years.

The strong realist tendencies and, in a sense, strong conservative tendencies of the respondents are reflected in these survey results. In fact, topics with high scores on the degree of importance index are concentrated in the areas "disaster prevention technology" and "revitalization, maintenance, and management of social infrastructure," perhaps reflecting the frequent occurrence of natural disasters in recent years. In addition, predicted times of both technological realization and social application for field topics tend to be markedly on the early side relative to all topics. The results for the fields with which the social infrastructure field should integrate and collaborate, the environment, social technology, and information and communications fields, were also very much in line with common sense.

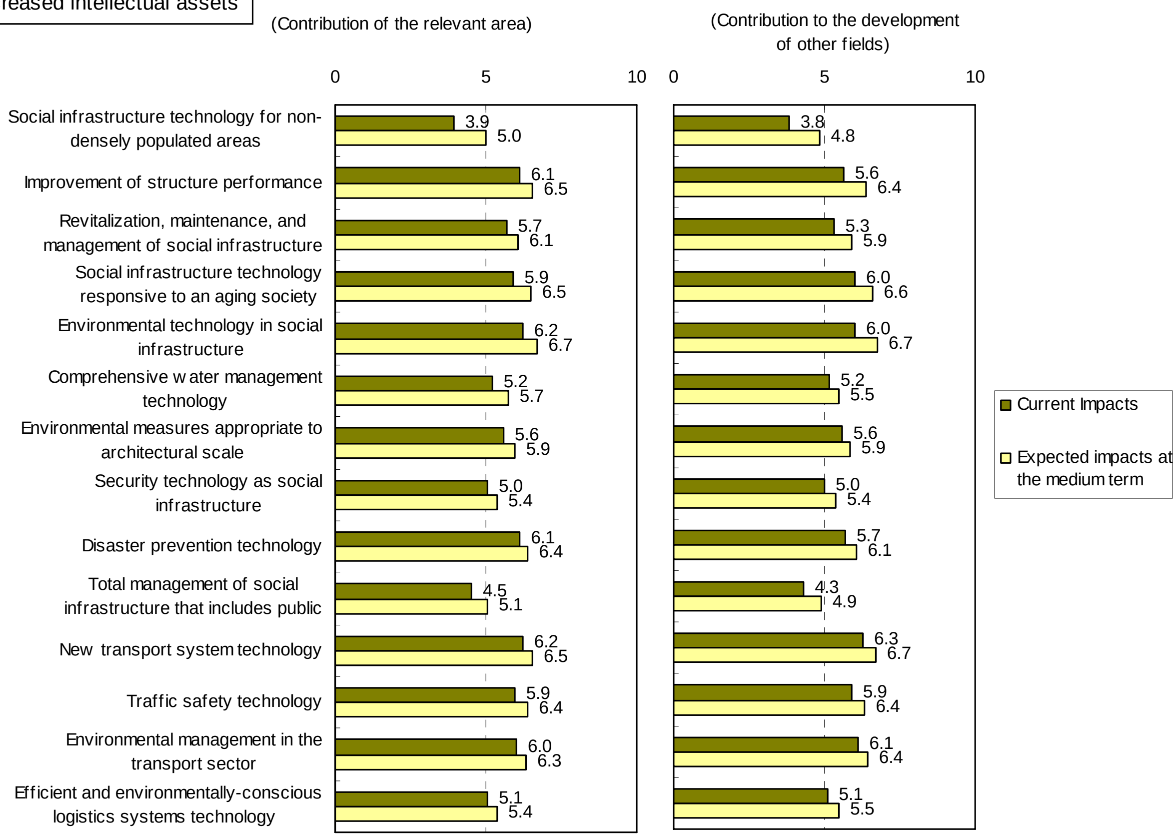
The field of social infrastructure technology is an extremely long-lasting one that has existed since the dawn of human history. In fact, in a sense human history is a history of "disaster prevention." Certainly social infrastructure is much less colorful than leading-edge technology sectors, but just as we are supported by the development efforts of the previous generation, the mission of human beings is to pass on the maximum fruits of technical development to the next generation. In a sense, the above survey results can therefore be seen as appropriate and steady results. On the other hand, the tendency of the respondents is towards disaster prevention and maintenance management rather than towards problem-solving topics. This may be a rather harsh assessment of the kind of technological topic that creates new services.

(IEDA Hitoshi)

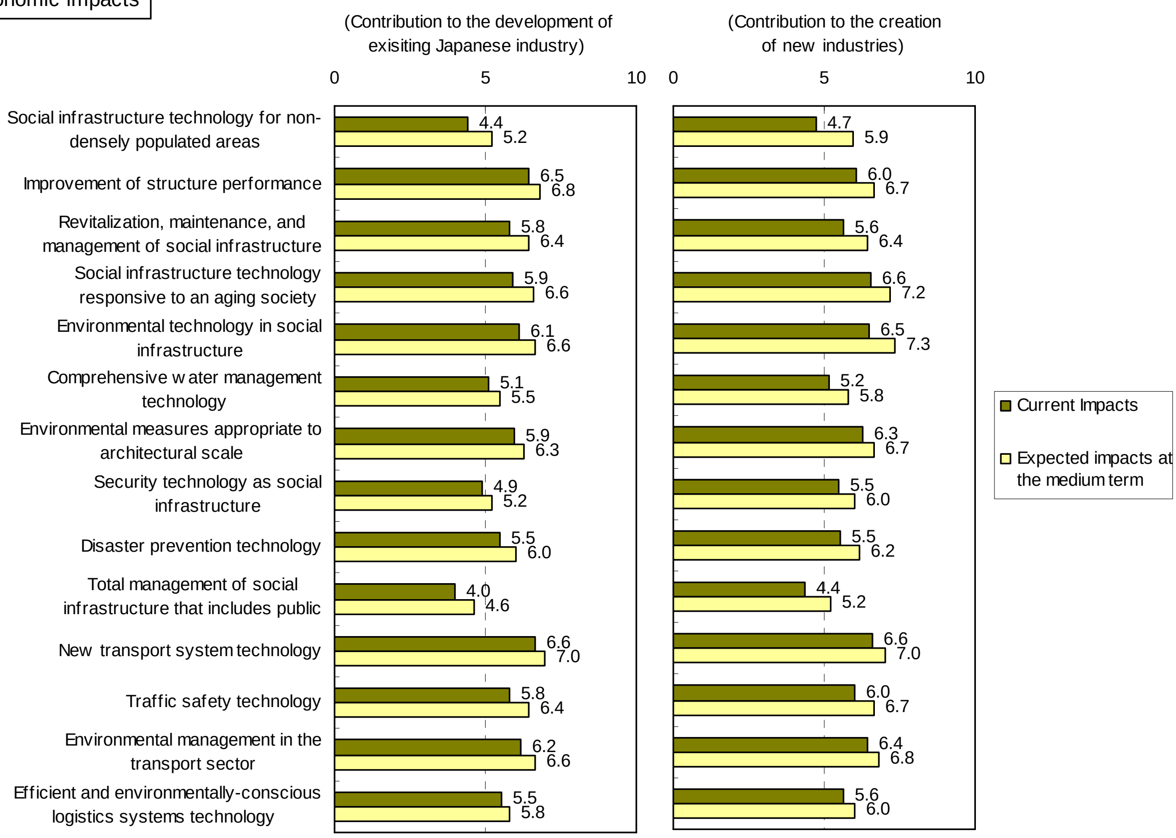
12.2. Main results

A. Impacts

Increased intellectual assets

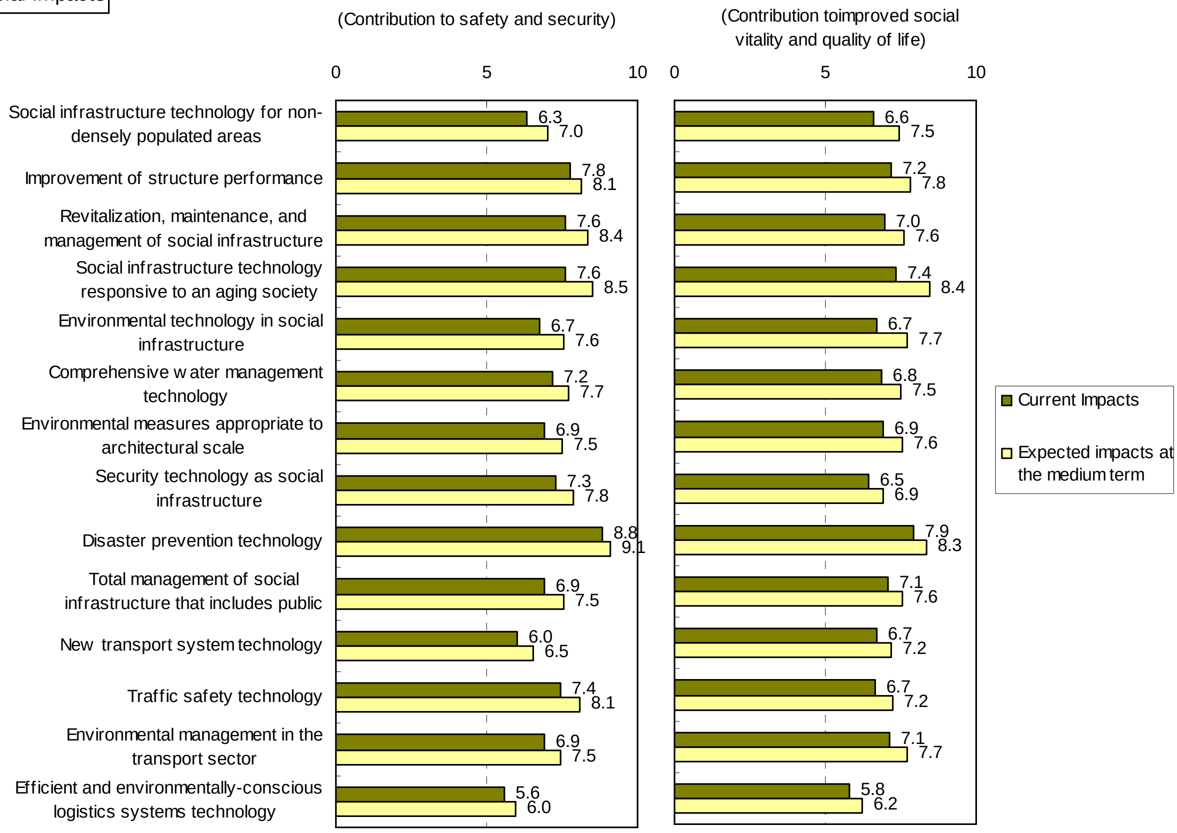


Economic impacts

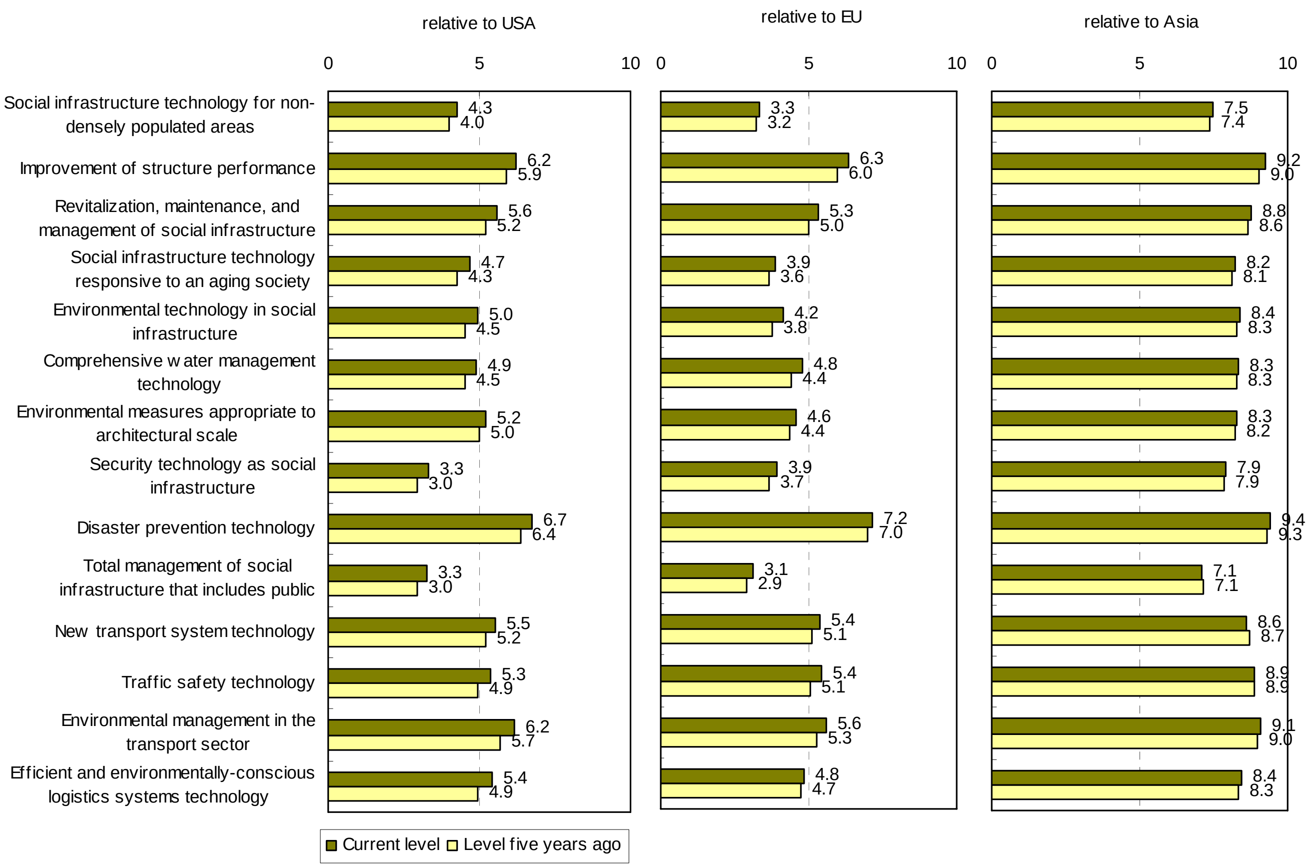


*Responses are indexed on a 10-point scale.

Social impacts



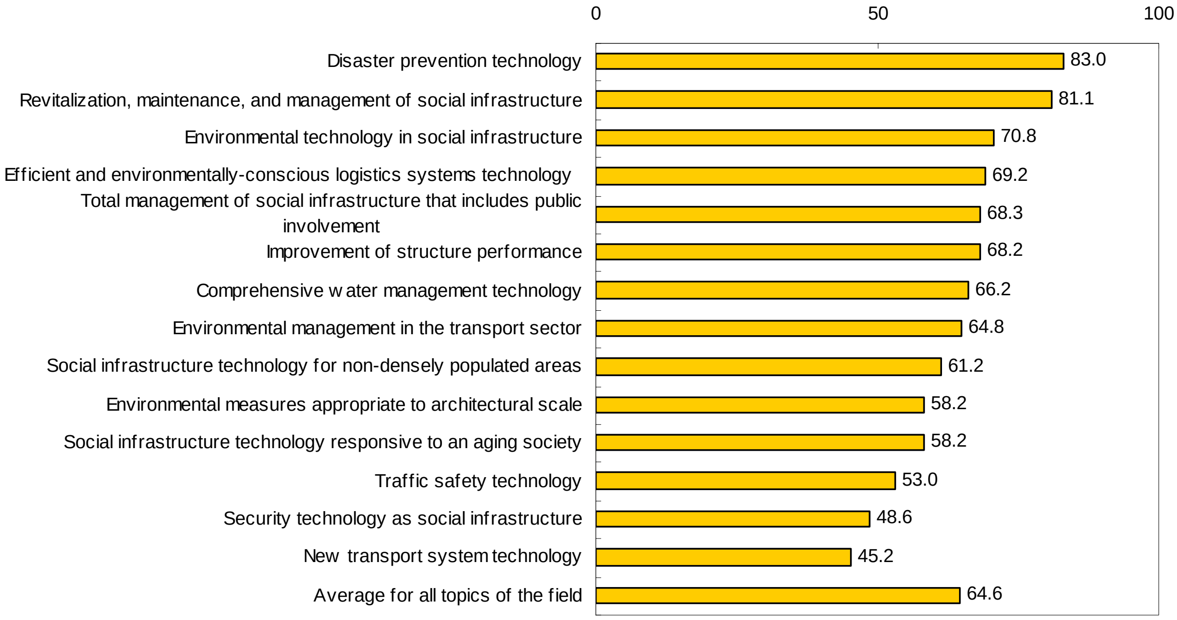
B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan

Average importance index by area



The most important 10 topics

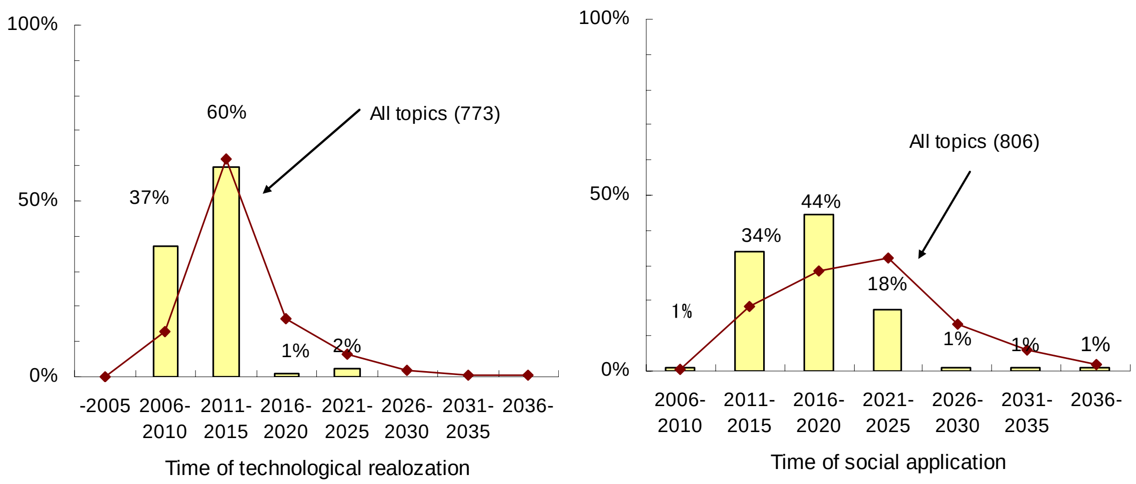
	Topic	Index	Year T*	Year S*
1	15: Technology for safely and efficiently demolishing and removing commercial nuclear power plants after decommissioning.	95	2013	2020
2	51: High-accuracy rainfall prediction technology capable of providing reliable forecast information on floods and landslides.	95	2012	2019
3	47: A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.	94	2008	2013
4	48: Technology for medium-term (5-10 years) prediction of major earthquakes (magnitude 8 or greater) by the analysis of crustal strain distribution and the records of past earthquakes.	93	2013	2021
5	19: Technology for recycling, rather than demolishing, deteriorated infrastructure and technology for maintaining and managing infrastructure to extend its life.	93	2012	2019
6	59: Technology for formulating an effective response strategy in the event of a major disaster, using systems for efficiently assessing the damage and predicting its spread.	93	2010	2015
7	50: Technology for accurately simulating the behavior of structures and the ground motion in response to a strong earthquake.	93	2010	2014
8	12: Technology for earthquake-resistance assessment and anti-seismic reinforcement to protect high-rise buildings and tanks from ocean-trench earthquakes that generate long-period seismic waves.	92	2009	2014
9	54: A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management (transport, storage, treatment) and in systems for warning, evacuation, and regulation.	92	2012	2017
10	55: Technology for supporting the restoration of the functions of an urban city that has been severely and extensively paralyzed by a large-scale power failure or a long-duration break in the water supply.	91	2011	2018

Year T: Time of technological realization   Year S: Time of social application

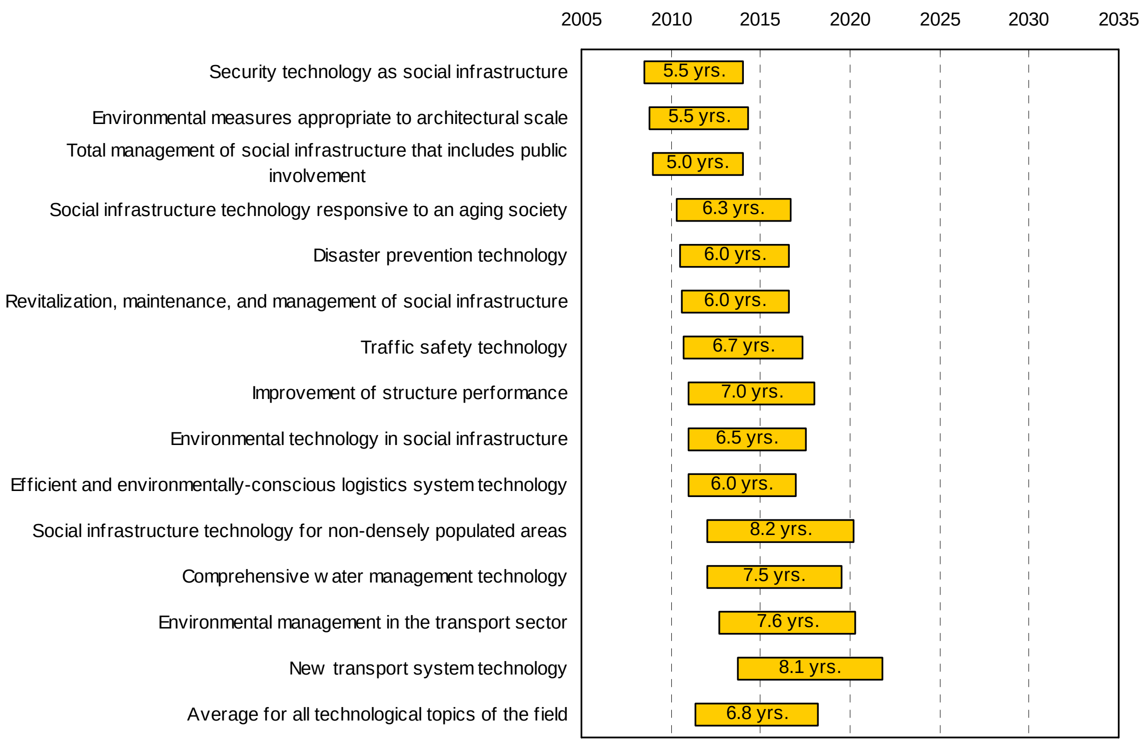
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

Topic	Year T*	Period*	Area
73: A space plane powered by an air-breathing engine and capable of traveling at Mach 25.	2025	11	New transport system technology
05: Technology that allows waste treatment and recycling to be performed by each household to eliminate emissions and the need for collection.	2013	10	Social infrastructure technology for non-densely populated areas
67: Commercial operation of a superconducting magnetic levitation railway at a speed of up to around 500 km/h.	2011	10	New transport system technology
75: An aircraft that can freely change the shape of the configurations like a bird by using smart composite materials and morphing technology to achieve energy savings.	2023	10	New transport system technology

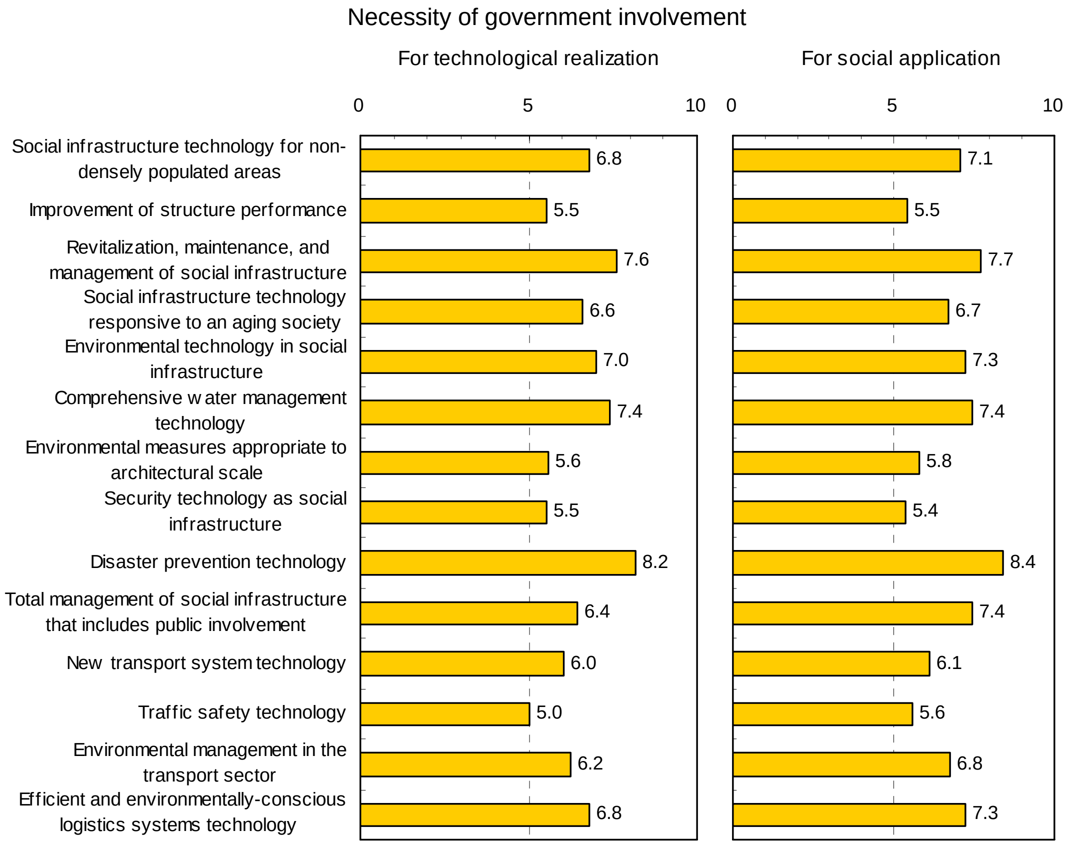
Topic	Year T*	Period*	Area
06: Distributed water-purification technology with long life and high reliability.	2012	9	Social infrastructure technology for non-densely populated areas
11: High-durability, high-performance bond for steel frames, for dramatically improving the efficiency of steel-frame work.	2014	9	Improvement of structure performance
37: Integrated river basin management technology is used for improving the river water quantity and quality to a swimmable level.	2012	9	Comprehensive water management technology
77: A pilotless high-altitude aircraft (or a airship platform) designed for stratospheric communications and observations.	2014	9	New transport system technology
86: Fuel cell-powered transport systems (automobiles, ships, etc.)	2012	9	Environmental management in the transport sector
88: An environment-friendly supersonic aircraft (at Mach 2-2.5, with a capacity of 250 passengers) that emits low noise even during supersonic flight over populated areas and generates a reduced amount of ozone-depleting emissions.	2018	9	Environmental management in the transport sector
90: Technology for reducing the frictional resistance of ships becomes commercially available, resulting in a 20% reduction in horsepower requirements.	2013	9	Environmental management in the transport sector
95: Technological systems for planning and constructing a city in a desert or polar region.	2015	9	–

Topic	Year T*	Period*	Area
50: Technology for accurately simulating the behavior of structures and the ground motion in response to a strong earthquake.	2010	4	Disaster prevention technology
12: Technology for earthquake-resistance assessment and anti-seismic reinforcement to protect high-rise buildings and tanks from ocean-trench earthquakes that generate long-period seismic waves.	2009	5	Improvement of structure performance
16: Technology for restoring dam function or extending the functional life of a dam by preventing silting in the reservoir through adequate sediment discharge and efficient sediment removal.	2011	5	Revitalization, maintenance, and management of social infrastructure
17: Technology for efficiently reinforcing existing structures by assessing their structural soundness through nondestructive inspection.	2009	5	Revitalization, maintenance, and management of social infrastructure
25: Technology for designing public spaces where anyone can move around safely and without barriers.	2009	5	Social infrastructure technology responsive to an aging society
28: A comprehensive database that contains soil texture, geological features, climate and other information to be considered in planning and designing structures.	2009	5	Environmental technology in social infrastructure
39: Room environment control technology for addressing indoor air contamination problems (sick-house syndrome) and ensuring safety, comfort, and health.	2007	5	Environmental measures appropriate to architectural scale
43: Technology for remodeling and converting spaces for effective use of social, economic, and physical resources.	2009	5	Environmental measures appropriate to architectural scale
44: Interior and exterior materials with environment control capability (e.g. photocatalyst).	2009	5	Environmental measures appropriate to architectural scale
46: Systems for positioning individuals anytime anywhere, whether indoor or outdoor, become widely available and find application in areas such as emergency position reporting and evacuation instructions for people in dangerous areas.	2009	5	Security technology as social infrastructure
47: A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.	2008	5	Disaster prevention technology

Topic	Year T*	Period*	Area
52: A disaster prevention system that ensures smooth evacuation, using navigation with personal mobile terminals.	2009	5	Disaster prevention technology
54: A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management (transport, storage, treatment) and in systems for warning, evacuation, and regulation.	2012	5	Disaster prevention technology
59: Technology for formulating an effective response strategy in the event of a major disaster, using systems for efficiently assessing the damage and predicting its spread.	2010	5	Disaster prevention technology
60: System technology for promptly providing provisional housing after disasters.	2007	5	Disaster prevention technology
65: Development of the tools for effective implementation of workshops and other public involvement programs.	2009	5	Total management of social infrastructure that includes public involvement
68: Short-term (several minutes to hours) travel time prediction technology with high accuracy for expressways and highways.	2009	5	New transport system technology
78: Widespread use of automobile collision avoidance systems that use image recognition and sensors to estimate the traffic condition around the vehicle.	2010	5	Traffic safety technology
91: A logistics system that uses trucks or ships to reduce logistics costs as well as the emissions of NO x , CO_2, and suspended particulate matter (SPM).	2012	5	Environment-friendly, efficient logistics system technology
93: Widespread use of procedures through which users of a planned building assess its ease of use in advance using virtual reality technology and the results are reflected into design.	2009	5	–

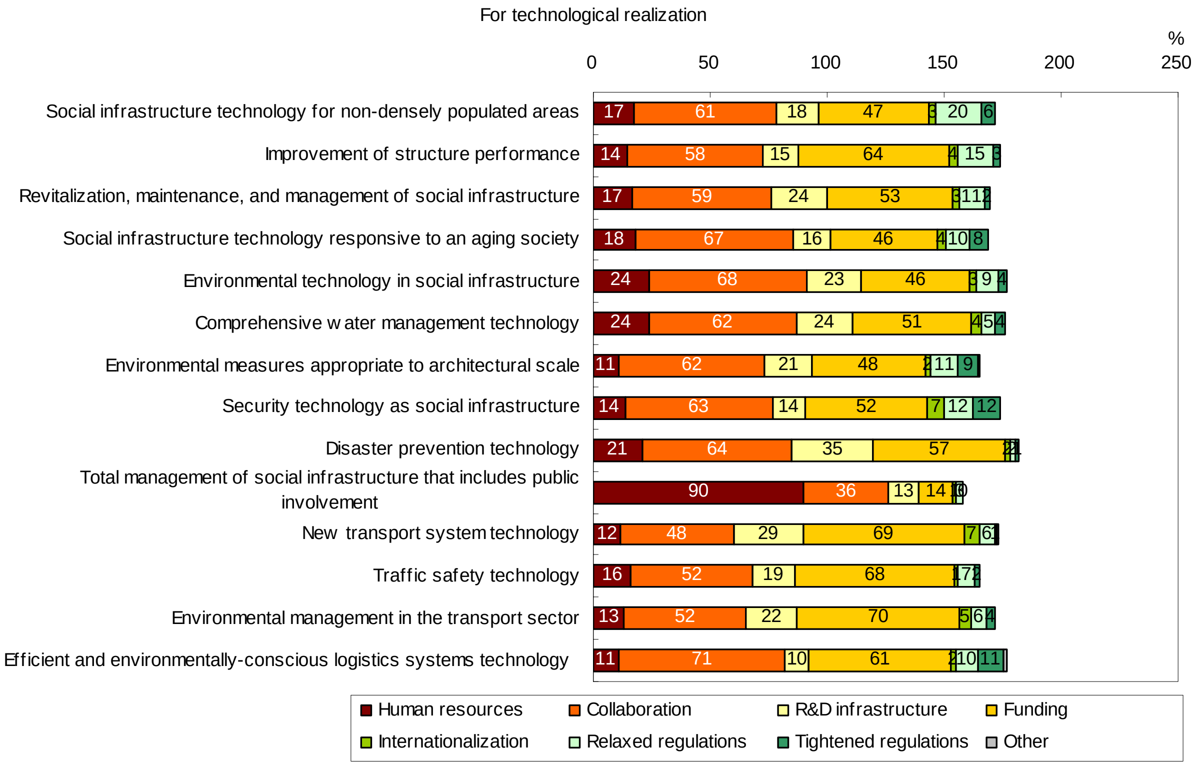
*Year T: Time of technological realization Period: Period until social application (years)

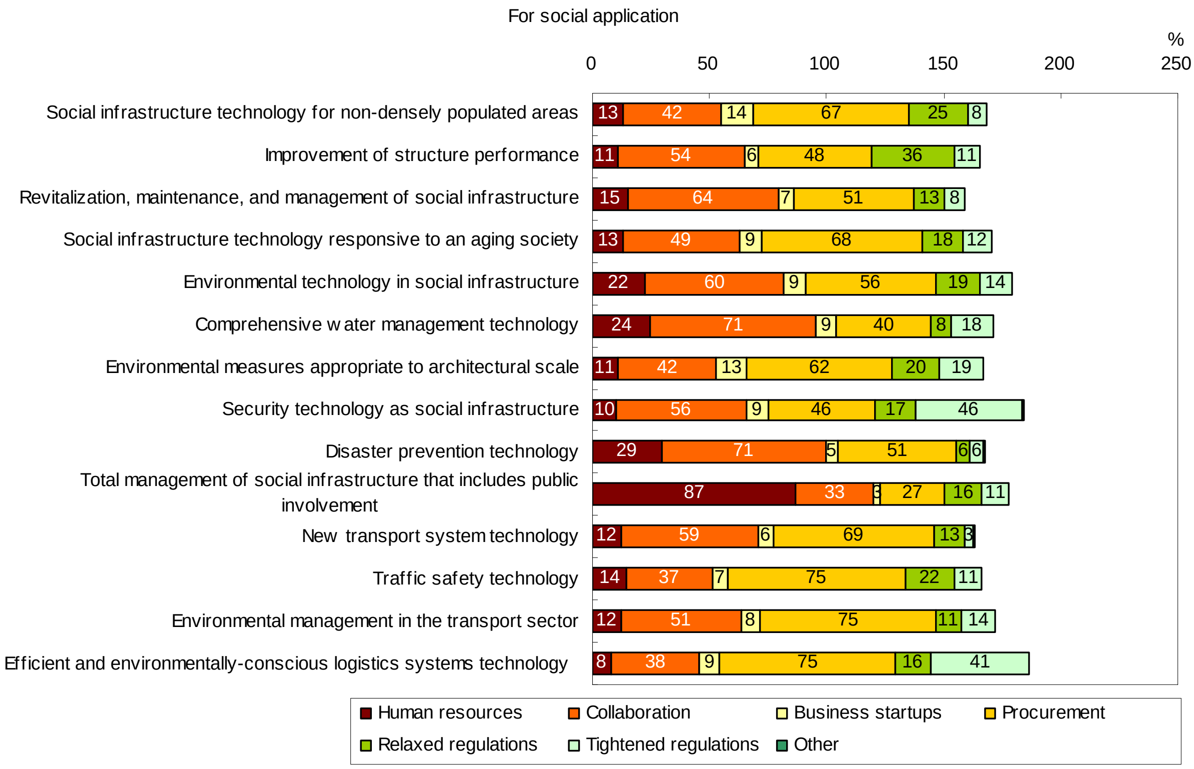
E. Effective measures that should taken by government



*Responses were indexed on a 10-point scale

Effective measures





F. Time-line of topics

Technological realization

year	topic
2007	13: Base-isolation and vibration-control devices that dramatically improve buildings' safety and property protection.
	39: Room environment control technology for addressing indoor air contamination problems (sick-house syndrome) and ensuring safety, comfort, and health.
	60: System technology for promptly providing provisional housing after disasters.
2008	18: Technology for building overpasses or underpasses in a short time while maintaining traffic during construction.
	21: A sensor-applied guidance system for people with visual impairment on railway platforms.
	26: A public sign system (e.g. for traffic signs) that takes account of age-related deterioration in dynamic vision.
	27: A design scheme for civil engineering structures and buildings that adopts the concept of life cycle assessment (LCA).
	41: A system for building self-sufficient energy structures using natural energy, natural air circulation, and natural light.
	45: An automatic surveillance system in which security cameras are networked so that anyone acting suspiciously can be detected at an early stage.
	47: A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.
2009	04: Technology for building houses that use natural energy and support systems to use rainwater and groundwater.
	12: Technology for earthquake-resistance assessment and anti-seismic reinforcement to protect high-rise buildings and tanks from ocean-trench earthquakes that generate long-period seismic waves.
	14: Technology for monitoring, evaluating, and maintaining the structural and environmental performance of buildings.
	17: Technology for efficiently reinforcing existing structures by assessing their structural soundness through nondestructive inspection.
	25: Technology for designing public spaces where anyone can move around safely and without barriers.
	28: A comprehensive database that contains soil texture, geological features, climate and other information to be considered in planning and designing structures.
	43: Technology for remodeling and converting spaces for effective use of social, economic, and physical resources.
	44: Interior and exterior materials with environment control capability (e.g. photocatalyst).
	46: Systems for positioning individuals anytime anywhere, whether indoor or outdoor, become widely available and find application in areas such as emergency position reporting and evacuation instructions for people in dangerous areas.
	52: A disaster prevention system that ensures smooth evacuation, using navigation with personal mobile terminals.
	65: Development of the tools for effective implementation of workshops and other public involvement programs.
	66: A railway system in which motor bogies are interchangeable between dissimilar lines (e.g. conventional lines and new trunk lines) to shorten travel time and eliminate the need for passengers to change cars.
	68: Short-term (several minutes to hours) travel time prediction technology with high accuracy for expressways and highways.
	79: A collision avoidance system that uses inter-vehicle communications to prevent accidents at intersections.
	93: Widespread use of procedures through which users of a planned building assess its ease of use in advance using virtual reality technology and the results are reflected into design.
2010	40: Widespread use of regional energy supply systems based on fuel cells, cogeneration, etc.
	42: Sensor technology and indoor-environment control technology that use not only temperature and humidity, but also new environmental indicators including pollutants.
	49: Fire extinguishing and rescue technology adapted to fires in high-rise buildings.
	50: Technology for accurately simulating the behavior of structures and the ground motion in response to a strong earthquake.

year	topic
	59: Technology for formulating an effective response strategy in the event of a major disaster, using systems for efficiently assessing the damage and predicting its spread.
	78: Widespread use of automobile collision avoidance systems that use image recognition and sensors to estimate the traffic condition around the vehicle.
	84: Automobile recycling technology that can almost completely solve car scrapping problems.
	92: Common distribution systems across urban areas that relieve urban traffic congestion stemming from an increased volume of small-package deliveries due to the proliferation of e-commerce.
2011	10: Housing and building technology that is highly adaptive/resistant to change in requirements and to deterioration over time due to generational change, life-stage transition, change in business operation, and environmental change.
	16: Technology for restoring dam function or extending the functional life of a dam by preventing silting in the reservoir through adequate sediment discharge and efficient sediment removal.
	33: Groundwater management technology through the development of technology for groundwater quality and flow observation/estimation and technology for groundwater increment.
	38: Technology for easy and inexpensive replacement and life extension of water and sewer pipes.
	55: Technology for supporting the restoration of the functions of an urban city that has been severely and extensively paralyzed by a large-scale power failure or a long-duration break in the water supply.
	57: Widespread adoption of earthquake risk management as a result of the establishment of the technique for long-term estimation of the probability of earthquake occurrence.
	67: Commercial operation of a superconducting magnetic levitation railway at a speed of up to around 500 km/h.
	72: A commercial icebreaker that can cruise the Arctic Ocean and other icy waters.
	83: Paving technology that uses new materials to reduce traffic noise levels below environmental standards.
2012	02: Sensing and information networking technologies that protect people's health and safety through the centralized control of the water and energy supply systems and the sewage, kitchen-garbage, and human-waste treatment/recycling systems distributed across individual households.
	06: Distributed water-purification technology with long life and high reliability.
	07: New construction materials are developed based on new materials, and are used for buildings, bridges, dams, and other structures.
	19: Technology for recycling, rather than demolishing, deteriorated infrastructure and technology for maintaining and managing infrastructure to extend its life.
	22: A ubiquitous computing environment that provides helpful information for the elderly and the disabled (visually impaired) in urban public spaces so that they can freely and safely move around (intelligent wearable devices and sensor, combined with embedded sensing networks and the communication environment to support them).
	24: An information sharing system in which all accidents and crimes, from a slight injury to a fatal accident to a murder, and their sites are recorded so that anyone approaching the site can be informed of the potential risk and avoid it.
	29: Technology that allows communities to use natural and unused energy and to form material recycling cycles.
	30: "Venous" logistics support systems to promote more efficient use of resources in urban cities.
	31: A system to support corporative decision-making among parties with diverse interests by using knowledge/information bases, such as environmental databases and knowledge bases.
	35: Technology for measuring and evaluating the impact of trace amounts of carcinogenic or endocrine-disrupting water pollutants.
	37: Integrated river basin management technology is used for improving the river water quantity and quality to a swimmable level.
	51: High-accuracy rainfall prediction technology capable of providing reliable forecast information on floods and landslides.
	53: The elucidation of the slope failure mechanism leads to the development of a system that can detect the possibility of slope failure and help appropriate actions (e.g. closing the road) to be taken to prevent accidents.
	54: A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management (transport, storage, treatment) and in systems for warning, evacuation, and regulation.
	56: Disaster rescue robot technology applicable to human search and rescue at the site of a disaster.
	69: A driving assistance system for people who have difficulty in driving or are unable to drive ordinary cars because of age-related problems.

year	topic
	70: A system that automatically drives a car safely and smoothly along an expressway to the specified destination.
	71: A means of high-speed (50-60 knots) marine transport that may be used in the East Asian economic zone and the trans-Pacific route.
	82: Train-mounted energy devices (e.g. flywheel, fuel cell) to store regenerative energy and reduce peak loads at substations.
	85: A system that reduces connection time and cost by streamlining connections between railways and highways, between highways and seaports/airports, and between railways and seaports/airports for efficient freight transport.
	86: Fuel cell-powered transport systems (automobiles, ships, etc.)
	91: A logistics system that uses trucks or ships to reduce logistics costs as well as the emissions of NO x , CO2, and suspended particulate matter (SPM).
	94: Technology for the ground-based probing of buried objects and soil properties 5 meters underground, to address the growing use of underground spaces.
2013	01: Technology that allows communities to use natural and untapped energy and to form material recycling cycles.
	03: Technology for distributed ecological waste water treatment that ensures water quality control, the natural cycle of nutrient salts, and sanitation protection.
	05: Technology that allows waste treatment and recycling to be performed by each household to eliminate emissions and the need for collection.
	08: Technology for Intelligent robots to be used in construction sites for faster and safer construction work.
	09: Construction technology with which maintenance and demolition capability may be incorporated into buildings and civil engineering structures during construction.
	15: Technology for safely and efficiently demolishing and removing commercial nuclear power plants after decommissioning.
	20: A house equipped with robots and devices that assist an elderly person in eating, bathing, using the toilet, and enjoying pastimes without any help from a caregiver.
	32: A system for the integrated and efficient use of energy, water and organic waste within a unit space, such as a relatively small community or an airtight house (e.g. integration of fuel cell, biogas, natural energy, rainwater, etc.).
	34: A compact waste water treatment system that can efficiently treat persistent and toxic substances and achieve waste-free water treatment by fully recycling the sludge.
	36: A system for advance or semi-real time detection of floods and droughts around the world by combining satellite and above-ground observations with the long-term prediction of wide-area water cycles and the prediction of social activities and water usage.
	48: Technology for medium-term (5-10 years) prediction of major earthquakes (magnitude 8 or greater) by the analysis of crustal strain distribution and the records of past earthquakes.
	74: Air transport management technology in which both the aircraft and the air traffic control use a high-accuracy navigation system to achieve twice as much air-traffic capacity safely as the current technology can.
	80: A safe aircraft that prevents crash during takeoff and landing using self correction, a technology that allows the aircraft to automatically restore the correct orientation if it loses stability.
	81: Technology that allows a shinkansen train running at 350 km/h to satisfy the noise standards (70 dB(A) or less in residential areas), through the use of new materials for the rails and wheels and the technical improvement of railroad structures and the car design.
	87: Emissions treatment technology that allows all land and marine transport systems to satisfy the current automobile emissions limits (current limits for gasoline passenger vehicles in g/km: 1.27(0.67) for carbon monoxide; 0.17(0.08) for hydrocarbon; 0.17(0.08) for nitrogen oxides; in 10/15 mode tests, max. values per car, average of emissions per type of vehicle in parentheses).
	89: A low-emission, energy-efficient aircraft that achieves reduction in the takeoff and landing noise and in-flight emissions, reduction in frictional resistance, and improvement of engine fuel efficiency.
	90: Technology for reducing the frictional resistance of ships becomes commercially available, resulting in a 20% reduction in horsepower requirements.
2014	11: High-durability, high-performance bond for steel frames, for dramatically improving the efficiency of steel-frame work.
	76: A pilotless aircraft capable of autonomous low-altitude flight and applicable widely to the surveillance of territorial waters, disaster monitoring, and rescue assistance.

year	topic
	77: A pilotless high-altitude aircraft (or a airship platform) designed for stratospheric communications and observations.
2015	95: Technological systems for planning and constructing a city in a desert or polar region.
2018	88: An environment-friendly supersonic aircraft (at Mach 2-2.5, with a capacity of 250 passengers) that emits low noise even during supersonic flight over populated areas and generates a reduced amount of ozone-depleting emissions.
2023	75: An aircraft that can freely change the shape of the configurations like a bird by using smart composite materials and morphing technology to achieve energy savings.
2025	73: A space plane powered by an air-breathing engine and capable of traveling at Mach 25.

Social application

year	topic
2010	96: Public works bidding and contracting schemes in which the quality of public works are ensured through comprehensive assessment of the technical capability of each contractor, including its performance in past projects.
2012	39: Room environment control technology for addressing indoor air contamination problems (sick-house syndrome) and ensuring safety, comfort, and health.
	60: System technology for promptly providing provisional housing after disasters.
2013	13: Base-isolation and vibration-control devices that dramatically improve buildings' safety and property protection.
	23: Proliferation of collective houses (shared by groups of individuals), group homes (shared by groups of elderly people), and other type of houses adapted to the aging society with a declining birthrate.
	47: A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.
	64: Institutional approaches concerning community architect programs and community design associations intended for building, maintaining, and conserving the unique landscape features of the local community.
	97: International standards for general contracting and execution of international projects are established.
2014	12: Technology for earthquake-resistance assessment and anti-seismic reinforcement to protect high-rise buildings and tanks from ocean-trench earthquakes that generate long-period seismic waves.
	17: Technology for efficiently reinforcing existing structures by assessing their structural soundness through nondestructive inspection.
	18: Technology for building overpasses or underpasses in a short time while maintaining traffic during construction.
	21: A sensor-applied guidance system for people with visual impairment on railway platforms.
	25: Technology for designing public spaces where anyone can move around safely and without barriers.
	26: A public sign system (e.g. for traffic signs) that takes account of age-related deterioration in dynamic vision.
	27: A design scheme for civil engineering structures and buildings that adopts the concept of life cycle assessment (LCA).
	28: A comprehensive database that contains soil texture, geological features, climate and other information to be considered in planning and designing structures.
	41: A system for building self-sufficient energy structures using natural energy, natural air circulation, and natural light.
	43: Technology for remodeling and converting spaces for effective use of social, economic, and physical resources.
	44: Interior and exterior materials with environment control capability (e.g. photocatalyst).
	45: An automatic surveillance system in which security cameras are networked so that anyone acting suspiciously can be detected at an early stage.
	46: Systems for positioning individuals anytime anywhere, whether indoor or outdoor, become widely available and find application in areas such as emergency position reporting and evacuation instructions for people in dangerous areas.
	50: Technology for accurately simulating the behavior of structures and the ground motion in response to a strong earthquake.
	52: A disaster prevention system that ensures smooth evacuation, using navigation with personal mobile terminals.

year	topic
	58: Construction of effective information and social systems that help improve the capacity of community-based activities for disaster prevention and welfare.
	62: A system in which citizens can actively participate in community design and the construction and management of social infrastructure so as to feel a sense of fulfillment as they play the given roles.
	63: A system that allows people to recognize and understand the disaster risk potential associated with natural phenomena (e.g. earthquakes, volcanic eruption, flood) and man-made accidents, so that they can construct disaster mitigation measures in cooperation with the government.
	65: Development of the tools for effective implementation of workshops and other public involvement programs.
	68: Short-term (several minutes to hours) travel time prediction technology with high accuracy for expressways and highways.
	93: Widespread use of procedures through which users of a planned building assess its ease of use in advance using virtual reality technology and the results are reflected into design.
2015	14: Technology for monitoring, evaluating, and maintaining the structural and environmental performance of buildings.
	59: Technology for formulating an effective response strategy in the event of a major disaster, using systems for efficiently assessing the damage and predicting its spread.
	61: A new system that establishes ties between the community and its members to prevent crimes stemming from emotional problems.
	66: A railway system in which motor bogies are interchangeable between dissimilar lines (e.g. conventional lines and new trunk lines) to shorten travel time and eliminate the need for passengers to change cars.
	78: Widespread use of automobile collision avoidance systems that use image recognition and sensors to estimate the traffic condition around the vehicle.
2016	16: Technology for restoring dam function or extending the functional life of a dam by preventing silting in the reservoir through adequate sediment discharge and efficient sediment removal.
	40: Widespread use of regional energy supply systems based on fuel cells, cogeneration, etc.
	42: Sensor technology and indoor-environment control technology that use not only temperature and humidity, but also new environmental indicators including pollutants.
	49: Fire extinguishing and rescue technology adapted to fires in high-rise buildings.
	79: A collision avoidance system that uses inter-vehicle communications to prevent accidents at intersections.
2017	4: Technology for building houses that use natural energy and support systems to use rainwater and groundwater.
	33: Groundwater management technology through the development of technology for groundwater quality and flow observation/estimation and technology for groundwater increment.
	38: Technology for easy and inexpensive replacement and life extension of water and sewer pipes.
	54: A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management (transport, storage, treatment) and in systems for warning, evacuation, and regulation.
	83: Paving technology that uses new materials to reduce traffic noise levels below environmental standards.
	84: Automobile recycling technology that can almost completely solve car scrapping problems.
	91: A logistics system that uses trucks or ships to reduce logistics costs as well as the emissions of NO x , CO2, and suspended particulate matter (SPM).
	92: Common distribution systems across urban areas that relieve urban traffic congestion stemming from an increased volume of small-package deliveries due to the proliferation of e-commerce.
2018	10: Housing and building technology that is highly adaptive/resistant to change in requirements and to deterioration over time due to generational change, life-stage transition, change in business operation, and environmental change.
	30: "Venous" logistics support systems to promote more efficient use of resources in urban cities.
	53: The elucidation of the slope failure mechanism leads to the development of a system that can detect the possibility of slope failure and help appropriate actions (e.g. closing the road) to be taken to prevent accidents.
	55: Technology for supporting the restoration of the functions of an urban city that has been severely and extensively paralyzed by a large-scale power failure or a long-duration break in the water supply.
	57: Widespread adoption of earthquake risk management as a result of the establishment of the technique for long-term estimation of the probability of earthquake occurrence.
	94: Technology for the ground-based probing of buried objects and soil properties 5 meters underground, to address the growing use of underground spaces.

year	topic
2019	19: Technology for recycling, rather than demolishing, deteriorated infrastructure and technology for maintaining and managing infrastructure to extend its life.
	22: A ubiquitous computing environment that provides helpful information for the elderly and the disabled (visually impaired) in urban public spaces so that they can freely and safely move around (intelligent wearable devices and sensor, combined with embedded sensing networks and the communication environment to support them).
	24: An information sharing system in which all accidents and crimes, from a slight injury to a fatal accident to a murder, and their sites are recorded so that anyone approaching the site can be informed of the potential risk and avoid it.
	31: A system to support corporative decision-making among parties with diverse interests by using knowledge/information bases, such as environmental databases and knowledge bases.
	51: High-accuracy rainfall prediction technology capable of providing reliable forecast information on floods and landslides.
	71: A means of high-speed (50-60 knots) marine transport that may be used in the East Asian economic zone and the trans-Pacific route.
	72: A commercial icebreaker that can cruise the Arctic Ocean and other icy waters.
	81: Technology that allows a shinkansen train running at 350 km/h to satisfy the noise standards (70 dB(A) or less in residential areas), through the use of new materials for the rails and wheels and the technical improvement of railroad structures and the car design.
	82: Train-mounted energy devices (e.g. flywheel, fuel cell) to store regenerative energy and reduce peak loads at substations.
	85: A system that reduces connection time and cost by streamlining connections between railways and highways, between highways and seaports/airports, and between railways and seaports/airports for efficient freight transport.
2020	1: Technology that allows communities to use natural and untapped energy and to form material recycling cycles.
	2: Sensing and information networking technologies that protect people's health and safety through the centralized control of the water and energy supply systems and the sewage, kitchen-garbage, and human-waste treatment/recycling systems distributed across individual households.
	3: Technology for distributed ecological waste water treatment that ensures water quality control, the natural cycle of nutrient salts, and sanitation protection.
	7: New construction materials are developed based on new materials, and are used for buildings, bridges, dams, and other structures.
	8: Technology for Intelligent robots to be used in construction sites for faster and safer construction work.
	15: Technology for safely and efficiently demolishing and removing commercial nuclear power plants after decommissioning.
	20: A house equipped with robots and devices that assist an elderly person in eating, bathing, using the toilet, and enjoying pastimes without any help from a caregiver.
	29: Technology that allows communities to use natural and unused energy and to form material recycling cycles.
	32: A system for the integrated and efficient use of energy, water and organic waste within a unit space, such as a relatively small community or an airtight house (e.g. integration of fuel cell, biogas, natural energy, rainwater, etc.).
	35: Technology for measuring and evaluating the impact of trace amounts of carcinogenic or endocrine-disrupting water pollutants.
	56: Disaster rescue robot technology applicable to human search and rescue at the site of a disaster.
	69: A driving assistance system for people who have difficulty in driving or are unable to drive ordinary cars because of age-related problems.
	70: A system that automatically drives a car safely and smoothly along an expressway to the specified destination.
	74: Air transport management technology in which both the aircraft and the air traffic control use a high-accuracy navigation system to achieve twice as much air-traffic capacity safely as the current technology can.
2021	6: Distributed water-purification technology with long life and high reliability.
	9: Construction technology with which maintenance and demolition capability may be incorporated into buildings and civil engineering structures during construction.
	34: A compact waste water treatment system that can efficiently treat persistent and toxic substances and achieve waste-free water treatment by fully recycling the sludge.

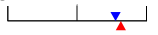
year	topic
	36: A system for advance or semi-real time detection of floods and droughts around the world by combining satellite and above-ground observations with the long-term prediction of wide-area water cycles and the prediction of social activities and water usage.
	37: Integrated river basin management technology is used for improving the river water quantity and quality to a swimmable level.
	48: Technology for medium-term (5-10 years) prediction of major earthquakes (magnitude 8 or greater) by the analysis of crustal strain distribution and the records of past earthquakes.
	67: Commercial operation of a superconducting magnetic levitation railway at a speed of up to around 500 km/h.
	80: A safe aircraft that prevents crash during takeoff and landing using self correction, a technology that allows the aircraft to automatically restore the correct orientation if it loses stability.
	86: Fuel cell-powered transport systems (automobiles, ships, etc.)
	87: Emissions treatment technology that allows all land and marine transport systems to satisfy the current automobile emissions limits (current limits for gasoline passenger vehicles in g/km: 1.27(0.67) for carbon monoxide; 0.17(0.08) for hydrocarbon; 0.17(0.08) for nitrogen oxides; in 10/15 mode tests, max. values per car, average of emissions per type of vehicle in parentheses).
	89: A low-emission, energy-efficient aircraft that achieves reduction in the takeoff and landing noise and in-flight emissions, reduction in frictional resistance, and improvement of engine fuel efficiency.
2022	76: A pilotless aircraft capable of autonomous low-altitude flight and applicable widely to the surveillance of territorial waters, disaster monitoring, and rescue assistance.
	90: Technology for reducing the frictional resistance of ships becomes commercially available, resulting in a 20% reduction in horsepower requirements.
2023	5: Technology that allows waste treatment and recycling to be performed by each household to eliminate emissions and the need for collection.
	11: High-durability, high-performance bond for steel frames, for dramatically improving the efficiency of steel-frame work.
	77: A pilotless high-altitude aircraft (or a airship platform) designed for stratospheric communications and observations.
2024	95: Technological systems for planning and constructing a city in a desert or polar region.
2027	88: An environment-friendly supersonic aircraft (at Mach 2-2.5, with a capacity of 250 passengers) that emits low noise even during supersonic flight over populated areas and generates a reduced amount of ozone-depleting emissions.
2033	75: An aircraft that can freely change the shape of the configurations like a bird by using smart composite materials and morphing technology to achieve energy savings.
2036-	73: A space plane powered by an air-breathing engine and capable of traveling at Mach 25.

Appendix: Results of R1 and R2

I. Social infrastructure technology for non-densely populated areas

1. Questions regarding the relevant area

1) Degree of expertise in the area

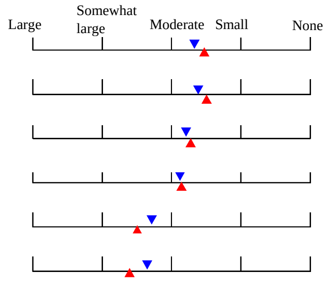


2) Current impacts

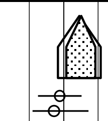
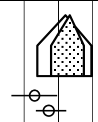
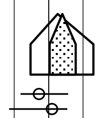
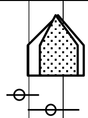
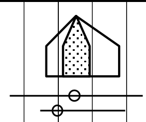
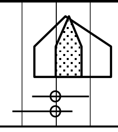
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

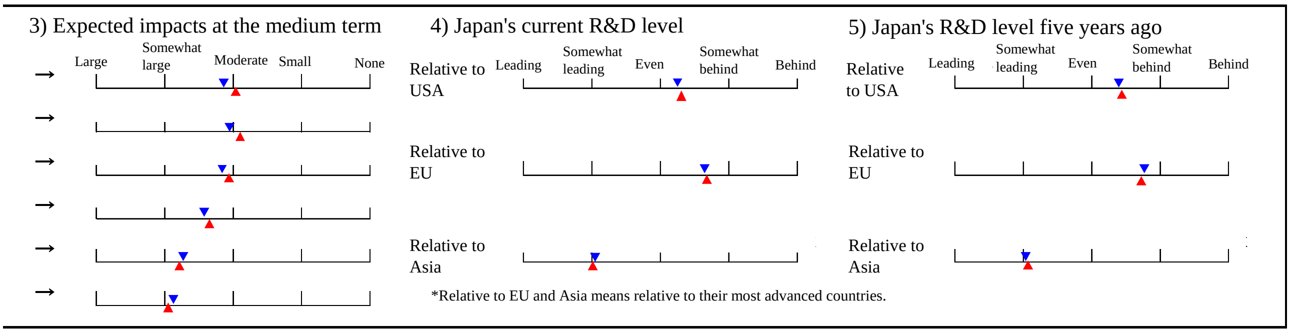
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

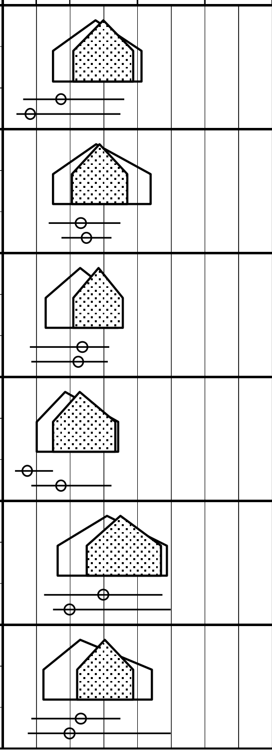


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
1	Technology that allows communities to use natural and untapped energy and to form material recycling cycles.	1	124	12	25	63	-	78	59	36	5	0		1	11
		2	98	5	20	75	-	80	61	37	2	0		0	5
		E	5	100	0	0	-	100	100	0	0	0		0	0
2	Sensing and information networking technologies that protect people's health and safety through the centralized control of the water and energy supply systems and the sewage, kitchen-garbage, and human-waste treatment/recycling systems distributed across individual households.	1	101	8	30	62	-	59	32	44	20	4		3	10
		2	86	3	19	78	-	58	27	52	20	1		2	6
		E	3	100	0	0	-	83	67	33	0	0		0	0
3	Technology for distributed ecological waste water treatment that ensures water quality control, the natural cycle of nutrient salts, and sanitation protection.	1	83	17	24	59	-	64	35	52	13	0		1	10
		2	78	9	15	76	-	60	23	69	8	0		0	4
		E	7	100	0	0	-	64	29	71	0	0		0	0
4	Technology for building houses that use natural energy and support systems to use rainwater and groundwater.	1	116	10	35	55	-	65	36	51	13	0		0	1
		2	98	8	22	70	-	58	21	71	8	0		0	3
		E	8	100	0	0	-	88	75	25	0	0		0	0
5	Technology that allows waste treatment and recycling to be performed by each household to eliminate emissions and the need for collection.	1	95	6	26	68	-	60	29	54	16	1		7	7
		2	81	4	10	86	-	58	21	68	11	0		5	5
		E	3	100	0	0	-	75	67	0	33	0		33	0
6	Distributed water-purification technology with long life and high reliability.	1	76	11	25	64	-	55	26	47	24	3		0	8
		2	76	8	11	81	-	54	13	75	12	0		0	3
		E	6	100	0	0	-	63	33	50	17	0		0	0



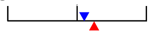
Countries at the leading edge: Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	Regarding social application – Necessity of gov't involvement: High	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
6	7	81	3	3	39	38	21	2	29	51	27	47	3	22	14	0						1	8	39	40	18	3	22	40	22	51	32	20	0
1	1	98	0	0	49	45	6	0	24	63	17	45	2	28	6	0						0	5	37	61	1	1	14	46	13	68	30	8	0
20	0	80	0	0	60	40	0	0	40	100	0	20	20	40	0	0						0	0	80	20	0	0	20	80	20	60	60	0	0
21	15	62	0	2	24	47	20	9	31	58	27	40	3	14	12	2						5	14	31	38	22	9	19	42	26	49	25	16	0
7	2	91	0	0	18	71	10	1	21	71	10	39	2	21	5	0						5	6	24	67	8	1	11	49	13	60	22	5	0
33	0	67	0	0	33	67	0	0	33	67	33	0	0	67	0	0						0	0	0	100	0	0	0	33	33	33	33	0	0
30	10	59	0	1	25	55	16	4	26	44	36	38	3	19	19	0						0	8	32	44	20	4	14	37	30	48	21	24	1
16	0	83	0	1	16	77	7	0	20	62	27	47	3	14	5	0						0	4	24	72	4	0	19	44	12	65	24	13	0
14	0	86	0	0	14	86	0	0	14	57	29	29	0	29	14	0						0	0	33	67	0	0	33	50	0	67	33	17	0
36	9	52	2	1	14	49	29	8	20	45	22	37	4	30	13	1						2	3	15	45	35	5	16	31	24	59	31	17	1
30	1	69	0	0	9	65	26	0	12	67	13	33	1	28	5	0						0	3	10	71	19	0	10	31	16	71	26	6	0
38	13	49	0	0	50	25	25	0	25	50	25	38	0	38	13	0						0	0	50	33	17	0	33	0	33	50	17	17	0
22	12	59	4	3	17	38	39	6	18	32	33	44	5	18	17	1						8	7	19	42	32	7	15	25	28	49	29	20	1
8	0	92	0	0	10	62	25	3	12	49	25	61	3	15	5	0						1	6	16	75	8	1	13	37	12	68	28	8	0
33	0	67	0	0	0	67	0	33	0	50	0	50	0	100	0	0						0	33	0	100	0	0	0	0	0	100	50	0	0
46	12	37	0	5	26	38	29	7	18	38	25	48	3	17	12	3						1	7	27	41	28	4	18	37	18	52	22	18	4
64	4	32	0	0	18	65	17	0	15	56	14	58	6	14	7	0						0	3	16	76	7	1	13	44	17	67	22	6	0
83	17	0	0	0	20	80	0	0	40	80	20	20	0	40	20	0						0	0	17	66	17	0	17	50	17	67	33	17	0



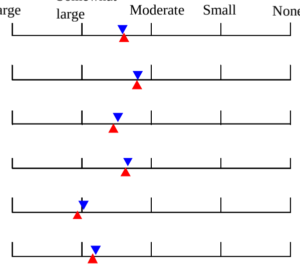
II. Improvement of structure performance

1. Questions regarding the relevant area

1) Degree of expertise in the area

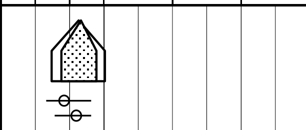
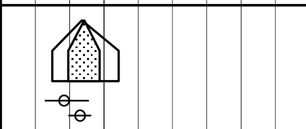
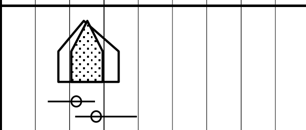
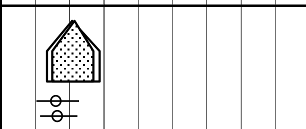
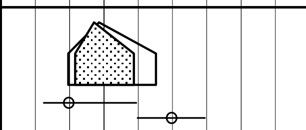
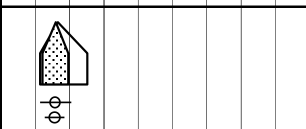
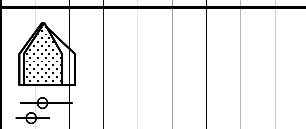
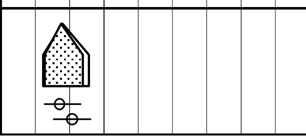


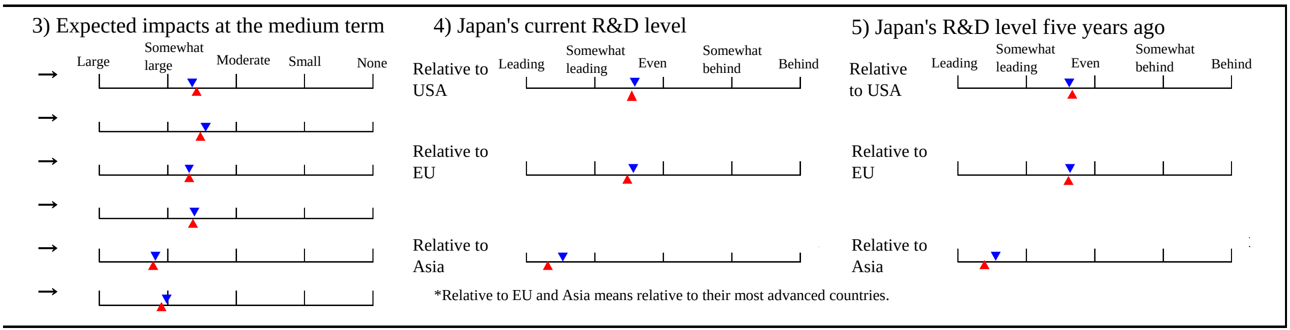
2) Current impacts



[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
7	New construction materials are developed based on new materials, and are used for buildings, bridges, dams, and other structures.	1	130	27	27	46	-	63	34	49	15	2		2	17
		2	105	21	32	47	-	61	24	73	3	0		1	6
		E	22	100	0	0	-	69	38	62	0	0		0	0
8	Technology for Intelligent robots to be used in construction sites for faster and safer construction work.	1	116	9	33	58	-	57	24	56	19	1		3	6
		2	92	5	29	66	-	57	18	74	7	1		1	2
		E	5	100	0	0	-	60	20	80	0	0		0	20
9	Construction technology with which maintenance and demolition capability may be incorporated into buildings and civil engineering structures during construction.	1	127	16	31	53	-	64	36	49	14	1		3	6
		2	98	12	30	58	-	65	33	60	7	0		0	3
		E	12	100	0	0	-	88	75	25	0	0		0	0
10	Housing and building technology that is highly adaptive/resistant to change in requirements and to deterioration over time due to generational change, life-stage transition, change in business operation, and environmental change.	1	114	18	31	51	-	66	39	48	13	0		3	5
		2	92	13	30	57	-	64	31	61	8	0		0	3
		E	12	100	0	0	-	83	67	33	0	0		0	0
11	High-durability, high-performance bond for steel frames, for dramatically improving the efficiency of steel-frame work.	1	85	13	20	67	-	44	14	40	41	5		6	20
		2	76	5	30	65	-	43	7	51	41	1		4	8
		E	4	100	0	0	-	44	25	0	75	0		25	25
12	Technology for earthquake-resistance assessment and anti-seismic reinforcement to protect high-rise buildings and tanks from ocean-trench earthquakes that generate long-period seismic waves.	1	114	30	32	38	-	79	60	36	4	0		0	1
		2	98	19	41	40	-	92	85	13	2	0		0	2
		E	19	100	0	0	-	100	100	0	0	0		0	0
13	Base-isolation and vibration-control devices that dramatically improve buildings' safety and property protection.	1	123	21	36	43	-	79	61	34	5	0		1	2
		2	98	22	31	47	-	90	80	19	1	0		0	1
		E	22	100	0	0	-	92	86	9	5	0		0	0
14	Technology for monitoring, evaluating, and maintaining the structural and environmental performance of buildings.	1	122	25	31	44	-	69	44	43	12	1		1	4
		2	101	22	31	47	-	75	51	46	3	0		0	1
		E	22	100	0	0	-	91	82	18	0	0		0	0



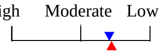
Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
49	33	14	0	4	15	36	36	13	19	48	29	56	7	28	3	0		2	20	16	33	41	10	21	41	14	34	46	11	2
73	21	6	0	0	4	53	38	5	12	60	15	62	5	27	2	0		2	8	8	43	45	4	10	44	2	29	73	3	0
82	9	9	0	0	9	54	32	5	19	71	14	67	10	33	5	0		5	0	18	45	32	5	10	62	5	33	76	5	0
73	21	4	0	2	10	33	41	16	17	47	30	53	9	13	3	1		4	12	10	29	45	16	18	49	23	34	27	6	2
96	3	1	0	0	1	50	46	3	11	56	15	75	5	11	0	0		1	3	4	32	61	3	9	68	15	33	26	1	0
100	0	0	0	0	0	40	60	0	20	20	0	80	0	0	0	0		0	20	0	40	60	0	20	40	0	60	20	0	0
43	32	18	0	7	15	40	37	8	21	43	29	54	7	20	13	0		2	13	17	40	35	8	19	43	17	43	35	22	0
78	16	6	0	0	8	65	24	3	16	58	18	71	3	13	3	0		2	4	5	58	34	3	9	63	5	53	34	9	0
83	0	17	0	0	33	50	17	0	33	42	25	75	8	25	0	0		17	0	25	58	17	0	25	58	0	58	33	25	0
35	16	48	0	1	14	33	39	14	21	44	33	47	11	29	11	1		1	8	19	31	38	12	21	37	24	47	42	17	2
22	3	74	0	1	8	45	42	5	18	51	12	58	2	24	5	2		0	3	9	40	46	5	15	31	11	65	44	11	0
42	0	50	0	8	33	50	17	0	50	33	8	33	0	42	8	0		0	0	34	33	33	0	42	17	8	58	25	17	0
38	40	8	0	14	6	20	50	24	19	53	25	46	3	15	5	0		8	21	5	19	54	22	20	52	13	23	33	7	3
32	61	4	0	3	1	20	68	11	9	62	9	62	0	9	0	0		4	7	3	19	70	8	7	65	4	19	46	3	0
50	50	0	0	0	0	25	75	0	0	50	0	75	0	0	0	0		25	25	0	25	75	0	0	25	0	25	50	0	0
89	9	0	0	2	31	39	19	11	21	42	36	55	4	14	17	0		0	4	35	40	19	6	18	43	7	43	25	31	2
96	4	0	0	0	36	54	9	1	15	65	24	68	4	7	7	0		0	2	36	55	8	1	13	64	2	53	23	23	1
95	5	0	0	0	53	42	5	0	21	68	21	74	5	5	5	0		0	0	48	47	5	0	11	63	0	63	16	26	0
92	5	1	0	2	14	39	35	12	15	38	28	42	7	24	16	2		0	5	21	38	29	12	16	30	10	56	36	28	0
98	1	0	0	1	7	61	28	4	13	56	14	55	6	25	6	0		0	1	11	61	24	4	9	39	5	69	34	15	0
100	0	0	0	0	9	46	36	9	15	45	5	45	10	35	5	0		0	0	18	37	36	9	10	30	10	80	30	5	0
59	25	15	0	1	20	39	32	9	30	43	29	56	11	7	7	0		1	7	21	37	33	9	26	40	17	47	21	29	1
79	12	9	0	0	11	59	27	3	20	56	16	66	3	4	2	0		1	1	12	61	22	5	17	55	5	62	9	20	0
72	14	14	0	0	27	50	18	5	33	67	19	81	0	10	0	0		5	0	23	54	14	9	40	75	5	55	15	25	0

III. Revitalization, maintenance, and management of social infrastructure

1. Questions regarding the relevant area

1) Degree of expertise in the area

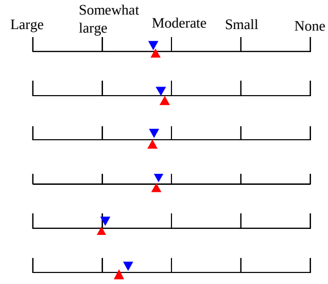
High Moderate Low



2) Current impacts

Large / Somewhat large / Moderate / Small / None

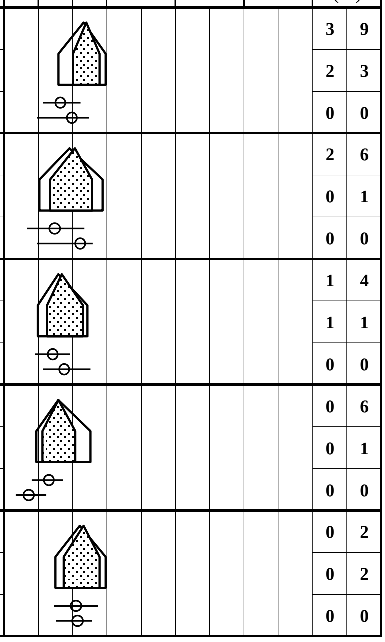
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

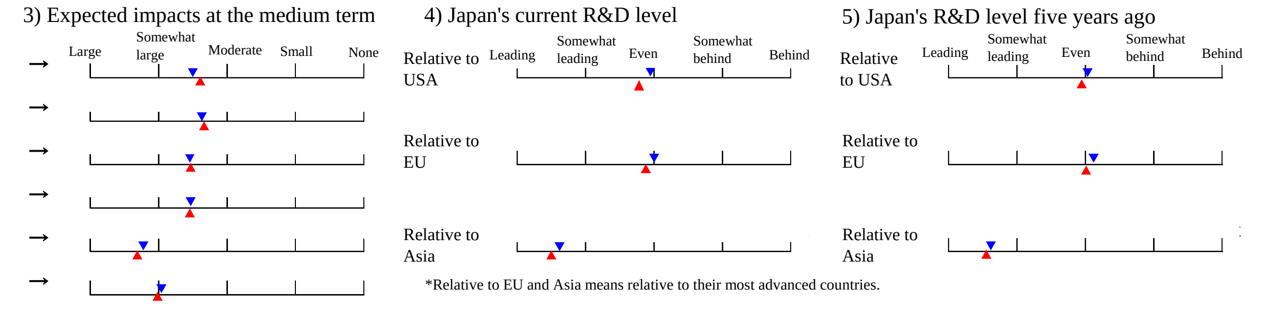


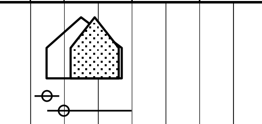
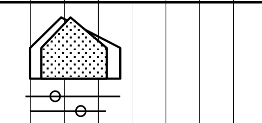
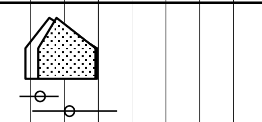
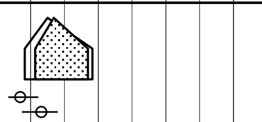
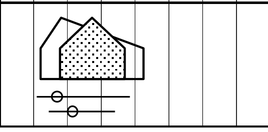
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Will not be realized (%)	Do not know (%)
15	Technology for safely and efficiently demolishing and removing commercial nuclear power plants after decommissioning.	1	**68**	**9**	**13**	**78**	-	**86**	**73**	**22**	**5**	**0**	**3**	**9**
		2	**65**	**6**	**8**	**86**	-	**95**	**91**	**9**	**0**	**0**	**2**	**3**
		E	**4**	**100**	**0**	**0**	-	**88**	**75**	**25**	**0**	**0**	**0**	**0**
16	Technology for restoring dam function or extending the functional life of a dam by preventing silting in the reservoir through adequate sediment discharge and efficient sediment removal.	1	**97**	**15**	**26**	**59**	-	**70**	**47**	**41**	**12**	**0**	**2**	**6**
		2	**79**	**15**	**25**	**60**	-	**78**	**56**	**41**	**3**	**0**	**0**	**1**
		E	**12**	**100**	**0**	**0**	-	**88**	**75**	**25**	**0**	**0**	**0**	**0**
17	Technology for efficiently reinforcing existing structures by assessing their structural soundness through nondestructive inspection.	1	**126**	**17**	**33**	**50**	-	**77**	**55**	**43**	**2**	**0**	**1**	**4**
		2	**94**	**18**	**30**	**52**	-	**85**	**71**	**29**	**0**	**0**	**1**	**1**
		E	**17**	**100**	**0**	**0**	-	**94**	**88**	**12**	**0**	**0**	**0**	**0**
18	Technology for building overpasses or underpasses in a short time while maintaining traffic during construction.	1	**88**	**11**	**24**	**65**	-	**58**	**30**	**46**	**22**	**2**	**0**	**6**
		2	**75**	**8**	**29**	**63**	-	**54**	**13**	**76**	**11**	**0**	**0**	**1**
		E	**6**	**100**	**0**	**0**	-	**67**	**33**	**67**	**0**	**0**	**0**	**0**
19	Technology for recycling, rather than demolishing, deteriorated infrastructure and technology for maintaining and managing infrastructure to extend its life.	1	**118**	**26**	**27**	**47**	-	**84**	**67**	**32**	**1**	**0**	**0**	**2**
		2	**93**	**16**	**34**	**50**	-	**93**	**86**	**14**	**0**	**0**	**0**	**2**
		E	**15**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**	**0**	**0**

Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–





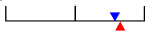
Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
17	43	40	0	0	66	26	5	3	35	46	41	59	17	11	10	0		5	11	72	20	5	3	35	52	11	47	18	23	2
5	65	30	0	0	91	6	3	0	27	55	31	63	11	3	2	0		2	5	90	8	2	0	27	67	5	46	10	16	0
50	25	25	0	0	100	0	0	0	75	75	25	25	0	25	0	0		0	0	100	0	0	0	75	75	25	50	0	0	0
70	17	10	0	3	52	32	14	2	24	35	29	58	7	13	8	1		1	9	50	36	12	2	25	41	11	41	18	17	6
91	5	4	0	0	81	14	4	1	18	47	24	59	1	11	4	0		0	1	81	18	1	0	16	64	6	56	9	6	0
92	0	8	0	0	75	17	0	8	36	55	27	55	9	18	9	0		0	0	83	17	0	0	33	58	17	50	25	8	0
61	27	12	0	0	20	49	20	11	24	48	34	50	7	8	7	0		0	6	24	47	21	8	25	47	19	40	15	22	3
84	12	4	0	0	12	68	16	4	17	60	23	60	1	7	1	0		0	1	11	73	13	3	15	60	9	53	7	6	0
70	18	12	0	0	18	53	29	0	35	65	24	65	6	6	6	0		0	0	12	53	29	6	31	69	19	38	0	19	0
80	12	7	0	1	16	43	31	10	18	42	29	34	5	27	12	1		0	6	24	38	35	3	14	47	12	42	33	14	7
96	3	1	0	0	8	61	28	3	8	74	14	25	1	25	1	0		0	3	11	67	22	0	4	64	7	45	23	5	1
100	0	0	0	0	17	66	17	0	0	83	33	17	0	50	0	0		0	0	17	83	0	0	0	83	17	50	50	0	0
39	12	48	0	1	35	42	19	4	27	48	39	56	7	17	8	0		1	4	37	44	15	4	32	50	25	43	27	16	4
26	5	69	0	0	26	64	10	0	14	62	27	59	2	8	4	0		0	2	21	70	7	2	13	68	6	55	18	8	0
53	0	47	0	0	47	33	20	0	27	67	33	60	13	13	7	0		0	0	33	47	13	7	21	57	7	57	36	14	0

IV. Social infrastructure technology responsive to aging society

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



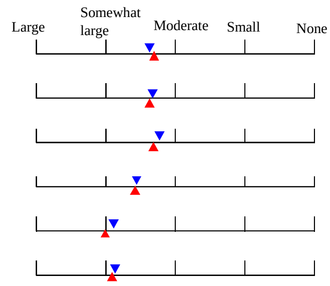
2) Current impacts

Large / Somewhat large / Moderate / Small / None

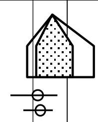
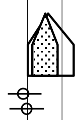
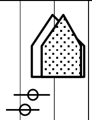
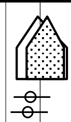
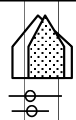
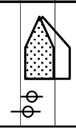
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

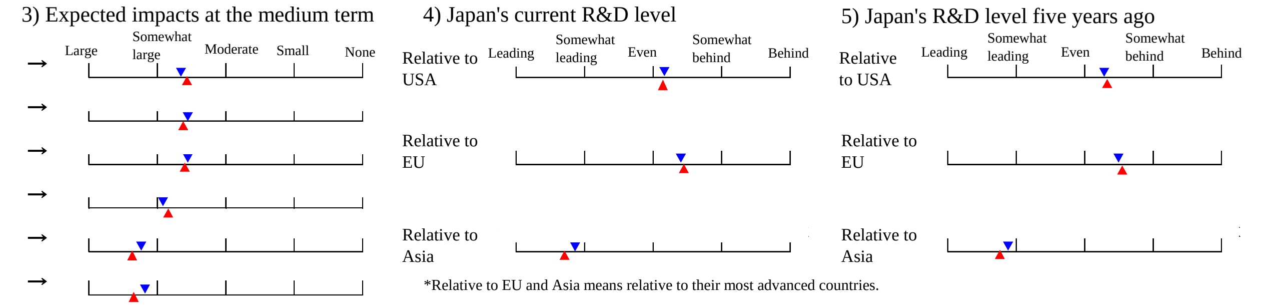
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

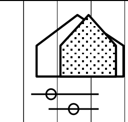
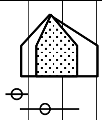
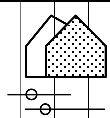
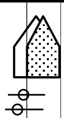
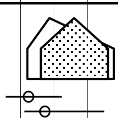
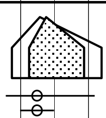
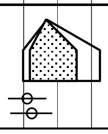


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization	(%) Will not be realized	Do not know
20	A house equipped with robots and devices that assist an elderly person in eating, bathing, using the toilet, and enjoying pastimes without any help from a caregiver.	1	94	7	26	67	-	64	34	56	8	2		4	8
		2	71	4	17	79	-	60	24	67	9	0		1	3
		E	3	100	0	0	-	83	67	33	0	0		0	0
21	A sensor-applied guidance system for people with visual impairment on railway platforms.	1	88	10	19	71	-	59	28	52	20	0		1	2
		2	69	9	19	72	-	52	9	83	7	1		0	5
		E	6	100	0	0	-	75	50	50	0	0		0	0
22	A ubiquitous computing environment that provides helpful information for the elderly and the disabled (visually impaired) in urban public spaces so that they can freely and safely move around (intelligent wearable devices and sensor, combined with embedded sensing networks and the communication environment to support them).	1	96	11	28	61	-	62	33	51	14	2		2	3
		2	75	8	19	73	-	54	15	73	12	0		0	4
		E	6	100	0	0	-	75	50	50	0	0		0	17
23	Proliferation of collective houses (shared by groups of individuals), group homes (shared by groups of elderly people), and other type of houses adapted to the aging society with a declining birthrate.	1	89	16	29	55	-	66	39	47	14	0			
		2	72	8	21	71	-	59	21	72	7	0			
		E	6	100	0	0	-	75	50	50	0	0			
24	An information sharing system in which all accidents and crimes, from a slight injury to a fatal accident to a murder, and their sites are recorded so that anyone approaching the site can be informed of the potential risk and avoid it.	1	84	10	25	65	-	53	27	42	22	9		9	8
		2	66	9	12	79	-	47	6	73	18	3		3	3
		E	6	100	0	0	-	75	50	50	0	0		0	0
25	Technology for designing public spaces where anyone can move around safely and without barriers.	1	108	18	36	46	-	73	50	43	6	1		1	4
		2	89	10	24	66	-	79	58	41	1	0		0	3
		E	9	100	0	0	-	100	100	0	0	0		0	11
26	A public sign system (e.g. for traffic signs) that takes account of age-related deterioration in dynamic vision.	1	86	12	21	67	-	57	24	56	19	1		0	5
		2	62	10	16	74	-	56	21	63	16	0		0	2
		E	6	100	0	0	-	67	33	67	0	0		0	0

Time of technological realization columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–

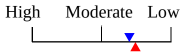


Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
		(%)					(%)					(%)										(%)				(%)					(%)			
50	22	26	0	2	11	45	35	9	30	48	36	63	4	15	8	0						3	11	16	41	35	8	26	35	37	55	27	11	0
74	6	20	0	0	11	65	24	0	29	53	21	64	4	6	1	0						4	3	10	66	24	0	17	50	16	74	13	4	0
33	0	67	0	0	33	67	0	0	33	0	33	67	0	0	0	0						0	0	33	67	0	0	33	0	0	67	33	33	0
56	14	29	0	1	19	42	31	8	15	40	23	46	6	10	19	1						0	7	25	44	26	5	14	38	19	47	16	21	2
87	0	13	0	0	11	69	18	2	14	69	11	48	3	6	9	0						0	6	15	72	13	0	10	49	7	75	12	13	0
100	0	0	0	0	33	50	0	17	0	100	0	60	0	20	20	0						0	0	50	50	0	0	17	50	17	83	17	17	0
46	29	23	0	2	21	43	29	7	20	51	29	56	6	15	9	1						2	6	21	46	29	4	18	38	33	51	28	15	3
76	14	10	0	0	12	72	15	1	14	69	15	57	1	10	3	0						1	5	15	63	19	3	11	50	13	75	13	7	0
83	0	17	0	0	20	80	0	0	0	100	0	40	0	20	0	0						0	17	50	50	0	0	33	50	17	50	33	17	0
																						2	10	21	48	26	5	26	32	20	58	36	18	0
																						0	3	14	75	8	3	17	35	7	78	33	6	0
																						0	0	50	50	0	0	50	0	0	67	50	17	0
35	36	22	0	7	24	37	27	12	19	43	34	40	3	16	16	3						12	18	27	34	26	13	18	52	25	29	25	17	3
22	69	6	0	3	19	62	17	2	13	68	16	42	2	11	10	0						8	6	17	59	22	2	6	71	13	32	21	8	0
66	17	17	0	0	50	50	0	0	33	50	0	33	17	33	17	0						0	17	67	33	0	0	33	33	17	50	17	0	0
16	22	62	0	0	31	44	22	3	28	46	23	32	12	24	25	5						1	5	41	42	15	2	25	38	14	53	27	30	3
3	7	90	0	0	25	67	8	0	28	68	16	25	6	17	16	0						0	5	38	55	7	0	22	46	6	70	18	26	0
22	0	78	0	0	56	44	0	0	44	78	0	22	22	22	22	0						0	11	78	22	0	0	44	44	11	67	22	22	0
28	15	54	0	3	21	44	31	4	22	54	31	34	7	14	12	1						0	8	27	45	27	1	19	31	19	43	19	30	6
12	3	83	0	2	13	74	11	2	11	77	16	38	7	11	8	0						0	5	19	73	8	0	8	45	5	74	16	21	0
67	0	33	0	0	33	67	0	0	0	100	0	17	17	33	17	0						0	17	67	33	0	0	17	33	17	67	50	17	0

V. Environmental technology in social infrastructure

1. Questions regarding the relevant area

1) Degree of expertise in the area

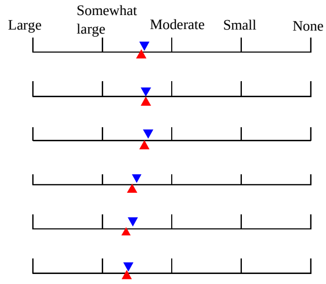


2) Current impacts

[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

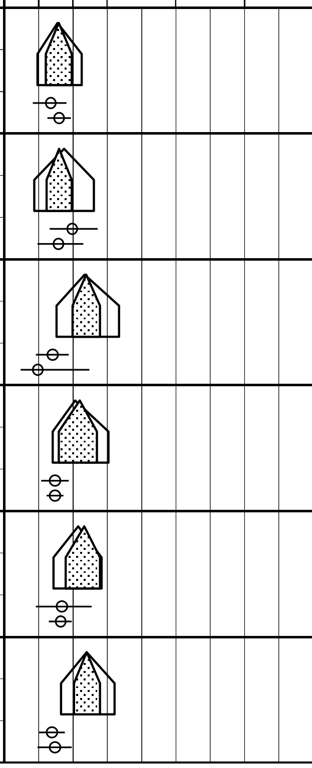
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

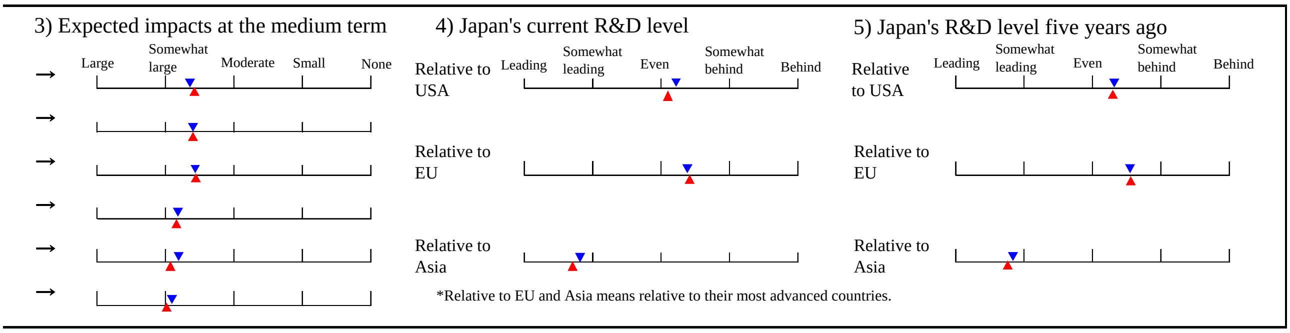
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
27	A design scheme for civil engineering structures and buildings that adopts the concept of life cycle assessment (LCA).	1	135	19	39	42	-	74	50	46	4	0							1	6
		2	115	16	41	43	-	79	58	41	1	0							0	2
		E	18	100	0	0	-	94	89	11	0	0							0	6
28	A comprehensive database that contains soil texture, geological features, climate and other information to be considered in planning and designing structures.	1	127	14	39	47	-	66	38	50	10	2							1	3
		2	107	11	34	55	-	63	27	72	1	0							0	2
		E	12	100	0	0	-	79	58	42	0	0							0	0
29	Technology that allows communities to use natural and unused energy and to form material recycling cycles.	1	106	14	26	60	-	72	50	39	9	2							3	6
		2	93	2	20	78	-	81	62	38	0	0							0	2
		E	2	100	0	0	-	100	100	0	0	0							0	0
30	"Venous" logistics support systems to promote more efficient use of resources in urban cities.	1	82	13	23	64	-	68	43	44	13	0							1	12
		2	73	4	19	77	-	69	41	52	7	0							0	3
		E	3	100	0	0	-	83	67	33	0	0							0	0
31	A system to support corporative decision-making among parties with diverse interests by using knowledge/information bases, such as environmental databases and knowledge bases.	1	106	15	31	54	-	64	40	41	15	4							6	10
		2	87	5	25	70	-	64	34	54	11	1							6	2
		E	4	100	0	0	-	88	75	25	0	0							0	0
32	A system for the integrated and efficient use of energy, water and organic waste within a unit space, such as a relatively small community or an airtight house (e.g. integration of fuel cell, biogas, natural energy, rainwater, etc.).	1	99	9	27	64	-	70	44	49	7	0							1	7
		2	83	5	23	72	-	69	38	62	0	0							0	2
		E	4	100	0	0	-	88	75	25	0	0							0	0





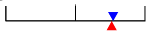
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
23	39	36	0	2	32	33	27	8	35	45	31	36	9	14	19	2		1	7	35	41	19	5	28	39	13	36	21	38	3
10	47	43	0	0	24	57	17	2	31	79	19	30	6	11	6	0		0	2	25	65	9	1	26	58	9	40	22	34	0
34	33	33	0	0	44	33	17	6	53	76	24	47	12	12	6	0		0	6	50	44	6	0	50	78	11	50	28	33	0
36	48	14	0	2	38	33	21	8	25	46	35	51	8	6	4	3		3	7	36	38	19	7	28	42	21	42	14	13	4
22	72	6	0	0	33	61	5	1	16	66	30	48	3	8	2	0		0	2	29	64	7	0	19	74	6	50	7	10	0
25	67	8	0	0	51	33	8	8	18	64	36	45	18	0	0	0		0	0	67	25	8	0	33	75	25	42	0	0	0
16	9	72	0	3	30	45	21	4	30	40	35	56	7	22	19	0		1	7	34	41	23	2	29	38	24	54	32	25	1
1	3	96	0	0	26	70	4	0	19	59	19	60	2	13	4	0		0	3	29	68	3	0	18	46	12	75	23	10	0
0	0	100	0	0	100	0	0	0	0	100	0	0	0	0	0	0		0	0	50	50	0	0	50	100	0	100	0	0	0
18	15	62	0	5	36	44	17	3	32	44	38	38	7	21	29	3		4	12	38	39	20	3	27	40	30	43	29	34	1
4	3	93	0	0	20	74	6	0	22	72	23	41	0	7	4	0		1	3	32	62	6	0	15	58	10	58	18	15	0
67	0	33	0	0	33	67	0	0	67	67	33	100	0	33	33	0		0	0	33	67	0	0	0	67	33	100	67	33	0
12	48	37	0	3	24	39	24	13	39	44	38	46	11	7	7	2		8	10	28	41	21	10	33	40	27	36	19	16	2
0	75	24	0	1	14	69	16	1	33	65	25	43	5	0	1	0		10	2	19	66	13	2	36	65	8	46	15	8	0
0	75	25	0	0	50	50	0	0	50	50	50	50	0	0	0	0		0	0	50	50	0	0	75	50	0	50	25	0	0
22	7	70	0	1	27	47	22	4	30	52	34	54	11	24	17	0		2	10	33	43	21	3	26	42	25	53	34	25	1
5	0	95	0	0	11	79	10	0	24	64	21	55	4	16	4	0		0	4	19	78	3	0	19	58	10	64	30	6	0
25	0	75	0	0	50	50	0	0	75	50	0	50	25	25	0	0		0	0	75	25	0	0	75	50	0	75	25	0	0

VI. Comprehensive water management technology

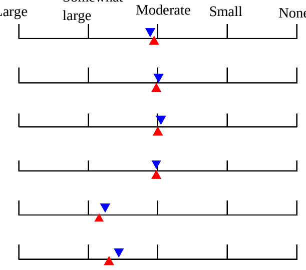
1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



2) Current impacts

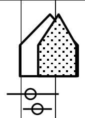
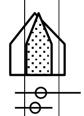
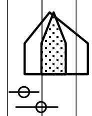
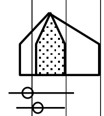
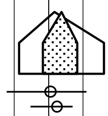
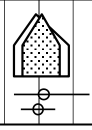


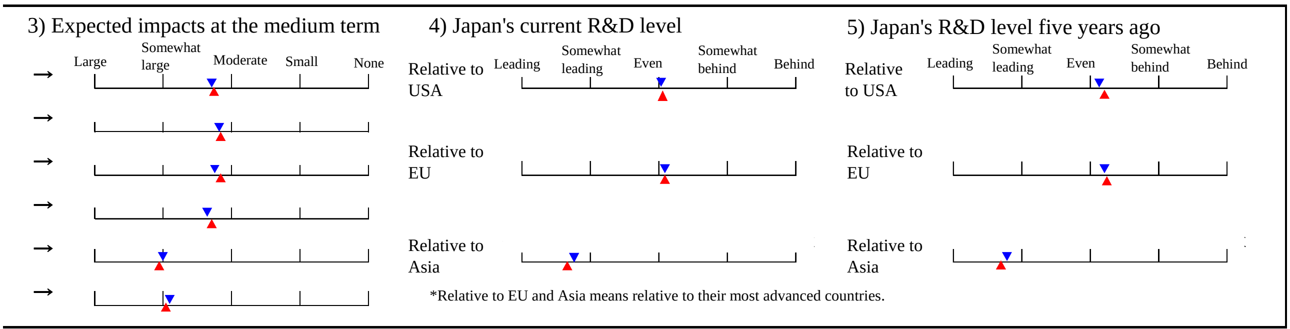
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

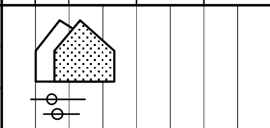
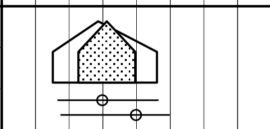
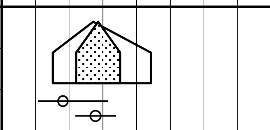
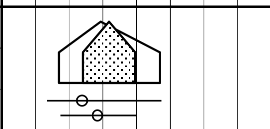
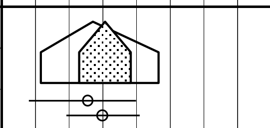
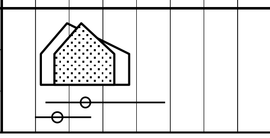
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
33	Groundwater management technology through the development of technology for groundwater quality and flow observation/estimation and technology for groundwater increment.	1	75	20	32	48	-	62	32	54	13	1		0	9
		2	64	16	23	61	-	59	19	79	2	0		0	5
		E	10	100	0	0	-	75	50	50	0	0		0	0
34	A compact waste water treatment system that can efficiently treat persistent and toxic substances and achieve waste-free water treatment by fully recycling the sludge.	1	67	21	21	58	-	71	49	38	13	0		8	11
		2	60	12	22	66	-	74	50	47	3	0		2	3
		E	7	100	0	0	-	100	100	0	0	0		14	0
35	Technology for measuring and evaluating the impact of trace amounts of carcinogenic or endocrine-disrupting water pollutants.	1	60	17	22	61	-	72	49	40	11	0		2	11
		2	60	10	17	73	-	77	56	41	3	0		0	3
		E	6	100	0	0	-	92	83	17	0	0		0	0
36	A system for advance or semi-real time detection of floods and droughts around the world by combining satellite and above-ground observations with the long-term prediction of wide-area water cycles and the prediction of social activities and water usage.	1	75	29	15	56	-	66	39	49	11	1		1	3
		2	67	24	9	67	-	62	27	66	7	0		0	2
		E	16	100	0	0	-	78	56	44	0	0		0	0
37	Integrated river basin management technology is used for improving the river water quantity and quality to a swimmable level.	1	82	32	21	47	-	63	36	44	17	3		4	7
		2	69	30	13	57	-	61	25	68	7	0		1	4
		E	21	100	0	0	-	76	52	48	0	0		0	5
38	Technology for easy and inexpensive replacement and life extension of water and sewer pipes.	1	87	15	24	61	-	64	37	44	19	0		1	4
		2	78	10	18	72	-	64	30	67	3	0		0	1
		E	8	100	0	0	-	94	87	13	0	0		0	0



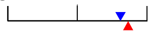
Countries at the leading edge					Regarding technological realization													Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't												Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
37	41	18	2	2	28	43	22	7	31	43	41	41	8	5	16	2		0	16	25	46	22	7	30	46	19	33	18	33	4
29	64	5	2	0	22	71	5	2	26	66	29	44	0	6	5	0		0	5	23	71	6	0	27	72	8	30	8	20	0
30	70	0	0	0	60	40	0	0	40	80	30	30	0	10	0	0		0	0	50	50	0	0	30	80	0	40	10	10	0
37	19	38	0	6	30	54	11	5	26	40	32	60	9	7	19	2		7	15	37	41	19	3	22	42	31	47	13	38	5
45	7	48	0	0	10	88	2	0	18	65	18	62	2	3	3	0		2	3	19	78	3	0	15	68	12	61	8	19	0
43	0	57	0	0	14	86	0	0	14	43	14	57	0	14	0	0		14	0	33	67	0	0	17	67	0	67	17	0	0
24	45	27	0	4	32	49	11	8	34	38	43	60	6	6	17	2		0	14	28	50	18	4	30	46	33	46	11	48	4
7	79	14	0	0	15	83	2	0	25	48	25	63	0	3	3	0		2	3	10	87	3	0	22	69	10	50	5	28	0
0	67	33	0	0	33	50	17	0	50	67	33	33	0	0	0	0		0	0	17	66	17	0	33	83	17	33	0	17	0
25	65	8	0	2	45	38	11	6	38	42	45	50	35	6	5	0		0	4	42	38	16	4	38	67	21	29	8	5	6
8	90	2	0	0	51	42	7	0	31	51	30	58	22	1	0	0		0	2	45	47	8	0	36	77	8	24	3	0	2
19	81	0	0	0	88	6	6	0	44	50	31	63	31	6	0	0		0	0	75	19	6	0	50	81	0	25	6	0	6
34	21	42	0	3	42	29	24	5	35	41	32	35	4	22	29	3		5	13	40	39	17	4	35	47	8	26	24	47	4
32	12	56	0	0	54	40	6	0	26	72	22	35	1	12	12	0		1	7	54	43	3	0	32	69	4	28	13	35	0
29	24	47	0	0	80	15	5	0	40	75	20	35	5	5	15	0		0	10	71	24	5	0	57	67	0	24	10	48	0
53	18	24	0	5	23	48	23	6	27	53	32	41	8	11	9	1		0	5	33	40	22	5	21	51	24	44	14	17	6
78	4	17	0	1	16	71	13	0	18	73	21	44	0	6	1	0		0	1	17	76	7	0	13	72	11	49	13	5	0
50	0	50	0	0	50	50	0	0	13	75	25	50	0	0	0	0		0	0	62	38	0	0	0	88	13	38	13	0	0

VII. Environmental measures appropriate to architectural scale

1. Questions regarding the relevant area

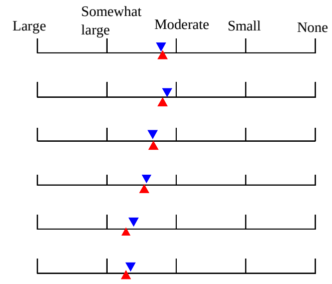
1) Degree of expertise in the area

High Moderate Low

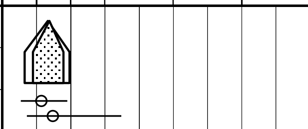
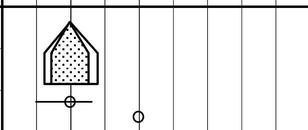
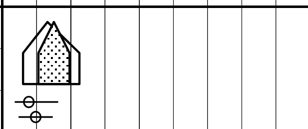
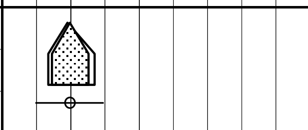
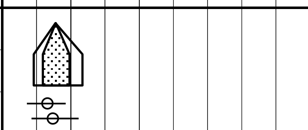
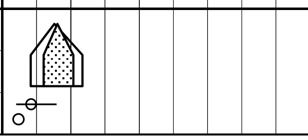


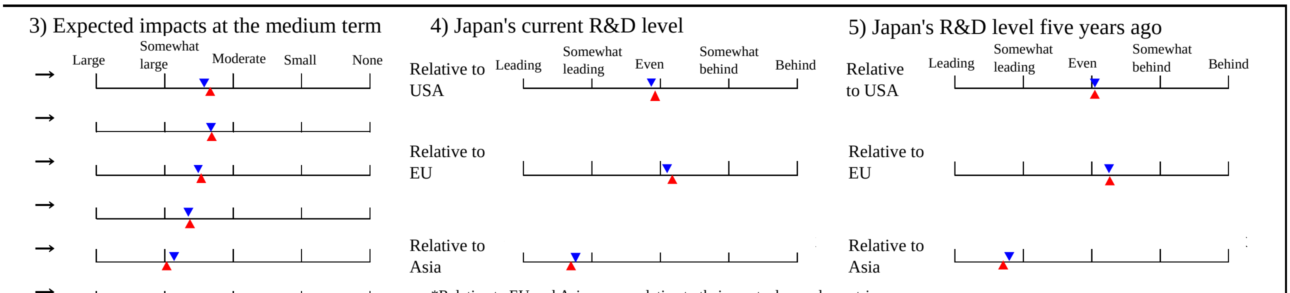
2) Current impacts

[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

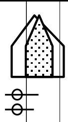
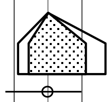
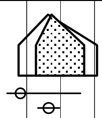
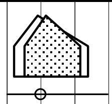
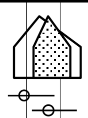
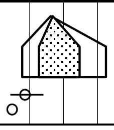


2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
39	Room environment control technology for addressing indoor air contamination problems (sick-house syndrome) and ensuring safety, comfort, and health.	1	86	10	24	66	-	56	24	55	18	3		0	4
		2	65	5	17	78	-	58	20	72	8	0		0	2
		E	3	100	0	0	-	83	67	33	0	0		0	0
40	Widespread use of regional energy supply systems based on fuel cells, cogeneration, etc.	1	96	8	27	65	-	69	41	53	6	0		0	4
		2	75	1	23	76	-	66	32	65	3	0		0	1
		E	1	100	0	0	-	100	100	0	0	0		0	0
41	A system for building self-sufficient energy structures using natural energy, natural air circulation, and natural light.	1	93	18	30	52	-	68	43	43	13	1		0	7
		2	74	5	28	67	-	68	38	59	3	0		0	1
		E	4	100	0	0	-	88	75	25	0	0		0	0
42	Sensor technology and indoor-environment control technology that use not only temperature and humidity, but also new environmental indicators including pollutants.	1	73	7	22	71	-	43	8	53	36	3		3	8
		2	62	2	15	83	-	51	8	79	13	0		0	3
		E	1	100	0	0	-	100	100	0	0	0		0	100
43	Technology for remodeling and converting spaces for effective use of social, economic, and physical resources.	1	90	23	24	53	-	65	39	41	20	0		0	6
		2	69	10	26	64	-	61	25	69	6	0		0	1
		E	7	100	0	0	-	79	57	43	0	0		0	0
44	Interior and exterior materials with environment control capability (e.g. photocatalyst).	1	73	11	27	62	-	45	12	49	36	3		1	6
		2	61	3	18	79	-	45	3	72	25	0		0	3
		E	2	100	0	0	-	75	50	50	0	0		0	50



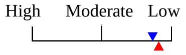
*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
48	14	36	0	2	21	35	35	9	23	41	20	30	8	8	44	3		0	5	19	40	36	5	19	30	22	38	15	62	4
71	2	27	0	0	13	49	35	3	13	67	16	34	3	0	34	2		0	2	12	63	23	2	14	47	9	36	5	59	2
33	0	67	0	0	67	0	33	0	0	33	0	0	33	0	67	33		0	0	67	33	0	0	0	67	0	33	67	100	0
38	21	38	0	3	34	42	18	6	17	50	40	57	5	23	12	1		0	8	38	39	18	5	17	34	31	58	41	28	4
45	5	50	0	0	26	70	3	1	8	67	31	53	3	13	6	0		0	4	25	63	11	1	11	39	15	65	35	14	0
0	0	100	0	0	100	0	0	0	0	0	0	100	0	0	0	0		0	100	100	0	0	0	0	0	100	0	0	0	0
26	5	62	4	3	15	39	37	9	25	37	37	44	4	23	14	4		0	11	17	43	32	8	21	26	26	57	31	25	3
11	1	87	1	0	11	54	32	3	14	50	24	54	3	13	3	1		0	6	9	66	22	3	11	40	14	74	19	13	0
25	25	50	0	0	75	25	0	0	0	50	0	25	0	0	0	25		0	0	50	50	0	0	25	25	50	25	0	0	0
28	22	41	0	9	10	30	43	17	24	47	37	43	8	14	20	0		8	11	11	28	47	14	20	31	31	52	9	30	0
27	8	63	0	2	5	38	55	2	10	69	15	47	3	3	5	0		2	7	6	37	55	2	10	37	14	71	2	17	0
100	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0		0	100	100	0	0	0	0	0	100	0	0	0	0
25	10	61	0	4	20	34	35	11	28	51	29	35	4	42	17	1		1	10	22	37	32	9	24	35	21	45	51	25	3
12	4	84	0	0	7	57	33	3	15	68	18	38	2	35	5	0		0	3	10	64	25	1	12	34	7	57	60	7	0
0	0	100	0	0	29	57	14	0	43	57	29	43	0	100	0	0		0	14	43	57	0	0	29	43	14	43	86	29	0
69	17	12	0	2	3	31	46	20	18	42	18	44	6	12	16	2		3	6	2	36	38	24	16	44	30	46	14	18	2
83	5	10	0	2	0	30	62	8	5	51	18	62	0	4	2	0		0	5	0	39	51	10	5	55	20	69	2	2	0
100	0	0	0	0	0	0	100	0	0	0	50	50	0	0	0	0		0	50	0	0	100	0	0	0	50	50	0	0	0

VIII. Security technology as social infrastructure

1. Questions regarding the relevant area

1) Degree of expertise in the area

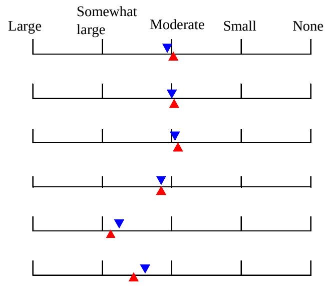


2) Current impacts

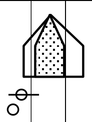
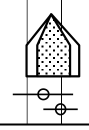
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

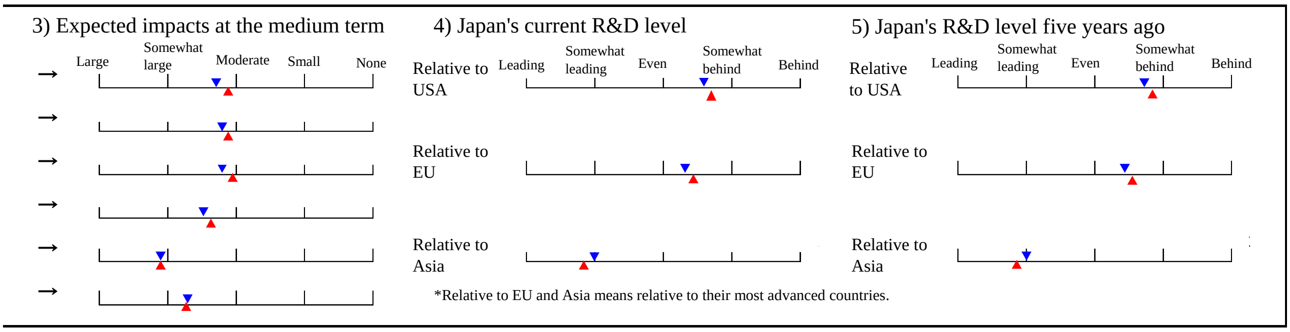
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

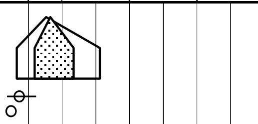
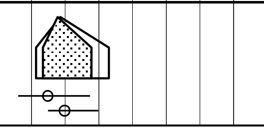
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
45	An automatic surveillance system in which security cameras are networked so that anyone acting suspiciously can be detected at an early stage.	1	**77**	**5**	**19**	**76**	**-**	**52**	**21**	**48**	**28**	**3**							**1**	**6**
		2	**68**	**1**	**18**	**81**	**-**	**49**	**7**	**77**	**15**	**1**							**0**	**2**
		E	**1**	**100**	**0**	**0**	**-**	**50**	**0**	**100**	**0**	**0**							**0**	**0**
46	Systems for positioning individuals anytime anywhere, whether indoor or outdoor, become widely available and find application in areas such as emergency position reporting and evacuation instructions for people in dangerous areas.	1	**95**	**5**	**24**	**71**	**-**	**46**	**13**	**49**	**36**	**2**							**2**	**6**
		2	**76**	**3**	**16**	**81**	**-**	**48**	**9**	**66**	**24**	**1**							**1**	**0**
		E	**2**	**100**	**0**	**0**	**-**	**50**	**0**	**100**	**0**	**0**							**0**	**0**

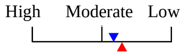


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
14	78	5	0	3	18	35	32	15	15	41	20	46	11	17	20	11						6	7	24	26	35	15	18	36	24	40	24	44	2
0	98	2	0	0	7	63	24	6	15	65	13	52	8	10	13	0						2	3	12	46	39	3	11	52	10	46	15	46	2
0	100	0	0	0	0	100	0	0	100	0	0	100	0	0	0	0						0	0	100	0	0	0	0	0	0	100	0	100	0
25	67	5	0	3	14	33	35	18	14	43	29	46	6	22	20	9						9	10	20	31	33	16	16	38	20	38	26	38	6
7	93	0	0	0	11	49	31	9	14	61	15	53	6	15	11	0						5	3	11	39	45	5	9	59	9	46	19	46	0
0	100	0	0	0	0	100	0	0	50	50	0	50	0	0	0	0						0	0	50	50	0	0	0	50	0	50	50	50	0

IX. Disaster prevention technology

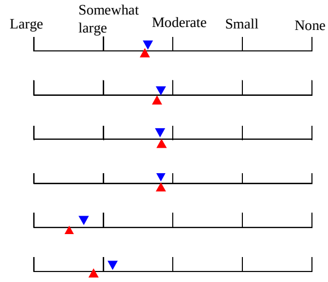
1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

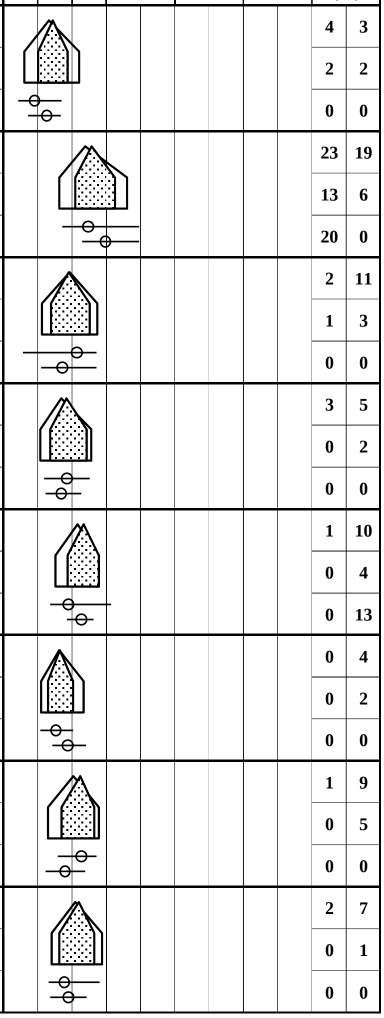
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

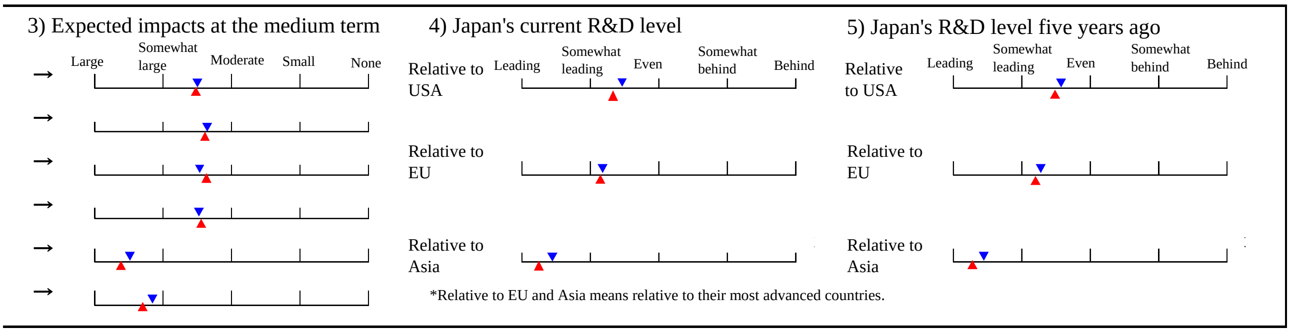


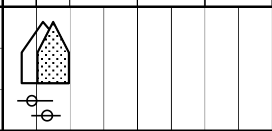
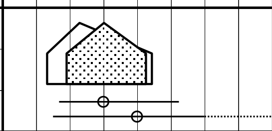
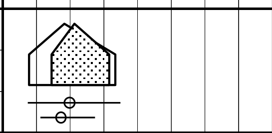
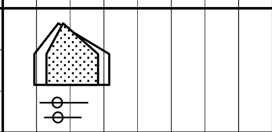
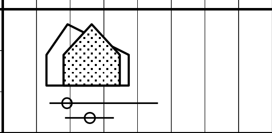
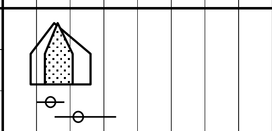
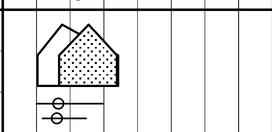
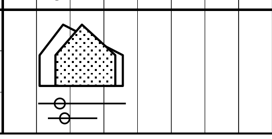
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Will not be realized (%)	Do not know (%)
47	A disaster prevention system in which the occurrence of an earthquake is reported through a nation-wide earthquake detection network to the areas more than 50 km away from the epicenter before the seismic waves reach there.	1	106	29	25	46	-	81	66	27	6	1	4	3
		2	98	24	22	54	-	94	89	11	0	0	2	2
		E	24	100	0	0	-	92	83	17	0	0	0	0
48	Technology for medium-term (5-10 years) prediction of major earthquakes (magnitude 8 or greater) by the analysis of crustal strain distribution and the records of past earthquakes.	1	99	23	20	57	-	82	68	27	5	0	23	19
		2	96	10	22	68	-	93	86	13	1	0	13	6
		E	10	100	0	0	-	90	80	20	0	0	20	0
49	Fire extinguishing and rescue technology adapted to fires in high-rise buildings.	1	86	8	30	62	-	68	40	53	6	1	2	11
		2	79	6	15	79	-	75	49	51	0	0	1	3
		E	5	100	0	0	-	100	100	0	0	0	0	0
50	Technology for accurately simulating the behavior of structures and the ground motion in response to a strong earthquake.	1	114	32	23	45	-	81	63	33	4	0	3	5
		2	98	30	20	50	-	93	87	10	3	0	0	2
		E	29	100	0	0	-	89	80	17	3	0	0	0
51	High-accuracy rainfall prediction technology capable of providing reliable forecast information on floods and landslides.	1	92	18	26	56	-	84	70	24	6	0	1	10
		2	83	10	25	65	-	95	90	9	1	0	0	4
		E	8	100	0	0	-	94	87	13	0	0	0	13
52	A disaster prevention system that ensures smooth evacuation, using navigation with personal mobile terminals.	1	109	14	33	53	-	64	35	51	13	1	0	4
		2	96	9	24	67	-	60	23	73	4	0	0	2
		E	9	100	0	0	-	72	44	56	0	0	0	0
53	The elucidation of the slope failure mechanism leads to the development of a system that can detect the possibility of slope failure and help appropriate actions (e.g. closing the road) to be taken to prevent accidents.	1	97	9	28	63	-	73	49	46	5	0	1	9
		2	75	9	24	67	-	80	60	40	0	0	0	5
		E	7	100	0	0	-	86	71	29	0	0	0	0
54	A major reduction in human suffering from river- and road-related disasters through advances in technology for short-term rainfall prediction and rainwater management (transport, storage, treatment) and in systems for warning, evacuation, and regulation.	1	93	20	25	55	-	81	66	30	4	0	2	7
		2	81	19	15	66	-	92	84	16	0	0	0	1
		E	15	100	0	0	-	97	93	7	0	0	0	0

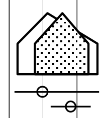
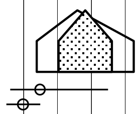
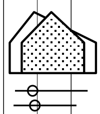
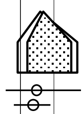
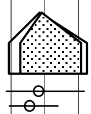
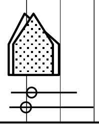
Time of technological realization: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–





Countries at the leading edge					Regarding technological realization												Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't											Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
92	8	0	0	0	60	27	9	4	28	45	43	51	5	2	4	2		5	4	63	23	11	3	28	49	13	44	9	11	9
99	1	0	0	0	81	16	2	1	16	67	29	60	2	2	1	0		2	2	83	15	2	0	18	69	7	63	7	5	1
100	0	0	0	0	75	25	0	0	13	70	22	65	4	4	4	0		0	0	67	33	0	0	13	63	13	71	8	8	4
76	20	1	1	2	57	26	9	8	35	28	53	60	8	0	2	1		15	25	55	23	13	9	44	46	10	38	2	10	5
98	1	0	0	1	80	16	3	1	23	37	54	56	2	1	0	1		12	8	79	16	4	1	42	70	3	44	2	2	2
90	10	0	0	0	80	10	10	0	44	11	44	78	0	0	0	0		11	0	80	0	20	0	60	60	0	30	10	10	10
36	64	0	0	0	28	50	16	6	28	44	35	40	6	14	19	1		3	13	32	46	21	1	34	43	14	38	14	30	3
18	82	0	0	0	17	78	4	1	16	74	26	51	0	3	7	1		1	1	22	73	5	0	23	68	0	44	5	22	0
60	40	0	0	0	40	60	0	0	40	80	40	60	0	0	0	0		0	0	20	80	0	0	20	60	0	80	20	20	0
80	18	2	0	0	32	49	15	4	33	42	46	67	6	2	2	2		3	7	34	39	23	4	40	49	11	41	13	12	2
97	3	0	0	0	28	60	12	0	28	54	39	64	1	1	0	0		1	4	39	54	7	0	41	69	3	40	7	6	0
93	7	0	0	0	18	64	18	0	25	50	36	64	4	4	0	0		3	3	28	58	14	0	55	69	7	31	14	7	0
71	23	5	0	1	55	34	10	1	28	38	48	66	6	0	3	3		1	12	53	31	16	0	37	48	11	44	8	6	8
96	2	1	0	1	77	20	3	0	21	50	45	64	3	0	0	0		0	2	78	21	1	0	25	75	1	51	3	0	0
87	0	0	0	13	100	0	0	0	13	63	50	38	13	0	0	0		0	13	100	0	0	0	13	75	0	63	0	0	0
72	25	1	0	2	25	39	30	6	20	54	35	52	3	12	5	1		3	6	34	36	24	6	21	50	17	45	23	15	3
93	7	0	0	0	20	58	22	0	11	69	18	61	2	5	2	0		3	3	25	64	11	0	9	72	9	51	13	6	1
89	11	0	0	0	25	62	13	0	13	88	13	63	0	13	0	0		0	0	33	45	22	0	11	78	22	56	0	11	0
89	8	2	0	1	43	49	7	1	28	44	47	60	6	3	3	3		0	13	44	49	5	2	33	55	14	43	8	19	5
96	3	1	0	0	45	54	1	0	19	57	38	76	0	1	0	0		0	5	45	55	0	0	23	76	3	49	1	11	0
100	0	0	0	0	57	43	0	0	71	57	29	100	0	0	0	0		0	0	71	29	0	0	43	71	0	57	0	14	0
82	12	5	0	1	47	40	11	2	33	43	48	53	6	4	8	4		0	12	50	43	5	2	34	51	11	35	10	16	4
98	1	0	0	1	63	37	0	0	22	54	40	58	2	0	0	1		0	3	69	30	1	0	26	76	1	44	3	5	1
93	0	0	0	7	100	0	0	0	40	67	40	73	0	0	0	7		0	7	100	0	0	0	27	87	0	60	0	0	7

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan Index	High (%)	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know
55	Technology for supporting the restoration of the functions of an urban city that has been severely and extensively paralyzed by a large-scale power failure or a long-duration break in the water supply.	1	**88**	**14**	**25**	**61**	**-**	**78**	**60**	**33**	**6**	**1**							**1**	**7**
		2	**71**	**10**	**20**	**70**	**-**	**91**	**83**	**16**	**1**	**0**							**0**	**1**
		E	**7**	**100**	**0**	**0**	**-**	**93**	**86**	**14**	**0**	**0**							**0**	**0**
56	Disaster rescue robot technology applicable to human search and rescue at the site of a disaster.	1	**88**	**7**	**26**	**67**	**-**	**60**	**31**	**52**	**15**	**2**							**2**	**10**
		2	**70**	**3**	**24**	**73**	**-**	**55**	**14**	**81**	**4**	**1**							**0**	**1**
		E	**2**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**
57	Widespread adoption of earthquake risk management as a result of the establishment of the technique for long-term estimation of the probability of earthquake occurrence.	1	**109**	**30**	**19**	**51**	**-**	**73**	**52**	**37**	**10**	**1**							**4**	**7**
		2	**88**	**26**	**20**	**54**	**-**	**85**	**73**	**24**	**3**	**0**							**0**	**2**
		E	**23**	**100**	**0**	**0**	**-**	**91**	**83**	**17**	**0**	**0**							**0**	**0**
58	Construction of effective information and social systems that help improve the capacity of community-based activities for disaster prevention and welfare.	1	**105**	**23**	**26**	**51**	**-**	**75**	**53**	**39**	**8**	**0**								
		2	**80**	**15**	**35**	**50**	**-**	**89**	**80**	**19**	**1**	**0**								
		E	**12**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**								
59	Technology for formulating an effective response strategy in the event of a major disaster, using systems for efficiently assessing the damage and predicting its spread.	1	**109**	**36**	**18**	**46**	**-**	**81**	**64**	**29**	**7**	**0**							**1**	**5**
		2	**86**	**24**	**21**	**55**	**-**	**93**	**86**	**14**	**0**	**0**							**0**	**2**
		E	**21**	**100**	**0**	**0**	**-**	**95**	**90**	**10**	**0**	**0**							**0**	**0**
60	System technology for promptly providing provisional housing after disasters.	1	**86**	**14**	**28**	**58**	**-**	**62**	**35**	**45**	**18**	**2**							**1**	**2**
		2	**72**	**11**	**22**	**67**	**-**	**65**	**32**	**65**	**3**	**0**							**0**	**1**
		E	**8**	**100**	**0**	**0**	**-**	**72**	**49**	**38**	**13**	**0**							**0**	**0**

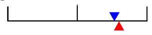
Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
		(%)				(%)						(%)										(%)			(%)						(%)			
51	45	3	0	1	45	41	13	1	36	53	54	51	12	3	5	1						1	13	50	37	12	1	35	64	8	51	8	13	3
70	30	0	0	0	58	41	1	0	20	79	38	52	1	1	0	0						0	1	62	34	4	0	21	84	3	53	6	4	0
86	14	0	0	0	71	29	0	0	29	86	57	100	14	0	0	0						0	0	86	14	0	0	29	100	14	57	0	0	0
62	33	4	0	1	25	53	16	6	26	53	51	62	11	0	3	0						4	11	26	51	17	6	24	53	27	54	7	5	1
87	13	0	0	0	13	83	3	1	16	61	32	62	3	0	0	0						1	1	14	76	9	1	16	68	9	65	4	0	0
100	0	0	0	0	100	0	0	0	100	0	0	100	0	0	0	0						0	0	100	0	0	0	100	100	0	50	0	0	0
57	42	1	0	0	40	33	19	8	36	49	48	47	8	1	3	1						2	13	42	33	16	9	38	47	15	34	13	10	2
72	28	0	0	0	54	39	6	1	29	74	32	47	2	0	0	1						0	2	54	38	7	1	32	74	9	41	6	5	1
73	27	0	0	0	55	45	0	0	41	77	23	55	0	0	0	0						0	0	52	39	9	0	43	65	26	48	4	9	0
																						1	13	52	33	13	2	48	43	17	44	22	19	3
																						1	7	77	18	5	0	68	47	8	52	10	5	0
																						0	9	75	17	8	0	58	75	25	58	8	8	0
45	50	4	0	1	58	30	12	0	42	56	45	44	12	6	6	0						2	10	63	27	8	2	42	47	12	41	14	21	4
36	64	0	0	0	79	21	0	0	31	76	43	46	5	2	0	0						1	4	80	20	0	0	48	72	6	44	5	8	0
48	52	0	0	0	86	14	0	0	43	81	52	67	5	0	0	0						0	5	86	14	0	0	67	81	14	57	5	5	0
73	18	8	1	0	43	37	16	4	28	44	29	40	4	21	12	7						1	5	53	29	13	5	30	49	18	53	19	8	7
90	9	1	0	0	55	35	10	0	23	74	16	46	4	9	3	0						0	1	73	21	6	0	20	68	6	72	7	3	0
75	25	0	0	0	74	13	13	0	38	75	25	63	13	0	0	0						0	0	87	0	13	0	38	75	0	50	13	0	0

X. Total management of social infrastructure that includes public involvement

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



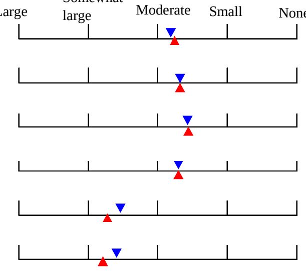
2) Current impacts

Large | Somewhat large | Moderate | Small | None

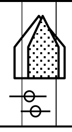
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

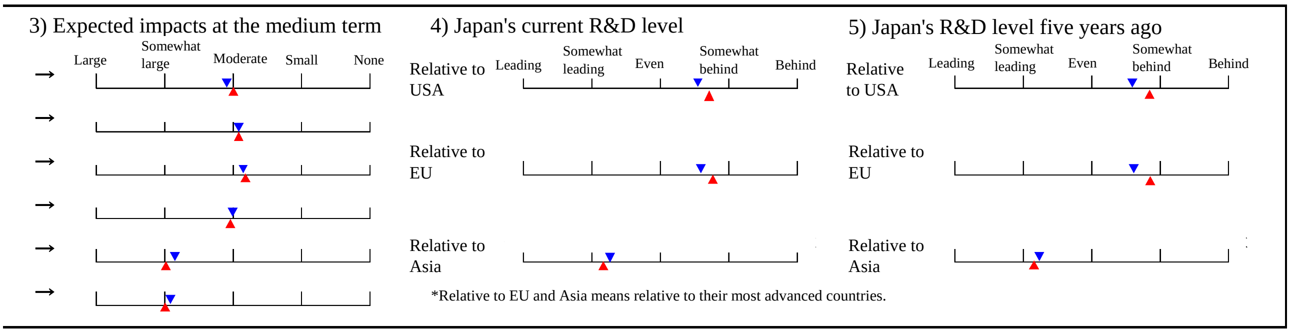
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

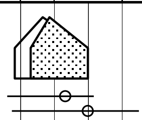
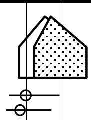
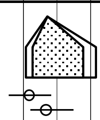
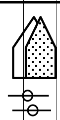
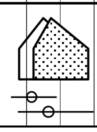
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
61	A new system that establishes ties between the community and its members to prevent crimes stemming from emotional problems.	1	65	9	11	80	-	58	31	46	14	9								
		2	59	7	14	79	-	62	26	69	5	0								
		E	4	100	0	0	-	88	75	25	0	0								
62	A system in which citizens can actively participate in community design and the construction and management of social infrastructure so as to feel a sense of fulfillment as they play the given roles.	1	87	20	29	51	-	66	39	52	5	4								
		2	75	8	28	64	-	62	26	69	5	0								
		E	6	100	0	0	-	90	80	20	0	0								
63	A system that allows people to recognize and understand the disaster risk potential associated with natural phenomena (e.g. earthquakes, volcanic eruption, flood) and man-made accidents, so that they can construct disaster mitigation measures in cooperation with the government.	1	107	23	35	42	-	78	60	35	3	2								
		2	91	19	36	45	-	91	82	17	1	0								
		E	17	100	0	0	-	100	100	0	0	0								
64	Institutional approaches concerning community architect programs and community design associations intended for building, maintaining, and conserving the unique landscape features of the local community.	1	96	22	24	54	-	67	41	46	11	2								
		2	77	16	27	57	-	66	33	64	3	0								
		E	12	100	0	0	-	86	73	27	0	0								
65	Development of the tools for effective implementation of workshops and other public involvement programs.	1	86	23	30	47	-	64	37	47	13	3							0	4
		2	78	17	26	57	-	62	27	66	7	0							0	4
		E	13	100	0	0	-	71	42	58	0	0							0	0



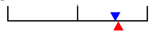
Countries at the leading edge					Regarding technological realization												Time of social application			Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't											Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)									(%)		(%)				(%)						
																		6	17	32	33	25	10	59	39	7	33	20	33	7
																		4	11	28	50	18	4	82	36	2	24	15	16	0
																		0	25	25	25	50	0	50	25	0	50	50	25	0
																		3	14	31	38	25	6	72	30	13	31	24	18	6
																		3	7	30	55	15	0	86	30	1	21	26	8	1
																		0	17	50	33	17	0	67	0	17	50	67	17	0
																		1	8	53	35	12	0	65	51	13	33	17	19	6
																		0	5	77	18	5	0	86	48	3	33	8	7	0
																		0	12	82	18	0	0	82	59	12	53	12	6	0
																		1	7	31	33	32	4	56	41	19	36	27	27	5
																		0	7	32	56	12	0	86	28	4	27	23	18	0
																		0	8	33	50	17	0	92	25	0	33	25	25	0
5	49	43	0	3	23	44	23	10	78	35	26	26	9	4	6	2		0	5	25	40	29	6	75	33	19	33	19	15	4
4	64	32	0	0	11	73	13	3	90	36	13	14	1	3	0	0		0	4	18	68	14	0	92	22	4	33	9	7	0
17	50	33	0	0	33	59	8	0	92	33	25	17	0	8	0	0		0	8	38	54	8	0	92	15	8	46	23	23	0

XI. New transport system technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

High　Moderate　Low



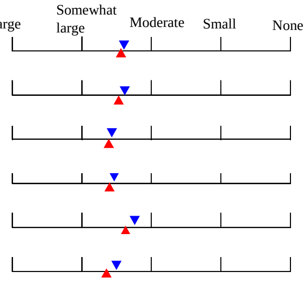
2) Current impacts

Large　Somewhat large　Moderate　Small　None

[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

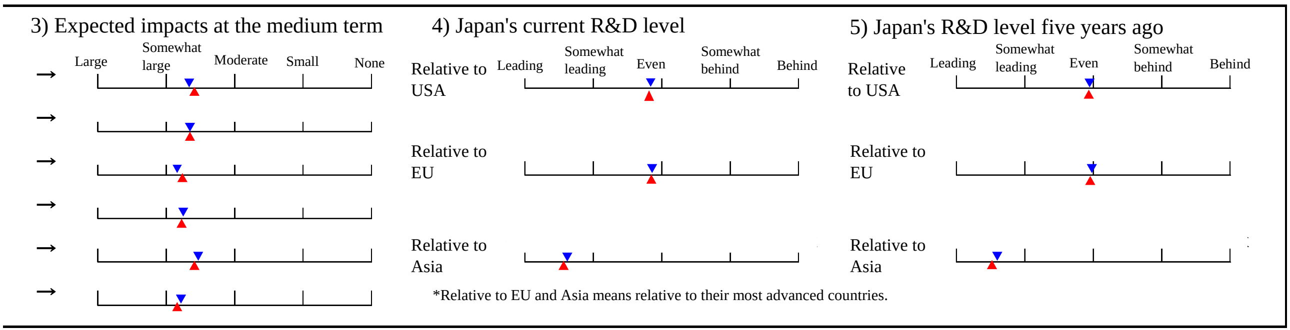
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

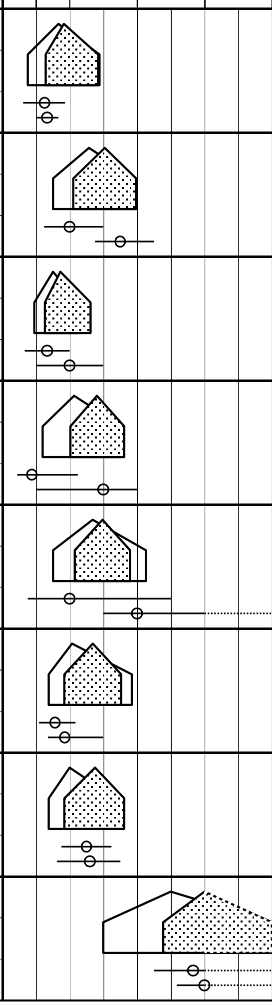
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

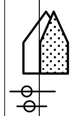
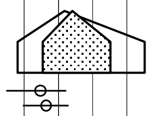
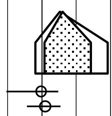
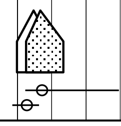


2. Questions regarding topics

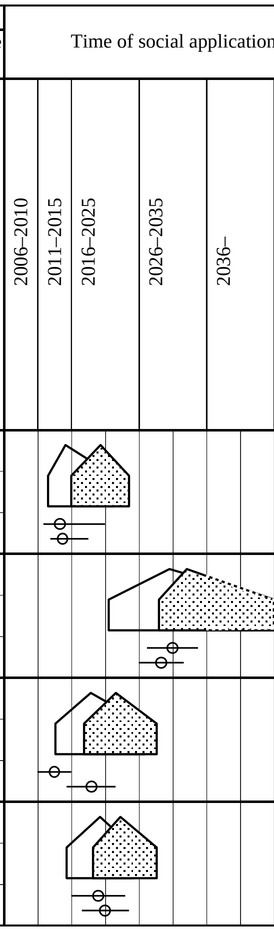
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
66	A railway system in which motor bogies are interchangeable between dissimilar lines (e.g. conventional lines and new trunk lines) to shorten travel time and eliminate the need for passengers to change cars.	1	65	9	18	73	-	45	13	47	35	5		2	10
		2	58	7	9	84	-	47	7	68	23	2		0	0
		E	4	100	0	0	-	75	50	50	0	0		0	0
67	Commercial operation of a superconducting magnetic levitation railway at a speed of up to around 500 km/h.	1	75	15	16	69	-	49	19	41	37	3		4	9
		2	66	5	11	84	-	46	11	53	34	2		3	0
		E	3	100	0	0	-	50	0	100	0	0		0	0
68	Short-term (several minutes to hours) travel time prediction technology with high accuracy for expressways and highways.	1	70	14	16	70	-	46	15	43	37	5		2	5
		2	62	6	11	83	-	42	5	53	40	2		0	0
		E	4	100	0	0	-	56	25	50	25	0		0	0
69	A driving assistance system for people who have difficulty in driving or are unable to drive ordinary cars because of age-related problems.	1	75	12	17	71	-	55	26	48	21	5		0	4
		2	59	7	12	81	-	51	12	68	18	2		0	0
		E	4	100	0	0	-	56	25	50	25	0		0	0
70	A system that automatically drives a car safely and smoothly along an expressway to the specified destination.	1	72	13	21	66	-	46	17	39	39	5		6	4
		2	64	8	11	81	-	41	7	45	46	2		2	2
		E	5	100	0	0	-	50	20	40	40	0		0	20
71	A means of high-speed (50-60 knots) marine transport that may be used in the East Asian economic zone and the trans-Pacific route.	1	65	26	17	57	-	52	22	47	26	5		2	8
		2	59	25	7	68	-	50	11	68	19	2		0	2
		E	15	100	0	0	-	58	23	62	15	0		0	7
72	A commercial icebreaker that can cruise the Arctic Ocean and other icy waters.	1	52	13	25	62	-	36	11	28	46	15		7	20
		2	56	16	11	73	-	35	5	27	64	4		2	0
		E	9	100	0	0	-	42	0	67	33	0		0	0
73	A space plane powered by an air-breathing engine and capable of traveling at Mach 25.	1	46	20	9	71	-	34	7	27	54	12		5	25
		2	44	16	2	82	-	32	5	23	63	9		2	12
		E	7	100	0	0	-	46	14	43	43	0		0	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application		(%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
74	7	19	0	0	14	42	26	18	7	41	41	46	2	17	4	0		2	9	15	34	33	18	9	40	7	51	29	7	4
93	0	7	0	0	9	60	27	4	6	57	32	55	0	11	2	2		0	2	10	59	24	7	6	56	2	72	13	0	0
100	0	0	0	0	25	75	0	0	25	50	25	50	0	25	25	0		0	0	50	50	0	0	25	50	0	100	0	0	0
80	3	12	5	0	23	39	26	12	9	32	41	63	14	11	2	0		6	11	28	36	25	11	13	45	24	56	20	4	4
92	0	5	3	0	15	53	26	6	10	39	36	72	5	3	0	0		5	3	24	45	26	5	8	48	13	76	13	2	0
100	0	0	0	0	33	67	0	0	0	33	0	100	0	0	0	0		0	0	100	0	0	0	0	0	0	100	0	0	0
70	22	4	2	2	10	35	40	15	16	46	42	46	6	10	4	2		2	8	15	36	37	12	13	50	19	54	17	6	4
87	3	8	0	2	3	38	56	3	12	64	31	49	2	7	0	0		0	2	10	42	48	0	8	63	11	66	8	2	2
100	0	0	0	0	0	50	50	0	25	50	25	25	0	25	0	0		0	0	50	50	0	0	0	25	0	75	25	0	0
55	25	16	0	4	10	38	34	18	16	39	39	59	7	20	11	2		0	8	11	46	31	12	14	44	14	56	33	12	2
77	14	9	0	0	5	56	37	2	7	45	27	71	0	14	2	0		0	0	3	68	29	0	9	47	5	76	26	5	0
75	25	0	0	0	0	75	25	0	0	0	25	100	0	25	0	0		0	0	0	75	25	0	25	50	0	100	25	0	0
59	28	11	0	2	15	38	27	20	15	37	42	54	8	23	10	2		6	10	16	42	26	16	10	42	12	52	32	20	6
87	10	3	0	0	2	62	34	2	10	46	31	61	2	16	2	3		3	2	6	64	30	0	10	56	5	63	25	10	3
80	20	0	0	0	0	100	0	0	40	40	20	60	0	20	0	0		20	0	20	80	0	0	20	40	20	60	20	0	0
67	12	17	2	2	19	39	33	9	10	47	29	53	14	10	0	0		2	11	13	42	36	9	10	60	16	50	14	2	2
84	9	7	0	0	11	64	21	4	11	55	24	69	7	11	0	0		0	4	9	63	26	2	7	70	7	60	14	0	0
74	13	13	0	0	27	53	13	7	7	43	21	79	7	36	0	0		0	7	20	60	20	0	7	67	7	60	40	0	0
24	24	47	0	5	9	34	39	18	14	31	26	57	14	11	0	0		9	21	14	32	36	18	17	40	23	54	17	0	0
7	19	74	0	0	7	30	57	6	14	31	20	80	8	2	0	0		4	6	11	24	58	7	12	56	10	64	6	0	4
0	11	89	0	0	0	67	33	0	22	33	11	100	0	0	0	0		0	0	0	44	56	0	22	56	11	67	0	0	0
5	95	0	0	0	30	32	25	13	21	42	48	64	30	3	0	0		8	26	30	35	25	10	15	44	18	59	12	0	0
0	100	0	0	0	27	32	34	7	12	39	39	73	24	0	0	0		5	21	23	38	32	7	18	53	8	75	5	0	0
0	100	0	0	0	72	14	14	0	29	29	71	71	29	0	0	0		0	0	72	14	14	0	57	29	0	86	0	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
74	Air transport management technology in which both the aircraft and the air traffic control use a high-accuracy navigation system to achieve twice as much air-traffic capacity safely as the current technology can.	1	**55**	**13**	**20**	**67**	**-**	**64**	**36**	**48**	**14**	**2**							**0**	**12**
		2	**44**	**14**	**7**	**79**	**-**	**56**	**20**	**67**	**11**	**2**							**0**	**2**
		E	**6**	**100**	**0**	**0**	**-**	**92**	**83**	**17**	**0**	**0**							**0**	**0**
75	An aircraft that can freely change the shape of the configurations like a bird by using smart composite materials and morphing technology to achieve energy savings.	1	**49**	**16**	**12**	**72**	**-**	**37**	**9**	**32**	**48**	**11**							**7**	**28**
		2	**44**	**9**	**14**	**77**	**-**	**35**	**7**	**25**	**63**	**5**							**5**	**9**
		E	**4**	**100**	**0**	**0**	**-**	**69**	**50**	**25**	**25**	**0**							**0**	**0**
76	A pilotless aircraft capable of autonomous low-altitude flight and applicable widely to the surveillance of territorial waters, disaster monitoring, and rescue assistance.	1	**60**	**13**	**18**	**69**	**-**	**61**	**33**	**48**	**15**	**4**							**0**	**13**
		2	**57**	**12**	**16**	**72**	**-**	**57**	**19**	**70**	**9**	**2**							**0**	**2**
		E	**7**	**100**	**0**	**0**	**-**	**71**	**43**	**57**	**0**	**0**							**0**	**0**
77	A pilotless high-altitude aircraft (or a airship platform) designed for stratospheric communications and observations.	1	**55**	**16**	**15**	**69**	**-**	**56**	**27**	**47**	**24**	**2**							**4**	**12**
		2	**51**	**14**	**12**	**74**	**-**	**52**	**14**	**68**	**14**	**4**							**2**	**4**
		E	**7**	**100**	**0**	**0**	**-**	**79**	**57**	**43**	**0**	**0**							**0**	**0**

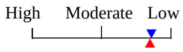
Countries at the leading edge					Regarding technological realization												Time of social application		Regarding social application										
					Necessity of gov't involvement				Effective measures that should be taken by gov't										Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)								(%)		(%)				(%)						
11	87	2	0	0	38	43	17	2	23	39	43	55	16	9	5	0	4	13	43	38	17	2	23	48	5	50	23	14	2
0	100	0	0	0	30	59	9	2	12	42	37	67	14	2	2	0	0	7	46	41	11	2	14	64	0	67	19	12	0
0	100	0	0	0	100	0	0	0	33	50	33	50	50	0	17	0	0	0	100	0	0	0	33	50	0	83	50	50	0
3	97	0	0	0	23	31	30	16	32	44	32	71	15	6	3	0	10	24	21	33	30	16	26	32	24	65	12	3	3
0	100	0	0	0	23	34	38	5	19	43	19	76	2	0	0	0	9	19	11	48	34	7	23	55	3	70	3	3	0
0	100	0	0	0	100	0	0	0	50	25	25	100	0	0	0	0	0	0	75	25	0	0	50	25	0	100	0	0	0
2	94	2	0	2	42	35	13	10	28	48	41	74	13	15	2	0	4	12	45	30	17	8	29	47	20	60	22	7	2
0	98	0	0	2	41	46	11	2	15	56	31	81	7	6	2	0	0	4	43	42	11	4	20	70	6	67	15	4	0
0	100	0	0	0	86	14	0	0	29	43	29	86	0	14	14	0	0	0	57	43	0	0	29	43	0	86	43	29	0
13	83	4	0	0	48	29	19	4	18	43	36	73	16	7	2	0	6	11	47	33	16	4	13	53	20	56	24	7	0
8	90	2	0	0	49	37	10	4	15	65	27	73	10	2	2	0	2	6	41	41	14	4	10	71	4	71	15	4	0
43	57	0	0	0	86	14	0	0	14	71	29	71	0	14	14	0	0	0	71	29	0	0	14	57	0	100	29	29	0



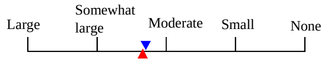
XII. Traffic safety technology

1. Questions regarding the relevant area

1) Degree of expertise in the area



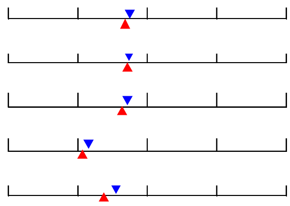
2) Current impacts



[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

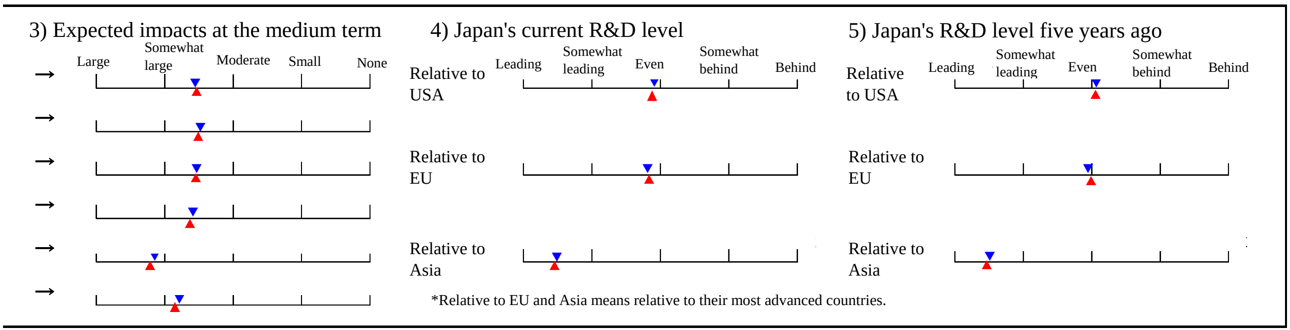
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

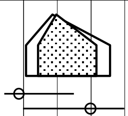
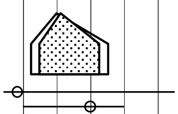
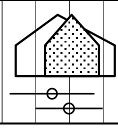
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
78	Widespread use of automobile collision avoidance systems that use image recognition and sensors to estimate the traffic condition around the vehicle.	1	78	12	13	75	-	60	27	61	11	1							3	7
		2	66	8	12	80	-	53	9	83	8	0							2	0
		E	5	100	0	0	-	65	40	40	20	0							20	0
79	A collision avoidance system that uses inter-vehicle communications to prevent accidents at intersections.	1	72	7	13	80	-	59	28	56	13	3							2	5
		2	62	8	6	86	-	52	8	84	8	0							2	2
		E	5	100	0	0	-	65	40	40	20	0							20	0
80	A safe aircraft that prevents crash during takeoff and landing using self correction, a technology that allows the aircraft to automatically restore the correct orientation if it loses stability.	1	51	14	14	72	-	60	33	43	22	2							0	19
		2	47	9	11	80	-	54	15	72	13	0							0	2
		E	4	100	0	0	-	75	50	50	0	0							0	0

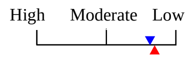


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Time of social application (%)		Regarding social application: Necessity of gov't (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
60	**31**	**7**	**0**	**2**	**8**	**35**	**46**	**11**	**18**	**45**	**28**	**57**	**3**	**15**	**10**	**2**		**3**	**7**	**10**	**43**	**33**	**14**	**17**	**33**	**10**	**45**	**22**	**24**	**7**
86	**9**	**5**	**0**	**0**	**9**	**29**	**60**	**2**	**14**	**59**	**17**	**64**	**0**	**9**	**3**	**0**		**2**	**0**	**8**	**54**	**36**	**2**	**11**	**35**	**6**	**76**	**24**	**13**	**0**
80	**20**	**0**	**0**	**0**	**20**	**20**	**60**	**0**	**0**	**60**	**20**	**40**	**0**	**20**	**0**	**0**		**20**	**0**	**0**	**80**	**20**	**0**	**0**	**20**	**0**	**60**	**20**	**20**	**0**
62	**25**	**13**	**0**	**0**	**8**	**32**	**51**	**9**	**18**	**44**	**35**	**55**	**4**	**13**	**9**	**2**		**3**	**6**	**13**	**36**	**37**	**14**	**15**	**34**	**15**	**49**	**25**	**25**	**8**
88	**7**	**5**	**0**	**0**	**5**	**30**	**63**	**2**	**13**	**55**	**18**	**68**	**0**	**8**	**2**	**0**		**0**	**2**	**7**	**41**	**50**	**2**	**12**	**33**	**5**	**78**	**23**	**12**	**0**
100	**0**	**0**	**0**	**0**	**20**	**40**	**40**	**0**	**0**	**40**	**20**	**60**	**0**	**20**	**0**	**0**		**0**	**0**	**0**	**60**	**40**	**0**	**0**	**0**	**0**	**80**	**40**	**20**	**0**
18	**82**	**0**	**0**	**0**	**27**	**30**	**36**	**7**	**34**	**37**	**34**	**61**	**11**	**8**	**8**	**3**		**0**	**19**	**19**	**41**	**26**	**14**	**32**	**35**	**18**	**47**	**18**	**21**	**0**
6	**90**	**2**	**2**	**0**	**20**	**33**	**45**	**2**	**20**	**42**	**20**	**71**	**4**	**4**	**2**	**0**		**0**	**4**	**13**	**57**	**28**	**2**	**20**	**43**	**9**	**72**	**17**	**9**	**0**
25	**75**	**0**	**0**	**0**	**50**	**50**	**0**	**0**	**25**	**0**	**0**	**75**	**0**	**50**	**25**	**0**		**0**	**0**	**50**	**50**	**0**	**0**	**25**	**0**	**0**	**50**	**75**	**25**	**0**

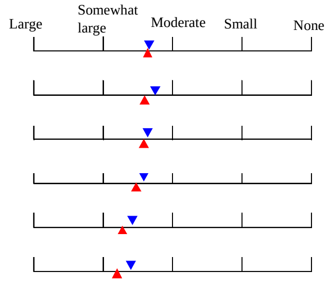
XIII. Environmental management in the transport sector

1. Questions regarding the relevant area

1) Degree of expertise in the area

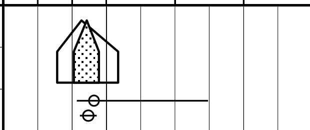
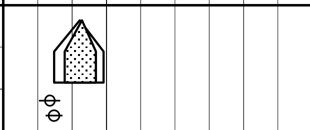
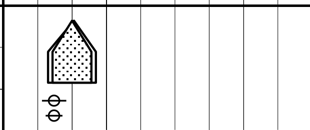
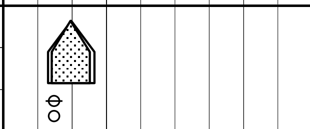
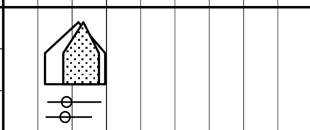
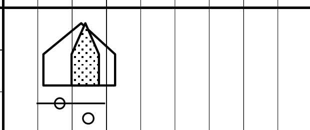
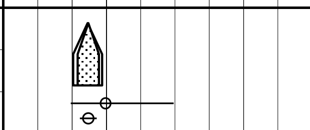
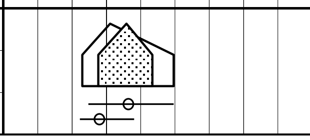


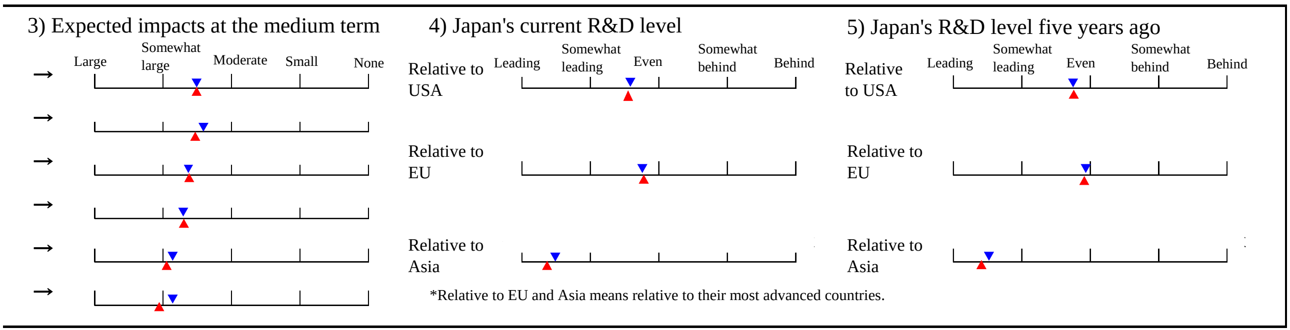
2) Current impacts

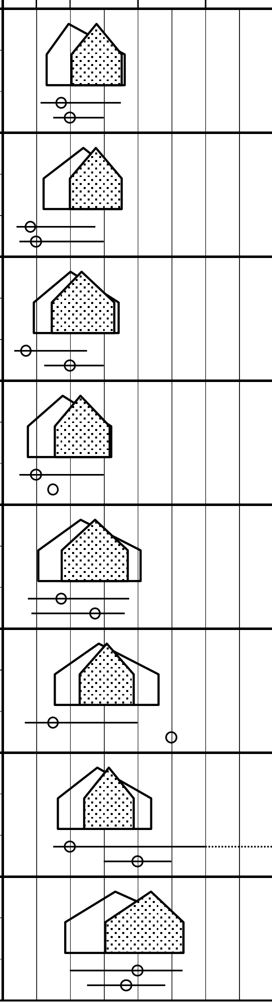


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
81	Technology that allows a shinkansen train running at 350 km/h to satisfy the noise standards (70 dB(A) or less in residential areas), through the use of new materials for the rails and wheels and the technical improvement of railroad structures and the car design.	1	54	11	24	65	-	59	27	56	17	0		0	11
		2	51	4	8	88	-	53	8	86	6	0		0	4
		E	2	100	0	0	-	75	50	50	0	0		0	0
82	Train-mounted energy devices (e.g. flywheel, fuel cell) to store regenerative energy and reduce peak loads at substations.	1	47	11	17	72	-	58	26	55	19	0		0	10
		2	48	4	10	86	-	53	6	94	0	0		0	2
		E	2	100	0	0	-	50	0	100	0	0		0	0
83	Paving technology that uses new materials to reduce traffic noise levels below environmental standards.	1	68	12	22	66	-	55	24	50	24	2		2	5
		2	62	10	16	74	-	50	7	82	11	0		0	0
		E	6	100	0	0	-	67	33	67	0	0		0	0
84	Automobile recycling technology that can almost completely solve car scrapping problems.	1	63	5	14	81	-	74	52	39	9	0		0	7
		2	58	2	9	89	-	89	77	23	0	0		0	0
		E	1	100	0	0	-	100	100	0	0	0		0	0
85	A system that reduces connection time and cost by streamlining connections between railways and highways, between highways and seaports/airports, and between railways and seaports/airports for efficient freight transport.	1	71	14	17	69	-	64	36	47	17	0		0	13
		2	62	11	15	74	-	64	31	66	3	0		0	0
		E	7	100	0	0	-	79	66	17	17	0		0	0
86	Fuel cell-powered transport systems (automobiles, ships, etc.)	1	67	13	30	57	-	76	57	35	8	0		0	8
		2	67	3	22	75	-	88	76	24	0	0		0	0
		E	2	100	0	0	-	100	100	0	0	0		0	0
87	Emissions treatment technology that allows all land and marine transport systems to satisfy the current automobile emissions limits (current limits for gasoline passenger vehicles in g/km: 1.27(0.67) for carbon monoxide; 0.17(0.08) for hydrocarbon; 0.17(0.08) for nitrogen oxides; in 10/15 mode tests, max. values per car, average of emissions per type of vehicle in parentheses).	1	52	10	31	59	-	74	52	44	4	0		0	11
		2	50	4	6	90	-	89	78	20	2	0		0	4
		E	2	100	0	0	-	100	100	0	0	0		0	0
88	An environment-friendly supersonic aircraft (at Mach 2-2.5, with a capacity of 250 passengers) that emits low noise even during supersonic flight over populated areas and generates a reduced amount of ozone-depleting emissions.	1	44	23	11	66	-	48	23	36	28	13		5	21
		2	41	17	5	78	-	48	15	51	32	2		0	10
		E	7	100	0	0	-	75	57	29	14	0		0	0



Countries at the leading edge: Japan (%)	USA (%)	EU (%)	Asia (%)	Other (%)	Regarding technological realization – Necessity of gov't involvement: High (%)	Moderate (%)	Low (%)	None (%)	Regarding technological realization – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration (%)	Development of R&D infrastructure (%)	Expansion of R&D funding (%)	Internationalization of R&D activities (%)	Relaxation or elimination of relevant regulations (%)	Tightened or new regulations (%)	Other (%)	Time of social application: 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement: High (%)	Moderate (%)	Low (%)	None (%)	Regarding social application – Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration (%)	Improvement of environment for business startups (%)	Support through taxation, subsidies, and procurement (%)	Relaxation or elimination of relevant regulations (%)	Tightened or new regulations (%)	Other (%)
98	0	2	0	0	15	39	31	15	22	32	44	63	7	10	7	0		0	18	11	46	28	15	18	31	18	59	18	18	5
96	0	4	0	0	6	74	20	0	14	38	30	78	2	2	2	0		0	6	8	70	22	0	16	39	10	82	10	12	0
100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0		0	0	0	100	0	0	0	0	0	100	0	0	0
80	11	9	0	0	15	29	46	10	14	36	31	67	3	19	6	0		0	13	13	46	33	8	11	37	11	51	23	11	0
94	2	4	0	0	6	30	62	2	13	40	16	78	0	9	0	0		0	2	6	65	27	2	13	41	9	76	11	7	0
100	0	0	0	0	0	50	50	0	0	0	0	100	0	0	0	0		0	0	0	100	0	0	0	0	0	100	0	0	0
63	21	16	0	0	16	48	26	10	22	55	38	49	5	13	7	4		2	5	25	45	23	7	16	47	19	51	16	18	4
94	3	3	0	0	8	74	18	0	13	70	16	57	2	5	2	0		0	2	13	76	11	0	13	55	8	76	8	10	0
100	0	0	0	0	17	83	0	0	17	83	0	33	0	17	0	0		0	0	17	83	0	0	17	33	0	83	17	0	0
46	10	44	0	0	18	51	19	12	19	46	35	42	8	21	23	0		0	7	21	51	21	7	15	40	19	49	26	36	2
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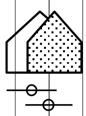
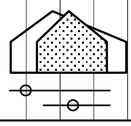
28	21	41	7	3	35	32	25	8	14	53	34	39	10	17	7	5		0	13	41	28	23	8	12	53	14	37	27	15	7
15	7	78	0	0	30	59	11	0	8	84	26	39	2	13	0	0		0	2	55	34	11	0	10	71	6	55	19	8	0
29	0	71	0	0	43	57	0	0	14	86	29	43	0	14	0	0		0	0	57	43	0	0	43	86	0	86	14	14	0
52	35	9	0	4	30	41	21	8	18	45	38	71	7	20	5	2		0	8	34	40	21	5	14	40	26	64	34	19	3
72	17	9	0	2	23	68	6	3	11	59	19	75	6	8	0	0		0	2	25	67	7	1	8	48	11	83	17	9	0
0	100	0	0	0	50	50	0	0	0	0	0	100	0	0	0	0		0	0	50	50	0	0	0	0	0	100	0	50	0
72	5	21	0	2	26	46	24	4	11	34	27	59	7	11	25	0		0	7	46	31	16	7	14	31	14	55	14	55	0
92	4	4	0	0	16	72	10	2	8	47	18	78	2	4	18	0		0	4	70	22	8	0	10	37	8	76	6	45	0
100	0	0	0	0	0	100	0	0	0	50	0	50	0	0	0	0		0	0	50	50	0	0	0	50	0	50	0	0	0
11	84	5	0	0	29	32	34	5	17	28	33	67	25	17	11	0		11	16	25	36	31	8	18	42	18	52	21	24	6
2	96	2	0	0	17	44	37	2	15	33	23	83	18	5	3	0		0	13	17	57	24	2	15	55	8	80	15	10	0
14	86	0	0	0	71	29	0	0	29	43	29	100	43	14	0	0		0	0	71	29	0	0	14	71	0	86	29	0	0

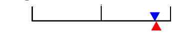
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%) High	Moderate	Low	None	Importance to Japan (%) Index	High	Moderate	Low	None	Time of technological realization Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
89	A low-emission, energy-efficient aircraft that achieves reduction in the takeoff and landing noise and in-flight emissions, reduction in frictional resistance, and improvement of engine fuel efficiency.	1	**43**	**19**	**14**	**67**	**-**	**59**	**34**	**34**	**29**	**3**							**5**	**13**
		2	**41**	**17**	**7**	**76**	**-**	**64**	**37**	**46**	**17**	**0**							**0**	**5**
		E	**7**	**100**	**0**	**0**	**-**	**86**	**71**	**29**	**0**	**0**							**0**	**0**
90	Technology for reducing the frictional resistance of ships becomes commercially available, resulting in a 20% reduction in horsepower requirements.	1	**50**	**26**	**22**	**52**	**-**	**52**	**20**	**51**	**27**	**2**							**11**	**11**
		2	**48**	**25**	**8**	**67**	**-**	**51**	**9**	**76**	**15**	**0**							**6**	**2**
		E	**12**	**100**	**0**	**0**	**-**	**54**	**8**	**92**	**0**	**0**							**25**	**0**

Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
17	**77**	**6**	**0**	**0**	**31**	**28**	**35**	**6**	**18**	**35**	**29**	**62**	**21**	**18**	**15**	**0**						**5**	**11**	**31**	**35**	**28**	**6**	**18**	**41**	**18**	**53**	**24**	**38**	**0**
5	**90**	**5**	**0**	**0**	**22**	**39**	**39**	**0**	**17**	**44**	**22**	**78**	**12**	**7**	**2**	**0**						**0**	**5**	**23**	**49**	**28**	**0**	**13**	**55**	**8**	**73**	**13**	**18**	**0**
0	**86**	**14**	**0**	**0**	**71**	**29**	**0**	**0**	**29**	**43**	**14**	**100**	**14**	**0**	**0**	**0**						**0**	**0**	**57**	**43**	**0**	**0**	**14**	**57**	**0**	**86**	**14**	**0**	**0**
84	**12**	**2**	**2**	**0**	**7**	**44**	**37**	**12**	**11**	**26**	**29**	**68**	**5**	**8**	**5**	**0**						**11**	**9**	**7**	**44**	**35**	**14**	**14**	**35**	**19**	**51**	**14**	**11**	**8**
86	**8**	**6**	**0**	**0**	**4**	**63**	**31**	**2**	**13**	**36**	**28**	**81**	**2**	**0**	**0**	**0**						**6**	**2**	**2**	**62**	**34**	**2**	**15**	**52**	**7**	**78**	**4**	**0**	**0**
100	**0**	**0**	**0**	**0**	**0**	**67**	**25**	**8**	**18**	**45**	**18**	**91**	**0**	**0**	**0**	**0**						**25**	**0**	**0**	**67**	**25**	**8**	**18**	**55**	**0**	**91**	**0**	**0**	**0**

XIV. Efficient environmentally-conscious logistics system technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

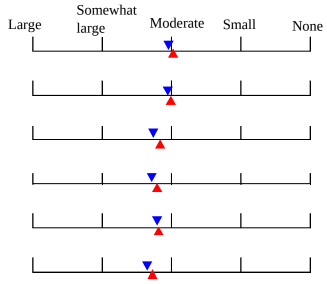


2) Current impacts

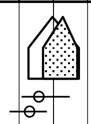
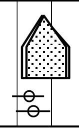
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

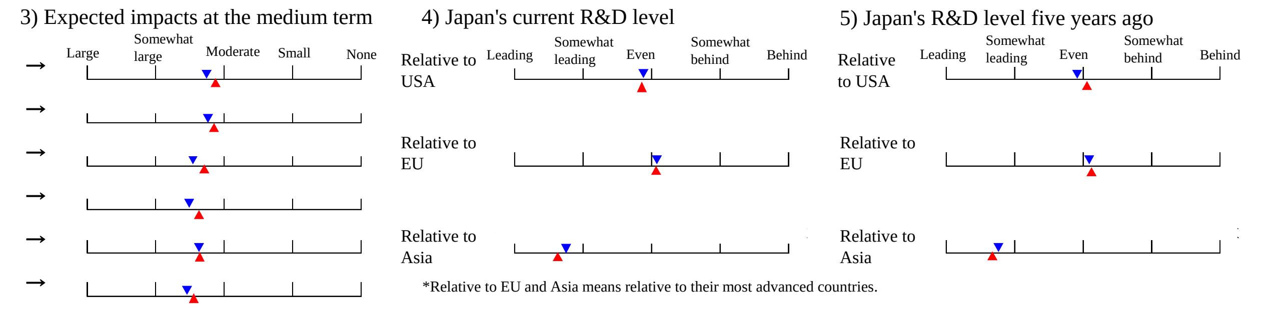
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

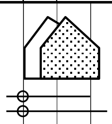
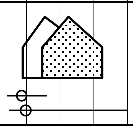
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
91	A logistics system that uses trucks or ships to reduce logistics costs as well as the emissions of NOx, CO2, and suspended particulate matter (SPM).	1	**74**	**14**	**16**	**70**	**-**	**71**	**45**	**47**	**8**	**0**							**0**	**6**
		2	**61**	**10**	**11**	**79**	**-**	**75**	**53**	**44**	**3**	**0**							**0**	**2**
		E	**6**	**100**	**0**	**0**	**-**	**83**	**67**	**33**	**0**	**0**							**0**	**0**
92	Common distribution systems across urban areas that relieve urban traffic congestion stemming from an increased volume of small-package deliveries due to the proliferation of e-commerce.	1	**63**	**11**	**13**	**76**	**-**	**62**	**31**	**54**	**15**	**0**							**0**	**9**
		2	**59**	**7**	**10**	**83**	**-**	**63**	**29**	**66**	**5**	**0**							**0**	**0**
		E	**4**	**100**	**0**	**0**	**-**	**75**	**50**	**50**	**0**	**0**							**0**	**0**



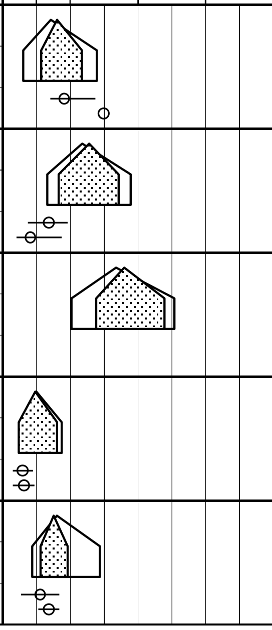
Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
59	6	35	0	0	27	45	23	5	13	48	29	52	2	13	31	2						0	9	38	43	17	2	14	38	22	52	17	54	2
66	0	34	0	0	23	67	10	0	10	68	15	68	3	3	10	2						0	2	37	51	12	0	8	42	8	78	7	44	0
83	0	17	0	0	67	33	0	0	17	33	33	50	17	17	17	0						0	0	67	33	0	0	17	50	0	83	33	50	0
56	19	19	2	4	24	39	28	9	21	50	23	48	6	29	25	2						4	11	29	44	22	5	16	35	31	49	35	45	2
86	7	5	0	2	23	52	21	4	11	74	6	54	0	17	11	2						2	2	26	60	12	2	7	33	9	72	25	39	0
100	0	0	0	0	50	50	0	0	25	50	0	50	0	25	25	0						0	0	50	50	0	0	0	50	25	75	25	25	0

Questions regarding other topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
93	Widespread use of procedures through which users of a planned building assess its ease of use in advance using virtual reality technology and the results are reflected into design.	1	95	5	23	72	-	42	7	51	36	6							0	8
		2	74	1	19	80	-	44	3	66	31	0							0	0
		E	1	100	0	0	-	50	0	100	0	0							0	0
94	Technology for the ground-based probing of buried objects and soil properties 5 meters underground, to address the growing use of underground spaces.	1	88	11	26	63	-	56	26	48	25	1							3	10
		2	75	7	16	77	-	57	22	63	15	0							0	3
		E	5	100	0	0	-	75	60	20	20	0							0	0
95	Technological systems for planning and constructing a city in a desert or polar region.	1	58	2	19	79	-	24	2	21	46	31							10	18
		2	58	2	14	84	-	26	0	19	67	14							4	4
		E	1	100	0	0	-	50	0	100	0	0							0	0
96	Public works bidding and contracting schemes in which the quality of public works are ensured through comprehensive assessment of the technical capability of each contractor, including its performance in past projects.	1	95	16	27	57	-	68	45	38	17	0								
		2	80	11	23	66	-	78	58	37	5	0								
		E	9	100	0	0	-	81	67	22	11	0								
97	International standards for general contracting and execution of international projects are established.	1	90	10	30	60	-	70	46	43	11	0								
		2	77	8	13	79	-	80	62	34	4	0								
		E	6	100	0	0	-	92	83	17	0	0								

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application (%)		Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
39	52	6	0	3	2	19	44	35	26	53	30	58	9	6	6	2	1	13	1	21	40	38	31	42	23	48	10	12	4
15	84	1	0	0	1	14	72	13	20	54	15	72	3	2	0	0	0	1	3	11	67	19	20	47	15	69	4	4	0
0	100	0	0	0	0	0	100	0	0	0	100	100	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0
45	47	6	0	2	10	32	44	14	25	43	34	69	7	8	5	2	1	9	7	38	41	14	18	44	23	50	21	5	5
40	60	0	0	0	4	43	49	4	10	46	20	72	6	1	0	0	0	3	5	46	45	4	10	51	9	71	9	0	0
40	60	0	0	0	0	100	0	0	0	60	40	60	0	20	0	0	0	0	0	80	20	0	25	100	25	75	25	0	0
9	63	12	2	14	6	21	44	29	33	36	36	48	39	3	6	3	15	25	4	24	41	31	34	56	16	44	6	9	6
2	98	0	0	0	2	16	69	13	27	42	21	65	23	0	0	0	9	7	2	19	64	15	34	64	7	57	2	0	0
100	0	0	0	0	0	100	0	0	0	100	0	100	100	0	0	0	100	0	0	100	0	0	0	100	0	0	0	0	0
																	4	8	58	28	13	1	28	31	9	19	33	53	4
																	3	1	83	12	4	1	29	30	3	14	24	63	3
																	0	0	89	0	11	0	22	67	0	22	44	67	0
																	4	10	57	25	18	0	45	45	13	16	31	29	4
																	0	7	83	9	7	1	61	64	8	11	22	26	1
																	0	0	100	0	0	0	33	83	0	17	17	50	0

Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–



13. Social technology field

13.1. Overview

(1) Social technology

The social technology field is a new addition to this foresight survey. This field covers technologies that contribute to the solution of social problems and the socialization of technologies. The nature of these technologies means that many of them cross fields. Therefore, topics such as those related to a safe and secure society, an aging society with a declining birthrate, and a knowledge society include matters related to other technology fields. The social technology field therefore forms the core of this combination and coordination across fields. We took care both to avoid redundancy and to ensure that important topics were not omitted.

The social technology field comprises 11 individual topics. Topics handled as social technology in this field fit one of the following two general categories.

A. Technologies that are applied to the solutions of problems caused by socialization of technologies and to the solutions of general social problems
B. Technologies that are applied directly to the solution of social problems

Of the field's 11 areas, 2 areas, “technology for solving international problems” and “technology assessment”, belong to A. The remaining 9 areas, “safety, security, and stability of day to day life”, “urban safety, security, and stability”, “universal availability of services”, “support for the elderly and the disabled”, “social application of brain research”, “technology that supports education and learning”, “handing down and preserving culture and technology”, “knowledge production system” and “entertainment technology”, belong to B. However, because all 9 areas are technologies predicated upon application to society, they must be taken into view during the development stage in order to smooth the social application of their topics.

The common thread of these social technologies is that they are technologies to respond to social needs and they require the integration of knowledge from multiple specialized areas in order to address problems. In many cases, the necessary specialized areas are in both the natural sciences and the social sciences or humanities.

(2) Expected impacts and times of social application

This analysis investigated expected current and medium-term impacts for each area. For social impacts related to safety and security and to social vitality, the 4 areas in the field with the highest scores are “urban safety, security, and stability”, “support for the elderly and the disabled”, “safety, security, and stability of day to day life” and “universal availability of services”. The areas receiving the lowest scores were “entertainment technology”, “handing down and preserving culture and technology” and “knowledge production system”, but these received relatively high scores on increased intellectual assets.

Paying attention to the time of social application for technology is especially important with social technology. Social technology typically requires a great deal of time from technological realization until social application. Comparing times of technological realization and social application based on the median values in the foresight survey results, for most social technology areas about twice as much time is required to reach the time of social application as is needed to reach technological realization. The reasons so much time is required for social application are that in most cases related systems must be developed and social consensus obtained, and it is known that these are not necessarily easy tasks.

The above time frame is an average characteristic for all areas in the field, so some areas require more than twice as much time, while others require less. The former are “universal availability of services”, “safety, security, and stability of day to day life” and “handing down and preserving culture and technology”; the latter is “support for the elderly and the disabled.”

“Social application of brain research” is an average area in that the time frame applies, but it is predicted to require the longest time of any area for both technological realization and social application.

(3) Fields for integration and collaboration and the realization of a desirable society

The results for science and technology in other fields that are targets for integration and collaboration differ by whether the time is "the coming 5 to 10 years" or "2016 or later." Three fields, "information and communications; health, medical care, and welfare; and environment, were named in at least 50 percent of responses for the former, while 2 fields, life science and energy and resources, received the same amount of responses for the latter. This change is probably due to respondents seeing the fields related to topics that should be engaged as social technology as gradually shifting in emphasis from the former fields to the latter.

As for the predictions of respondents in the social technology field on society 30 years from now, 75 percent see science and technology contributing to a certain degree to solve problems related to secure lives. However, in answer to the question of how science and technology and social technology will change people's sense of security in their lives, 56.0 percent said it will lower it, and 38.5 percent said it will make no difference.

Respondents in the social technology field understand that seed technologies are not all that is needed to solve social problems and calmly accept the general difficulty of the social application of technology, so they gave calm responses such as those above.

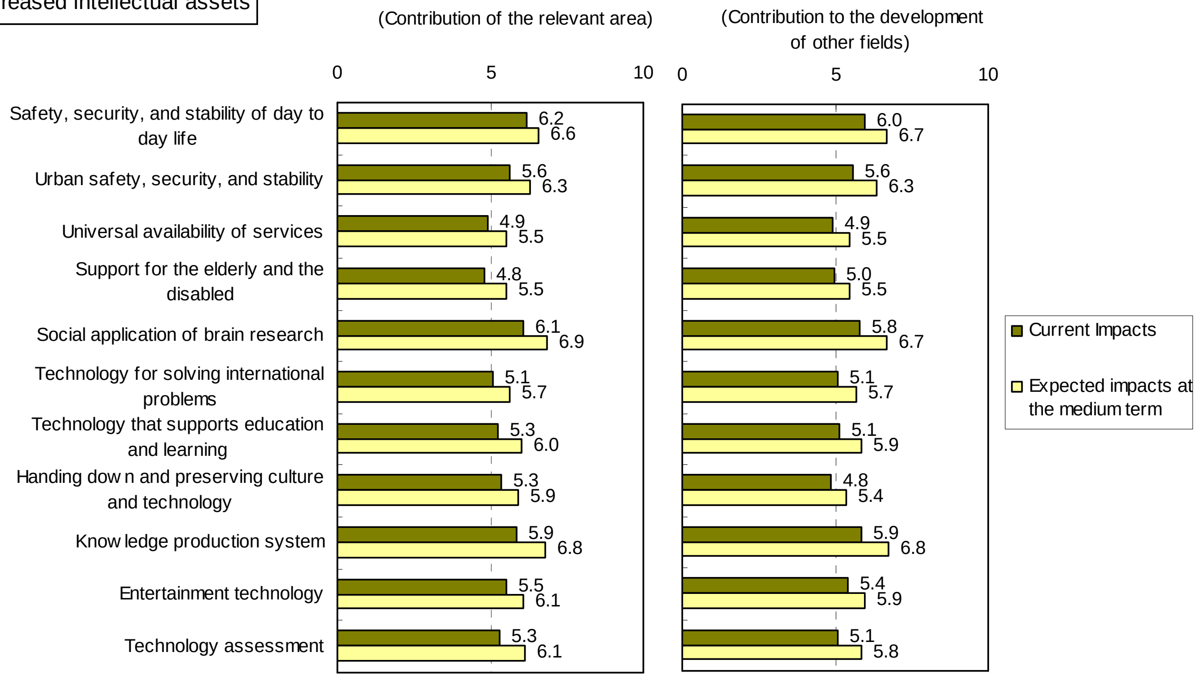
The discretion of the social technology field's respondents also seems to be reflected in the survey results for the contributions of the field's topics to the achievement of a desirable society. Although the field's degree of contribution is high in terms of direct contributions to safety and security, health, population decline, and global problems and in terms of indirect contributions to population decline, a sustainable society, and global problems, compared to other fields the answers seem somewhat cautious.

(NAKAJIMA Naomasa)

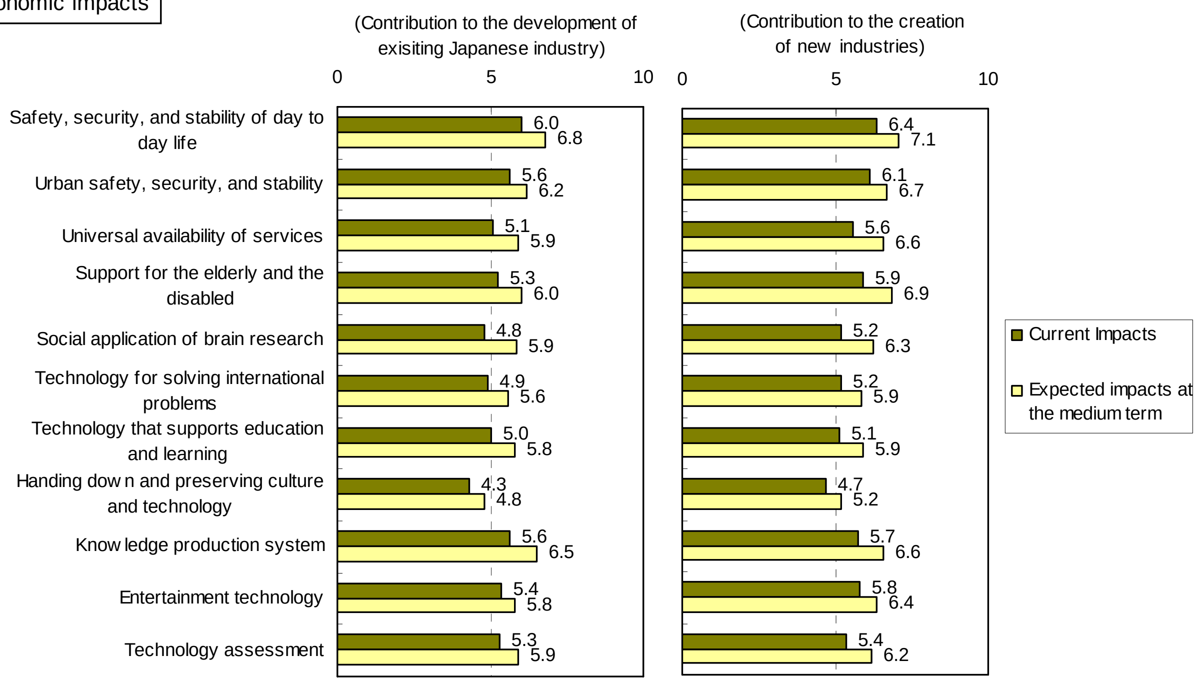
13.2. Main results

A. Impacts

Increased intellectual assets

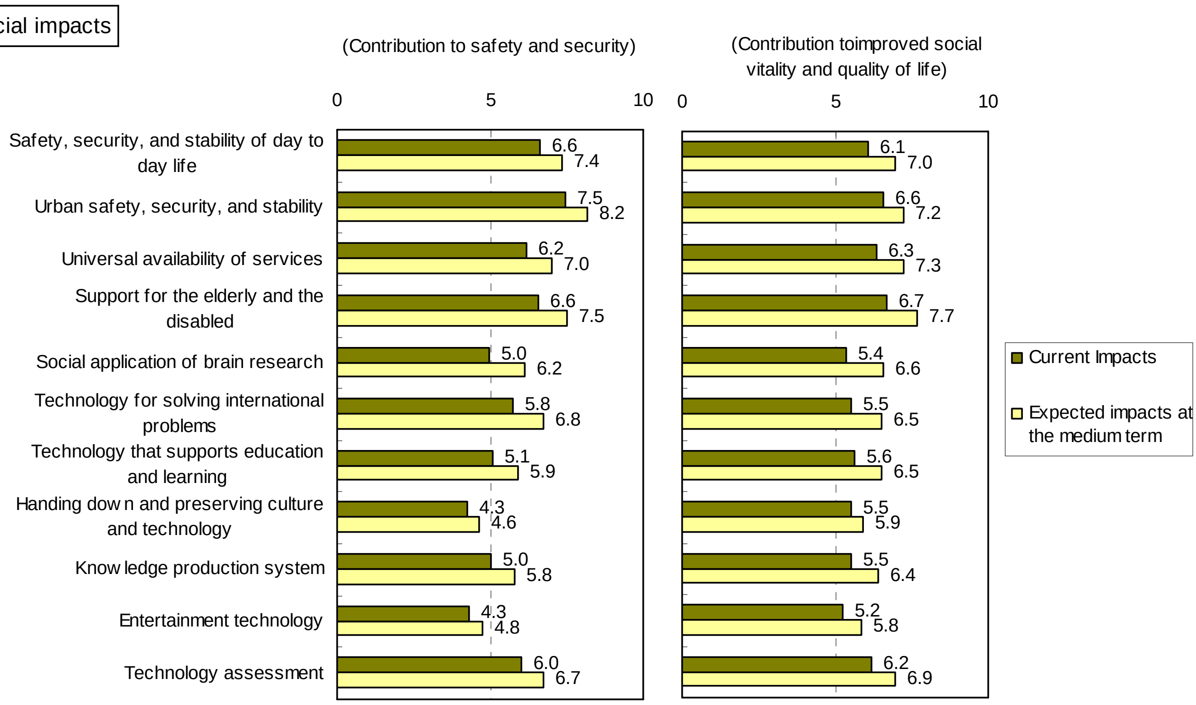


Economic impacts



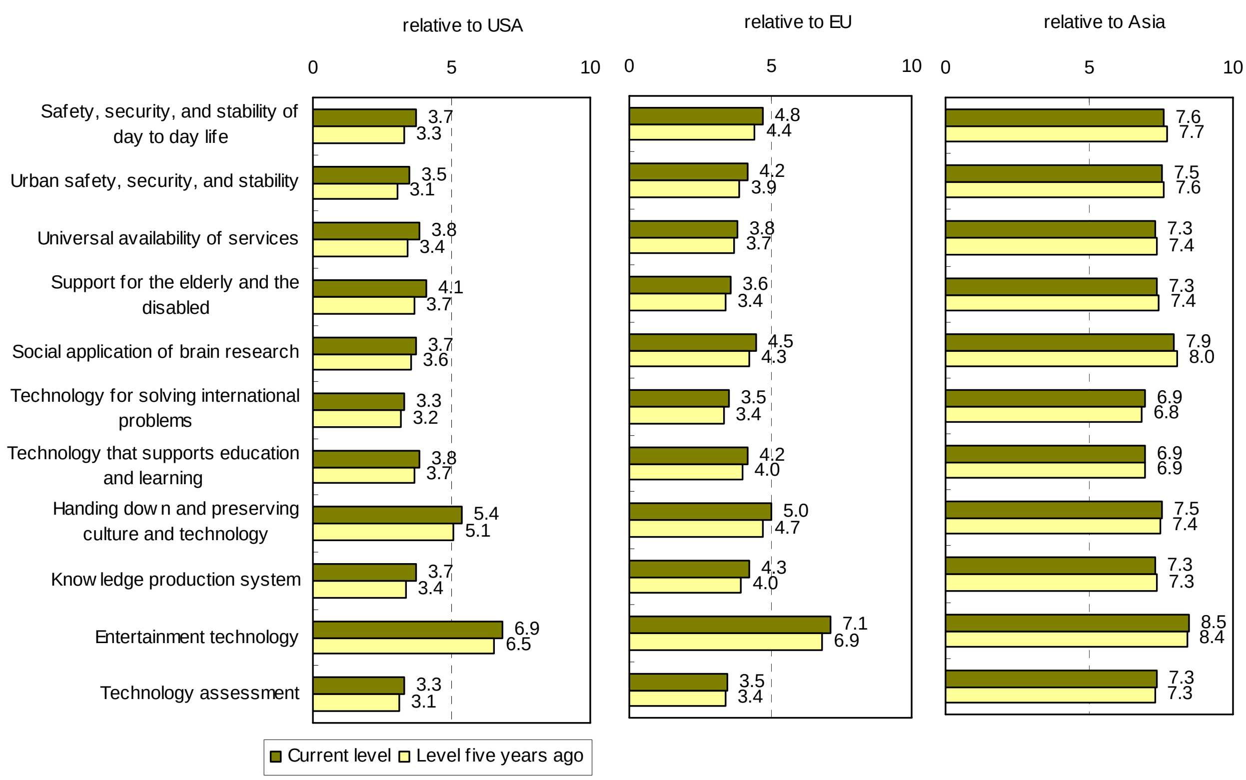
*Responses are indexed on a 10-point scale.

Social impacts



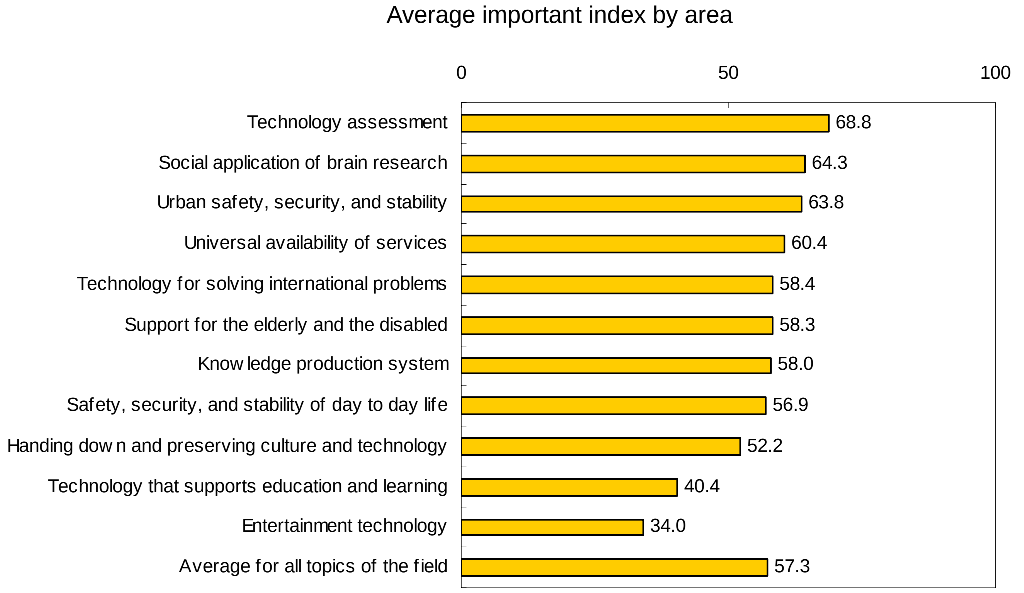
*Responses are indexed on a 10-point scale.

B. Japan’s R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan



The most important 10 topics

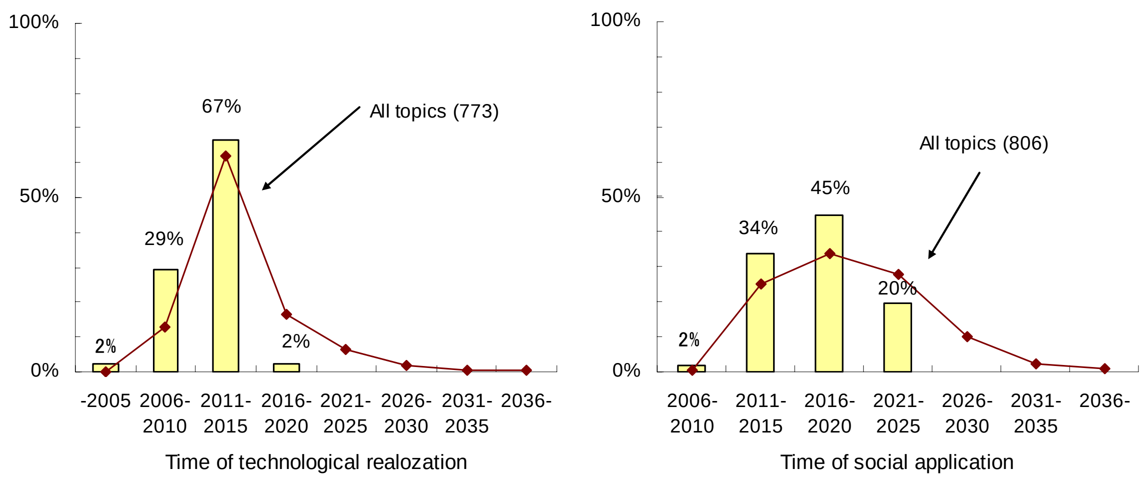
	Topic	Index	Year T*	Year S*
1	09: A wide-area disaster monitoring system that monitors, when a major disaster occurs, the impacts of the disaster widely across the affected area, by using satellite images and the analysis by laser radar equipment, to help provide prompt and safe evacuation guidance.	88	2011	2018
2	10: A system for quickly and accurately detecting trace amounts of explosives, drugs, radioactive substances, and pathogenic microorganisms in public and other crowd-attracting facilities and public transportation such as airports, seaports, and railroads.	86	2013	2020
3	51: Systems for early warning and prediction by experts (e.g. early detection of human/livestock infection and prediction of its impacts, early warning of the environmental effects of an accident or disaster) are established, enabling early detection and impact assessment of the problems that should be solved by science and technology.	85	2013	2021
4	19: A system that supports women's social participation by ensuring mothers the future availability of child-rearing support such as nursery schools, at the time of pregnancy or childbirth.	84	-	2012
5	26: A system that prevents senile dementia by inhibiting impairment of an elderly person's brain function.	82	2015	2022
6	52: Systems for assessing the long-term impacts of artificial and natural substances and systems on health and the environment are established, so that the government can systematically provide monitoring/surveillance results on potential threats and other negative issues.	79	2013	2021
7	56: To address the NIMBY (not in my backyard) problem, the form of discussion and the procedure intended for convincing the interested parties are established.	75	-	2018
8	46: Establishment of global rules concerning the copyright of multimedia information to promote the production and distribution of multimedia content.	69	-	2014
9	02: Technology for promoting the formation of local communities using disaster prevention, crime prevention, and welfare as the key concepts.	69	2011	2018
10	06: Low-cost, fast, and secure biometrics authentication technology as a means of identification verification to prevent crime.	68	2009	2014

Year T: Time of technological realization Year S: Time of social application

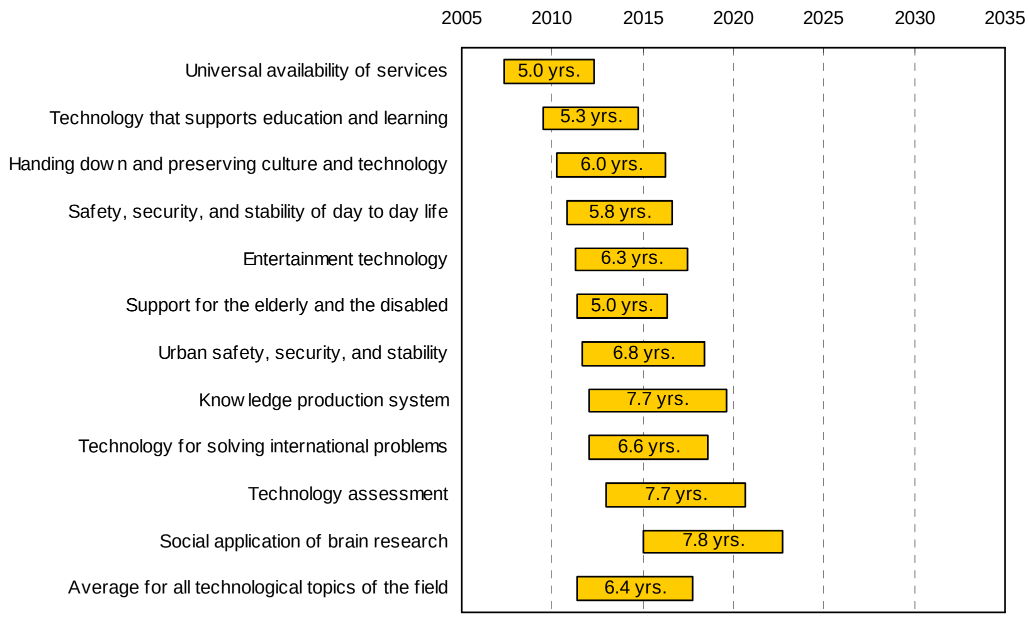
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

Topic	Year T*	Period*	Area
28: Technology for assisting people who cannot make oral or written conversation because of disease or other reasons in communicating smoothly with others by reading their thoughts based on brain activities.	2015	9	Social application of brain research
08: Automobiles with automatic driving function for preventing traffic accidents.	2012	8	Urban safety, security, and stability
25: Media technology that facilitates the sound development of children's brain functions for thinking, creating, and communicating.	2014	8	Social application of brain research
29: Technology for promoting international communication and mutual understanding by not only interpreting words, but displaying wider information such as the culture, custom, and social principle behind the utterance.	2013	8	Technology for solving international problems
42: Reconstruction of educational and communication systems as a result of the establishment of a knowledge production method independent of space, time, and language.	2013	8	Knowledge production system

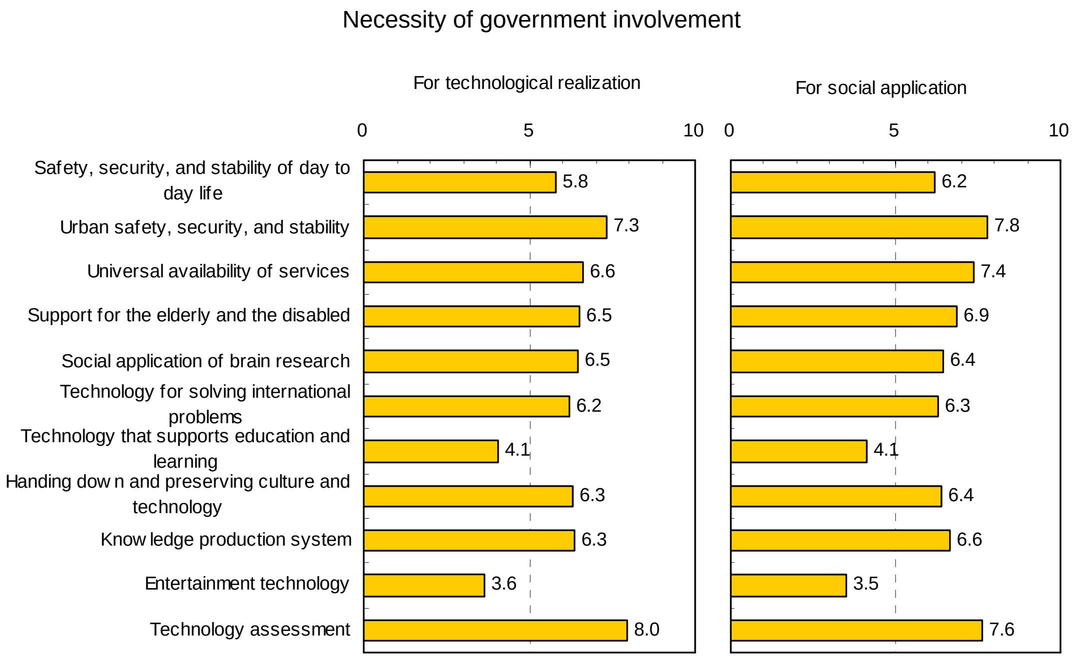
Topic	Year T*	Period*	Area
45: Construction of a public database that gives centralized access to a collection of the data owned by public institutions and universities, and serves as the infrastructure for knowledge production in society.	2010	8	Knowledge production system
48: Robot leasing service in which customers can lease robots suited to their needs, such as gardening, nursing care, and household chores.	2013	8	Entertainment technology
50: A robot that acts as the user's sibling or friend and allows the user to experience pseudo-brotherhood, -sisterhood or -friendship to improve social skills.	2014	8	Entertainment technology
51: Systems for early warning and prediction by experts (e.g. early detection of human/livestock infection and prediction of its impacts, early warning of the environmental effects of an accident or disaster) are established, enabling early detection and impact assessment of the problems that should be solved by science and technology.	2013	8	Technology assessment
52: Systems for assessing the long-term impacts of artificial and natural substances and systems on health and the environment are established, so that the government can systematically provide monitoring/surveillance results on potential threats and other negative issues.	2013	8	Technology assessment

Topic	Year T*	Period*	Area
24: A nursing-care robot that can assist a caregiver in bathing without making the patient feel uncomfortable or uneasy.	2012	4	Support for the elderly and the disabled
49: Technology for expanding leisure time, such as a system in which people can easily find a substitute who performs their office work or household chores, for encouraging the proposal of new ways of spending leisure time.	2011	4	Entertainment technology
01: A robot that provides diverse information and services to enrich people's lives and allows distant family members to monitor each other's safety and health.	2012	5	Safety, security, and stability of day to day life
05: A multi-function smart card that performs personal authentication and other security functions, electronic payments, etc. and may be used for almost all transactions and purchases across the world.	2009	5	Safety, security, and stability of day to day life
06: Low-cost, fast, and secure biometrics authentication technology as a means of identification verification to prevent crime.	2009	5	Safety, security, and stability of day to day life
12: A centralized food safety management system that covers all processes of food, including production, distribution, processing, and sales.	2009	5	Urban safety, security, and stability
16: An information terminal and software with which elderly and disabled people can easily access information networks.	2009	5	Universal availability of services
18: Governmental services through which applications and other formal documents may be submitted to government offices over the Internet.	2005	5	Universal availability of services
20: A secure wide-area medical information system in which individuals can access their own electronic patient charts from their homes.	2008	5	Universal availability of services
22: A work environment in which disabled and elderly people can comfortably work fully using their abilities, and work support technology for constructing such an environment.	2011	5	Support for the elderly and the disabled
31: Traceability technology with which the transport history of every item distributed and traded may be recorded, inspected, and looked up.	2009	5	Technology for solving international problems
34: A scientific system that allows the youth who cannot engage in ordinal communication to acquire sociability even without face-to-face communication.	2012	5	Technology that supports education and learning
36: A learning system that can enhance scientific thinking by allowing learners to experiment/experience unrealistic phenomena/events in a virtual space created by simulation or other technology.	2010	5	Technology that supports education and learning
37: Advances in web-based language translation function allow people to search through online information in any language and retrieve results in a specific language, resulting in the construction of a knowledge repository system from which desired information is instantly retrievable from any part of the world.	2010	5	Technology that supports education and learning

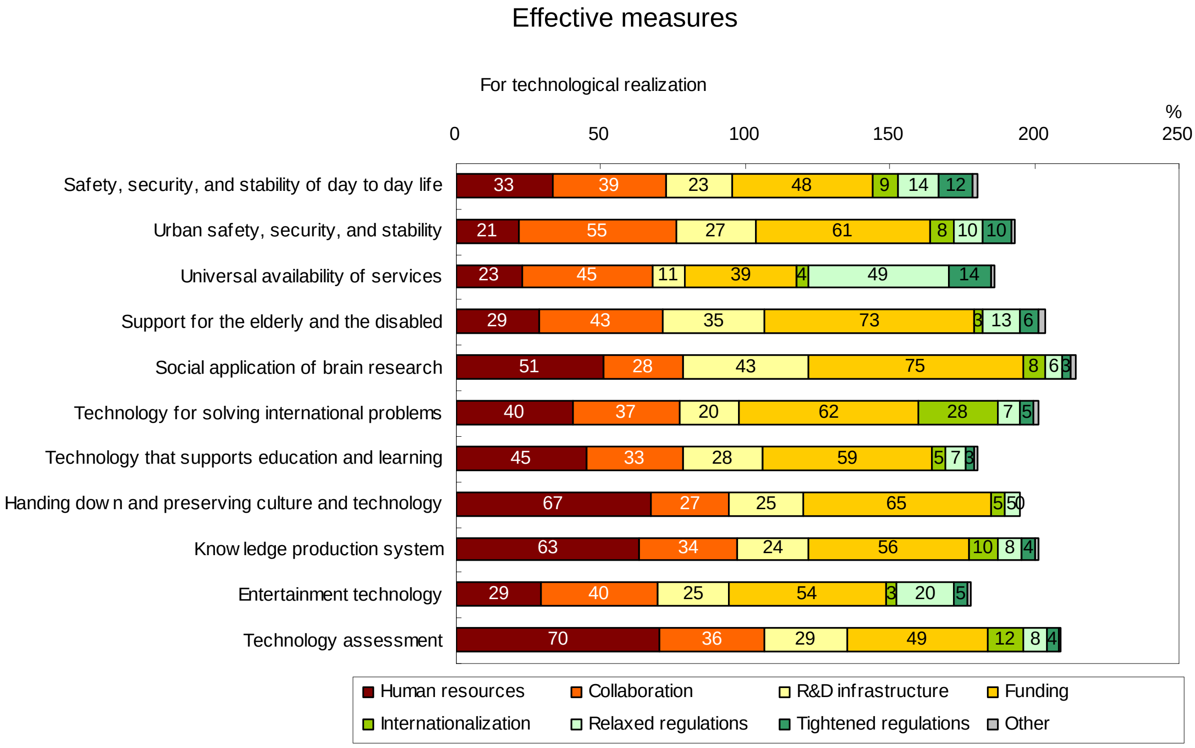
Topic	Year T*	Period*	Area
41: Preserving and protecting intangible cultural properties, such as traditional performing arts, and handing down relevant skills, through the use of digital images, virtual reality technology, etc.	2009	5	Handing down and preserving culture and technology
47: An intelligent transport system (ITS) that makes a motor trip more enjoyable and comfortable by, for example, providing voice guidance on nearby tourist attractions and events for those who make a stop at a roadside station or an expressway toll booth.	2007	5	Entertainment technology

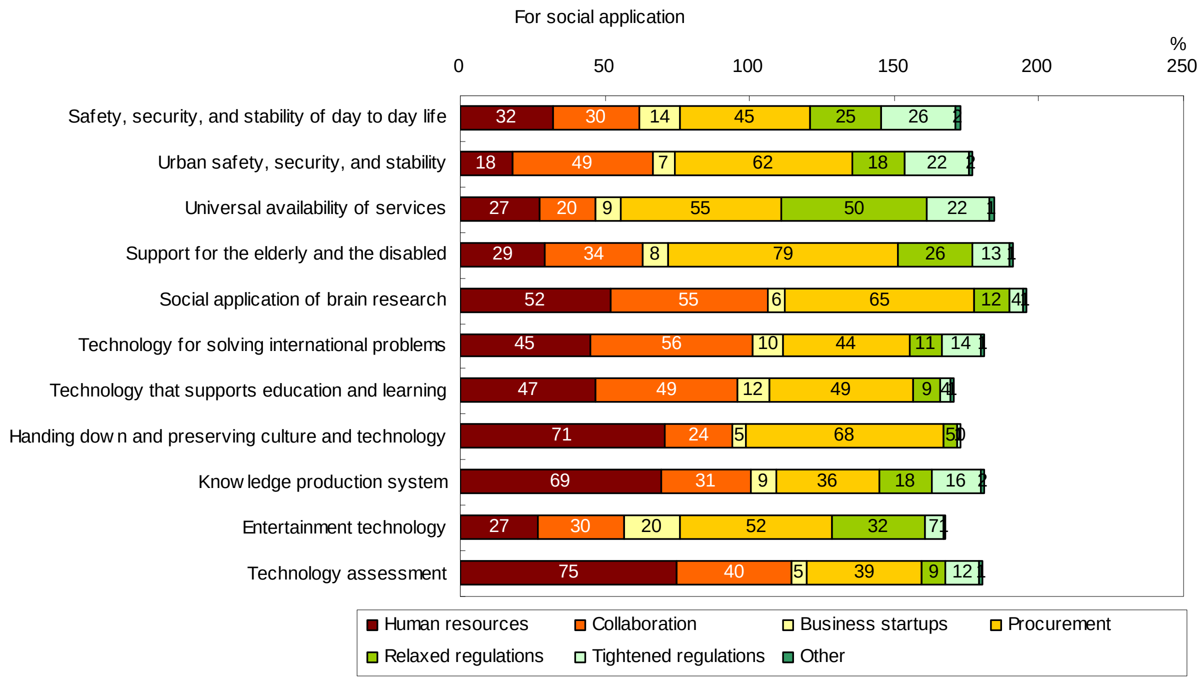
*Year T: Time of technological realization Period: Period until social application (years)

E. Effective measures that should taken by government



*Responses were indexed on a 10-point scale





F. Time-line of topics

Technological realization

year	topic
2005	18: Governmental services through which applications and other formal documents may be submitted to government offices over the Internet.
2006	35: An electronic book that makes full use of multimedia technology for reversing the growing trend of aliteracy or people not reading books.
2007	47: An intelligent transport system (ITS) that makes a motor trip more enjoyable and comfortable by, for example, providing voice guidance on nearby tourist attractions and events for those who make a stop at a roadside station or an expressway toll booth.
2008	20: A secure wide-area medical information system in which individuals can access their own electronic patient charts from their homes.
2009	05: A multi-function smart card that performs personal authentication and other security functions, electronic payments, etc. and may be used for almost all transactions and purchases across the world.
	06: Low-cost, fast, and secure biometrics authentication technology as a means of identification verification to prevent crime.
	12: A centralized food safety management system that covers all processes of food, including production, distribution, processing, and sales.
	14: A secure information storage service widely applicable to central and local government offices.
	16: An information terminal and software with which elderly and disabled people can easily access information networks.
	31: Traceability technology with which the transport history of every item distributed and traded may be recorded, inspected, and looked up.
	40: Handing down skills of producing tangible cultural properties, such as pottery, painting, and woven fabric, through the use of digital images, virtual reality technology, etc.
	41: Preserving and protecting intangible cultural properties, such as traditional performing arts, and handing down relevant skills, through the use of digital images, virtual reality technology, etc.
2010	36: A learning system that can enhance scientific thinking by allowing learners to experiment/experience unrealistic phenomena/events in a virtual space created by simulation or other technology.
	37: Advances in web-based language translation function allow people to search through online information in any language and retrieve results in a specific language, resulting in the construction of a knowledge repository system from which desired information is instantly retrievable from any part of the world.
	45: Construction of a public database that gives centralized access to a collection of the data owned by public institutions and universities, and serves as the infrastructure for knowledge production in society.

year	topic
2011	02: Technology for promoting the formation of local communities using disaster prevention, crime prevention, and welfare as the key concepts.
	09: A wide-area disaster monitoring system that monitors, when a major disaster occurs, the impacts of the disaster widely across the affected area, by using satellite images and the analysis by laser radar equipment, to help provide prompt and safe evacuation guidance.
	21: Technology for advanced mobility/walking support equipment and systems that can dramatically improve the social lives of elderly and disabled people.
	22: A work environment in which disabled and elderly people can comfortably work fully using their abilities, and work support technology for constructing such an environment.
	39: Information storage technology that enables the restoration of tangible cultural properties in the event of loss or damage.
	49: Technology for expanding leisure time, such as a system in which people can easily find a substitute who performs their office work or household chores, for encouraging the proposal of new ways of spending leisure time.
2012	01: A robot that provides diverse information and services to enrich people's lives and allows distant family members to monitor each other's safety and health.
	03: An assessment system for the domestic risk of individual households and a system for supporting concrete safeguards against each risk item.
	04: An information service system that contributes to reducing anxieties about old age by supporting the decision-making process based on future prediction.
	08: Automobiles with automatic driving function for preventing traffic accidents.
	13: An interactive risk management system that applies the conversational knowledge process.
	24: A nursing-care robot that can assist a caregiver in bathing without making the patient feel uncomfortable or uneasy.
	33: A portable voice translation device that enables smooth international communication.
	34: A scientific system that allows the youth who cannot engage in ordinal communication to acquire sociability even without face-to-face communication.
	38: Technology for protecting, restoring, and preserving tangible cultural properties by making full use of nanotechnology, biotechnology, and materials technology.
2013	07: A robot that incorporates sensors capable of quickly detecting explosives, drugs, and toxic substances with as high a sensitivity as animals such as a bomb- or drug-sniffer dog and a canary, which is sensitive to toxic substances.
	10: A system for quickly and accurately detecting trace amounts of explosives, drugs, radioactive substances, and pathogenic microorganisms in public and other crowd-attracting facilities and public transportation such as airports, seaports, and railroads.
	11: A robot applicable to contamination treatment activities at the site of an NBC terror attack (a terror attack aimed at mass killing with nuclear, biological, or chemical material/weapons).
	15: A regional security system in which home security systems are interconnected and use personal robots whose services are not limited to disaster prevention, crime prevention, and nursing care, but much more diverse.
	29: Technology for promoting international communication and mutual understanding by not only interpreting words, but displaying wider information such as the culture, custom, and social principle behind the utterance.
	30: Technology for predicting the occurrence and spread of infectious diseases by combining data on global social and economic activities with a model of infectious disease occurrence.
	32: Technology that assists the interested nations of an international problem in making rational decisions by showing diverse scientific knowledge, arguments, and value judgments in an organized and analytical manner to give an overview of the problem.
	42: Reconstruction of educational and communication systems as a result of the establishment of a knowledge production method independent of space, time, and language.
	44: Widespread use of an evidence-based policy making approach as a result of the clarification and visualization of social problems.
	48: Robot leasing service in which customers can lease robots suited to their needs, such as gardening, nursing care, and household chores.
	51: Systems for early warning and prediction by experts (e.g. early detection of human/livestock infection and prediction of its impacts, early warning of the environmental effects of an accident or disaster) are established, enabling early detection and impact assessment of the problems that should be solved by science and technology.

year	topic
	52: Systems for assessing the long-term impacts of artificial and natural substances and systems on health and the environment are established, so that the government can systematically provide monitoring/surveillance results on potential threats and other negative issues.
	55: Participatory technology assessment (TA) methods involving NPOs and citizens are established to adapt to Japanese society, and over 200 of such assessments are performed in Japan.
2014	25: Media technology that facilitates the sound development of children's brain functions for thinking, creating, and communicating.
	50: A robot that acts as the user's sibling or friend and allows the user to experience pseudo-brotherhood, -sisterhood or -friendship to improve social skills.
2015	26: A system that prevents senile dementia by inhibiting impairment of an elderly person's brain function.
	28: Technology for assisting people who cannot make oral or written conversation because of disease or other reasons in communicating smoothly with others by reading their thoughts based on brain activities.
2016	27: Remedies for truant students, classroom chaos, and learning disabilities as a result of the elucidation of the brain mechanisms behind them.

Social application

year	topic
2010	18: Governmental services through which applications and other formal documents may be submitted to government offices over the Internet.
2012	17: A human resources database and a system for coordinating human resources placement and outsourcing, for eliminating regional disparities in human resources.
	19: A system that supports women's social participation by ensuring mothers the future availability of child-rearing support such as nursery schools, at the time of pregnancy or childbirth.
	35: An electronic book that makes full use of multimedia technology for reversing the growing trend of aliteracy or people not reading books.
	47: An intelligent transport system (ITS) that makes a motor trip more enjoyable and comfortable by, for example, providing voice guidance on nearby tourist attractions and events for those who make a stop at a roadside station or an expressway toll booth.
2013	20: A secure wide-area medical information system in which individuals can access their own electronic patient charts from their homes.
2014	05: A multi-function smart card that performs personal authentication and other security functions, electronic payments, etc. and may be used for almost all transactions and purchases across the world.
	06: Low-cost, fast, and secure biometrics authentication technology as a means of identification verification to prevent crime.
	12: A centralized food safety management system that covers all processes of food, including production, distribution, processing, and sales.
	16: An information terminal and software with which elderly and disabled people can easily access information networks.
	23: Proliferation of terminal-care environments, facilities, and technology in which patients can end their lives comfortably and peacefully.
	31: Traceability technology with which the transport history of every item distributed and traded may be recorded, inspected, and looked up.
	41: Preserving and protecting intangible cultural properties, such as traditional performing arts, and handing down relevant skills, through the use of digital images, virtual reality technology, etc.
	46: Establishment of global rules concerning the copyright of multimedia information to promote the production and distribution of multimedia content.
2015	14: A secure information storage service widely applicable to central and local government offices.
	36: A learning system that can enhance scientific thinking by allowing learners to experiment/experience unrealistic phenomena/events in a virtual space created by simulation or other technology.
	37: Advances in web-based language translation function allow people to search through online information in any language and retrieve results in a specific language, resulting in the construction of a knowledge repository system from which desired information is instantly retrievable from any part of the world.
	40: Handing down skills of producing tangible cultural properties, such as pottery, painting, and woven fabric, through the use of digital images, virtual reality technology, etc.

year	topic
	49: Technology for expanding leisure time, such as a system in which people can easily find a substitute who performs their office work or household chores, for encouraging the proposal of new ways of spending leisure time.
	53: A cycle is established in which ELSI (Ethical, Legal and Social Issues) research is promoted, in parallel with advanced research, and the results contribute to the formulation of research strategy, and subsequently, the ELSI research funds exceed 3% of the total research funds.
2016	22: A work environment in which disabled and elderly people can comfortably work fully using their abilities, and work support technology for constructing such an environment.
	24: A nursing-care robot that can assist a caregiver in bathing without making the patient feel uncomfortable or uneasy.
2017	01: A robot that provides diverse information and services to enrich people's lives and allows distant family members to monitor each other's safety and health.
	21: Technology for advanced mobility/walking support equipment and systems that can dramatically improve the social lives of elderly and disabled people.
	34: A scientific system that allows the youth who cannot engage in ordinal communication to acquire sociability even without face-to-face communication.
	39: Information storage technology that enables the restoration of tangible cultural properties in the event of loss or damage.
	54: An bioethical public debate involving diverse and numerous people of Japan is held to form a consensus on how to combine bioethics and research activities.
2018	02: Technology for promoting the formation of local communities using disaster prevention, crime prevention, and welfare as the key concepts.
	03: An assessment system for the domestic risk of individual households and a system for supporting concrete safeguards against each risk item.
	09: A wide-area disaster monitoring system that monitors, when a major disaster occurs, the impacts of the disaster widely across the affected area, by using satellite images and the analysis by laser radar equipment, to help provide prompt and safe evacuation guidance.
	33: A portable voice translation device that enables smooth international communication.
	45: Construction of a public database that gives centralized access to a collection of the data owned by public institutions and universities, and serves as the infrastructure for knowledge production in society.
	56: To address the NIMBY (not in my backyard) problem, the form of discussion and the procedure intended for convincing the interested parties are established.
2019	04: An information service system that contributes to reducing anxieties about old age by supporting the decision-making process based on future prediction.
	13: An interactive risk management system that applies the conversational knowledge process.
	38: Technology for protecting, restoring, and preserving tangible cultural properties by making full use of nanotechnology, biotechnology, and materials technology.
2020	07: A robot that incorporates sensors capable of quickly detecting explosives, drugs, and toxic substances with as high a sensitivity as animals such as a bomb- or drug-sniffer dog and a canary, which is sensitive to toxic substances.
	08: Automobiles with automatic driving function for preventing traffic accidents.
	10: A system for quickly and accurately detecting trace amounts of explosives, drugs, radioactive substances, and pathogenic microorganisms in public and other crowd-attracting facilities and public transportation such as airports, seaports, and railroads.
	11: A robot applicable to contamination treatment activities at the site of an NBC terror attack (a terror attack aimed at mass killing with nuclear, biological, or chemical material/weapons).
	15: A regional security system in which home security systems are interconnected and use personal robots whose services are not limited to disaster prevention, crime prevention, and nursing care, but much more diverse.
	30: Technology for predicting the occurrence and spread of infectious diseases by combining data on global social and economic activities with a model of infectious disease occurrence.
	32: Technology that assists the interested nations of an international problem in making rational decisions by showing diverse scientific knowledge, arguments, and value judgments in an organized and analytical manner to give an overview of the problem.
	44: Widespread use of an evidence-based policy making approach as a result of the clarification and visualization of social problems.

year	topic
	55: Participatory technology assessment (TA) methods involving NPOs and citizens are established to adapt to Japanese society, and over 200 of such assessments are performed in Japan.
2021	29: Technology for promoting international communication and mutual understanding by not only interpreting words, but displaying wider information such as the culture, custom, and social principle behind the utterance.
	42: Reconstruction of educational and communication systems as a result of the establishment of a knowledge production method independent of space, time, and language.
	43: Introduction of a new social decision-making approach as a result of the dissolution of the boundary between experts and non-experts through fusion between knowledge producers and knowledge consumers.
	48: Robot leasing service in which customers can lease robots suited to their needs, such as gardening, nursing care, and household chores.
	51: Systems for early warning and prediction by experts (e.g. early detection of human/livestock infection and prediction of its impacts, early warning of the environmental effects of an accident or disaster) are established, enabling early detection and impact assessment of the problems that should be solved by science and technology.
	52: Systems for assessing the long-term impacts of artificial and natural substances and systems on health and the environment are established, so that the government can systematically provide monitoring/surveillance results on potential threats and other negative issues.
2022	25: Media technology that facilitates the sound development of children's brain functions for thinking, creating, and communicating.
	26: A system that prevents senile dementia by inhibiting impairment of an elderly person's brain function.
	50: A robot that acts as the user's sibling or friend and allows the user to experience pseudo-brotherhood, -sisterhood or -friendship to improve social skills.
2023	27: Remedies for truant students, classroom chaos, and learning disabilities as a result of the elucidation of the brain mechanisms behind them.
2024	28: Technology for assisting people who cannot make oral or written conversation because of disease or other reasons in communicating smoothly with others by reading their thoughts based on brain activities.

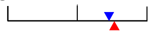
Appendix: Results of R1 and R2

I. Safety, security, and stability of day to day life

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



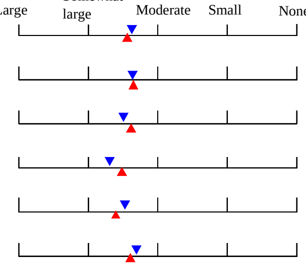
2) Current impacts

Large / Somewhat large / Moderate / Small / None

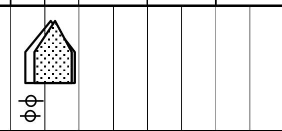
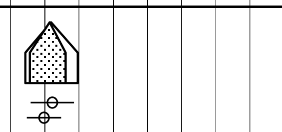
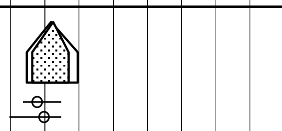
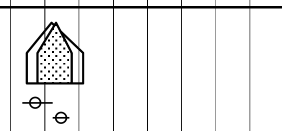
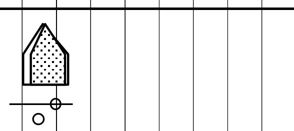
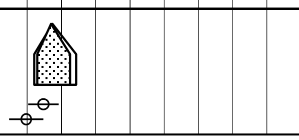
[Increased intellectual assets]
Contribution of the relevant area itself to increased intellectual assets
Contribution to the development of other fields

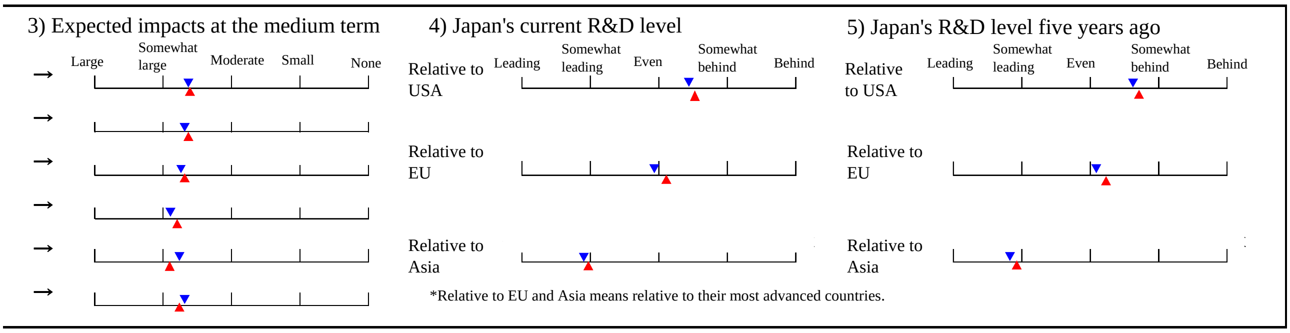
[Economic impacts]
Contribution to the development of existing Japanese industry
Contribution to the creation of new industries or businesses

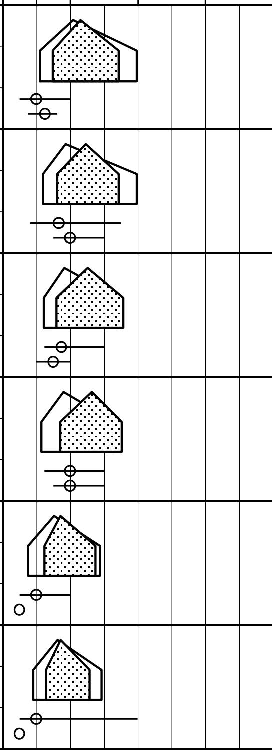
[Social impacts]
Contribution to safety and security
Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–)	Will not be realized (%)	Do not know (%)
1	A robot that provides diverse information and services to enrich people's lives and allows distant family members to monitor each other's safety and health.	1	97	12	20	68	-	58	28	50	20	2		2	4
		2	86	7	19	74	-	54	19	61	20	0		1	1
		E	6	100	0	0	-	90	80	20	0	0		0	0
2	Technology for promoting the formation of local communities using disaster prevention, crime prevention, and welfare as the key concepts.	1	105	10	27	63	-	70	46	46	6	2		3	10
		2	89	4	21	75	-	69	40	57	3	0		0	7
		E	4	100	0	0	-	88	75	25	0	0		0	0
3	An assessment system for the domestic risk of individual households and a system for supporting concrete safeguards against each risk item.	1	76	11	25	64	-	46	12	52	31	5		5	13
		2	76	5	24	71	-	46	7	66	24	3		3	5
		E	4	100	0	0	-	56	25	50	25	0		0	0
4	An information service system that contributes to reducing anxieties about old age by supporting the decision-making process based on future prediction.	1	84	8	23	69	-	55	29	41	24	6		8	13
		2	82	4	20	76	-	50	19	50	25	6		4	6
		E	3	100	0	0	-	58	34	33	33	0		0	33
5	A multi-function smart card that performs personal authentication and other security functions, electronic payments, etc. and may be used for almost all transactions and purchases across the world.	1	100	9	19	72	-	54	27	41	27	5		3	3
		2	85	2	11	87	-	54	22	53	21	4		2	2
		E	2	100	0	0	-	63	50	0	50	0		0	50
6	Low-cost, fast, and secure biometrics authentication technology as a means of identification verification to prevent crime.	1	96	9	20	71	-	66	40	46	13	1		0	3
		2	81	2	16	82	-	68	39	55	6	0		0	1
		E	2	100	0	0	-	75	50	50	0	0		0	0



Countries at the leading edge					Regarding technological realization: Necessity of gov't involvement				Regarding technological realization: Effective measures that should be taken by gov't								Time of social application			Regarding social application: Necessity of gov't involvement				Regarding social application: Effective measures that should be taken by gov't						
Japan (%)	USA (%)	EU (%)	Asia (%)	Other (%)	High (%)	Moderate (%)	Low (%)	None (%)	Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration (%)	Development of R&D infrastructure (%)	Expansion of R&D funding (%)	Internationalization of R&D activities (%)	Relaxation or elimination of relevant regulations (%)	Tightened or new regulations (%)	Other (%)	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	High (%)	Moderate (%)	Low (%)	None (%)	Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration (%)	Improvement of environment for business startups (%)	Support through taxation, subsidies, and procurement (%)	Relaxation or elimination of relevant regulations (%)	Tightened or new regulations (%)	Other (%)
68	28	2	2	0	22	33	32	13	28	51	33	60	9	21	12	0		2	6	24	33	32	11	28	36	28	51	31	23	0
73	25	2	0	0	11	41	43	5	18	53	18	61	5	20	5	0		1	4	14	46	37	3	15	34	20	60	27	11	1
83	17	0	0	0	17	50	33	0	33	50	17	100	0	33	17	0		0	0	50	33	17	0	50	17	33	67	50	33	0
17	43	36	2	2	31	46	15	8	40	42	30	43	8	16	12	4		3	12	32	40	21	7	47	30	18	43	26	25	2
7	51	38	2	2	21	61	13	5	54	43	26	40	4	11	10	2		0	5	25	54	16	5	48	24	13	60	30	12	2
50	25	25	0	0	75	25	0	0	50	75	50	50	0	25	50	0		0	0	75	25	0	0	50	50	25	100	50	50	0
11	61	22	0	6	15	34	33	18	41	39	32	43	9	14	5	0		8	16	13	38	32	17	44	28	14	40	21	16	0
3	85	9	0	3	8	49	36	7	53	31	10	47	4	13	4	1		4	5	9	45	41	5	59	17	8	52	14	10	1
0	75	25	0	0	25	25	50	0	50	0	0	50	0	25	0	0		0	0	25	25	50	0	50	25	0	25	0	25	0
23	59	17	0	1	24	36	25	15	42	34	40	43	9	17	5	2		7	14	19	44	22	15	38	28	20	42	20	14	0
6	82	9	0	3	19	46	29	6	50	26	32	43	7	11	3	3		3	3	14	52	26	8	44	19	17	57	19	7	1
0	100	0	0	0	50	50	0	0	50	50	0	100	50	0	0	0		0	0	0	50	50	0	0	50	0	50	50	50	0
20	71	8	1	0	25	27	19	29	13	37	25	31	31	31	34	1		7	5	32	29	22	17	14	28	17	18	38	53	4
9	87	4	0	0	22	36	21	21	11	39	22	36	22	23	30	2		2	2	33	36	20	11	14	27	15	18	42	57	3
100	0	0	0	0	50	0	50	0	50	50	0	0	50	50	100	0		0	50	0	50	50	0	50	50	50	0	50	100	0
14	83	2	1	0	30	34	22	14	21	41	35	53	22	17	27	1		1	4	33	33	22	12	19	40	18	25	23	51	3
6	94	0	0	0	24	50	22	4	15	44	30	63	12	5	18	1		0	1	35	52	11	2	14	56	10	25	15	57	1
100	0	0	0	0	50	0	50	0	50	50	100	100	50	50	100	0		0	0	50	50	0	0	50	100	0	50	50	100	0

II. Urban safety, security, and stability

1. Questions regarding the relevant area

1) Degree of expertise in the area

High — Moderate — Low

2) Current impacts

Scale: Large — Somewhat large — Moderate — Small — None

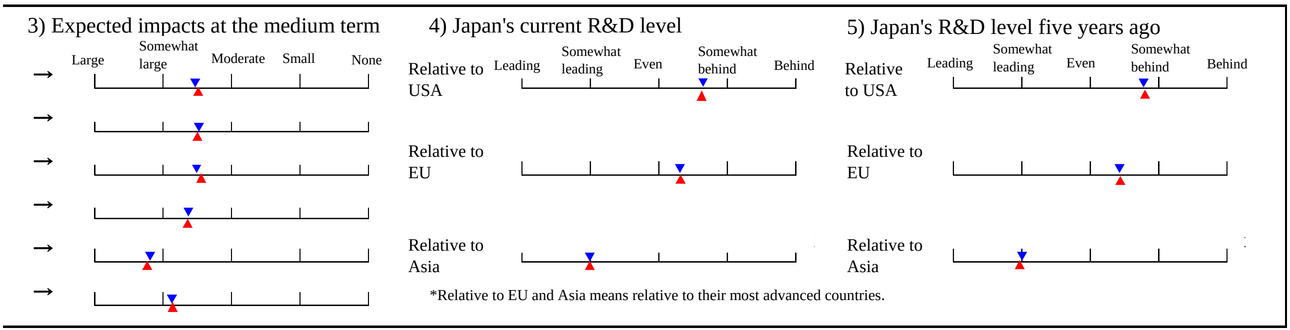
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

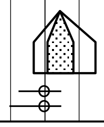
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life

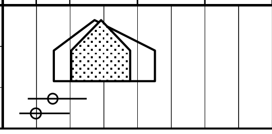
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
7	A robot that incorporates sensors capable of quickly detecting explosives, drugs, and toxic substances with as high a sensitivity as animals such as a bomb- or drug-sniffer dog and a canary, which is sensitive to toxic substances.	1	82	11	24	65	-	64	36	52	10	2							2	2
		2	74	7	14	79	-	57	19	70	11	0							0	3
		E	5	100	0	0	-	90	80	20	0	0							0	0
8	Automobiles with automatic driving function for preventing traffic accidents.	1	95	13	17	70	-	64	39	40	20	1							1	4
		2	81	5	10	85	-	57	25	55	19	1							1	4
		E	4	100	0	0	-	100	100	0	0	0							0	0
9	A wide-area disaster monitoring system that monitors, when a major disaster occurs, the impacts of the disaster widely across the affected area, by using satellite images and the analysis by laser radar equipment, to help provide prompt and safe evacuation guidance.	1	90	12	30	58	-	81	67	28	4	1							1	2
		2	77	4	22	74	-	88	76	21	3	0							0	1
		E	3	100	0	0	-	83	67	33	0	0							0	0
10	A system for quickly and accurately detecting trace amounts of explosives, drugs, radioactive substances, and pathogenic microorganisms in public and other crowd-attracting facilities and public transportation such as airports, seaports, and railroads.	1	87	20	24	56	-	73	53	35	8	4							6	1
		2	78	9	22	69	-	86	76	18	6	0							0	3
		E	7	100	0	0	-	93	86	14	0	0							0	0
11	A robot applicable to contamination treatment activities at the site of an NBC terror attack (a terror attack aimed at mass killing with nuclear, biological, or chemical material/weapons).	1	83	10	25	65	-	65	40	43	15	2							4	4
		2	72	4	15	81	-	65	34	59	7	0							0	3
		E	3	100	0	0	-	50	0	100	0	0							0	0
12	A centralized food safety management system that covers all processes of food, including production, distribution, processing, and sales.	1	86	8	27	65	-	67	39	53	8	0							0	6
		2	73	4	16	80	-	67	38	56	6	0							0	1
		E	3	100	0	0	-	67	33	67	0	0							0	0
13	An interactive risk management system that applies the conversational knowledge process.	1	76	20	28	52	-	51	23	43	26	8							3	7
		2	72	7	32	61	-	46	11	55	30	4							0	4
		E	5	100	0	0	-	75	60	20	20	0							0	0
14	A secure information storage service widely applicable to central and local government offices.	1	87	9	24	67	-	64	39	40	21	0							1	3
		2	76	4	22	74	-	58	23	64	12	1							0	3
		E	3	100	0	0	-	58	34	33	33	0							0	0



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application			Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
10	89	0	0	1	44	36	14	6	25	49	36	67	23	4	5	0		1	5	50	33	8	9	23	46	23	56	14	24	0
8	92	0	0	0	49	40	10	1	18	56	29	72	8	7	3	1		0	4	62	26	11	1	10	52	10	68	10	17	1
40	60	0	0	0	75	25	0	0	50	75	50	75	25	0	0	0		0	0	80	20	0	0	40	80	0	80	0	20	0
69	21	10	0	0	17	30	33	20	17	51	23	46	11	31	17	1		1	7	31	27	24	18	17	33	14	46	44	38	0
81	16	3	0	0	10	49	35	6	12	62	16	57	4	22	7	1		1	4	29	42	23	6	8	34	5	56	51	29	1
100	0	0	0	0	25	75	0	0	25	25	0	50	0	0	25	0		0	0	50	50	0	0	25	50	0	25	25	25	0
17	81	2	0	0	68	25	7	0	25	47	44	69	25	8	5	0		0	2	71	21	7	1	30	49	14	54	19	18	2
9	90	0	0	1	75	20	4	1	17	55	35	81	13	5	3	1		0	3	77	21	1	1	21	58	3	73	8	7	1
67	33	0	0	0	67	33	0	0	67	67	33	100	0	0	0	0		0	0	67	33	0	0	67	33	0	33	0	33	0
10	89	1	0	0	60	28	8	4	33	45	43	65	28	10	14	0		4	2	65	25	6	4	23	50	22	54	21	26	3
4	95	1	0	0	73	19	5	3	21	55	32	79	12	8	7	1		0	3	74	19	4	3	12	68	9	66	11	14	1
29	71	0	0	0	86	14	0	0	43	86	29	57	14	29	29	0		0	0	83	17	0	0	17	83	0	33	17	17	0
25	72	3	0	0	52	33	12	3	32	45	45	64	25	8	7	0		5	5	58	29	10	3	27	45	20	61	18	22	3
6	94	0	0	0	63	29	7	1	21	45	30	75	15	8	4	1		0	3	75	23	1	1	9	59	7	74	10	13	1
67	33	0	0	0	67	33	0	0	67	33	0	100	0	33	33	0		0	0	100	0	0	0	33	67	0	100	0	33	0
50	28	21	0	1	42	33	20	5	33	48	33	33	15	16	39	1		0	6	48	30	17	5	31	39	11	40	28	54	1
76	10	14	0	0	59	32	5	4	17	74	17	30	4	14	34	1		1	4	70	25	1	4	9	40	4	59	15	60	3
67	33	0	0	0	33	67	0	0	33	67	33	0	0	0	67	0		0	0	67	33	0	0	33	67	0	33	0	67	0
22	62	13	0	3	10	39	36	15	35	35	34	44	13	8	6	0		4	8	16	34	36	14	48	39	21	39	16	16	2
6	87	6	0	1	1	56	36	7	46	35	22	55	5	8	3	2		4	3	6	44	41	9	61	33	5	48	10	7	2
40	60	0	0	0	0	80	20	0	80	0	40	40	0	0	0	0		0	0	0	60	40	0	80	20	0	40	20	0	0
4	83	13	0	0	40	42	18	0	30	43	34	30	6	18	24	4		2	6	50	33	16	1	30	38	10	43	28	38	3
1	95	4	0	0	37	47	15	1	25	65	27	28	6	8	21	1		0	1	68	19	10	3	25	41	4	45	24	39	1
0	67	33	0	0	34	33	33	0	33	33	67	33	67	0	0	0		0	0	67	0	33	0	33	67	0	33	33	33	0

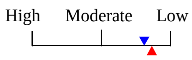
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan (%)					Time of technological realization	Will not be realized (%)	Do not know (%)
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–		
15	A regional security system in which home security systems are interconnected and use personal robots whose services are not limited to disaster prevention, crime prevention, and nursing care, but much more diverse.	1	**86**	**8**	**30**	**62**	**-**	**53**	**22**	**49**	**25**	**4**		**4**	**6**
		2	**73**	**5**	**14**	**81**	**-**	**50**	**15**	**58**	**23**	**4**		**1**	**3**
		E	**4**	**100**	**0**	**0**	**-**	**69**	**50**	**25**	**25**	**0**		**0**	**0**

Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
47	**44**	**6**	**0**	**3**	**23**	**41**	**30**	**6**	**25**	**47**	**48**	**57**	**12**	**17**	**14**	**3**		**6**	**9**	**27**	**43**	**23**	**7**	**20**	**45**	**24**	**61**	**27**	**19**	**4**
53	**44**	**3**	**0**	**0**	**10**	**66**	**18**	**6**	**15**	**46**	**39**	**67**	**3**	**12**	**6**	**1**		**3**	**1**	**17**	**61**	**16**	**6**	**9**	**53**	**17**	**67**	**24**	**12**	**2**
75	**0**	**25**	**0**	**0**	**25**	**50**	**25**	**0**	**50**	**75**	**75**	**75**	**0**	**0**	**25**	**0**		**0**	**0**	**25**	**50**	**25**	**0**	**50**	**50**	**50**	**100**	**25**	**50**	**0**

III. Universal availability of services

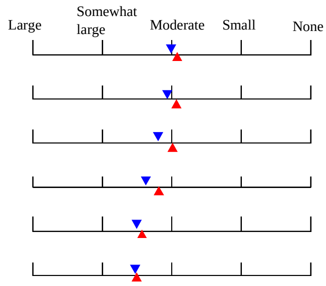
1. Questions regarding the relevant area

1) Degree of expertise in the area



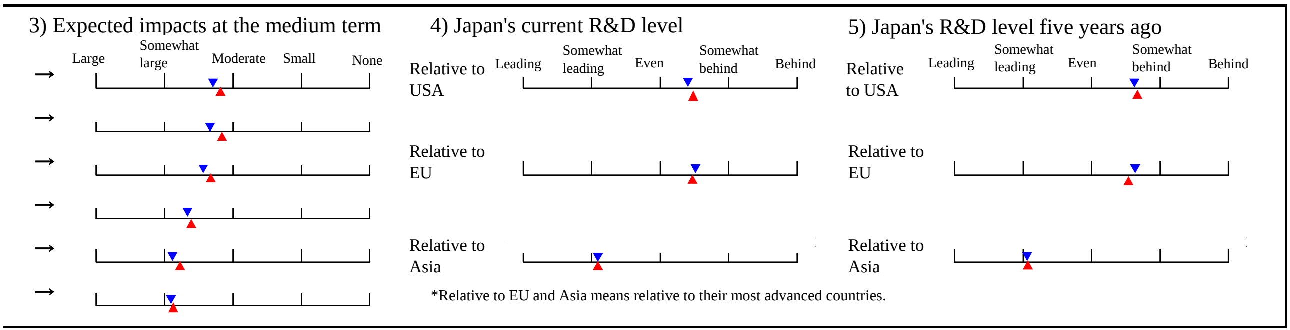
2) Current impacts

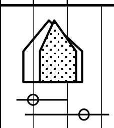
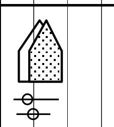
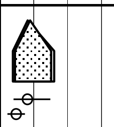
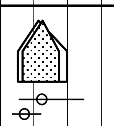
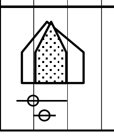
Category	Item
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
16	An information terminal and software with which elderly and disabled people can easily access information networks.	1	**94**	**9**	**27**	**64**	-	**63**	**34**	**53**	**12**	**1**							**0**	**1**
		2	**83**	**4**	**18**	**78**	-	**57**	**18**	**73**	**9**	**0**							**0**	**1**
		E	**3**	**100**	**0**	**0**	-	**67**	**33**	**67**	**0**	**0**							**0**	**0**
17	A human resources database and a system for coordinating human resources placement and outsourcing, for eliminating regional disparities in human resources.	1	**76**	**8**	**28**	**64**	-	**53**	**22**	**51**	**23**	**4**								
		2	**71**	**3**	**21**	**76**	-	**51**	**13**	**67**	**17**	**3**								
		E	**2**	**100**	**0**	**0**	-	**63**	**50**	**0**	**50**	**0**								
18	Governmental services through which applications and other formal documents may be submitted to government offices over the Internet.	1	**92**	**11**	**21**	**68**	-	**59**	**30**	**47**	**21**	**2**							**0**	**1**
		2	**81**	**5**	**15**	**80**	-	**58**	**20**	**73**	**6**	**1**							**0**	**1**
		E	**4**	**100**	**0**	**0**	-	**63**	**25**	**75**	**0**	**0**							**0**	**0**
19	A system that supports women's social participation by ensuring mothers the future availability of child-rearing support such as nursery schools, at the time of pregnancy or childbirth.	1	**77**	**12**	**18**	**70**	-	**77**	**56**	**40**	**4**	**0**								
		2	**77**	**4**	**13**	**83**	-	**84**	**69**	**27**	**4**	**0**								
		E	**3**	**100**	**0**	**0**	-	**75**	**50**	**50**	**0**	**0**								
20	A secure wide-area medical information system in which individuals can access their own electronic patient charts from their homes.	1	**85**	**12**	**25**	**63**	-	**59**	**29**	**48**	**22**	**1**							**2**	**5**
		2	**79**	**5**	**19**	**76**	-	**53**	**13**	**75**	**9**	**3**							**1**	**3**
		E	**4**	**100**	**0**	**0**	-	**63**	**25**	**75**	**0**	**0**							**0**	**0**

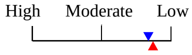


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application							Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
21	45	33	0	1	24	43	26	7	37	42	32	56	6	13	11	0						0	5	26	43	24	7	30	36	29	60	24	14	4
7	76	17	0	0	11	69	13	7	25	55	17	71	7	8	4	1						0	1	15	70	10	5	21	32	18	81	15	8	1
33	67	0	0	0	33	67	0	0	33	100	67	100	67	0	0	0						0	0	33	67	0	0	67	67	67	67	33	0	0
																						3	7	21	38	31	10	37	27	17	46	38	16	5
																						0	1	10	65	19	6	39	16	11	64	30	11	2
																						0	0	0	50	50	0	100	0	0	0	0	0	0
19	57	19	5	0	35	30	19	16	21	33	8	16	5	49	32	4						0	2	44	31	18	7	19	18	8	27	60	37	6
5	90	4	1	0	58	23	8	11	24	37	6	11	1	72	23	1						0	1	73	16	6	5	16	12	4	23	81	32	1
0	50	50	0	0	25	25	25	25	67	67	33	33	33	67	33	33						0	0	50	25	25	0	50	25	25	50	75	75	25
																						0	9	60	29	10	1	33	20	14	56	47	37	3
																						0	5	84	12	3	1	35	13	7	76	50	24	1
																						0	0	67	33	0	0	100	0	0	100	33	33	0
13	63	20	0	4	20	45	23	12	24	39	20	37	7	50	29	3						2	11	26	46	21	7	31	28	12	37	52	40	3
4	92	4	0	0	14	65	9	12	19	44	10	34	4	66	16	1						3	3	19	64	9	8	27	26	4	33	76	33	1
25	75	0	0	0	50	50	0	0	50	50	0	75	0	50	0	0						0	0	50	50	0	0	50	25	0	75	50	0	0

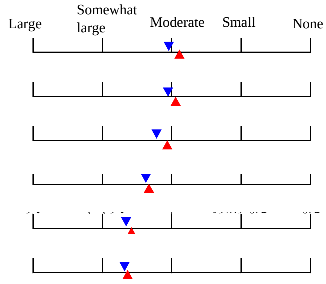
IV. Support for the elderly and the disabled

1. Questions regarding the relevant area

1) Degree of expertise in the area



2) Current impacts

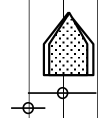


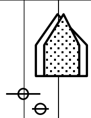
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

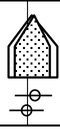
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate	Low	None	Time of technological realization: Will not be realized (%)	Do not know
21	Technology for advanced mobility/walking support equipment and systems that can dramatically improve the social lives of elderly and disabled people.	1	82	5	30	65	-	64	35	53	11	1	0	1
		2	78	3	14	83	-	60	23	72	5	0	0	1
		E	2	100	0	0	-	100	100	0	0	0	0	0
22	A work environment in which disabled and elderly people can comfortably work fully using their abilities, and work support technology for constructing such an environment.	1	80	5	24	71	-	69	42	49	9	0	0	6
		2	76	3	16	81	-	64	32	63	4	1	0	1
		E	2	100	0	0	-	100	100	0	0	0	0	0
23	Proliferation of terminal-care environments, facilities, and technology in which patients can end their lives comfortably and peacefully.	1	83	7	24	69	-	64	34	54	11	1		
		2	80	1	19	80	-	54	14	74	9	3		
		E	1	100	0	0	-	100	100	0	0	0		
24	A nursing-care robot that can assist a caregiver in bathing without making the patient feel uncomfortable or uneasy.	1	89	9	26	65	-	64	35	52	11	2	0	2
		2	78	5	14	81	-	55	14	77	9	0	0	1
		E	4	100	0	0	-	63	25	75	0	0	0	0

Time of technological realization (columns: Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–):



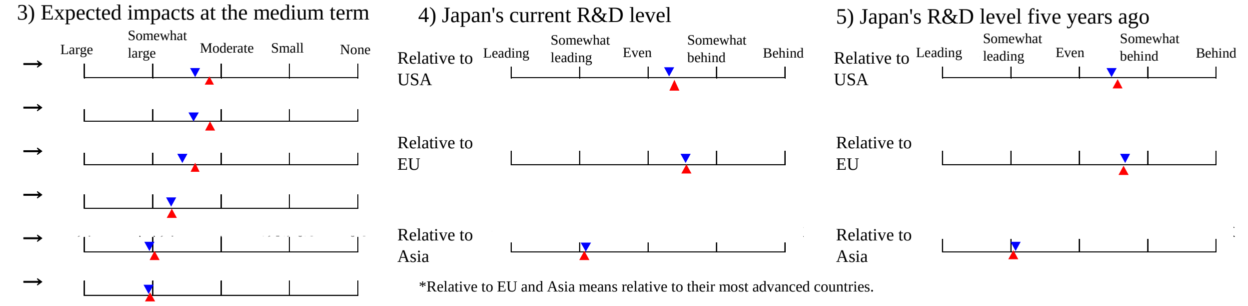




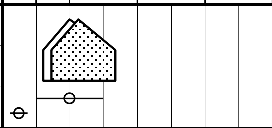
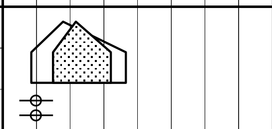
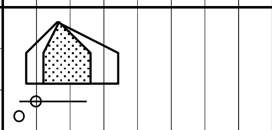
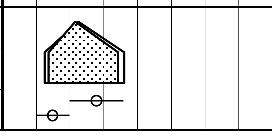
3) Expected impacts at the medium term

4) Japan's current R&D level

5) Japan's R&D level five years ago



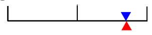
*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge: Japan (%)	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application (2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be applied (%)	Do not know	Regarding social application – Necessity of gov't: High (%)	Moderate	Low	None	Effective measures that should be taken by gov't: Human resources development (%)	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
41	28	30	0	1	22	50	23	5	26	42	46	72	9	14	11	3		1	1	31	39	26	4	25	40	29	66	32	19	3
61	14	25	0	0	12	74	13	1	13	45	37	76	1	11	4	3		0	1	27	60	9	4	20	45	8	77	27	8	1
50	0	50	0	0	50	50	0	0	50	50	0	100	0	0	0	0		0	0	100	0	0	0	50	50	0	100	50	50	0
10	27	60	0	3	37	49	13	1	42	36	33	46	5	29	16	1		0	4	38	45	14	3	36	36	23	64	31	34	1
4	12	83	0	1	19	69	9	3	51	31	29	67	4	17	11	1		0	3	28	64	5	3	30	30	9	84	24	20	1
0	0	100	0	0	50	50	0	0	50	50	0	100	0	0	0	0		0	0	100	0	0	0	50	50	0	100	50	50	0
																		3	13	29	44	18	9	34	24	19	50	41	31	1
																		1	3	23	60	11	6	47	19	7	69	30	12	1
																		0	0	100	0	0	0	100	0	0	100	0	0	0
66	14	19	0	1	20	51	22	7	26	45	44	73	10	19	9	4		0	3	26	44	23	7	21	39	23	69	36	21	3
79	8	13	0	0	8	73	16	3	21	53	39	76	3	12	4	3		0	1	17	67	12	4	19	42	10	88	23	10	1
100	0	0	0	0	50	50	0	0	50	50	50	100	0	0	0	0		0	0	50	50	0	0	50	75	0	100	0	0	0

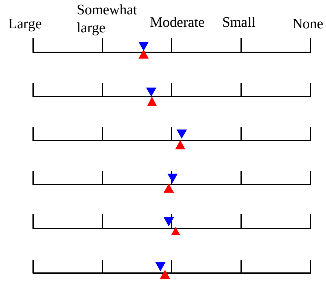
V. Social application of brain research

1. Questions regarding the relevant area

1) Degree of expertise in the area

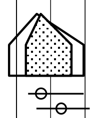
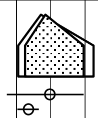
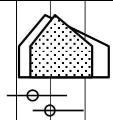
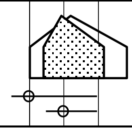


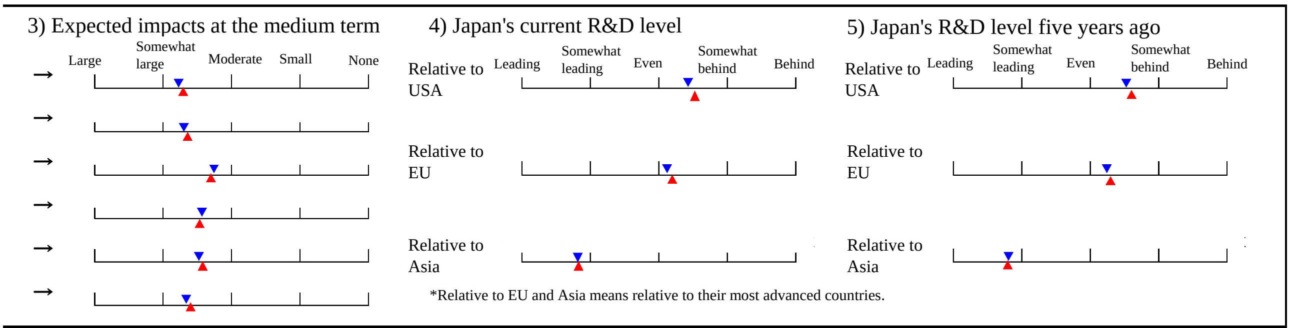
2) Current impacts

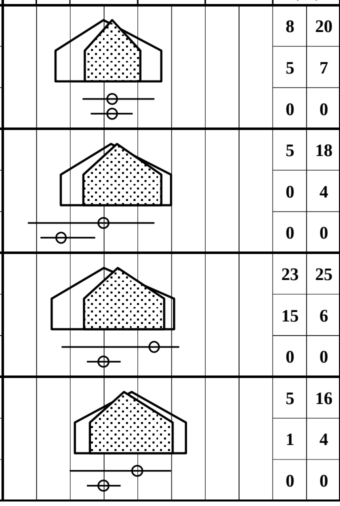


[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
25	Media technology that facilitates the sound development of children's brain functions for thinking, creating, and communicating.	1	80	11	24	65	-	62	37	37	23	3		8	19
		2	76	7	16	77	-	60	31	50	15	4		4	7
		E	5	100	0	0	-	100	100	0	0	0		0	0
26	A system that prevents senile dementia by inhibiting impairment of an elderly person's brain function.	1	77	8	21	71	-	69	47	38	12	3		4	16
		2	71	7	11	82	-	82	66	31	3	0		0	6
		E	5	100	0	0	-	100	100	0	0	0		0	0
27	Remedies for truant students, classroom chaos, and learning disabilities as a result of the elucidation of the brain mechanisms behind them.	1	78	5	26	69	-	55	26	44	26	4		21	25
		2	71	6	18	76	-	58	23	65	9	3		14	4
		E	4	100	0	0	-	88	75	25	0	0		0	0
28	Technology for assisting people who cannot make oral or written conversation because of disease or other reasons in communicating smoothly with others by reading their thoughts based on brain activities.	1	76	7	24	69	-	57	24	56	20	0		4	12
		2	71	3	13	84	-	58	20	70	10	0		1	4
		E	2	100	0	0	-	75	50	50	0	0		0	0

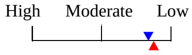


Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
12	68	13	0	7	23	35	30	12	53	43	47	57	18	10	3	1		8	20	25	35	26	14	58	55	18	48	18	15	2
7	92	1	0	0	19	46	28	7	60	31	34	70	10	9	6	3		5	7	16	53	24	7	59	48	6	49	14	7	3
0	100	0	0	0	80	20	0	0	60	20	20	100	40	0	0	0		0	0	40	60	0	0	40	40	20	80	20	0	0
18	68	9	0	5	36	45	16	3	37	42	46	75	21	11	6	0		5	18	34	39	23	4	41	54	19	65	22	13	0
3	94	3	0	0	27	63	9	1	41	38	51	77	7	6	1	0		0	4	21	66	10	3	41	60	7	75	12	3	0
40	40	20	0	0	80	20	0	0	60	40	20	100	20	0	0	0		0	0	40	60	0	0	40	60	20	80	0	0	0
20	59	9	0	12	28	29	32	11	52	39	40	58	10	9	1	3		23	25	30	29	26	15	54	56	8	43	15	10	3
6	90	3	0	1	23	48	25	4	65	18	36	74	8	3	3	5		15	6	34	43	14	9	65	52	3	56	11	5	2
0	100	0	0	0	75	25	0	0	100	25	0	75	25	0	0	0		0	0	25	75	0	0	50	25	0	75	25	0	0
12	67	15	0	6	20	44	32	4	39	37	49	63	8	8	3	0		5	16	24	34	38	4	34	46	17	63	17	7	0
6	93	1	0	0	18	61	20	1	38	23	51	78	6	6	1	0		1	4	16	55	26	3	42	58	6	82	12	3	0
0	100	0	0	0	50	50	0	0	50	0	50	50	50	0	0	0		0	0	0	100	0	0	50	50	0	100	0	0	0

VI. Technology for solving international problems

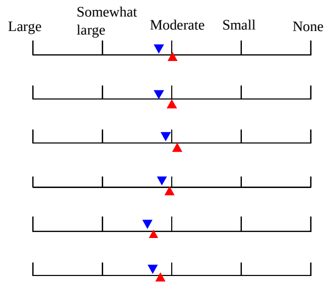
1. Questions regarding the relevant area

1) Degree of expertise in the area

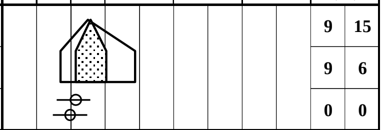
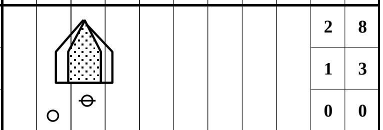
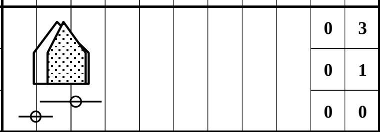
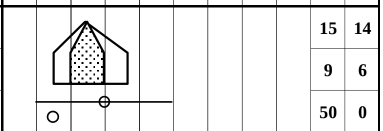
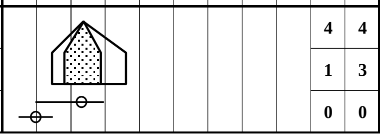


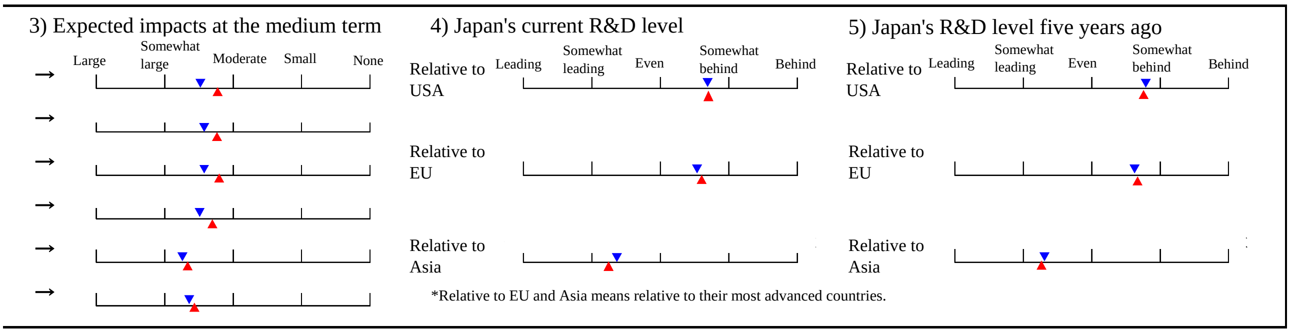
2) Current impacts

[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



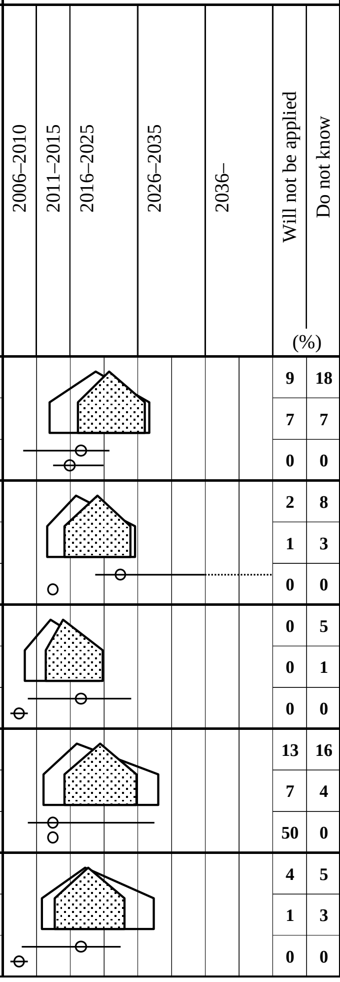
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
29	Technology for promoting international communication and mutual understanding by not only interpreting words, but displaying wider information such as the culture, custom, and social principle behind the utterance.	1	**70**	**7**	**30**	**63**	-	**64**	**36**	**47**	**17**	**0**		**9**	**15**
		2	**70**	**3**	**17**	**80**	-	**59**	**26**	**59**	**14**	**1**		**9**	**6**
		E	**2**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**		**0**	**0**
30	Technology for predicting the occurrence and spread of infectious diseases by combining data on global social and economic activities with a model of infectious disease occurrence.	1	**69**	**4**	**22**	**74**	-	**63**	**30**	**59**	**11**	**0**		**2**	**8**
		2	**69**	**1**	**14**	**85**	-	**60**	**23**	**71**	**6**	**0**		**1**	**3**
		E	**1**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**		**0**	**0**
31	Traceability technology with which the transport history of every item distributed and traded may be recorded, inspected, and looked up.	1	**81**	**11**	**27**	**62**	-	**59**	**28**	**53**	**18**	**1**		**0**	**3**
		2	**77**	**3**	**18**	**79**	-	**58**	**19**	**73**	**8**	**0**		**0**	**1**
		E	**2**	**100**	**0**	**0**	-	**75**	**50**	**50**	**0**	**0**		**0**	**0**
32	Technology that assists the interested nations of an international problem in making rational decisions by showing diverse scientific knowledge, arguments, and value judgments in an organized and analytical manner to give an overview of the problem.	1	**79**	**8**	**24**	**68**	-	**63**	**36**	**47**	**14**	**3**		**15**	**14**
		2	**70**	**3**	**19**	**78**	-	**61**	**29**	**58**	**10**	**3**		**9**	**6**
		E	**2**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**		**50**	**0**
33	A portable voice translation device that enables smooth international communication.	1	**77**	**10**	**22**	**68**	-	**63**	**36**	**45**	**18**	**1**		**4**	**4**
		2	**68**	**3**	**13**	**84**	-	**55**	**18**	**68**	**13**	**1**		**1**	**3**
		E	**2**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**		**0**	**0**



Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
16	48	23	2	11	20	37	35	8	52	37	38	55	45	8	2	2
9	76	14	0	1	9	54	30	7	57	20	18	63	35	5	3	5
0	100	0	0	0	0	100	0	0	50	50	50	100	50	0	0	0
14	76	7	0	3	36	51	13	0	42	44	41	58	47	11	6	2
1	96	3	0	0	29	63	7	1	39	42	19	75	37	3	1	1
0	0	100	0	0	100	0	0	0	0	0	0	100	100	0	0	0
28	57	14	0	1	33	41	21	5	14	45	26	40	34	26	25	0
19	76	5	0	0	25	60	12	3	11	68	19	50	35	15	14	1
50	50	0	0	0	50	50	0	0	50	100	0	50	50	0	0	0
6	50	28	0	16	31	37	24	8	55	32	35	45	38	10	3	4
5	77	15	3	0	22	56	16	6	77	19	13	53	20	6	3	0
0	50	50	0	0	100	0	0	0	100	0	0	0	0	0	0	0
50	36	10	1	3	17	33	34	16	32	38	43	57	29	11	3	2
77	15	8	0	0	7	43	41	9	18	37	32	69	11	8	2	2
50	50	0	0	0	0	100	0	0	50	50	100	100	50	0	0	0

Time of social application



Time of social application (%)		Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
9	18	24	29	36	11	51	49	25	49	8	5	2
7	7	10	44	36	10	67	48	10	46	6	3	2
0	0	50	50	0	0	50	50	0	50	0	0	0
2	8	39	46	12	3	48	59	16	51	16	19	2
1	3	30	65	4	1	40	74	4	53	4	7	0
0	0	0	100	0	0	100	0	0	0	0	0	0
0	5	38	36	21	5	19	47	13	36	38	49	3
0	1	38	50	9	3	12	59	9	35	26	54	3
0	0	50	0	50	0	50	100	0	0	0	50	0
13	16	35	34	24	7	60	47	16	34	10	6	10
7	4	29	54	11	6	76	47	5	32	3	2	0
50	0	100	0	0	0	100	0	0	0	0	0	0
4	5	20	24	35	21	40	48	33	45	17	7	0
1	3	12	26	52	10	30	53	23	53	15	3	2
0	0	50	50	0	0	100	50	50	50	0	0	0

VII. Technology that supports education and learning

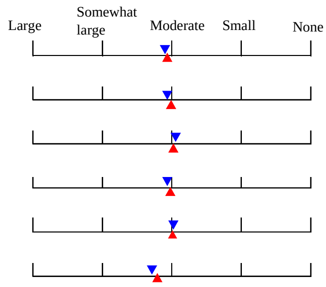
1. Questions regarding the relevant area

1) Degree of expertise in the area

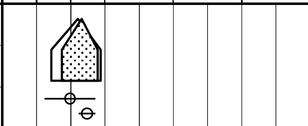
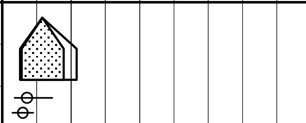
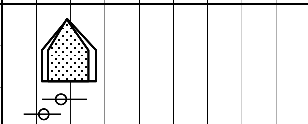
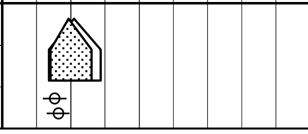
High Moderate Low

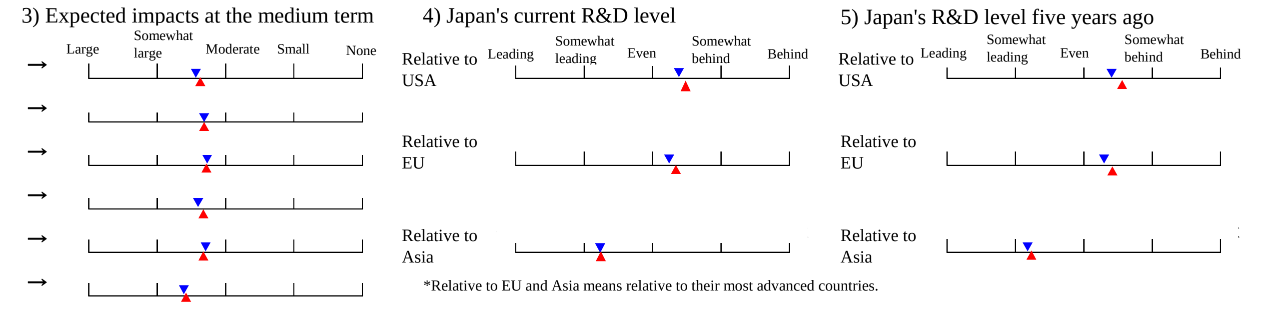
2) Current impacts

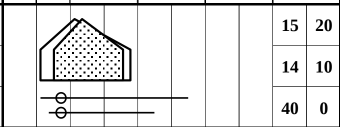
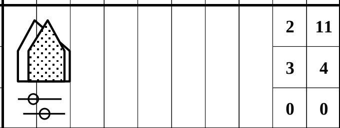
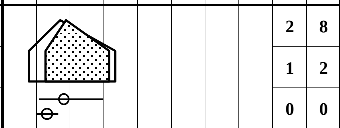
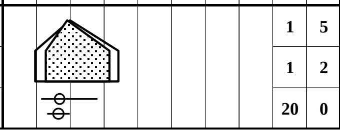
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
34	A scientific system that allows the youth who cannot engage in ordinal communication to acquire sociability even without face-to-face communication.	1	74	14	28	58	-	46	22	32	32	14		18	18
		2	75	7	19	74	-	38	9	40	35	16		19	5
		E	5	100	0	0	-	40	20	20	40	20		40	0
35	An electronic book that makes full use of multimedia technology for reversing the growing trend of aliteracy or people not reading books.	1	86	15	26	59	-	41	14	27	52	7		4	6
		2	81	6	15	79	-	32	5	23	63	9		1	4
		E	5	100	0	0	-	35	0	40	60	0		0	0
36	A learning system that can enhance scientific thinking by allowing learners to experiment/experience unrealistic phenomena/events in a virtual space created by simulation or other technology.	1	94	21	31	48	-	51	22	45	27	6		3	7
		2	93	9	22	69	-	44	4	65	29	2		2	2
		E	8	100	0	0	-	47	13	49	38	0		0	0
37	Advances in web-based language translation function allow people to search through online information in any language and retrieve results in a specific language, resulting in the construction of a knowledge repository system from which desired information is instantly retrievable from any part of the world.	1	82	16	27	57	-	54	23	50	26	1		3	1
		2	81	6	14	80	-	48	4	82	12	2		1	2
		E	5	100	0	0	-	50	20	60	0	20		20	0

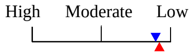


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't involvement (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application			Regarding social application: Necessity of gov't involvement (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied (%)	Do not know (%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
13	59	15	0	13	13	38	33	16	60	38	38	41	5	12	5	0		15	20	19	26	34	21	63	39	15	44	13	6	2
3	91	3	0	3	11	44	27	18	75	27	32	42	0	5	2	0		14	10	11	35	39	15	77	30	3	48	5	2	0
0	80	0	0	20	40	40	0	20	25	25	25	75	0	25	0	0		40	0	20	60	0	20	25	50	0	50	25	0	0
47	40	5	0	8	8	26	34	32	35	35	25	51	11	16	2	0		2	11	10	24	32	34	30	46	26	39	24	6	0
63	34	3	0	0	3	21	47	29	32	34	20	55	4	13	7	2		3	4	3	21	50	26	23	63	16	39	16	7	2
60	40	0	0	0	0	60	20	20	25	0	0	75	25	25	0	0		0	0	0	40	40	20	50	25	25	75	25	0	0
15	75	5	0	5	10	27	48	15	40	36	35	58	10	13	4	0		2	8	14	30	43	13	42	51	26	39	18	5	0
2	97	1	0	0	3	27	59	11	47	41	23	65	6	6	2	1		1	2	7	25	59	9	48	54	13	46	10	4	1
0	100	0	0	0	13	38	49	0	13	25	50	50	25	0	0	0		0	0	13	25	62	0	38	50	25	50	13	0	0
19	71	6	3	1	11	33	46	10	32	34	42	59	21	8	0	1		1	5	11	34	41	14	42	43	31	46	10	3	3
15	78	3	4	0	4	23	61	12	27	30	36	71	9	6	1	1		1	2	3	27	60	10	39	48	14	65	7	3	1
0	100	0	0	0	0	40	40	20	25	50	50	100	25	25	0	0		20	0	0	75	25	0	25	75	50	100	25	0	0

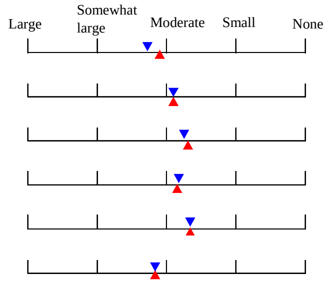
VIII. Handing down and preserving culture and technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

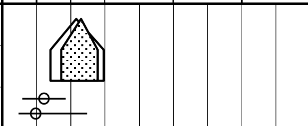
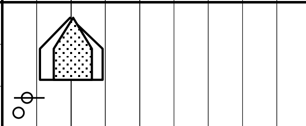
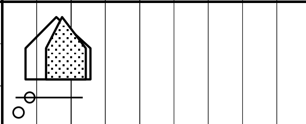
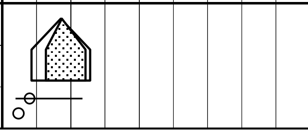


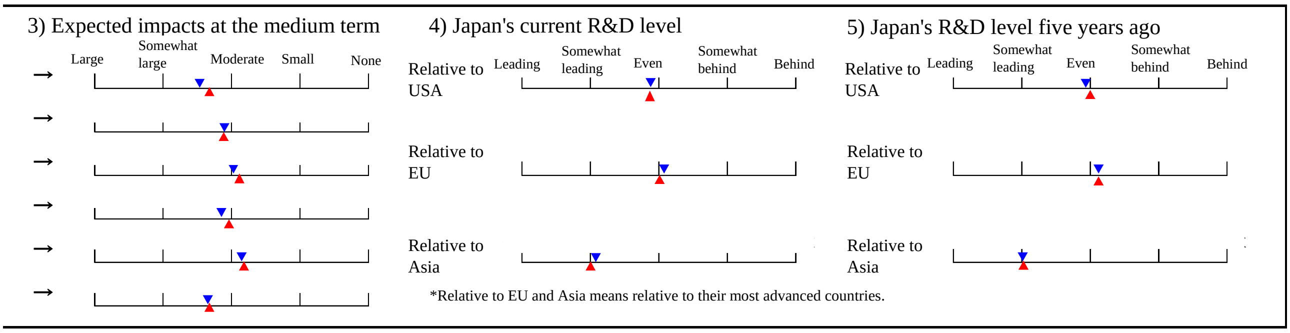
2) Current impacts



[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
	Contribution to the development of other fields
[Economic impacts]	Contribution to the development of existing Japanese industry
	Contribution to the creation of new industries or businesses
[Social impacts]	Contribution to safety and security
	Contribution to improved social vitality and quality of life

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
38	Technology for protecting, restoring, and preserving tangible cultural properties by making full use of nanotechnology, biotechnology, and materials technology.	1	59	8	20	72	-	60	26	64	10	0		0	10
		2	65	3	12	85	-	54	11	81	8	0		0	3
		E	2	100	0	0	-	75	50	50	0	0		0	0
39	Information storage technology that enables the restoration of tangible cultural properties in the event of loss or damage.	1	62	6	19	75	-	57	23	61	16	0		2	7
		2	68	1	9	90	-	54	10	84	6	0		1	3
		E	1	100	0	0	-	50	0	100	0	0		0	0
40	Handing down skills of producing tangible cultural properties, such as pottery, painting, and woven fabric, through the use of digital images, virtual reality technology, etc.	1	71	7	15	78	-	54	21	53	26	0		1	1
		2	72	1	15	84	-	50	8	78	13	1		0	1
		E	1	100	0	0	-	25	0	0	100	0		0	0
41	Preserving and protecting intangible cultural properties, such as traditional performing arts, and handing down relevant skills, through the use of digital images, virtual reality technology, etc.	1	71	7	18	75	-	53	20	55	24	1		1	1
		2	72	1	11	88	-	51	10	76	13	1		0	1
		E	1	100	0	0	-	25	0	0	100	0		0	0



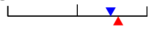
Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
49	23	26	0	2	38	47	13	2	62	35	50	62	21	2	4	0						0	13	35	50	15	0	69	31	17	61	7	13	0
76	8	16	0	0	20	59	16	5	57	26	33	67	3	3	2	0						0	3	17	66	14	3	68	24	2	65	5	3	0
100	0	0	0	0	100	0	0	0	100	50	0	50	0	0	50	0						0	0	100	0	0	0	100	50	0	50	0	50	0
44	22	30	0	4	38	47	13	2	58	36	49	55	16	5	5	0						2	7	38	43	19	0	66	31	12	59	9	12	0
71	11	18	0	0	16	68	13	3	68	24	29	66	5	6	0	0						1	3	16	69	12	3	72	23	6	68	5	2	0
100	0	0	0	0	100	0	0	0	100	100	0	100	0	100	0	0						0	0	100	0	0	0	100	100	0	100	0	100	0
51	35	12	0	2	28	38	28	6	56	38	34	51	20	3	2	2						0	4	25	47	25	3	62	35	18	57	11	6	0
76	17	7	0	0	13	66	17	4	71	32	21	64	6	5	0	0						0	1	8	73	15	4	69	24	4	71	4	0	0
100	0	0	0	0	0	0	100	0	100	0	0	100	0	0	0	0						0	0	0	0	100	0	0	0	0	100	0	0	0
34	53	11	0	2	28	35	31	6	62	38	36	51	21	3	3	0						1	4	27	44	28	1	65	35	18	59	8	5	0
34	60	6	0	0	12	65	17	6	72	28	18	65	5	5	0	0						0	1	8	75	11	6	73	24	6	70	4	0	0
100	0	0	0	0	0	0	100	0	100	0	0	100	0	0	0	0						0	0	0	0	100	0	0	0	0	100	0	0	0

IX. Knowledge production system

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low

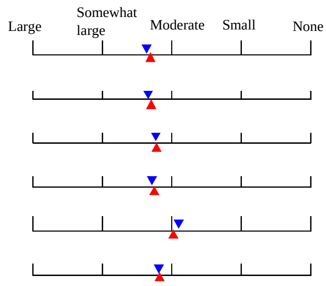


2) Current impacts

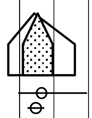
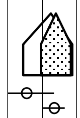
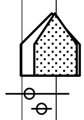
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

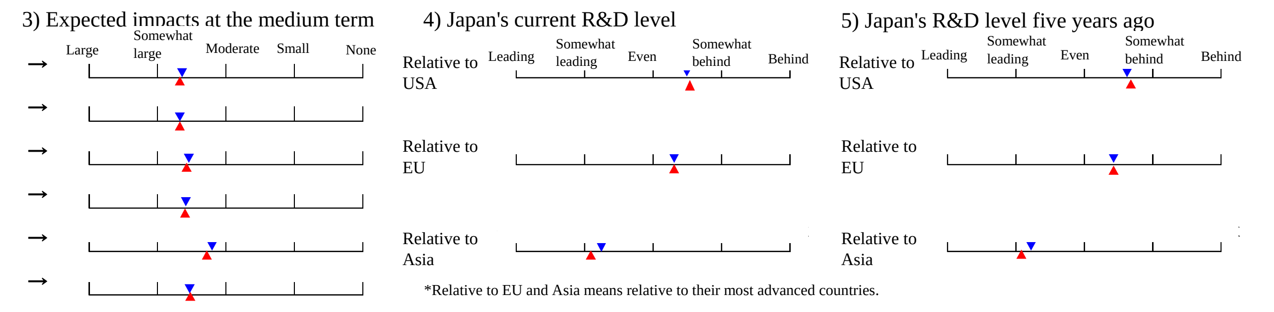
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

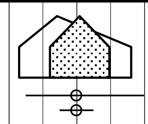
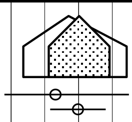
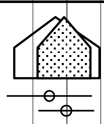
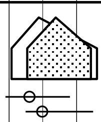
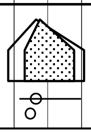
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%): High	Moderate	Low	None	Importance to Japan (%): Index	High	Moderate	Low	None	Time of technological realization (Already realized, 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–)	Will not be realized (%)	Do not know (%)
42	Reconstruction of educational and communication systems as a result of the establishment of a knowledge production method independent of space, time, and language.	1	**72**	**14**	**43**	**43**	-	**59**	**29**	**52**	**16**	**3**		**3**	**14**
		2	**79**	**3**	**38**	**59**	-	**51**	**12**	**69**	**19**	**0**		**0**	**4**
		E	**2**	**100**	**0**	**0**	-	**75**	**50**	**50**	**0**	**0**		**0**	**0**
43	Introduction of a new social decision-making approach as a result of the dissolution of the boundary between experts and non-experts through fusion between knowledge producers and knowledge consumers.	1	**83**	**18**	**37**	**45**	-	**60**	**35**	**45**	**11**	**9**			
		2	**79**	**6**	**29**	**65**	-	**55**	**19**	**65**	**12**	**4**			
		E	**5**	**100**	**0**	**0**	-	**90**	**80**	**20**	**0**	**0**			
44	Widespread use of an evidence-based policy making approach as a result of the clarification and visualization of social problems.	1	**81**	**17**	**36**	**47**	-	**62**	**36**	**43**	**18**	**3**		**6**	**8**
		2	**73**	**7**	**25**	**68**	-	**56**	**21**	**60**	**19**	**0**		**4**	**1**
		E	**5**	**100**	**0**	**0**	-	**100**	**100**	**0**	**0**	**0**		**0**	**0**
45	Construction of a public database that gives centralized access to a collection of the data owned by public institutions and universities, and serves as the infrastructure for knowledge production in society.	1	**95**	**13**	**32**	**55**	-	**64**	**39**	**41**	**18**	**2**		**4**	**1**
		2	**81**	**7**	**30**	**63**	-	**59**	**25**	**61**	**14**	**0**		**2**	**1**
		E	**6**	**100**	**0**	**0**	-	**63**	**33**	**50**	**17**	**0**		**0**	**0**
46	Establishment of global rules concerning the copyright of multimedia information to promote the production and distribution of multimedia content.	1	**78**	**9**	**26**	**65**	-	**64**	**40**	**37**	**20**	**3**			
		2	**77**	**3**	**21**	**76**	-	**69**	**47**	**39**	**13**	**1**			
		E	**2**	**100**	**0**	**0**	-	**50**	**50**	**0**	**0**	**50**			

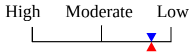


Countries at the leading edge (%)					Regarding technological realization: Necessity of gov't (%)				Regarding technological realization: Effective measures that should be taken by gov't (%)								Time of social application	Time of social application (%)		Regarding social application: Necessity of gov't (%)				Regarding social application: Effective measures that should be taken by gov't (%)						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
13	66	13	0	8	21	36	34	9	64	43	39	57	20	5	2	0		3	14	19	37	38	6	63	38	25	44	19	8	3
4	92	4	0	0	11	56	30	3	68	20	30	64	12	4	1	1		0	4	13	47	37	3	69	34	15	53	9	4	1
0	100	0	0	0	0	100	0	0	100	0	50	50	0	0	0	0		0	0	50	50	0	0	100	0	0	50	0	0	0
																		8	14	17	43	28	12	64	35	21	33	27	14	6
																		4	3	16	56	23	5	75	31	8	31	14	6	1
																		0	0	40	60	0	0	80	20	0	40	60	0	0
4	71	21	0	4	24	46	21	9	65	43	35	41	18	13	10	0		3	15	35	41	19	5	60	36	18	32	25	21	7
0	97	3	0	0	14	68	15	3	75	36	13	39	9	6	4	1		4	3	23	57	14	6	80	36	6	26	14	8	2
0	100	0	0	0	80	20	0	0	100	20	0	60	0	0	20	0		0	0	80	20	0	0	100	20	0	40	40	40	0
5	90	2	0	3	31	44	18	7	43	45	41	54	19	18	13	0		4	7	39	36	21	4	48	42	16	49	26	20	6
0	100	0	0	0	19	68	11	2	47	46	30	65	9	15	8	1		2	2	35	50	11	4	64	36	6	60	18	10	1
0	100	0	0	0	33	67	0	0	33	17	67	33	17	17	17	0		0	0	67	33	0	0	83	0	17	17	33	17	0
																		1	4	40	48	11	1	46	30	14	17	40	50	7
																		0	5	42	49	6	3	59	19	8	9	36	55	3
																		0	0	0	50	50	0	0	0	50	0	50	50	0

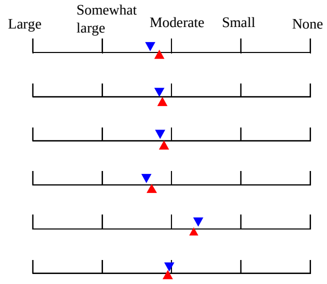
X. Entertainment technology

1. Questions regarding the relevant area

1) Degree of expertise in the area

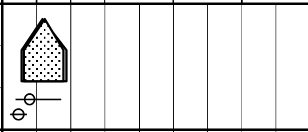
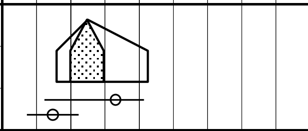
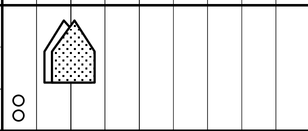
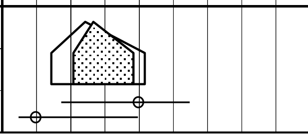


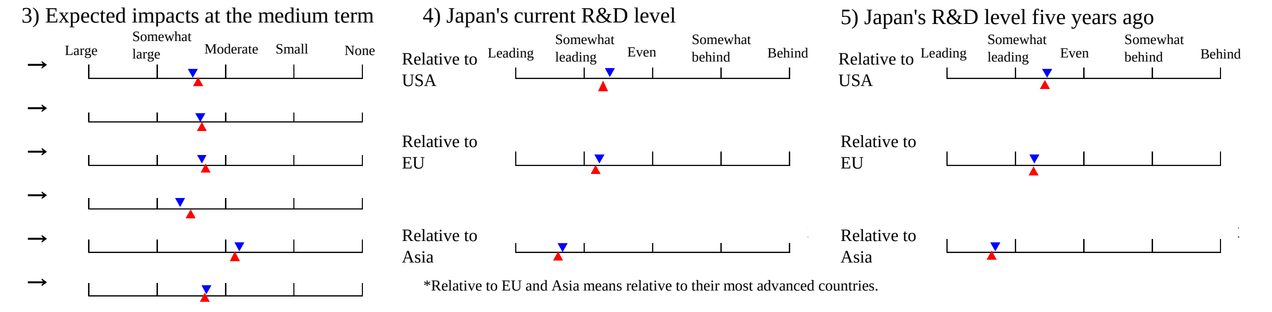
2) Current impacts



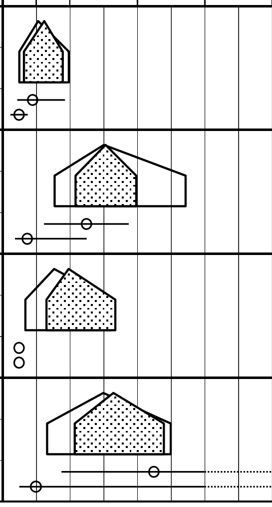
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	
	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	
	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate	Low	None	Importance to Japan: Index	High (%)	Moderate	Low	None	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know
47	An intelligent transport system (ITS) that makes a motor trip more enjoyable and comfortable by, for example, providing voice guidance on nearby tourist attractions and events for those who make a stop at a roadside station or an expressway toll booth.	1	**87**	**11**	**20**	**69**	-	**44**	**12**	**46**	**35**	**7**		**0**	**2**
		2	**80**	**3**	**13**	**84**	-	**38**	**1**	**57**	**36**	**6**		**0**	**1**
		E	**2**	**100**	**0**	**0**	-	**50**	**0**	**100**	**0**	**0**		**0**	**0**
48	Robot leasing service in which customers can lease robots suited to their needs, such as gardening, nursing care, and household chores.	1	**76**	**7**	**28**	**65**	-	**48**	**15**	**52**	**28**	**5**		**5**	**4**
		2	**77**	**4**	**13**	**83**	-	**44**	**7**	**64**	**22**	**7**		**6**	**6**
		E	**3**	**100**	**0**	**0**	-	**67**	**33**	**67**	**0**	**0**		**0**	**0**
49	Technology for expanding leisure time, such as a system in which people can easily find a substitute who performs their office work or household chores, for encouraging the proposal of new ways of spending leisure time.	1	**70**	**1**	**30**	**69**	-	**41**	**12**	**38**	**38**	**12**		**4**	**9**
		2	**69**	**1**	**9**	**90**	-	**32**	**1**	**39**	**43**	**17**		**6**	**12**
		E	**1**	**100**	**0**	**0**	-	**50**	**0**	**100**	**0**	**0**		**0**	**0**
50	A robot that acts as the user's sibling or friend and allows the user to experience pseudo-brotherhood, -sisterhood or -friendship to improve social skills.	1	**67**	**10**	**25**	**65**	-	**26**	**5**	**24**	**38**	**33**		**17**	**9**
		2	**76**	**3**	**14**	**83**	-	**22**	**1**	**16**	**49**	**34**		**14**	**7**
		E	**2**	**100**	**0**	**0**	-	**25**	**0**	**0**	**100**	**0**		**0**	**0**



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied (%)	Do not know (%)	Regarding social application – Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application – Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
64	22	13	1	0	8	39	29	24	18	44	32	47	8	35	8	3						1	7	12	29	41	18	19	31	25	41	38	13	0
90	5	5	0	0	4	43	29	24	12	65	17	50	3	37	5	2						0	4	8	28	45	19	12	32	12	57	45	9	2
100	0	0	0	0	0	50	0	50	100	100	0	100	0	100	100	0						0	0	50	0	0	50	100	100	0	100	100	100	0
63	25	6	0	6	11	38	31	20	29	38	34	61	9	21	9	2						5	9	8	30	41	21	26	26	40	51	36	19	0
88	11	0	0	1	5	47	32	16	24	51	21	68	2	14	5	2						7	8	5	30	53	12	17	26	29	67	35	9	2
100	0	0	0	0	67	0	33	0	67	0	33	67	0	0	0	0						0	0	67	33	0	0	67	0	0	100	33	33	0
24	41	29	0	6	7	21	37	35	41	17	39	37	7	32	10	5						4	13	9	22	40	29	43	30	27	20	32	9	2
11	69	18	2	0	2	17	54	27	53	17	40	28	9	19	9	2						6	9	1	16	61	22	52	25	25	21	23	6	0
100	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0						0	0	0	0	100	0	100	0	0	0	0	0	0
63	24	3	0	10	3	24	30	43	29	39	34	58	8	13	5	5						21	12	5	17	33	45	32	35	26	41	32	18	0
90	8	1	0	1	1	13	44	42	29	29	21	71	0	10	0	0						16	8	3	10	45	42	26	36	12	64	26	2	0
100	0	0	0	0	0	0	100	0	100	0	0	50	0	0	0	0						0	0	0	0	100	0	100	0	0	0	0	0	0

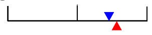


XI. Technology assessment

1. Questions regarding the relevant area

1) Degree of expertise in the area

High Moderate Low



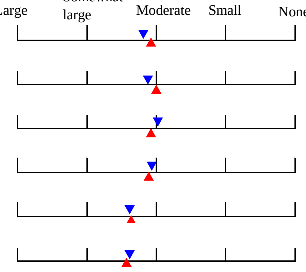
2) Current impacts

Large / Somewhat large / Moderate / Small / None

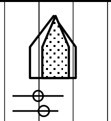
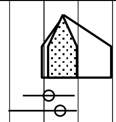
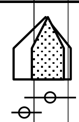
[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

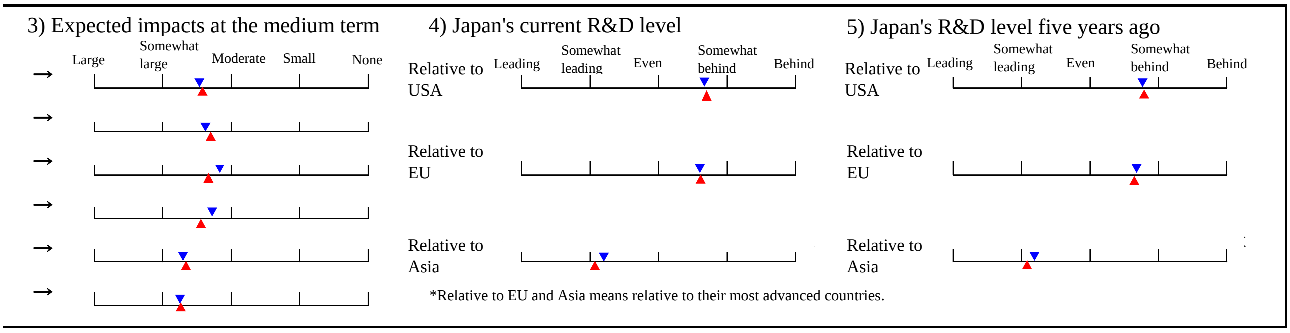
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

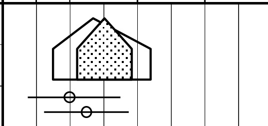
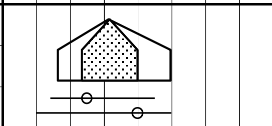
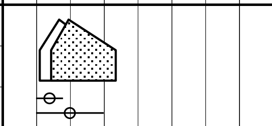
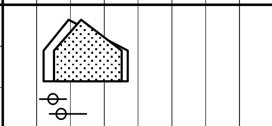
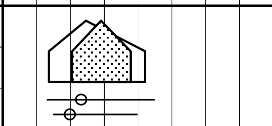
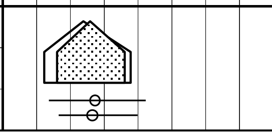
[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise: High (%)	Moderate (%)	Low (%)	None (%)	Importance to Japan: Index	High (%)	Moderate (%)	Low (%)	None (%)	Time of technological realization: Already realized / 2006–2010 / 2011–2015 / 2016–2025 / 2026–2035 / 2036–	Will not be realized (%)	Do not know (%)
51	Systems for early warning and prediction by experts (e.g. early detection of human/livestock infection and prediction of its impacts, early warning of the environmental effects of an accident or disaster) are established, enabling early detection and impact assessment of the problems that should be solved by science and technology.	1	71	8	34	58	-	73	52	38	9	1		3	10
		2	71	7	15	78	-	85	73	23	4	0		1	4
		E	5	100	0	0	-	100	100	0	0	0		0	0
52	Systems for assessing the long-term impacts of artificial and natural substances and systems on health and the environment are established, so that the government can systematically provide monitoring/surveillance results on potential threats and other negative issues.	1	76	12	30	58	-	69	47	38	14	1		4	10
		2	74	5	18	77	-	79	61	35	4	0		1	1
		E	4	100	0	0	-	75	50	50	0	0		0	0
53	A cycle is established in which ELSI (Ethical, Legal and Social Issues) research is promoted, in parallel with advanced research, and the results contribute to the formulation of research strategy, and subsequently, the ELSI research funds exceed 3% of the total research funds.	1	67	16	28	56	-	60	37	38	17	8			
		2	65	6	23	71	-	59	25	62	11	2			
		E	4	100	0	0	-	75	50	50	0	0			
54	An bioethical public debate involving diverse and numerous people of Japan is held to form a consensus on how to combine bioethics and research activities.	1	66	14	30	56	-	59	33	45	14	8			
		2	68	4	28	68	-	61	25	70	4	1			
		E	3	100	0	0	-	83	67	33	0	0			
55	Participatory technology assessment (TA) methods involving NPOs and citizens are established to adapt to Japanese society, and over 200 of such assessments are performed in Japan.	1	76	20	26	54	-	56	30	41	22	7		4	13
		2	71	6	24	70	-	54	17	66	16	1		0	4
		E	4	100	0	0	-	75	50	50	0	0		0	0
56	To address the NIMBY (not in my backyard) problem, the form of discussion and the procedure intended for convincing the interested parties are established.	1	75	21	28	51	-	66	44	35	14	7			
		2	73	11	30	59	-	75	53	40	7	0			
		E	8	100	0	0	-	81	62	38	0	0			



Countries at the leading edge (%): Japan	USA	EU	Asia	Other	Regarding technological realization — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding technological realization — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	Time of social application: 2006–2010, 2011–2015, 2016–2025, 2026–2035, 2036–	Will not be applied (%)	Do not know (%)	Regarding social application — Necessity of gov't involvement (%): High	Moderate	Low	None	Regarding social application — Effective measures that should be taken by gov't (%): Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
14	59	25	0	2	53	37	9	1	59	48	48	53	32	14	11	3		1	7	49	38	11	2	52	52	11	54	21	37	3
1	93	6	0	0	76	14	7	3	66	42	40	55	16	6	6	0		1	1	75	16	6	3	56	47	9	65	6	15	1
0	100	0	0	0	80	20	0	0	80	20	40	60	20	0	20	0		0	0	80	20	0	0	80	40	0	80	0	0	0
4	60	32	0	4	53	31	13	3	55	48	45	58	28	14	14	3		4	11	54	35	10	1	58	59	14	45	21	29	3
0	89	11	0	0	73	19	4	4	64	36	33	64	14	9	4	0		0	1	75	19	3	3	69	59	4	48	10	10	0
0	67	33	0	0	75	25	0	0	75	25	25	25	25	0	25	0		0	0	75	25	0	0	100	50	0	50	0	0	0
																		5	24	33	43	14	10	67	47	4	45	16	20	2
																		3	5	31	53	11	5	74	27	5	44	10	13	0
																		0	0	75	25	0	0	75	25	0	25	0	25	0
																		12	19	30	42	14	14	64	43	0	36	15	19	6
																		7	7	37	53	6	4	83	34	3	26	9	9	0
																		0	0	33	67	0	0	100	33	0	33	0	0	0
6	45	46	0	3	21	49	21	9	68	40	21	38	17	17	17	2		5	18	24	47	19	10	59	49	16	30	24	25	5
1	48	51	0	0	16	65	16	3	81	31	13	27	4	10	3	1		1	7	17	69	10	4	78	43	6	25	9	7	1
0	67	33	0	0	25	75	0	0	67	0	33	33	0	0	33	0		0	0	25	75	0	0	75	25	25	25	0	25	0
																		12	26	33	41	16	10	73	30	8	28	17	28	3
																		7	10	29	57	10	4	88	29	4	29	9	16	1
																		0	0	62	38	0	0	88	25	0	25	0	13	0

References

A. General descriptions of the areas

1) Information and communications

	Area	General description
1	**Very large scale information processing**	A technology expected in this area of research is platforms that integrate broadband, super-distributed, and ultra-fast computing environments such as high-speed mobile communications, wireless LANs, digital broadcasting, ETC, and RF tags. To comprehensively operate these constituent technologies having short life cycles, there will be a need for capabilities of handling interconnections and interoperations between individual functions autonomously and in a self-organized manner. This will make a large amount of information in mixed media available on a common platform.
2	**High-productivity computing**	High-productivity computing is a hot science and technology area where the comprehensive promotion of hardware, software, and network technologies is pursued, assuming supercomputers as a tool to generate high values in many scientific, technological, and industrial fields. More efficient utilization of supercomputers as a tool will be possible through the efficient use of computing resources, which involves not only improving the hardware of supercomputers, but also developing software with higher effective performance and using networks to achieve greater computing power.
3	**Human support (intellectual support)**	Artificial intelligence is twofold: it pursues computers that can substitute for human intellectual functions based on the findings on the brain's cognitive and decision-making mechanisms; it aims to support and supplement human intellectual activities. For the former research area, advances are expected in natural language understanding. For the latter, capabilities of handling environments where a large amount of information is distributed and shared is important, including the capabilities of screening information to organize and present it in an easy-to understand form and of assisting human memory and record-keeping. To achieve these aims, new prospects are desired in autonomous agent technology and science and technology on interactions between the human brain and the artificial brain.
4	**Ultra-transparent communications (space sharing); human interface (muscular strength support)**	Technological advances are expected to allow the sharing of virtual space with very high reality even among distant people by developing a transmission system that can, as its communications function, send and receive meta-data on human sensibilities and senses. To achieve this, it is necessary to enable capabilities of reproducing three-dimensional images with super high definition and highly realistic sound, and of conveying sensibilities such as texture and touch, air flow, temperature and humidity, and smell. This could be applicable to a system in which human muscle and perception of force are remotely transmitted to a robot that acts according to them.
5	**Information security**	Security, or ensuring safety and security, is critical in every aspect of social life. Security can be divided into two fields: information security and network security. The formeh refers to preventing information leakage and cyber crime, including physical security such as general crime prevention and physical access control. The latter aims at keeping network systems from cyber attackers. Diverse security measures are available, including surveillance cameras, building control, home security, information protection, privacy protection, copyright protection, personal identification, encryption, trace back technology, anti-virus measures and anti-spam measures.
6	**Information technology for developing social systems**	The wide availability of broadband access can contribute to vitalizing business activities and bringing more comfort to people's lives. These possibilities increase as technologies on human interfaces, security, etc. become organically linked, driven by the development of large-scale information processing technology. In the future, technology will be important, not simply as science and technology in a narrow sense, but as a social system that can comprehensively embrace even legislation and applied technologies; which are necessary for developing systems for governmental administration, health and medical care, financial distribution, and crime and disaster prevention.
7	**New principles for information and telecommunications**	In the information and communications field in recent years, basic theories on quantum encryption etc. have had a major impact on applied research in security and other fields. Life science, which has rapidly developed driven by information and communications technology, also has had a significant impact on basic research. This suggests that growing importance is placed on original research deriving from the dynamism between the scientific discovery of new theories or phenomena and information and communications technology. For the promotion of basic science, it is necessary to invest, in expectation of breakthroughs, in exploratory, and sometimes even eccentric, research projects.
8	**Ubiquitous networking**	An important element of the ubiquitous world is the networking function, which collects real-world information such as the physical location, identity, and environment of each object, interprets it, and facilitates interactions between the objects. To allow numerous miniature devices to communicate with one another, diverse technologies—including nanotechnology, information control technology, autonomous distribution control technology, robotics, and energy—need to be combined. There will be pursuit of new values such as single function, simplicity, multiplicity, super small size, and environmental adaptability, rather than higher efficiency, larger capacity, and higher performance.
9	**Software technology for large-scale networks**	As information processing systems become extremely large and ubiquitous along with the advancement of networks, there will be a growing need for software capable of handling large and complex processing tasks, ensuring usability and safety, and providing portability. Extensions of the current software production technology may fall short of ensuring efficient and correct production of increasingly larger-scale software in the future. Usability, safety, and portability should also be emphasized further. Hence, software production technology based on a new paradigm is required.

2) Electronics

	Area	General description
10	**Integrated systems**	While most of the current integrated systems are silicon VLSIs, new types of systems are being explored amid growing awareness of the sustainability of Moore's Law. This area's research addresses new integrated systems alternative to silicon devices, such as quantum computing and spintronics.

	Area	General description
11	**Silicon electronics**	This area addresses future silicon VLSI technologies, including not only higher performance processors and higher density memories, but also high-temperature superconductivity, optical interconnect, and other technologies that should be merged with silicon VLSI.
12	**Optical and photonic devices**	This area involves three perspectives. The first is the development of new materials and the addition of new wavelengths, which could lead to less expensive equipments and the creation of new application fields. The second aims at technologies for transforming photonic networks in quantity and quality, which would include higher performance optical fibers that would result in evolution of related technologies, ultra large capacity that would reach the petabit level as a whole, and higher-level security. The third refers to breakthroughs in optical signal processing, which could lead to the emergence of powerful devices whose capability is beyond simple signal transmission.
13	**Wireless electronics**	As demonstrated by the explosive proliferation of mobile phones and the widespread use of RF tags, wireless communications have a great advantage as a means of information transmission. This area consists of electronic device technology that further expands the possibilities of wireless communications, low-energy technology, wireless schemes, and the application of these technologies.
14	**Bioelectronics**	Blending electronics technology with biological knowledge is effective for the achievement of diverse advanced functions and miniaturization to a nano level. By integrating various functions of cells and biomolecules into electronics, social demands such as advancement in medicine and ensured food and environmental safety could be met. Furthermore, molecular self-organization in organisms could be a model for constructing complex systems.
15	**Molecular and organic electronics**	In the near future, new electronics centering on molecular and organic semiconductors are expected to play an important role, reaching beyond the current framework of electronics based on silicon and other inorganic semiconductors. Ultimately, logic and memory LSIs that use a single molecular as the basic switching element. Molecular/organic electronics are also essential for materials for displays and sensors. New innovative nanostructures comparable to the carbon nanotube could also be invented. This area will grow as an electronics technology that provides IC tags and other devices indispensable to the ubiquitous information society.
16	**Storage**	In response to growing storage needs as a result of the move toward broadband communications and digital images, magnetic and optical storage capacity is expected to expand. Fusion between optics and magnetics, the optical near-field, and spintronics are expected to be applied to achieve two orders of magnitude improvement in storage density. Other possibilities in this area include the practical use of memories in which a single atom or molecule stores a bit of information, probe array memories, and other large-scale memories based on new principles.
17	**Displays**	Displays are essential for the future information society as a man-machine interface. They are becoming larger and thinner as technologies advance. Further progress is needed to meet demands for higher resolution, portability, and higher realism (three-dimensional images). Other much-expected possibilities of displays include allowing people to enjoy movie theater-quality images at home and directly forming images on the retina of the viewer's eye, rather than on a display medium.
18	**Energy conversion/storage devices**	To make ubiquitous information society a reality, people need to be allowed to receive sophisticated information services anywhere, anytime. For this, very small, long-lasting batteries that can supply steady power to mobile information devices are required. This requires the development of fuel cells that have a 5-10 times longer life than the current secondary cells and a new type of battery that efficiently converts solar or other natural energy into electricity.
19	**Digital home appliances**	In response to global changes in the environment, widespread availability of the Internet, and growing environmental awareness, home appliances are becoming increasingly computerized, networked, and loaded with new functions. This area, as an important factor of QOL (Quality of Life), addresses audiovisual equipment, robots, and home furnishings as well as their human interfaces, their components, and the social systems linked to them.
20	**Ubiquitous electronics**	In a ubiquitous environment, people should be able to exchange information anywhere, anytime, and with anyone or anything. To make this a reality, a miniature computer chip with communications capability needs to be developed to allow real-time and autonomous information exchange.
21	**Robot electronics**	Robotic technology is expected to be applied more commonly to everyday life, for example, as domestic robots. To further expand the scope of robots, it is necessary to develop robots that carry intelligent sensors for advanced environment recognition and are capable of independent walking and offering an interactive interface. Miniaturization is also important for enabling microrobots that are sent into the human body for medical examination or are used to perform surgery by remote control.
22	**Car electronics**	Automobile technology has advanced mainly in areas such as intelligent driving and the emissions control for environmental protection. More recently, driver assistance such as GPS applications has been enhanced. Future possibilities include fully automatic driving on both expressways and open roads, protection against accidents and failures through built-in sensors, and the ubiquitous exchange of multimedia information.
23	**Network electronics**	To meet the rapidly growing traffic volume on the Internet, research is needed in diverse areas to achieve communications with higher speed and larger capacity. This area addresses device technologies for transmission services, high-speed communications, and large-capacity communications, from economic and other viewpoints.
24	**Security electronics**	Concentration of population in urban cities, while beneficial to economic activities, involves high vulnerability to disasters. In such an advanced and complex living environment, a security system that prevents natural and human-caused disasters, including earthquakes, fires, and terror attacks, is necessary. This area deals with sensors, a key element of such a system, that can quickly and accurately detect humans, objects, and natural phenomena.

3) Life science

	Area	General description
25	**Basic research in drug development**	Although outstanding drugs for infectious diseases, stomach ulcer, hypertention, and so on have been developed, the degree of sufficiency in therapeutic agents for the lifestyle related diseases, central nervous systems disorders, and cancers that increasingly accompany changes in lifestyle and the aging population remains low. Based on that understanding, research in this area centers on how far multiple biological phenomena can be elucidated through recent remarkable progress in advanced research in genome science, nucleic acid chemistry, protein engineering, bioinformatics, and so on, and on how such research can be applied to drug development in fields where research remains insufficient.
26	**Basic research for new medical technologies**	Based on data on genes and genomes, this area applies knowledge of gene expression, the proteome, and their networks to cancer, autoimmune disorders, lifestyle diseases, and so on. It carries out research and development of new medical technologies, including bioinformatics technology, to detect, diagnose, and treat based on the collective characteristics of the Japanese people as well as individual heredity.
27	**Brain generation and growth**	How the complex and delicate neural networks of our brains that are the basis for consciousness, movement, and higher order neural function are formed and how heredity and environment interact at the level of the brain are not only interesting questions, they are essential to understanding the brain. Recently, the molecules that are the key to neural network formation and their functions are rapidly being elucidated. In the future, understanding not only at the molecular level but also a hierarchical understanding of networks is needed. This area centers on research that in the future may be applied to recovery from central nervous system injury, to loss of function accompanying aging, and to problems in education.
28	**Higher-order brain functions**	Recently, in addition to neuron activity records from unanesthetized animal brains, advancements in noninvasive research methods such as functional MRI, PET, and magnetoencephalography have led to remarkable progress in research on mapping higher-order functions, which is difficult to carry out without human subjects. In addition, genes that regulate the personalities and behavioral characteristics of individuals are continually being discovered. Based on these conditions, this area centers on research attempting to elucidate mental function through neuroscience rather than through the humanities, as has been done traditionally.
29	**Understanding and treating brain conditions**	Traditionally, the causes of neurodegenerative disease were a complete mystery, and it is worth noting that progress on their elucidation has only come during the past 10-plus years. Alzheimer's disease is typical, with a succession of new findings being reported. However, practical treatment and prevention methods have yet to be developed. Schizophrenia is a disorder whose onset very frequently occurs during adolescence, with genetic background and early environmental factors believed to be contributors. Although symptomatic treatment exists, the causes remain unclear. Manic depression is believed to be a functional disorder, but at least partially it has a genetic background. These illnesses are also related the problem of controlling human emotions, and their elucidation will not end merely with an understanding of them. This area centers on the research just described.
30	**Regenerative medicine**	As both technology for the regeneration and conversion of somatic cells and the performance of artificial organs advance, the artificial creation and regeneration of cells, tissue, and organs is expected to become possible. In fields such as vision and hearing, in addition to the establishment of technologies to regenerate retinas, eardrums, and so on, it is hoped that artificial retinas and eardrums and interfaces with the sensory nervous system will become possible, broadening treatment options. This area centers on research in such fields.
31	**Monitoring and sensor technology for biological substances**	As construction of the human genome database and the protein database continues, we are entering the era in which life is understood and fully exploited based on the systems-level understanding of the cell. Therefore, there is a need for new technologies for ultrasensitive measuring and imaging of substances within cells and for the detection and imaging of specialized cells in vivo. This area targets such kinds of research.
32	**Control of higher-order biological functions**	As a major trend in 21st-century life science, it is expected that complex higher-order systems related to ontogenesis and functional differentiation in organisms, such as the immune and endocrine systems, will be elucidated. Life forms flexibly and effectively maintain homeostasis in the face of changes in external environments while repeatedly carrying out generational change. To maintain that homeostasis, the immune system has developed and improved through the process of mammalian evolution, including that of humans, becoming advanced and complex. This area focuses on the higher-order functions of life, especially immunity.
33	**Information biology**	Vast amounts of genome information and other biodata are being generated and rapidly accumulating. This area targets research broadly related to bioinformatics. It includes the integration of such data, the development of technologies to predict and elucidate the molecular mechanisms that are the basis for biological activity, the development of technologies to elucidate the behavior of molecular network systems and cells, the advanced use of informatics, mathematics, physics, and chemistry, and the development of technologies to apply the results to medicine, drug development, agriculture, engineering, and so on.
34	**Environmental and ecological biology**	Because of the rapid increase in the world population and the costs that result from civilization, the environment for living things continues to undergo major changes. Under these conditions, development of science and technology for environmental regeneration and conservation and for the conservation of ecologies is a vital issue. This area centers on basic technology for environmental adaptation, regeneration, and conservation based on the interaction of life forms and biodiversity.
35	**Nanobiology**	Nanobiology, an interdisciplinary field joining life science and nanotechnology, has been garnering much attention of late. The scholarly concept behind nanotechnology is to utilize the biological structures, functions, and operating principles of nanometer-sized biomolecules such as proteins and DNA to research effective and highly-concentrated system structures. Research oriented towards practical application includes not only the utilization of the functions of biological substances themselves, but also imitations of their structures and functions. This area focuses on research that includes such fusions of nanotechnology and biotechnology.

4) Health, medical care and welfare

	Area	General description
36	**Personalized medicine**	Evidence-based medicine (EBM) has taken hold, promoting the "standardization" of medicine. At the same time, the need for detailed "individualized medicine" that accords with individual genetic backgrounds, constitutions, and case histories is now being called for. The primary targets are lifestyle diseases such as arteriosclerosis and cancer, as well as infections. It is necessary to use information such as genome data to select the appropriate treatment fields (internal medicine, surgery, or radiology, etc.) and methods for each patient. This area centers on the development of medical technologies for detailed diagnosis and of treatment technologies that are highly specific and effective.
37	**Elucidation of biological defense mechanisms and therapeutic application**	If the mechanisms of biological defense against harmful substances and organisms are elucidated and can be controlled, not only infectious diseases but also various intractable diseases related to immune response as well as complications associated with organ transplants may be overcome. This area centers on technologies related to infection, immune disease, organ transplants, and interactions between humans and their environments.
38	**Recovery of biological functions focusing on QOL and support for it**	Expectations for treatment of tissues and functions damaged by illness or accident with regenerative medicine and compensatory medicine are rising. In addition, for the elderly and people with severe disabilities, the establishment of appropriate treatment, care, social support methods, and so on is extremely important. This area includes not only measures against pathological conditions, but also medicine that considers improving patient quality of life (QOL). It includes technologies such as regenerative medicine, medical materials, robots, and artificial organs.
39	**Application of IT to medicine**	The advancement of electronic charts, picture archive communication systems (PACS), and other means of putting medical data into electronic form will make it extremely simple for distant hospitals to transmit individual case history information when necessary, making possible the construction of unprecedented new medical systems. In addition, diagnosis of deep tissue and its functions will become possible through the use of medical engineering technology, and these technologies will be widely applied to patient screening and the determination of treatments.
40	**Human-centered medicine and construction of healthcare support systems**	Communication-oriented medicine that not only treats illness but also considers patients' peace of mind and respects their dignity is needed. In concrete terms, this area comprises pain-relief care, development of methods to communicate with people with cognitive or language disabilities, improvement of treatment and social support methods, terminal-care medicine that considers patient peace of mind, the development of human resources to serve as liaisons between patients and medical professionals, and the development of a full system to obtain second opinions.
41	**Preventive medicine**	There is a danger that chronic disease morbidity will rise as Japanese society ages. Most of those diseases are lifestyle diseases. It is necessary to carry out the development of standards for medical economic evaluation and, regarding preventable illness, the enhancement of general health education, diagnosis of individual disease trends through genomes, and lifestyle surveys are needed, with the resulting data used to provide lifestyle guidance. Preventive drugs are needed for cases where improvement is difficult. Meanwhile, as measures concerning the low birth rate, the development of technologies to prevent premature births and the onset serious hereditary disease are needed. This area targets the development of evaluation standards and prevention technologies needed to carry out preventive medicine.
42	**Measures against emerging and reemerging infectious diseases**	For approximately the last 30 years, many infectious diseases have been emerging or reemerging, with a serious impact not only on health but on social and economic activity as well. The reemergence of such infections is connected with factors such as environmental destruction due to industrialization, increased movement of men and cargo due to improved transportation systems, and the acquisition of drug resistance by pathogenic microorganisms due to widespread use of antibiotics. Caution must also be exercised regarding the spread of cross-species infections inclilding zoonosis by pathogens that affect both humans and animals. Along with the development of methods for the rapid detection of the causative agents and treatment of the diseases, international cooperation on vaccination strategies and international disease surveillance systems are necessary.
43	**Medicine and welfare for an aging society**	Japan's population is aging and its birthrate is declining at a speed unprecedented anywhere else in the world. The establishment of health, medicine, and welfare policies in response is an urgent need. This area targets technologies related to the low birthrate and aging population, including elucidation of the aging process, maintenance of the health of the elderly, prevention and treatment of diseases that seriously impair the activities daily life (ADL) of the elderly, support for improved care and rehabilitation of elderly people with disabilities, avoidance of a low birthrate, pediatric medicine, and support for childrearing.

5) Agriculture, forestry, fisheries and foods

	Area	General description
44	**Elucidation of the complex interaction between biodiversity and ecosystems**	To protect global biodiversity, use of natural resources must be based on its complex interaction with ecosystems. Forests, grasslands, cultivated land, and fishing grounds are important elements of agriculture, forestry, and fisheries, and they must be monitored with an eye to sustaining ecosystems, including biodiversity. This area's research centers on measurement and monitoring systems for widespread and complex ecosystems, and on technologies to utilize the measured and monitored data for dynamics prediction, impact assessment, and ecosystem management.
45	**Biological solutions to environmental problems and achievement of a sustainable society**	During this century, humanity must sincerely grapple with issues such as reducing use of fossil fuels, breaking out of the cycle of mass production, mass consumption, and mass disposal, and restoring polluted environments. This area aims towards the solution of such problems from the viewpoints of agriculture, forestry, and fisheries, centering on research on technology for the utilization of biomass energy, waste reduction and reuse, and environmental restoration.

	Area	General description
46	**Development of production technology that harmonizes with ecosystems and improves the environment**	With concern for environmental conservation and food safety on the rise, sustainable production technology that reigns in heavy use of pesticides and chemicals, builds healthy environments, and fully utilizes the functions of organisms is desired. In addition, the population of agriculture, forestry, and fisheries workers is estimated to decrease, necessitating the development of more efficient production technology that requires less labor. This area's research centers on production technologies for agriculture, forestry, and fisheries, including environmental management, integrated pest management (IPM), precision agriculture, exploration of untapped resources, and human engineering methods.
47	**Development of a food system for a safe, peaceful, long-lived, and healthy society and other new technologies for daily life**	In Japan, there are emerging problems such as aging society, the accompanying increase in lifestyle diseases, and the decrease in confidence in food accompanying increased imports and advancing production methods. Therefore, there is an urgent need to develop technology to support the production, inspection, and diagnosis of safe and reliable food and foods that boost the physical and mental health of the elderly. Research in this area centers on the use of molecular biology methods such as proteomics and metabolics, DNA chips and other information technology, and natural resources to improve health.
48	**Elucidation of genome/proteome, and biological information signal transduction mechanisms and development of innovative production technology**	This field covers genome/post-genome technology, gene manipulation, and clone techniques in agriculture, forestry, fisheries and foods. These techniques are hoped to develop from basic research techniques to practical production. This area is constituted by livestock transformation of animals, production of medicines by insects, and regulation of crop growth, etc.

6) Frontier

	Area	General description
49	**Planetary exploration technology**	The ultimate meaning of planetary exploration is to make clear the place held by the Earth and the Earth's organisms in the universe. Planetary exploration in the 21st century will clarify the diversity of bodies in the solar system, leading to understanding of how the solar system was formed and how it will evolve. To reach these goals, planetary exploration technology is needed.
50	**Earthlike life and extrasolar planetary exploration technology**	During the past few years, over 100 planets have been discovered around stars near our solar system via the Doppler effect, making it ever clearer that planetary systems are widespread. However, no images of such planets have ever been taken, and all those discovered outside the solar system so far are massive Jupiter-type planets. Obtaining direct images of such extrasolar Jupiter-type planets, discovering extrasolar Earthlike planets, and discovering on them environments suitable for life or subtle signs of biological activity have deep scientific significance and pose major technological challenges.
51	**Space and particle research**	In the 21st century, clarifying the birth and evolution of the universe, zeroing in on the characteristics of dark matter and dark energy, explaining the elementary particle species and their masses, exploring the nature of the asymmetry between matter and antimatter, understanding the process of nucleosynthesis, and delving into physics of energy non- quipartition are major issues essential to human understanding of the nature. They can provide a major incentive to technological innovation from an aspect that differs from that of economic activity.
52	**Basic technology for space transportation and manned space activity**	Already, two or three astronauts are stationed on board the International Space Station, in whose construction Japan is participating. Space environments are becoming a site of constant human activity. In Europe and North America, plans to exploit the Moon and send manned missions to Mars have been announced. Although they are expensive, space trips for members of the general public are also being carried out. Under these circumstances, this area targets the future of manned space activities, advances in technologies such as manned space transportation technology and orbital residence technology, and the degree to which Japanese technology can make a contribution in those fields. It also targets technology to independently launch satellites into space when necessary.
53	**Space utilization technology—basic satellite technology—**	Exploitation of space through satellite use is spreading in fields such as Earth observation, space science, planetary exploration, communications, broadcasting, and positioning. Observation sensors and basic technology are therefore essential. In addition, future satellites will be required to have increased reliability, greater capacity, ease of operation, and price competitiveness. In order to achieve that, developments are needed in areas such as large stationary platform technology, large antenna technology, multi-terabit class transponder technology, innovative satellite component technology, orbital maintenance, correction, and autonomy technology, and anti-debris technology.
54	**Technology for high precise observation of Earth environments and for prediction of change**	In response to global environmental issues, we are entering a new era in terms of both observation and prediction. Global data on clouds, water vapor, aerosol, vegetation, and so on is beginning to be provided by Earth observation satellites, with increased frequency and resolution expected. In marine observation, many moored buoys in tropical oceans and Argo buoys for ocean temperature observation are deployed, providing real-time reports on ocean conditions. On land as well, Fluxnet and other initiatives to observe the carbon cycle and so on are being created. Regarding numerical models for change forecasting, along with the appearance of the Earth Simulator, high-resolution models are being developed, as are system models of the global system as a whole. In addition, as precision and resolution in observation and modeling improve, the amount of data generated is also increasing radically. Therefore, innovative information science technology to comprehensively process, distribute, and store those large quantities of data is also necessary.
55	**Technology to explore, capture, and cultivate life under extreme environment**	Life on Earth initiated about 4 billion years ago in an extreme environment.To understand the diversity of life in our planet, this area explores the possibility that the extreme life forms thus generated may survive in the deep oceans or the Earth's subsurface environments. Discovery of life under extreme conditions is also connected with the search for the extraterrestrial life.

	Area	General description
56	**Deep Earth observation technology**	Understanding of heavenly bodies other than the Earth has radically advanced through planetary exploration, astronomical observation, and so on, yet no one has ever been to most of the Earth's interior, and it remains unknown territory. However, activity in the Earth's interior causes Earthquakes, volcanoes, long-term climate change, and geological phenomena and, as a result, can change the surface environment, which is deeply connected to the future lives of human beings. It is vital to elucidate the facts of Earth interior activity through observation, study, and laboratory experimentation, and to tie it into future change forecasting.
57	**Ocean and deep ocean floor observation research technology**	In ocean development, a balance among the three elements of "understanding, using, and conserving" the ocean is vital. Oceans have regulated the Earth's average atmospheric temperature and atmospheric composition (especially the amount of carbon gases), but human economic activity may be disrupting that mechanism. To carry out "safety-oriented" technological development in order to protect the environment, there is a need for broad based and ultra-long observation of the ocean's surface, depths, and floor.
58	**Space, ocean, and Earth technology for a safe and secure society**	The Japanese Islands are located in the area with the greatest number of natural disasters in the world. To realize a safe and secure society, we must monitor the natural phenomena that lead to disasters so that their occurrence may be predicted and immediately detected. This will greatly reduce human disasters. This area mainly targets satellite-based disaster monitoring technology, radioactive waste disposal technology, natural disaster prediction technology.
59	**Space, ocean, and Earth technology that drives science and technology innovation**	Next-generation technology for space and planetary exploration, space environment utilization, Earth observation, and Earth environment restoration integrates elemental technologies in fields such as nanotechnology, computers, new energy, new materials, and biotechnology. In other words, it brings together the frontlines of human technology, while leading the way to new development in other fields of science and technology.

7) Energy and resources

	Area	General description
60	**Innovative nuclear power systems**	Currently, about 7 percent of the world's energy and 17 percent of its electricity come from nuclear power. For a 21st-century Earth in which 10 billon people must live, greater use of nuclear power, which does not emit carbon gases, is clearly a possible solution. Therefore, the development of innovative technology to address issues such as waste disposal, nuclear nonproliferation, and improved safety is needed.
61	**Nuclear fusion energy**	Nuclear fusion energy, which could be realized by the middle of the 21st century, is a promising option as a future energy source. To realize that promise, technology that uses magnetic fields to contain plasma at temperatures of several hundred million degrees and technology that can extract energy from the fast neutrons generated by nuclear fusion reactions must be perfected. The technology related to nuclear fusion development covers many fields, but keys elements will be plasma diagnostic, heating, and control technology, neutron engineering, materials engineering, superconducting technology, tritium handling technology, vacuum technology, and robot technology.
62	**Hydrogen energy systems**	Worldwide expectations are high for the adoption of hydrogen energy as part of integrated measures for Earth environmental conservation and stable energy supply. The introduction of hydrogen energy requires the completion of a hydrogen energy system, including the establishment of hydrogen infrastructure technology such as hydrogen manufacturing, transport, and storage, and hydrogen utilization technology such as fuel-cell automobiles, stationary fuel cells (systems), hydrogen engines, and hydrogen turbines.
63	**Fuel cells**	Fuel cells are a highly efficient electric power generation system that does not require intermediate machinery. Utilizing hydrogen as fuel, they are highly compatible with the environment. Expectations are high for their large-scale diffusion in the future as an automobile power source, as stationary distributed electric power generation equipment (including cogeneration), and as a mobile power source.
64	**Decentralized energy systems**	Distributed energy systems convert and utilize on the demand side natural energy that is widely and sparsely distributed. They can also be systems to convert and utilize fossil fuels on the demand side, and are expected to complement existing centralized energy systems. Energy storage equipment is another key technology that help eliminate demand and timing mismatches and stabilize intermittent energy output. There is a need for methods to use these technologies in combination with electric and other existing energy networks in a mutually supplementary manner to benefit both the supply and demand sides.
65	**Renewable energy**	It is no exaggeration to say that the greatest issue in energy technology in the 21st century is shifting from fossil energy to renewable energy. To achieve that shift, along with the diffusion and improved performance of existing renewable energy technology, the broad development of new renewable energy technology is also needed. From that perspective, major foresight issues in this area are: large-area thin-film solar cells with a conversion rate of at least 20 percent; wind energy, which accounts for 1 percent of the world's primary energy; and new technologies such as space solar electric power generation systems, electric power generation from changes in ocean temperature, biomass plantations, and artificial photosynthesis technology with a conversion rate of at least 3 percent.
66	**Clean-coal technology**	Fossil resources are used as a major energy source, and in light of their abundant reserves, their mass use can be expected to continue in the future. Considering concern over global warming from CO_2 and other gases, however, they must entail resolution of global environmental issues. In the future, technology for the conversion of coal to gas and liquid will be the core to develop technology that simultaneously gasifies coal, biomass, and waste to convert them to energy and chemical raw materials, technology to manufacture hydrogen from coal without emitting CO_2 as we move towards a hydrogen energy society, and technology to recover, sequestration and store CO_2.

	Area	General description
67	**Efficient energy conversion and use**	This area's technology is so-called energy conservation technology. By reducing the amount of energy consumed, it is expected to contribute to both economic and environmental improvement. Technologies belonging to this area range widely, but typical technologies include efficient thermal electric power generation plants, efficient heat pumps, cogeneration systems, and high-temperature superconducting motors.
68	**Resource assessment**	The estimated lives of underground resources vary for numerous reasons. In addition, advancing exploration and mining technology is important from the perspective of discovering new oilfields and deposits and effectively using resources. Ultimately, therefore, it is important to know the total amount of recoverable resources. This area targets underground resources exploration technology, mining technology, reserve estimation technology, and so on.
69	**Recycling system (including biomass and waste)**	From the perspective of effective use of resources, the use of waste for energy is promising. In particular, the cost and labor required for the collection of organic waste from plants and of biomass resources are high, preventing expansion of their use. However, from the perspectives of building a recycling society and controlling carbon dioxide emissions, such technology deserves attention. This area mainly targets technology to utilize waste plastic as energy, technology to utilize biomass energy from agricultural, food, and construction waste.

8) Environment

	Area	General description
70	**Global environment (focus on global warming)**	Global growth in population, the increased energy consumption accompanying it, and the rapid development of technology are the major causes of the world's environmental problems. Serious problems are also arising from the fact that environmental pollutants released into the natural environment are exceeding the earth's natural absorption capacity. This has increased the urgency of awareness raising and concrete efforts toward environmental improvement at both international and personal levels.
71	**Urban environment**	Many elements, including people, goods, and energy, concentrate in urban cities. In different phases in the process of concentration, diverse environmental problems occur. The level of urbanization varies between cities in a country and between major cities in a developing country and those in a developed country. This research area addresses diverse issues related to urban environmental problems, including not only physical and chemical aspects, but also social and mental stress in urban cities.
72	**Focus on identification and mitigation of ecological effects (including soil and water)**	Degradation of ecosystems resulting from human activities is posing a greater concern. There is a need for preserving and conserving endangered species and the ecosystems around them and for restoring degraded ecosystems. This area addresses physical and chemical factors, such as acid rain and hazardous chemical substances, which affect the conservation and restoration of ecosystems, biological factors such as invasive foreign species, and factors of ecological restoration and destruction.
73	**Environmental economic index**	To achieve a sustainable society, the development of technology that can combine economic activities with reduced environmental burdens is necessary. For the developed technologies or products to be valued appropriately in society, it is important to raise awareness of objective and quantitative environmental assessment methods and indicators, and to provide relevant information. This area consists of environmental economic indicators, the attachment of LCA information to products, the technology for predicting product lives, and chemical risk assessment.
74	**Lifestyle based on environment**	In developed countries, the focus of environmental issues has shifted from regional problems to the issue of overloading the earth's environmental capacity through excessive consumption of resources and energy. Changing personal lifestyle is essential to solving this problem. That is to say, it is necessary, in addition to improving people's environmental literacy, to change values and develop social systems and product technologies that can naturally transform lifestyles.
75	**Environmental disasters**	Large-scale forest fires and other natural environmental disasters increasing in number recently may not be entirely natural and can partly be attributed to climate changes resulting from civilization. Since such natural environmental disasters have large regional impacts, there is a need for technology to quickly detect, predict, and respond to large-scale forest fires and other disasters. While technology for responding to certain human-caused disasters, including oil spills from large tankers, has accumulated through past disaster experiences, technology for responding to a growing number of accidents in large-scale industrial plants such as advanced waste-treatment facilities is immature. Since large plants are not limited to industrial areas but are sometimes located in residential areas, there is a need to develop technologies for not only preventing industrial accidents, but also for post-accident response such as minimizing the impact and enabling early recovery from damage.
76	**Water resources**	Water is the key to sustainable development and is essential for all life forms' survival. Currently, two thirds of deaths from natural disasters are caused by water-related disasters such as flooding or drought, and the ratio has increased recently. To solve these problems, advances are urgently required in areas such as the water source, water quality, and water management. In particular, monitoring technologies associated with data on water use and demand, groundwater assessment, water development impact assessment, and the Earth's surface observation from satellites are important.

9) Nanotechnology and materials

	Area	General description
77	**Nanomaterials modeling simulation**	As a technology for predicting new materials in the nanoscale domain before experimentation, first principle analysis is an extremely important element of nanotechnology. Rapid development is expected in this area through radical improvement in supercomputer performance, the development of quantum mechanics calculation methods, multiscale simulation technology that extends to the macro level, and research schemes that match combinatorial experiments with output from these technologies.

	Area	General description
78	**Nano measurement and analysis technology**	Currently, nano measuring and analysis technology to directly view or to discern atomic and molecular sequences is developing rapidly. The development of new leading-edge measurement and analysis technology is particularly important as basic elements of nanotechnology and nanomaterials. This includes the development of technology for three-dimensional high-resolution visualization of the structure and organization of matter at the nano level, technology to radically improve the resolution of electron microscopes, and new technology and equipment to measures organisms, macromolecules, and single molecules.
79	**Nano processing, molding, and manufacturing technology**	Notable issues in nano processing, molding, and manufacturing technology are: at the matter structural design and mapping stage, the establishment of technology for monatomic and monomolecular manipulation; at the processing and molding stage, the establishment of manufacturing methods such as self-organization of block structures from combinations of atoms and molecules that draw out fixed functions; and at the industry level, the establishment of manufacturing technology to test produce or mass produce three-dimensional structures with unit elements at the submicron scale by utilizing nanometer-scale resolution or processing precision.
80	**Matter and materials origination, synthesis technology and process technology**	Many new substances and materials are being compounded and fused from heterogeneous substances by structure control at the nm order. Among the new developments in matter and materials technology, expectations are high for the expression of unknown properties and functions, and for the radical improvement of known properties and functions. In particular, the establishment of manufacturing, compounding, and process technologies for matter and materials that offer large practical advantages is hoped for.
81	**New materials from nanolevel structure control**	Building and controlling the structure of materials, such as inorganic/organic matter and proteins, at the nano order can radically improve their function and strength. This area focuses on achieving, through nanostructure control, ceramics, macromolecules, metals, compound materials, amorphous materials, and other materials that have electrical, superconducting, magnetism, or mechanical performance far better than conventional materials, or completely new functions.
82	**Nano devices and sensors**	Expectations are high for the realization of quantum devices and spin devices that utilize quantum and spin effects appeared in the nanometer scale, and for photonic devices that control light propagation with nano-precision. In addition, the realization of new sensors that use nanodevices for biomolecules such as protein and DNA is also expected. Nanomolecular devices that utilize chemical reactions and other self-organization phenomena promise to be the ultimate low power dissipation nanodevices.
83	**NEMS technology**	This area pursues nanomachines and nanorobots capable of mechanically and directly controlling and manipulating individual atoms, molecules, and nanostructures, or of providing mechanical functions at the micrometer scale and below. Conceptually, such machines have long been discussed, but now the necessary basic technologies, such as nanoprobes, MEMS, and nano-biotechnology, are rapidly developing.
84	**Environment and energy materials**	Regular nanospatial matter includes zeolite, mesoporous material, and accumulated metal complexes. If this matter with properties such as ion exchange, catalytic, and adsorption ability is used in fields such as energy and environment, not only will efficiency and optionality be improved, completely new functions can be expected.
85	**Nanobiology**	This area holds the promise of minimally invasive diagnosis of cancer and other intractable diseases, targeted medicine, and tissue engineering for tissue and organ regeneration, as well as innovative bio-oriented nanotechnology such as biocomputers.
86	**Nanoscience for a safe and secure society**	This area focuses on the relationship between the achievements of nanoscience and human safety and security. There are two pespectives underlying the attention paid to that relationship. First, even if the achievements of nanoscience are widely applied to cosmetics, foods, and medicine, there is a need to prevent them from posing threats to human safety and security. Second, the achievements of nanoscience can be used in identification and sensing, contributing to a safer and more secure society.

10) Manufacturing

	Area	General description
87	**Manufacturing technology utilizing advanced information technology**	Development of manufacturing technology that makes advanced use of IT brings about a major change in manufacturing. For example, developing Japan's original operating systems technology for large variety small volume production and other manufacturing styles, autonomous adaptive manufacturing systems, remote maintenance and inspection systems, and skills learning support systems will allow diverse products to be steadily manufactured on demand, in short lead time, and at low cost.
88	**Manufacturing technology using virtual design**	Technology for expressing diverse information relevant to the actual production life cycle, from development to disposal, as accurately as possible in the virtual (computer) space needs to be developed to construct an environment in which the targeted product or production process with desired functions and performance can be promptly and reliably created without the need for prototyping.
89	**Manufacturing technology for high-value added products**	Since customer needs are diversifying in many markets, growing attention will be paid to product design more responsive to individual needs and to high-mix, low-volume manufacturing. Technology for such tailor-made (on-demand) production and technology for increasing added values by foreseeing the potential needs of people will be important.
90	**Nano-machining/ micromachining technology**	Nanotechnology is reshaping the manufacturing sector, making machining and measuring processes that have been impossible by conventional technology possible. This area focuses on the bottom-up approach as well as the super high precision process technology, packaging technology, net shape forming technology, and measuring technology at the few-micron to angstrom level.

	Area	General description
91	**Recycling-oriented manufacturing technology with a low environmental load**	As a result of production activities growth , environmental degradations, such as global warming ,acid rain etc.., become more serious concerns these days. Also greater attention has been paid to the issues closely related to them, such as energy resource depletion. Hence, in the area of manufacturing/production technology, further R&D is needed on "environment-oriented" & "environment friendly" technology, systems, and new energy sources and their application technology.
92	**Human and robot participation in manufacturing**	There are emerging issues such as the aging of operators and engineers--who are key in manufacturing--, globalization, female empowerment, and the shrinking workforce as a result of the declining birthrate. To cope with such changes, industrial infrastructure must be secured through innovations in IT and robotic technology. In particular, robotic technology for achieving higher robotic performance and control, work and thinking support systems, and process control support systems are important.
93	**Manufacturing technology in special environments**	A key element of vitalizing and advancing manufacturing technology is the development of new materials. Demands for engineering materials with increasingly advanced properties and functions bring about a need for new manufacturing technologies. For example, a high-efficiency manufacturing process in gravity-free, minimal-gravity, or other special environments will be developed. New manufacturing processes that use or mimic biological activities, such as a high-efficiency manufacturing process based on microorganism functions, are expected.
94	**Advanced manufacturing technology for social infrastructure**	Technology for building heavy structures such as high-rise buildings, bridges, vessels, and energy facilities is essential to support social infrastructure and to maintain a safe and secure society. In order to retain and further develop manufacturing techniques based on advanced science and technology, progress is required in terms of high-precision machining and bonding technology, the introduction of composite materials for the achievement of dramatic weight reductions, and innovative development techniques using simulations.
95	**Surface modification and interface control technology**	There is a growing need for environmental awareness in manufacturing and for extending the life and functionality of manufacturing equipment/facilities. Technological solutions to this include controlling properties through the modification of surface functions and producing and using new types of functional materials. This area focuses on achieving longer-life equipment through surface property innovations, producing super-hard thin films in complex shape, technology for manufacturing self-lubricating functional materials, and dry processing technology.

11) Industrial infrastructure

	Area	General description
96	**Optimization of industrial infrastructure through regional dispersion and concentration**	A region is the basic unit in which businesses and industries set up and operate and people reside, live their lives, and consume. A region is also a unit in which communities are formed and policies are implemented. There are regional challenges such as how to develop regional economies, how to build industrial clusters, and how to improve people's quality of life. Regional issues to be addressed on the national level include how to achieve regional dispersion and how to solve urban problems. For economic growth in developing countries, regional resolution of problems is emphasized. In the age of globalization, regions in different countries are sometimes interrelated directly across national boundaries. Broad multinational economic zones such as Europe and Eastern Asia are also important. This area consists of foresight issues concerning the optimization of industrial infrastructure through regional dispersion and concentration.
97	**Knowledge management**	The challenges lie in the need for industry, government, and non-profit organizations to improve intellectual productivity through knowledge management, which is the notion of appropriately managing individuals and organizations involved in knowledge creation. Knowledge management embraces analysis of the mechanisms of knowledge creation by individuals and organizations, analysis of knowledge creation support tools such as a system for sharing and managing text documents and image data, analysis of the value of intangible assets, such as intellectual property, as a result of intellectual activity, identification of relationships between individuals and organizations, and analysis of social capital. This area consists of foresight issues concerning knowledge management.
98	**Corporate decision-making, governance, and management**	The issues to be addressed concerning corporate decision-making are higher efficiency in resources allocation associated with the decision maker's activity and the development of technology for reducing transaction costs. They are related to areas such as finance, settlement schemes, motivation within companies, and reward system design. The subsequent challenge is analyzing the corporate decision-making process itself. This leads to the issue of corporate governance, which refers to how companies, as the mainstay of production activity, make what decisions and for the interests of whom. This area consists of foresight issues concerning corporate decision-making, governance, and management.
99	**Public-sector governance and management**	The quality of administrative services improves as the public-sector information systems advance. Improved efficiency can derive from the development of physical accounting, which uses non-monetary measures, and advances in public-sector assessment tools based on such accounting methods. Higher efficiency will lead to more specific economic (e.g. financial) policies, and to the development of "integrated risk management" technology to raise the public sector's risk management capacity. This will allow the public sector to assume a desirable society and formulate and implement relevant policies in a consistent framework. The challenges are improving efficiency and service quality in the public sector, which will require governance and improved management. Particular attention should be paid to the establishment of a public accounting system dissimilar to the corporate one, public-sector assessment methods (e.g. for public R&D funds) and resources allocation systems, and public risk management methods. This area consists of foresight issues concerning public-sector governance and management.

	Area	General description
100	**Risk management and finance**	Any entity confronts risk or uncertainty. Risks can be divided into five categories: "natural disaster risk," e.g. earthquakes, drought, storms and flooding, and global warming, "social risk," e.g. population explosion, depopulation, aging population, disintegration of community, crime, disease, and labor accidents, "political risk," e.g. war, terrorism, ethnic conflict, and famine, "economic risk" in economic activities involving securities, commodity transactions, interest, currency, and credit, and "domestic risk" of individuals, e.g. job security, income, health, and safety. How to cope with these risks is an essential issue in the field of industrial infrastructure. Possible solutions include risk avoidance, risk reduction, and risk transfer, as well as adopting risk-conscious schemes in designing and constructing the public sector, the corporate systems, and personal lives. Such risk management requires theoretical analysis of risks. This field consists of foresight issues concerning risk management and finance.
101	**Human resources management (relationship among education, competition, and cooperation)**	To allow the economy to grow in a highly complex society, there is a need for continuous education to develop highly specialized professionals. This requires policy measures that take work-study balance into consideration, with lifelong education as a precondition. It will also be necessary to make effective use of female human resources and to include every type of workforce, aside from the conventional full-time workers, in productive systems. This area addresses foresight issues concerning human resources management.
102	**Competition and cooperation in business**	Development of information technology (e.g. reduced cost of goods and information exchange) and other factors are changing the relationships not only among companies, but also between companies and consumers. For example, the cross-company sharing of information and progress in improvement activities will make companies less susceptible to economic cycles. Awareness of such issues underlies the listing of "business competition and cooperation" as a hot topic. It addresses foresight issues such as supply chain management across multiple companies, potential technologies required to achieve it, standardization, and consumer privacy protection.
103	**Higher productivity in service industries and the services sector**	Japan's service industry and indirect departments are said to have lower productivity than the manufacturing and production sectors. To strengthen national or industrial competitiveness, their low productivity needs to be improved. This area consists of foresight issues concerning methods for measuring productivity and service, standardization of operations, and unmanned systems for improved productivity.
104	**Environmental management**	Corporate and industrial activities are a burden on the natural, global, and social environments. Since many of today's major fears, such as global warming, pollution of air, soil, and water, and lower food safety, derive from business activities, companies assume a significant role in reducing, mitigating, and solving such problems. This area addresses foresight issues concerning the environment and the business operations.
105	**Art, culture, and entertainment that drive industry**	The workforce involved in supplying food, clothing, and shelter reduces as productivity improves. This means that the remaining sectors have to assume a greater role in employment, and this is particularly true for the art, culture, and entertainment sector. This sector will thrive to become the engine of industry, while even in sectors related to food, clothing, and shelter, products and services with higher artistic or entertainment values added will be developed. Art, culture, and entertainment also contribute to technological advance and mental improvement, enhancing invention and discovery technology. This area addresses foresight issues concerning art, culture, and entertainment.

12) Social infrastructure

	Area	General description
106	**Social infrastructure technology for non-densely populated areas**	Conventional social infrastructure has been designed and constructed assuming urban areas, or somewhat densely populated areas. However, growing importance is placed on issues associated with non-densely populated areas, which make up a larger part of Japan's land area, including the transition to a recycling-oriented society and coping with diverse lifestyles, unevenly distributed population, and the aging society. This area consists of foresight issues concerning the requirements of social infrastructures in non-densely populated areas and technologies relevant to them.
107	**Improvement of structure performance**	Requirements for structures and infrastructures are becoming increasingly complex and advanced. Considering the ratio of the addition to the stock of infrastructure, researchers should pay more attention to improving the performance of existing stock assets. This area addresses foresight issues concerning the improvement of the performance of structures by using new materials and design techniques, and technology to continuously monitor the performance of structures and infrastructures to make them function as robust systems over time.
108	**Revitalization, maintenance, and management of social infrastructure**	Japan has constructed a huge amount of social infrastructure over its high economic growth period. To keep it safe and functional, Japan needs to develop technology for infrastructure deterioration assessment, reinforcement, life extension, and replacement. This will contribute to restoring spaces, recycling resources, and coping with the aging society with a declining birthrate. This area addresses foresight issues concerning technology for restoring, maintaining, and managing social infrastructure by assessing the soundness of existing structures through nondestructive inspection and reinforcing them efficiently.
109	**Social infrastructure technology responsive to an aging society**	An issue of major importance in an aging society is constructing an environment that helps the socially vulnerable, such as the elderly and the disabled, to participate in social activities comfortably, safely, and independently. This area addresses foresight issues concerning technology that quickly assists elderly people by promptly detecting and understanding problems that they encounter while acting in diverse spaces. This includes ubiquitous computing, sensor networks, robots, and space design/management based on these technologies.

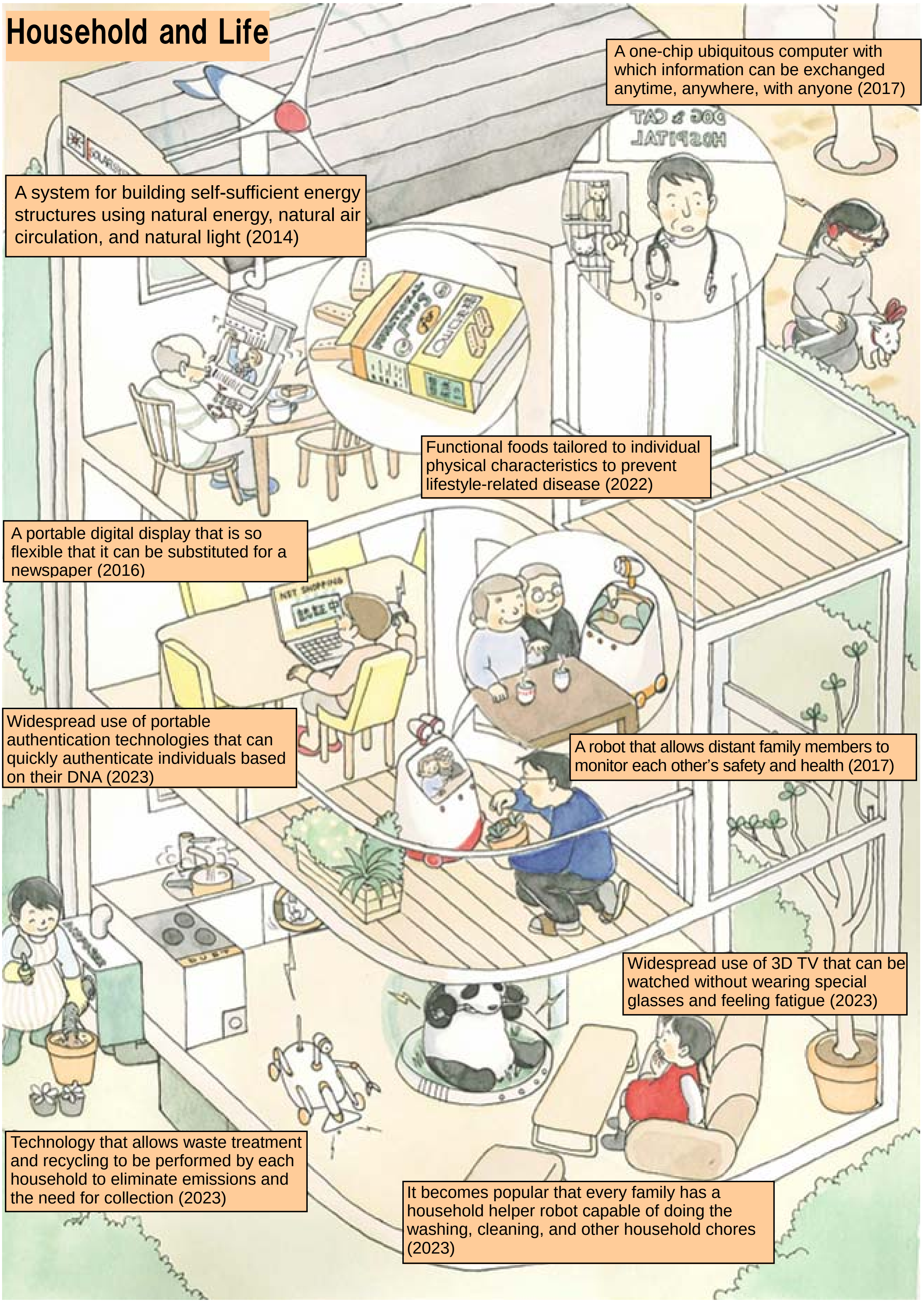
	Area	General description
110	**Environmental technology in social infrastructure**	Since social infrastructure is intended for long-term use, life cycle assessment is essential in estimating its environmental loads and financial costs. In designing infrastructure, there is also a need for a comprehensive database of meteorological and hydrological records, soil and geological distribution, and existing structures' geographical information. Such an environmental information base can be useful for facilitating cooperative decision-making among interested parties before constructing social infrastructure. Now that the application of fuel cells and film technology is enabling the effective use of natural energy, biogas, waste, and rainwater in an distributed environment, the next step will be the construction of a system for the integrated use of these resources.
111	**Comprehensive water management technology**	There is growing awareness of the global water crisis. The focus of attention in water resources issues has shifted from quantity to quality and quantity. This area addresses foresight issues concerning the water quantity and quality required for water use and environmental conservation, and technology for holistically managing water conversion, transport, and storage systems to meet these requirements.
112	**Environmental measures appropriate to architectural scale**	The limits of the global environment are defining the boundaries of human activities. People are searching for ways to use environmental resources sustainably and effectively in their daily lives. There is a need for systems in which various cycles are completed within a certain space, as demonstrated in the pursuit of self-sufficient houses and eco-cycle houses. Another major challenge is, despite the prevailing trend toward artificial environment, how to redefine the value of nature's power and use it for new systems. This area consists of foresight issues concerning indoor environment control, which addresses indoor air contamination, and space remodeling.
113	**Security technology as social infrastructure**	As society diversifies and advances, people have become more aware of the potential risks surrounding them. This area focuses on detecting and recognizing such risks as early as possible and sharing risk information with the many people involved; for example, quickly formulating protections against risks based on past examples. Foresight issues addressed here include technology for sensing, communicating, and describing risks, and technology for the timely definition of risk protections.
114	**Disaster prevention technology**	Key factors in making life safe and secure are disaster prevention, advance risk detection, and measures to minimize human suffering. From this perspective, this area addresses advanced disaster prevention systems--notably, technology for predicting, warning of, evacuating from natural disasters, such as earthquakes, floods, and landslides, and technology for, after a major disaster, assessing the damage, predicting its spread, and providing relief.
115	**Total management of social infrastructure that includes public involvement**	Public involvement and community-based development (CBD) are becoming the mainstream of regional project planning and urban development. However, the type of schemes and approaches that would be more effective in such activities remains unclear. This challenge involves questions even associated with social technology, such as how infrastructure should be developed in close relation with the local community, and what type of approaches are required. This area addresses foresight issues concerning public involvement schemes and administrative management.
116	**New transport system technology**	In the area of transport, as the means of transporting passengers and freight to their destinations, technology to achieve intelligent transport systems are pursued; for example, this refers to increasing service frequency by improving the speed, function, and information collection/processing capability of each transport system. This area consists of foresight issues concerning new transport systems to meet such needs.
117	**Traffic safety technology**	Ensured safety is a primary traffic-related issue demanded by society today. Traffic safety technology is no longer limited to technology and systems for safe operation/flight and technology for reducing damage due to accidents, but is extending to the capability of avoiding accidents resulting from human error and weather conditions. This area consists of foresight issues concerning advances in environment recognition technology, technology for allowing each vehicle to detect others' positions, and travel control technology.
118	**Environmental management in the transport sector**	The transport sector, including roads, railways, and ships, is required to reduce as much noise, air pollution, vibration and other negative impacts on the environment as possible. Because of the ongoing efforts to develop technology for transport-sector environmental management, there is a growing possibility that low-emission transport will become widely available. This area consists of foresight issues concerning low-noise, low-emission, and fuel-efficient transport systems.
119	**Efficient and environmentally-conscious logistics systems technology**	Logistics systems must be efficient for shippers and logistics service providers, while friendly to the environment. In the 20th century, a trade-off relationship was assumed to exist between efficiency and environmental friendliness. In the 21st century, however, a combination of these two elements is becoming a reality in constructing logistics systems, owing to advanced information and communications technology and management technology. This area consists of foresight issues concerning the design and management of efficient and environment-friendly logistics systems by simulations.

13) Social technology

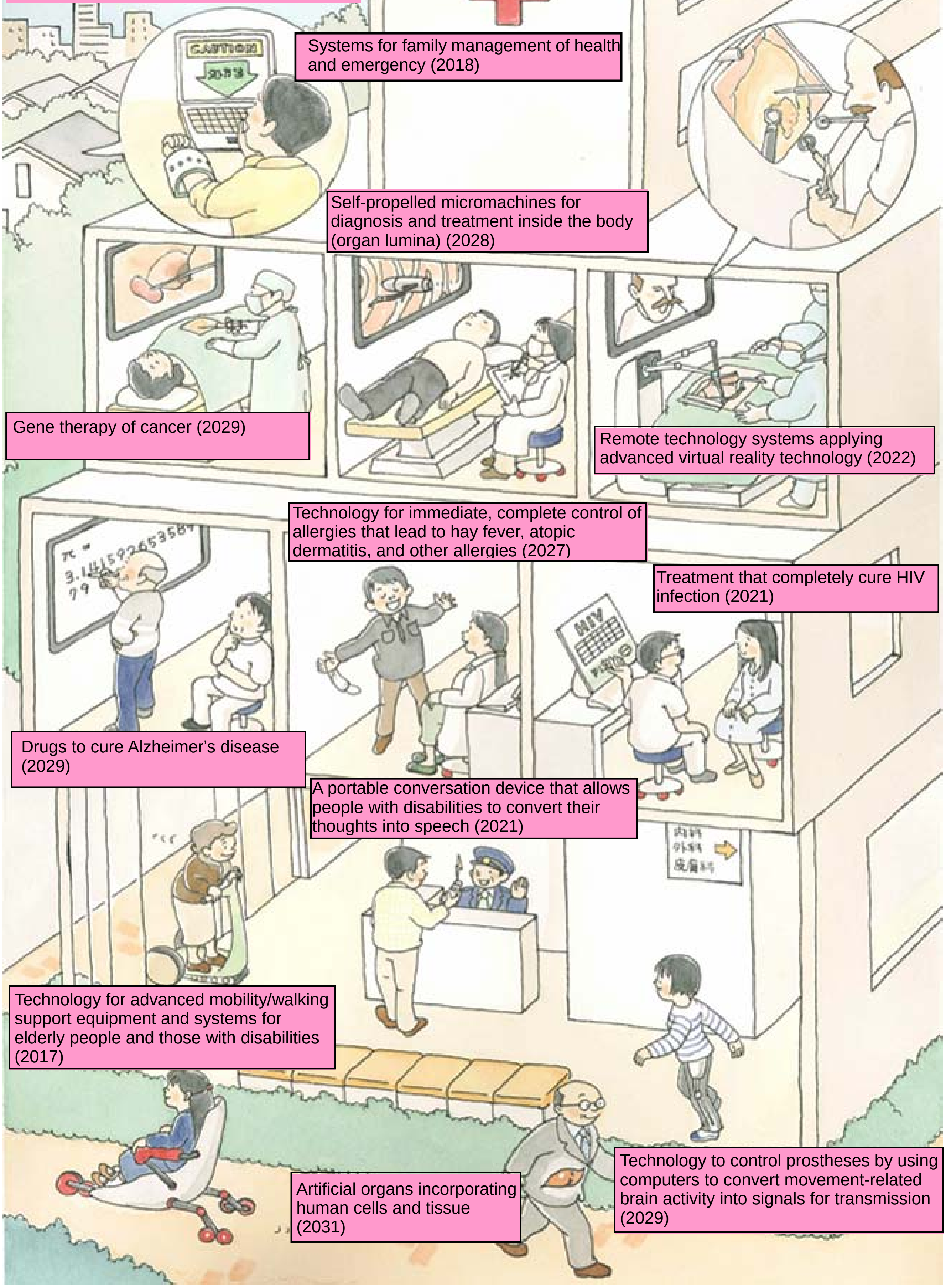
	Area	General description
120	**Safety, security, and stability of day to day life**	Ubiquitous computing, which is achievable by advanced use of information terminals, even including next-generation robots and miniature mobile terminals, is expected to contribute to coping with the declining birthrate and the aging population and preventing individuals from being involved in a crime or disaster, as well as promoting hobby activities and invigorating local communities. It will consequently help construct an environment where people can live their lives more easily and comfortably. On the other hand, it is also important to address the vulnerabilities of a computer-dependent society by, for example, developing technologies and systems to prevent cyber crime and terrorism intended for invasion of privacy, personal information theft, and disruption of the social system.

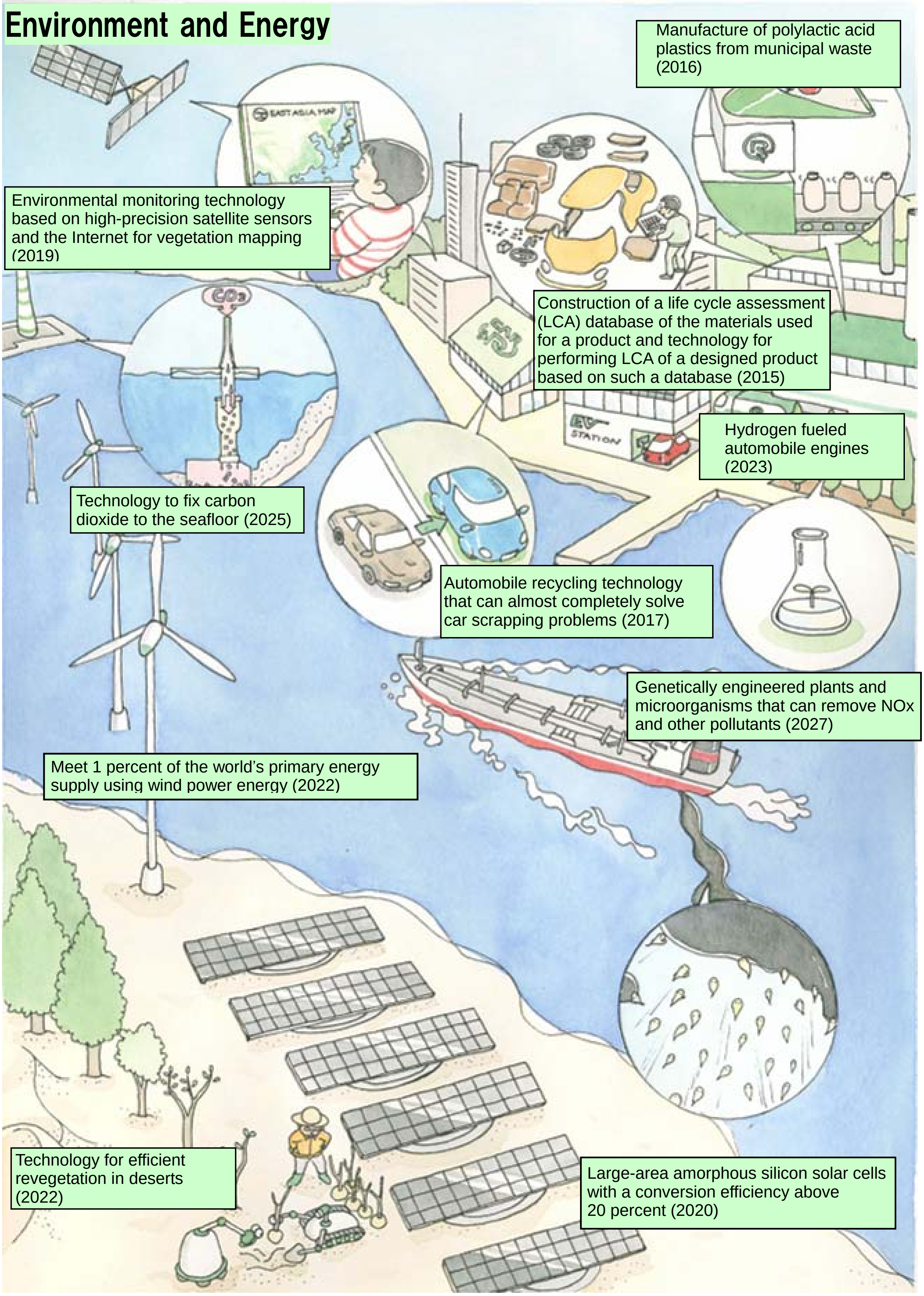
	Area	General description
121	**Urban safety, security, and stability**	As society diversifies and internationalizes, people are more prone to encounter unexpected incidents and accidents and are therefore feeling more insecure. To eliminate such a feeling of insecurity, there is a need for constructing a safe, secure, and stable social system by means of risk management, security safeguards, and crime prevention measures. This area of research focuses on technologies and systems that society should have for crime/terrorism prevention, disaster preparedness, and higher reliability of food production/distribution.
122	**Universal availability of services**	There is a disparity in services available to residents depending on the area of residence and the physical and life-stage conditions. This suggests that there is a need for universal services suitable for the diverse lifestyles of people. This area focuses on science and technology that can contribute to satisfying such a need by eliminating regional disparities, bridging the digital divide, and assisting socially isolated people.
123	**Support for the elderly and the disabled**	As a forecast that by the mid-21st century, the Japanese population aged under 20 years will almost equal that aged 65 and above shows, Japan is aging at an unprecedented rate. To prepare for such a future, in which greater emphasis should be placed on support for elderly and disabled people, who tend to be socially vulnerable, Japan's medical and welfare programs are facing an urgent need for a major transformation. Japan needs to address social and technological advances in light of "what should constitute the future aging society and what the Japanese people want it to be like," and to promote industries and technologies suited to such a society.
124	**Social application of brain research**	Advances in research into brain function imaging and into neuroscience and cerebral neural network modeling using experimental animals have resulted in accelerated progress in an integrated understanding of the higher function of the human brain. A future focus of attention will be applied research that directly links the results of brain science research (e.g. studies on the effects of the social and living environment, including home, community, education, and advanced information technology, on the development of a child's brain and the aging of an elderly person's brain function) to social technology.
125	**Technology for solving international problems**	The most important aspect for the international community in choosing and carrying out an adequate solution to an international problem is to build a common understanding of the status quo and the future. Without it, parties with dissimilar interests can neither reach an agreement, nor corporate in solving the problem. There is a need for establishing a procedure for analyzing the status quo--including natural scientific phenomena, people's lifestyles and awareness, historical background, and local, national, and transnational activities--and extracting the problems to be addressed. This area primarily consists of technology for promoting international mutual understanding, technology for grasping an overview of international problems, international product traceability technology, and technology for predicting the occurrence and spread of infectious diseases.
126	**Technology that supports education and learning**	Learning is a life-long desire of humanity. One challenge is how to take advantage of the latest scientific and technological findings in enhancing educational opportunity. Moreover, there is an emerging challenge of deciding what type of sciences and technologies should be developed to overcome educational problems surfacing in light of recent change in the social environment. This area focuses on science and technology as a means of receiving education and science and technology for solving or helping to solve educational problems.
127	**Handing down and preserving culture and technology**	While tangible and intangible cultural properties are invaluable assets for not only their owners (individuals, groups, local communities, and the nation), but also the whole of humanity, they are being scattered, damaged, or lost. Existing policies and programs for protecting and preserving them are insufficient, and the handing down of skills based on apprenticeship is facing limitations. The information currently collected for future restorations is limited to photos and written descriptions, and improvements are unlikely to occur to the traditional procedure for restoration, which depends on the existing parts of the target property and meager reference material available. There is a strong need for technology that enables the skills relevant to the existing cultural properties to be inherited by the next generation and ensures that such properties can be accurately restored in the event of loss or damage.
128	**Knowledge production system**	As information technology further advances, the method and system of knowledge production are undergoing a major transformation. As the boundary between producers and consumers is dissolving and international communication beyond language barriers expands, greater attention should be focused on the future form of knowledge production and social changes it may bring. From this perspective, this area addresses knowledge production/consumption, knowledge ownership, and knowledge-based decision making.
129	**Entertainment technology**	Japan's animation and game software are attracting worldwide respect for their uniqueness and meticulousness. This area addresses entertainment technology that is ever evolving, driven by the attractiveness of media arts and technology and by some enthusiastic supporters, and technology that results from the personal pursuit of hobbies and is innovative and exportable as culture.
130	**Technology assessment**	In the 21st century, science and technology is expected to be more closely connected with society. As social expectations grow for science and technology, there is an increasing need that activities in science and technology should seek support from and cooperate with society. Technology assessment, a concept adopted around 1970 and initially referring to the preliminary assessment of new technology, now involves broader activities intended for harmonizing science and technology with society, including studies on the social aspects of science and technology, social consensus building, and social scheme design.

B. Illustrations of future society

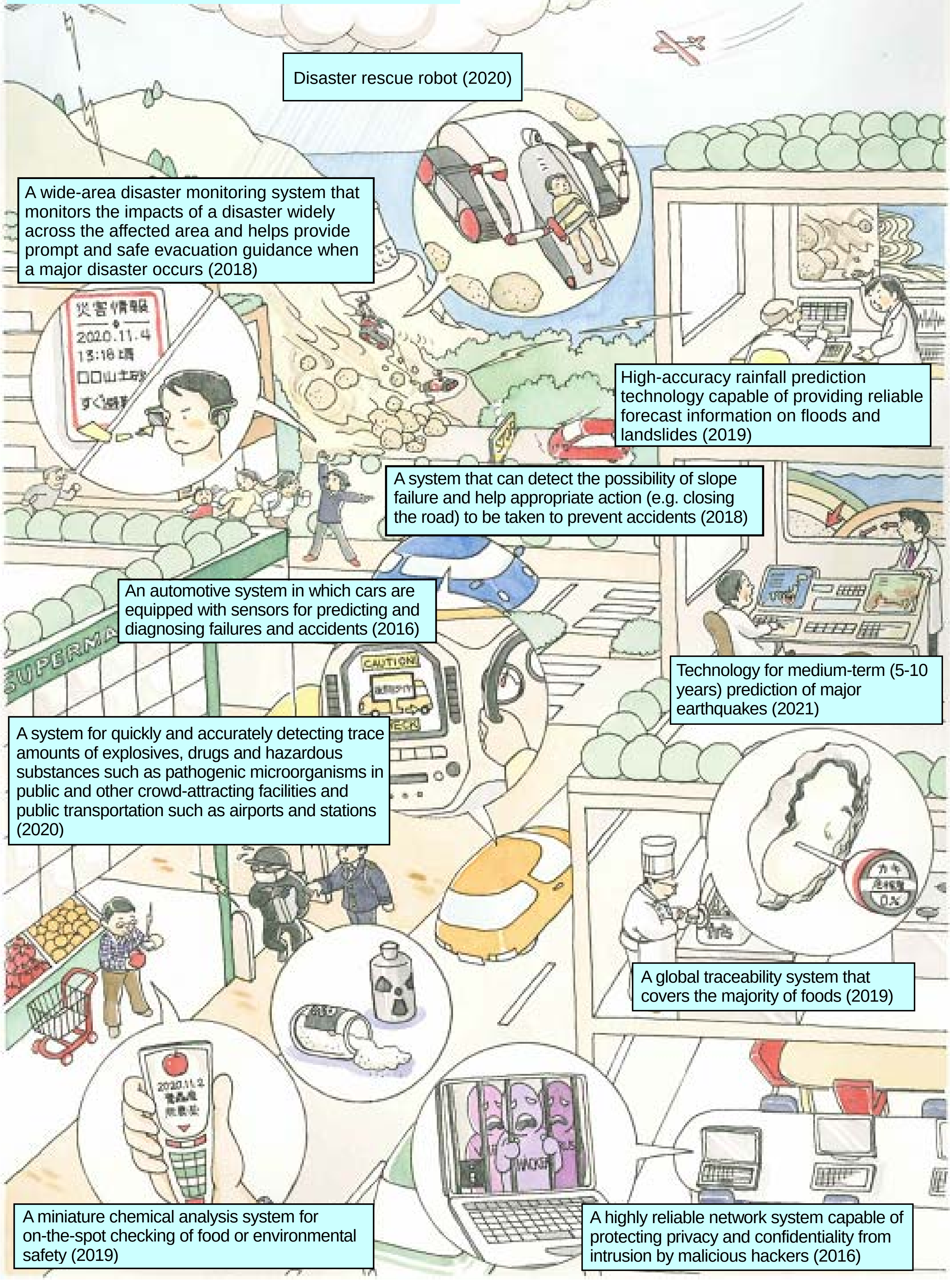


Medical care and Welfare




Environment and Energy
Manufacture of polylactic acid plastics from municipal waste (2016)
Environmental monitoring technology based on high-precision satellite sensors and the Internet for vegetation mapping (2019)
EAST ASIA MAP
Construction of a life cycle assessment (LCA) database of the materials used for a product and technology for performing LCA of a designed product based on such a database (2015)
Hydrogen fueled automobile engines (2023)
STATION
Technology to fix carbon dioxide to the seafloor (2025)
Automobile recycling technology that can almost completely solve car scrapping problems (2017)
Genetically engineered plants and microorganisms that can remove NOx and other pollutants (2027)
Meet 1 percent of the world’s primary energy supply using wind power energy (2022)
Technology for efficient revegetation in deserts (2022)
Large-area amorphous silicon solar cells with a conversion efficiency above 20 percent (2020)

Disaster Prevention and Safety



C. List of Participants

List of Committee Members (As of March 31, 2005)

<Steering Committee>

Chair	IKOMA Toshiaki	Visiting Professor, Graduate School of International Corporate Strategy, Hitotsubashi University	
	KARUBE Isao	Dean, School of Bionics, Tokyo University of Technology	(Engineering in general)
	MURAKAMI Yoichiro	Professor, Graduate School, International Christian University	(Needs Survey)
	HARASHIMA Fumio	President, Tokyo Denki University	(Scenario Survey)
	SAITO Tadao	CTO, Toyota InfoTechnology Center	(Information and Communications)
	ARAKAWA Yasuhiko	Professor, Research Center for Advanced Science and Technology, The University of Tokyo	(Electronics)
	SAKAKI Yoshiyuki	Director, RIKEN Genomic Sciences Center RIKEN Japan	(Life Science)
	SARUTA Takao	Member of the Board of Directors, Keio University	(Health, Medicine and Welfare)
	MIWA Eitaro	President, National Agriculture and Bio-oriented Research Organization	(Agriculture, Forestry, Fisheries, and Foods)
	MATOGAWA Yasunori	Associate Executive Director, Japan Aerospace Exploration Agency	(Frontier)
	YAMAJI Kenji	Professor, Graduate School of Frontier Sciences, The University of Tokyo	(Energy and Resources)
	YASUI Itaru	Vice Rector, United Nations University	(Environment)
	KAWAI Tomoji	Director, The Institute of Scientific and Industrial Research, Osaka University	(Nanotechnology and Materials)
	KOBAYASHI Toshio	President, Japan Automobile Research Institute	(Manufacturing)
	ANEGAWA Tomofumi	Professor, Graduate School of Business Administration, Keio University	(Industrial Infrastructure)
	IEDA Hitoshi	Professor, School of Engineering, The University of Tokyo	(Social Infrastructure)
	NAKAJIMA Naomasa	Vice President, The University of the Air	(Social Technology)
	OGATA Hitoshi	Vice President, R&D Mitsubishi Electric	
	TAMURA Mariko	Director of Secretariat, The Japan Academic Society for Ventures and Entrepreneurs	
	HIRAYAMA Sadao	Basic Research Senior Counselor, Japan Science and Technology Agency	

<Information and Communications Subcommittee>

Chair	SAITO Tadao	CTO, Toyota InfoTechnology Center
	ADACHI Jun	Professor and Director, Research Center for Information Resources, National Institute of Informatics, Research Organization of Information and Systems
	ASAMI Tohru	C.E.O. President, KDDI R&D Laboratories Inc.
	ICHIKAWA Haruhisa	Director, Network Innovation Laboratories, NTT Science & Core Technology Laboratory Group
	IKEDA Yoshikazu	Professor, Graduate School of Science and Engineering, Tokyo Institute of Technology
	ISHIZUKA Mitsuru	Professor, Graduate School of Information Science and Technology, The University of Tokyo
	KAMITAKE Takashi	General Manager of Core Technology Center, Toshiba Digital Media Network Company

	KAWAI Naoki	Director, Planning and Coordination, NHK Science and Technical Research Laboratories
	MASUMURA Tatsuro	Managing Director, NTT DoCoMo Wireless Laboratories
	NAKAGAWA Masao	Professor, Faculty of Science and Technology, Keio University
	NAMIKI Junji	Manager, NEC Corporation
	OHGA Kimiko	Manager, Customer Equipment Department, Consumer Business Headquarters, Nippon Telegraph and Telephone East Corporation
	SANO Susumu	Vice President, Japan Registry Services Co., Ltd.
	TSUDA Toshitaka	Member of the Board, Fujitsu Laboratories Limited

＜Electronics Subcommittee＞

Chair	ARAKAWA Yasuhiko	Professor, Research Center for Advanced Science and Technology, The University of Tokyo
		Director and Professor, Nanoelectronics Collaborative Research Center, The University of Tokyo
	ARINOBU Mutsuhiro	Director, Toshiba Corporate Research & Development Center
	BABA Toshihiko	Associate Professor, Graduate School of Engineering, Department of Electrical and Computer Engineering, Yokohama National University
	FUJITA Hiroyuki	Professor, Center for International Research on MicroMechatronics, Institute of Industrial Science, The University of Tokyo
	HIRAMOTO Toshiro	Professor, Institute of Industrial Science, The University of Tokyo
	IMAI Hajime	Professor, Faculty of Science, Japan Women’s University
	IWAI Hiroshi	Professor, Frontier Collaborative Research Center, Tokyo Institute of Technology
	KOMATSU Kazuhiko	Vice President, Leading-Edge Key Technology Business Headquarters, NTT Advanced Technology Corporation
	KOYAMA Fumio	Professor, Microsystem Research Center, Precision and Intelligence Laboratory, Tokyo Institute of Technology
	KYUMA Kazuo	Group Vice President of Corporate R&D, General Manager of Advanced Technology R&D Center, Mitsubishi Electric
	NISHINO Toshikazu	General Manager, Central Research Laboratory, Hitachi, Ltd.
	SONE Jun’ichi	General Manager, NEC Fundamental and Environmental Research Laboratories
	TORIUMI Akira	Professor, School of Engineering, The University of Tokyo

<Life Science Subcommittee>

Chair	SAKAKI Yoshiyuki	Director, RIKEN Genomic Sciences Center
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	GOJOBORI Takashi	Director and Professor, Center for Information Biology and DNA Data Bank of Japan, National Institute of Genetics, Research Organization of Information and Systems
	ITO Takashi	Professor, Department of Computational Biology, Graduate School of Frontier Sciences, The University of Tokyo
	KAI Chieko	Professor, Laboratory Animal Research Center, The Institute of Medical Science, The University of Tokyo
	KAMBARA Hideki	Fellow, Central Research Laboratory, Hitachi, Ltd.
	KARAKI Sachiko	Group Leader, Bio Business Promotion Department, Bioscience Division, Life Science Group, Olympus Corporation
	KITANO Hiroaki	Deputy Director, Sony Computer Science Laboratories
	NAKAUCHI Hiromitsu	Professor, Center for Experimental Medicine, The Institute of Medical Science, The University of Tokyo
	OGASAWARA Naotake	Professor, Graduate School of Network Science, Nara Institute of Science and Technology

	OKONOGI Kenji	Director, Frontier Research Laboratories, Takeda Chemical Industries, Ltd.
	SAKURAI Masaki	Professor & Chairman, Department of Physiology, Teikyo University School of Medicine
	SHIMAZU Kozo	Deputy General Manager, Corporate Officer, Analytical & Measuring Instruments Division, Shimazu Corporation
	SUGIYAMA Tatsuo	Director, RIKEN Plant Science Center
	TAKATSU Kiyoshi	Professor, Department of Microbiology and Immunology, The Institute of Medical Science, The University of Tokyo

<Health, Medicine and Welfare subcommittee>

Chair	SARUTA Takao	Executive Director, Keio University
	BESSHO Masami	Professor, Department of Internal Medicine (Division of Hematology), Saitama Medical School
	FUKUUCHI Yasuo	Director, Ashikaga Red Cross Hospital
	IMAI Yutaka	Associate Director and Professor, Department of Radiology, Tokai University School of Medicine
	KAGEYAMA Shigeru	Professor, Research Center for Medical Sciences, Jikei University School of Medicine
	KATO Norihiro	Director, Department of Gene Diagnostics and Therapeutics, International Medical Center of Japan
	KIMURA Akio	Director and Professor, Keio University Tsukigase Rehabilitation Center
	KIMURA Satoshi	Director General, AIDS Clinical Center, International Medical Center of Japan
	KOMATSU Hiroko	Professor, St. Luke’s College of Nursing
	MUTO Tetsuichiro	Hospital Director, Cancer Institute Hospital
	YAMAGUCHI Naohito	Chairman of Medicine, Tokyo Women’s Medical University

<Agriculture, Forestry, Fisheries, and Foods Subcommittee>

Chair	MIWA Eitaro	President, National Agriculture and Bio-oriented Research Organization
	HIRAFUJI Masayuki	Head of Computational Modeling Team, Department of Information Science and Technology, National Agricultural Research Center, National Agriculture and Bio-oriented Research Organization
	IKEGUCHI Atsuo	Department of Livestock Industry Environment, National Institute of Livestock & Grassland Science
	IKETANI Hiroyuki	Senior Researcher, Department of Breeding, National Institute of Fruit Tree Science, National Agriculture and Bio-oriented Research Organization
	IKUTA Kazumasa	Chief, Ecosystem Conservation Section, Freshwater Fisheries Research Division, National Research Institute of Fisheries Science, Fisheries Research Agency
	INUBUSHI Kazuyuki	Professor, Faculty of Horticulture, Chiba University
	ISHIKAWA Yutaka	Researcher, Agriculture, Forestry and Fisheries Research Council
	KANEMATSU Seiji	Researcher, Technical Coordination Team, Policy Planning and Evaluation Division, Minister’s Secretariat, Ministry of Agriculture, Forestry and Fisheries
	KATOH Junko	Director, Center for Risk Evaluation and Research, Mitsubishi Chemical Safety Institute, Ltd.
	MAEDA Miki	Senior Researcher, Genome Research Department, National Institute of Agrobiological Sciences
	NAKAMURA Masami	Staff Writer, Editorial Board, Science and Technology Department, Nihon Keizai Shimbun
	OGAWA Kinya	Technical Adviser, Organic Chemicals Division, Shin-Etsu Chemical Co., Ltd
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	TAJIMA Makoto	Professor, Faculty of Human Life Sciences, Jissen Women’s University

<Frontier Subcommittee>

Chair	MATOGAWA Yasunori	Associate Executive Director, Japan Aerospace Exploration Agency
	FUJII Toshitsugu	Professor and Director, Volcano Research Center, Earthquake Research Institute, The University of Tokyo
	HAMANO Yozo	Professor, Department of Earth and Planetary Science, The University of Tokyo
	HIGUCHI Kiyoshi	Executive Director, Japan Aerospace Exploration Agency
	IIDA Takashi	Advisor, National Institute of Information and Communications Technology
	KATO Chiaki	Group Leader, Marine Biology and Ecology Research Division, Japan Agency for Marine-Earth Science and Technology
	KINOSHITA Hajimu	Executive Director, Japan Agency for Marine-Earth Science and Technology
	KOIKE Isao	Director, Ocean Research Institute
	MAKISHIMA Kazuo	Professor, Graduate School of Science, The University of Tokyo
	MARUYAMA Shigenori	Professor, Graduate School of Engineering, Tokyo Institute of Technology
	MIZUTANI Hitoshi	Emeritus Professor, Department of Planetary Science, Japan Aerospace Exploration Agency
	SUGINOHARA Nobuo	Director, Institute of Observational Research for Global Change, Japan Agency for Marine-Earth Science and Technology
	SUMI Akimasa	Professor, Center for Climate System Research, The University of Tokyo
	URA Tamaki	Professor, Underwater Technology Research Center, Institute of Industrial Science, The University of Tokyo
	WATANABE Okitugu	Former Director-General and professor emeritus, National Institute of Polar Research, Research Organization of Information and Systems

<Energy and Resources Subcommittee>

Chair	YAMAJI Kenji	Professor, Graduate School of Frontier Sciences, The University of Tokyo
	ARAKAWA Hironori	Professor, Faculty of Engineering, Tokyo University of Science
	ASANO Hiroshi	Sector Leader and Senior Research Scientist, Sector for Energy Management and Business Strategy, Socio-Economic Research Center, Central Research Institute of Electric Power Industry
	FUJII Yasumasa	Associate Professor, Graduate School of Engineering, The University of Tokyo
	HARADA Michiaki	Group Leader, Technology Development Group, Center for Coal Utilization, Japan
	HASEGAWA Yasuo	Senior Planning Manager, Planning Headquarters, National Institute of Advanced Industrial Science and Technology
	HIKITA Tomoji	Director General, Japan Institute of Energy,
	INABA Atsushi	Director, Research Center for Life Cycle Assessment, National Institute of Advanced Industrial Science and Technology
	MATSUI Kazuaki	Research Director, The Institute of Applied Energy
	OKANO Kazukiyo	Director, Hydrogen Energy Systems Society of Japan
	OKI Yoshinori	Manager, Technology Planning Department, Mitsubishi Heavy Industries, Ltd.
	SHOJI Tetsuya	Emeritus Professor, Graduate School of Frontier Sciences, The University of Tokyo
	UCHIYAMA Yohji	Professor, Graduate Schools of Systems and Information Engineering, Tsukuba University

<Environment Subcommittee>

Chair	YASUI Itaru	Vice Rector, United Nations University
	ASANO Naohito	Professor, Faculty of Law, Fukuoka University
	HAYASHI Yoshitsugu	Professor, Graduate School of Environmental Studies, Nagoya University
	INABA Atsushi	Director, Research Center for Life Cycle Assessment, National Institute of Advanced Industrial Science and Technology
	ITO Tairo	Visiting Professor, Toin University of Yokohama

	KIDA Akiko	Senior Researcher, Research Center for Material Cycles and Waste Management, National Institute for Environmental Studies
	NAKAMURA Shinichiro	Professor, School of Political Science and Economics, Waseda University
	NITTA Hiroshi	Research Team Leader, National Institute for Environmental Studies
	OKADA Mitsumasa	Dean, Graduate School of Engineering, Hiroshima University
	OKI Yoshinori	Manager, Technology Planning Department, Mitsubishi Heavy Industries, Ltd.
	OTOMA Suehiro	Professor, Graduate School of Environmental Engineering, The University of Kitakyushu
	TAKEUCHI Kuniyoshi	Professor, Interdisciplinary Graduate School of Medicine and Engineering
	UENO Kiyoshi	Technology Manager, Public Relations Department, Living and Digital Media Division, Mitsubishi Electric Corporation
	YASUOKA Yoshifumi	Professor, Institute of Industrial Science, The University of Tokyo
	WASHITANI Izumi	Professor, Graduate School of Agricultural and Life Sciences, Faculty of Agriculture, The University of Tokyo

<Nanotechnology and Materials Subcommittee>

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	BANDO Yoshio	Director and Senior Researcher, Advanced Materials Laboratory, National Institute for Materials Science
	IKEZAWA Naoki	Chief Industry Specialist, Consulting Sector, Nomura Research Institute, Ltd.
	INOUE Akihisa	Director, Institute for Materials Research, Tohoku University
	IWAMOTO Masakazu	Professor, Chemical Resources Laboratory, Tokyo Institute of Technology
	KATAOKA Kazunori	Professor, Graduate School of Engineering, Faculty of Engineering, The University of Tokyo
	KAWAKATSU Hideki	Professor, Institute of Industrial Science, The University of Tokyo
	KAWAZOE Yoshiyuki	Professor and Director of Center for Computational Materials Science, Institute for Materials Research, Tohoku University
	NAKANISHI Hachiro	Director, Institute for Multidisciplinary Research for Advanced Materials, Tohoku University
	OKABE Yutaka	Deputy General Manager, Innovative Technology Business Development Office, Itochu Corporation
	OKANO Teruo	Director and Professor, Institute of Advanced Biomedical Engineering and Science, Tokyo Women's Medical University
	YAMADA Hirofumi	Associate Professor, Graduate School of Engineering, Faculty of Engineering, Kyoto University
	YAMASHITA Ichiro	Senior Researcher, Advanced Technology Research Laboratories, Matsushita Electric Industrial Co., Ltd.
	YOKOYAMA Hiroshi	Director, Nanotechnology Research Institute, National Institute of Advanced Industrial Science and Technology
	YOKOYAMA Naoki	Fellow & General Manager, Nanotechnology Research Center, Fujitsu Laboratories

＜Manufacturing Subcommittee＞

Chair	KOBAYASHI Toshio	President, Japan Automobile Research Institute
	AOYAMA Tojiro	Professor, Faculty of Science and Technology, Keio University
	HIRAMATSU Kaneo	Senior Chief Researcher, Japan Automobile Research Institute
	MORI Kazuo	Director, Digital Manufacturing Research Center, National Institute of Advanced Industrial Science and Technology
	MURAKAMI Hiroya	Professor, Graduate School of Science and Engineering, Tokyo Institute of Technology
	NAGASE Takashi	Project General Manager, Production Engineering Development Division, Toyota Motor Corporation
	OBIKAWA Toshiyuki	Professor, Graduate School of Science and Engineering, Tokyo Institute of Technology

	OHKI Hiroshi i	General Manager, Research and Development Division, Nanotechnology Products Business Group, Hitachi High-Technologies Corporation
	SUZUKI Shinichi	Group Manager, Optoelectronic Materials Laboratory, Research and Technology Development Division, Mitsubishi Chemical Group Science and Technology Research Center
	TOKUDA Kimishiro	Professor, Computer Science and Systems Engineering, Kyushu Institute of Technology
	YAMADA Yutaka	Supervisor, Vehicle Planning and Strategy Department, Vehicle Production Engineering Division, Nissan Motor Co., Ltd.
	YANAGIMOTO Jun	Professor, Institute of Industrial Science, The University of Tokyo

＜Industrial Infrastructure Subcommittee＞

Chair	ANWGAWA Tomofumi	Professor, Graduate School of Business Administration, Keio University
	ADACHI Tomohiko	Professor, Faculty of Economics, Musashi University
	HAMAOKA Yutaka	Associate Professor, Faculty of Business and Commerce, Keio University
	KANAMITSU Jun	Researcher, The Institute of Politics and Economy
	MASUDA Yasushi	Professor, Faculty of Science and Technology, Keio University
	YAMAGUCHI Fujio	Professor, Graduate School of Global Business, Meiji University
	YOSHIDA Kosaku	Professor, Graduate School of International Management, Aoyama Gakuin University

<Social Infrastructure Subcommittee>

Chair	IEDA Hitoshi	Professor, School of Engineering, The University of Tokyo
	FUNAMIZU Naoyuki	Professor, Graduate School of Engineering, Hokkaido University
	FUNO Shuji	Associate Professor, Graduate School of Engineering, Kyoto University
	HARA Kayoko	Manger, Nissan Research Center, Nissan Motor Co., Ltd.
	HINO Takanori	Director, Center for CFD Research, National Maritime Research Institute
	ISHIBASHI Tadayoshi	Manager of Construction Department and Director of Structural Technology Center, East Japan Railway Company
	ITOIGAWA Eiichi	Professor, Graduate School of Systems and Information Engineering, University of Tsukuba
	KASAI Kazuhiko	Professor, Structural Engineering Research Center, Tokyo Institute of Technology
	KASUKABE Osamu	Professor, Graduate School of Engineering, Tokyo Institute of Technology
	NOJIMA Nobuoto	Associate Professor, Faculty of Engineering, Gifu University
	OKI Taikan	Institute of Industrial Science, The University of Tokyo Associate Professor
	RINOIE Kenichi	Professor, Graduate School of Engineering, The University of Tokyo
	SHIBASAKI Ryosuke	Professor, Center for Spatial Information Science, The University of Tokyo
	TANIGUCHI Eiichi	Professor, Graduate School of Engineering, Kyoto University
	YASHIRO Tomonari	Professor, Institute of Industrial Science, The University of Tokyo

＜Social Technology Subcommittee＞

Chair	NAKAJIMA Naomasa	Vice President, The University of the Air
	HAYASHI Hideki	Assistant Acting General Manager, Turbo Machinery & General Machinery, Machinery, Headquarters, Mitsubishi Heavy Industries, Ltd.
	HORII Hideyuki	Professor, Graduate School of Engineering, The University of Tokyo
	HOSONO Mitsuaki	Researcher, Research Institute of Science and Technogy for Society (RISTEX), Japan Science and Technology Agency
	INOUE Kotaro	Principal Fellow, Center for Research and Development Strategy, Japan Science and Technology Agency
	KAWASHIMA Ryuta	Professor, New Industry Creation Hatchery Center, Tohoku University
	KIKKAWA Toshiko	Associate Professor, Faculty of Business and Commerce, Keio University
	KISHI Tohru	Director, Department of Third Forensic Science, National Research Institute of Police Science

KOBAYASHI Shinichi	Director, Center for Exploratory Research, Research Institute of Science and Technology for Society (RISTEX), Japan Science and Technology Agency
MATSUURA Hiroyuki	Department Head, Department of Gerontechnology, National Center for Geriatrics and Gerontology
NARA Yumiko	Associate Professor, Faculty of Liberal Arts, The University of the Air
YOSHIDA Aya	Professor, Research and Development Department, National Institute of Multimedia Education

List of Staff (As of March 31, 2005)

National Institute of Science and Technology Policy

KUWAHARA Terutaka,	Director, Science and Technology Foresight Center
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The Institute for Future Technology

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MORI Yasuko	Senior Researcher
OTAKE Hiroyuki	Researcher
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NAKAJIMA Hiroaki	Researcher
MIMA Tadashi	Researcher
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