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- Future Technology in Japan -

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Foreword

The Science and Technology Agency has traditionally conducted a Technology Forecast Survey to help predict the direction of future science and technology in Japan from a long period viewpoint. This report is the result of the fifth survey in this ongoing series and the first survey completed under charge of our institute (NISTEP).

This report is a comprehensive overview of future society as seen through the eyes of experts in Japan involved in research and development of various fields. It is our expectation that this report will be widely used and will contribute to the promotion of science and technology.

The range of the survey covers all fields of technology from basic to applied technology, with about 1,150 survey topics included.

In addition to the analyses made in this report, we feel that further work from a wide variety of viewpoints is necessary. Our institute would like to begin such analyses including policy-oriented surveys and ad hoc surveys in specific fields.

Recently, this series of surveys have been attracting attentions from abroad due to similar surveys in Germany. Two sets will be compared and are expected to yield interesting results.

This survey, therefore, can be seen as a starting point for further related surveys and analyses. In this endeavor we earnestly solicit the reader's continued cooperation. We would appreciate suggestions for future extensions on the above research, opinions, and other comments.

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Chapter 1 Outline of the Survey

1.1 Objectives

To search for the direction of technological growth in Japan from a long-term viewpoint, thereby contributing to the development of scientific and technological policies in the future and providing a reference for the direction of nongovernmental scientific and technological activities.

This survey, implemented as the 5th technology forecast survey, has been carried out by the Science and Technology Agency every five years since 1971.

1.2 Organizations that performed the survey

The survey was conducted by the joint efforts of two institutes. National Institute of Science and Technology Policy (NISTEP) established a Steering Committee. The Institute for Future Technology (IFTECH) established 13 Working Groups composed of specialists from a variety of sectors to be surveyed.

1.3 Outline

1.3.1 Fields covered and the number of topics asked

1.3.2 Forecast period

Thirty years from 1991 (year the survey was conducted) to 2020.

1.3.3 Survey method

The survey was conducted using the Delphi method. The questionnaire was implemented twice to organize views.

Note: ***Delphi method:*** A survey method in which the same questionnaire is repeatedly performed on many people to organize respondents' opinions. In the second questionnaire and after, the results of the preceding questionnaire are fed back to respondents so that each respondent can reassess the questionnaire while observing the trend of the overall opinions. This procedure is the most important characteristic of this survey method.

1.3.4 Survey parameters

1. Degree of importance
2. Forecasted realization time
3. Necessity for international joint development
4. Comparison of current R&D level between Japan and other countries
5. Constraints on realization

1.3.5 Responses to the questionnaire and characteristics of the respondents

The responses to the questionnaire and characteristics of the respondents are as shown in Table 1-1.

1.3.6 Comparison with the preceding surveys

	First	Second	Third	Fourth	Fifth
Survey year	1971	1976	1982	1986	1991
Number of topics	644	656	800	1,071	1,149
Number of respondents	2,482	1,316	1,727	2,007	2,385

Table 1-1 Responses to the questionnaire and characteristics of the respondents

Chapter 2 Characteristics of the Results of the Overall Forecast Topics

2.1 Topics regarded as very important

(1) Primarily, the fields of environment and life science involve topics of a high level of importance. This is considered due to growing public concern about recent global environmental issues and also the increasing interest in elucidating biological functions that range from the cellular level to the ecosystemic level.

(2) Other than the above fields, such topics as the conquering of diseases, including cancers and Alzheimer's dementia, and the prevention of disasters have a high level of importance.

(3) As an overall trend for topics of a high level of importance, many topics are related to a healthy and secure life which involves the preservation of the environment, conquest of diseases, and disaster prevention (35 topics out of 43 fall within these categories; they account for more than 80% of the topics of high importance). (See Table 2-1.)

Table 2-1 Topics with high level of importance in all areas (Ten most important topics)

2.2 Trend of the forecasted realization time

(1) Among all of the topics, 80% of them are projected to be realized between 2001 and 2010. (See Fig. 2-1.)

(2) Topics forecasted to be realized early: Many fall primarily under the fields of urbanization and construction, and of marine science and earth science.

Early advancement in the development and consolidation of social infrastructures and meteorological observation and forecast technologies is expected.

(3) Topics forecasted to be realized late: Many are in the field of life science and the field of outer space.

Many of them are related to basic research or large-scale technological development, requiring long-term approaches.

Fig. 2-1 Distribution of forecasted realization time

(All topics and typical fields that include many topics forecasted to be realized relatively early/late)

2.3 Constraints on realization

The constraints pointed out by a majority of the respondents were the technical aspect (83% of all concerns), the cost aspect (32% of all concerns), and the funding aspect (16% of all concerns). (See Fig. 2-2.)

Fig. 2-2 Trend of the responses in constraints on realization

2.4 Important areas selected from the fields

The following topics related to four areas were selected from each field and their characteristics were analyzed. When these topics were chosen, comprehensive consideration was given primarily to social needs for science and technology, expected impact upon life styles and economic and social growth, and the prospects of scientific and technological policies.

(1) Areas where the elucidation of principles and phenomena is regarded as important (77 topics)

1) The number of topics has significantly increased from the previous survey (51 topics) probably because of the trend of placing importance on basic researches.
2) There are a great number of topics on cerebral and nervous systems, diseases and aging, and basic topics of life science. This is considered to be because there are still many unelucidated parts.
3) There are relatively large number of topics involving great difficulties in the technical aspect and also in fostering and securing human resources (e.g., the elucidation of brains at the molecular level). Further, there are many topics on which other countries are regarded more advanced than Japan in the research and development (e.g., the elucidation of the mechanism of Alzheimer's dementia) and there are also many topics that involve the necessity of a high level of international joint development activities (e.g., the elucidation of the mechanism of canceration). Active approaches must be taken to overcome such difficulties.

(2) Areas where additional intellectual functions are regarded as important (225 topics)

1) The number of topics has doubled from the previous survey, 102 topics. This suggests the direction of growth of leading-edge science and technology.
2) There are simulations of the natural ecosystem, which apply artificial intelligence, as well as robots, intelligent systems for transporting machines, and the applied technologies for various fields including virtual reality.
3) There are relatively many topics in which Japan is regarded as more advanced than in research and development (e.g., intelligent construction robots). It can be said that, in this area, Japan is advanced in research. Also, many of these topics involve a great deal of constraints in the aspects of technology, cost (e.g., multi-purpose nursing robots), and

finance (e.g., models for prediction of ocean changes). Active approaches must be taken to overcome such constraints.

(3) Area where the relationship with environmental issues is regarded as important (This area has been newly added) (204 topics)

1) In this area, many topics were chosen partly due to increasing concern over global environmental issues.
2) Chosen topics include the measurement, monitoring and prediction of environmental changes, the elucidation of principles and mechanisms of the environmental changes, the prevention or reduction of environmental disruption, and the repair of disrupted environments. To be more specific, there are many topics on global warming, ozone layer disruption, measures for wastes, etc.
3) Many of the topics involve a great deal of constraints in the aspects of cost (e.g., recovery of valuable materials from urban refuse), and finance (e.g., the elucidation of the mechanism of the ozone layer) in addition to the technical aspect. Also, there are relatively many topics that require international joint development activities(e.g., the reduced emission of carbon dioxide). Active approaches must be taken to overcome the constraints and implement such international coordination.

(4) Area where international joint development activities are regarded as important (251 topics)

1) The number of such topics in this survey is almost the same as in the previous survey (252 topics). This implies that continued international cooperation is regarded as important.
2) Many basic tasks are observed. Some of them involve long-term research and development projects and realization is expected to be delayed.
3) Topics include those definitely requiring international cooperation (e.g., international communications network), the topics that will contribute to the formation of intellectual stock common to mankind (e.g., human genome), the topics that will contribute to the survival and welfare of the human race (e.g., AIDS-related), and the topics which should be internationally allotted (e.g., space stations). As a whole, many of the topics involve a great deal of difficulty in technical and funding aspects. Active approaches must be taken to overcome such constraints.

2.5 Comparison of current R&D level between Japan and other countries

(1) When compairing the topics in which Japan is more advanced with those in which other countries are more advanced, significant contrast is observed, as the following table shows, the forecasted realization time, constraints on realization, and the necessity of international joint development. (See Fig. 2-3 and Fig. 2-4.)

Topic	Forecasted realization time	Constraints on realization	Necessity of international joint development
Japan is more advanced	Relatively early	In the cost aspect	Low
Other countries are more advanced	Relatively late	In the funding aspect	High

This contrast is considred a result of the fact that many topics in which Japan is more advanced are in the stage of practical use of widespread use, while many topics in which other countries are more advanced are still in the stage of elucidation or development and are basic, long-term or large-scale. Japan must actively pursue basic, long-term or large-scale topics including the topics in which other countries are presently more advanced. In particular, the role of the Government in Japan is considered important in the aspects of R&D investment and international joint development.

Fig. 2-3 Distribution of forecasted realization time for the topics in which Japan/other countries are more advanced

Fig. 2-4 Trend of the responses in the questionnaire items related to the R&D promotion of the topics in which Japan/other countries are more advanced

(2) Regarding the trend in each field, it was pointed out that other countries were more advanced in many topics involving the three fields of outer space, life science, and health and medical care, but no significant difference is observed between the predominance by Japan and that by other countries in other fields. (See Fig. 2-5.)

Fig. 2-5 Trend in each field in the comparison of current R&D level between Japan and other countries

Chapter 3 Summary of notable finding by field

On the following pages, characteristic findings in each of the sixteen fields are summarized in terms of the evaluation of importance, the forecasted realization time, and areas of particular future interest.

3.1 Materials and processing

In developing new substances or materials, chemical reactions and their processes are as important as the novelty of the substances or materials themselves. Especially, structure control technology at the molecular or atomic level is recognized as an important topic in various material fields. The demand for such a structure control technology is increasing also in the semiconductor industry, chemical industry, bio-industry, etc. Thus, structure control technology is positioned as a generic technology.

Four areas that are expected to draw attention in the field of materials and processing have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.1.1 Structure control at the atomic/molecular level and assessment --- Operating technology and computer simulation

Further growth of electronic devices and material technology will be effected by the technology for controlling the structures of substances at the atomic or molecular level; this is attracting considerable attention. Especially in the field of semiconductors, the technology for laminating or exfoliating particular atomic layers one by one is expected to see advances [the widespread use of atomic-layer expitaxy and atomic-layer etching in all compound semiconductors (2003)]. Further, the technology for observing and manipulating a single atom, which will promote the advancement of such a technology is finally being realized [the widespread use of technology for analyzing molecular structures in any dispersed system by utilizing STM or AFM (2003)]. In addition to the approaches for achieving such state of the art experimental technologies, computer simulation based on quantum mechanics has become possible recently thanks to the improved arithmetic function of computers and a newly developed algorithm. This is expected to greatly contribute to structure observation and manipulation at the atomic or molecular level [the practical use of computer simulation technology for growing thin films according to the primary principle computation (2004)].

3.1.2 Emergence of functions by controlling an interface

Control of an interface at the atomic level is attracting attention as structure control technology at the atomic or molecular level develops. As a result of the functional material being watched, expected interface functions include the conductivity of electricity, heat, light, etc., in addition to the conventional mechanical properties. Many of the recent leading-edge materials have laminate structures, and the use of special interfaces having unique properties is becoming important [the practical use of super lattice semiconductor devices with two- or three-dimensionally controlled structures (2002)].

3.1.3 Thorough investigation into state-of-the-art materials and compounding and hybrid design

Efforts have been made to develop materials with higher performance by combining the advantages of a multiplicity of substances. In recent years, developing materials which comprehensively exhibit an even greater number of functions has become a goal. Thus, in diverse material fields, thorough investigation is being performed on materials which are compounded or fused even more uniformly than before by utilizing the technology for controlling structures at the atomic or molecular level [the practical use of a figuring technology for processing of structural ceramics (2005) and high-temperature, heat-resistant intermetallic compounds in mechanical components for aircraft, engines, turbines, etc. (2005) and the development of organic hybrid composite materials of controlled structure at monomolecular layer level (2003)]. With the growth of such hybrid designs, it is becoming possible to develop innovative technologies including intelligent materials and function-gradient materials [the practical use of function-gradient materials which have sufficient thermal stability and mechanical strength based on continuous composition from metal and ceramic (2004)].

3.1.4 Frontier of chemical processes

The chemical use of sunlight and the application of photocatalysts are expected in response to the energy and environmental problems that are growing in seriousness. It is difficult to predict the topics related to photocatalysts, but they are forecast to be realized in 15 to 20 years because there are expectations that we may find a breakthrough [the development of photocatalysts for synthesizing hydrogen peroxide and hydrogen from water (2004) and the development of photocatalysts for synthesizing ethylene glycol (including oxygen-containing compounds) and oxygen from carbon dioxide and water (2006)]. Once these photocatalyst processes are established, it should be possible to open up a new solar chemistry in the field of organic synthesizing chemistry.

3.2 Information and electronics

In the coming age, the technologies of information and electronics will undoubtedly trend toward greater information-intensiveness. The systems supporting such advanced information must grow larger in scale and increase in reliability and flexibility, and they must be provided with man-machine interfaces that are closer to human. Regarding this point, one aspect becomes clear, an aspect that is common to all tasks with a very high level of importance. The aspect is that the limitation of human abilities is beginning to be disclosed in the system technologies for planning, designing, manufacturing, and operating systems as the systems grow huge. And we are beginning to hope for technologies that will break through the limitation. The human abilities mentioned here refer to the abilities reinforced by means of the power of machines currently available rather than the abilities inherent in human beings as living organisms.

As the areas which are expected to draw attention in the fields of information and electronics, the following areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.2.1 Hoping to break through the limitation of human abilities to cope with systems growing huge

With respect to devices, the following are regarded as very important: super-large capacity memories; the processing technology supporting such memories; memories and logic devices with higher speed; CAD for breaking through the barrier of numbers, and the technology for achieving high reliability [the practical use of VLSI with memory capacities on the order of 1 Gb/chip (2002); the practical use of technology to easily enable processing of patterns with line-spacing down to 10 nm (2003), the development of LSI memory silicon devices with an access time of 1 ns (2000), the practical use of integrated logic circuit devices with a switching speed of 1 ps or less (2005), the practical use of CAD technology capable of IC design using high-level system specification language (2002), and the widespread use of multiprocessor systems equipped with advanced self-recovery capabilities (2006)].

With respect to software technologies, the topics on higher productivity, higher reliability, higher speed, and parallel design are considered important. It is also regarded as important to elucidate intellectual actions or behaviors and develop software utilizing the results of the elucidation. This, however, is forecast to take a few decades to be realized [the advances in software inspection and verification technology, enabling short-term development of error-free, large-scale software (2009), the widespread use of highly reliable security systems to eliminate leakage of information or invasion of privacy for individuals or groups (2004), the development of systems capable of retrieving any information out of a data base having a 1 tera-byte capacity within 10 seconds (2003), and the elucidation of the human decision-making mechanism from the chemical and physical aspects of brains (2020)].

Regarding system technology, as the important technologies that are considered to be realized within the next 15 years, the topics that may be implemented by steadily raising the current technological level have been enumerated [the completion of networks enabling interconnection from anywhere in Japan through pocketbook-size telephones (2002)].

On the other hand, the basic principles for some of the topics which are expected to require at least 15 years before realization have not yet been elucidated, and the forecasted realization time for them may change [the development of artificial brains with cells numbering in the order of 104, based on elucidation of the interconnection of the cerebral nerve system (2017)].

3.3 Life science

The results of this survey reveal that, in the field of life science, many topics related to information as the direction of technological growth were selected, and many topics related to individuals in the area of technological growth were chosen. This may suggest that life science is developing while it is closely related to the field of information and electronics.

As the areas which are expected to draw attention in the field of life science, the following seven areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.3.1 Progress in the research into cancers

The elucidation of cancers is a task closely related to people's health and also to the basis of the life mechanism. The research into cancers has dramatically shifted toward research into molecular biology during the period from the latter half of 1970s to the beginning of the 1980s. Thus, the research into cancers is expected to develop centering around cancer genes and cancer inhibiting genes [the elucidation of the whole aspect of the signal transduction in the carcinogenesis of cells (2007) and the identification of all cancer inhibiting genes and the elucidation of the relationships between those genes and carcinogenesis (2009)].

This is naturally expected to have a significant impact upon the prevention, diagnosis and treatment of cancers [the development of effective means to prevent metastasis of cancer (2007), the development of medicines preventing the development of cancers (2013), and the common use of medical treatments for dysdifferentiating carcinogenic cells (2015)].

3.3.2 Deciding and analyzing the entire primary structure of a genome

The primary structure of a genome refers to the sequence of bases of a chromosome DNA, the number of the arrays being as many as about 5 million in the case of a colon bacillus or about 3,000 million in the case of a human being. Elucidating them will identify the process of the development of mankind, and it will also provide a basis on which the true facts of genetic diseases will be elucidated. The research into cancers will be developed [the determination of all of the DNA base sequences in human chromosomes (2010)].

3.3.3 Molecular mechanisms of development & differentiation and morphosis

The process that started in the 1980s, of discovering the genes (homeobox genes) making up the body of living organisms will continue. It is considered that the rules for forming living organisms will be elucidated from the aspect of genetic functions before long [the elucidation of the entire aspect of the functions of homeobox genes in a vertebrate (2006) and the elucidation of the outlines of the molecular mechanisms of development and differentiation (2009)].

In addition, understanding the morphosis process at the molecular level should be effective for elucidating the physiological mechanism of an individual living organism and also for understanding the cerebral structure and functions [the elucidation of the morphogenic and developmental processes of the brain at the molecular level (2014)].

3.3.4 High-level functions of a brain (perception, memorization, thinking)

In recent years, the research into the information processing in a brain at the neuron (neural cell) level has been implemented and the perceiving or memorizing mechanisms in the brain are being gradually identified. It appears, however, that the related basic elucidation will take more time [the elucidation of the encoding and retrieval mechanisms of memories in the brain (2017), the elucidation of the relationship between the brain's neuron activities and the thinking processes (2018), and the elucidation of the mechanism of logical reasoning by the brain (2020)].

The researching means are developing rapidly [the development of noninvasive encephalometry technologies for analyzing macro brain activities (2003)], and they are expected to be used in medical science [the elucidation of the cause of manic-depressive psychosis at the molecular level (2008)].

3.3.5 Elucidation and high-level modification of the functions of plants

Foodstuff problems are selected as an important research task throughout the world. Much knowledge, providing the basis for such research, is being accumulated about the molecular mechanisms of the properties of plants. More efforts are considered necessary to effectively utilize the knowledge [the widespread use of new plants as foods, produced through gene manipulation (2003), and the possibility of increased food production by dramatic improvement of the photosynthetic ability in plants (2011)].

3.3.6 Protein engineering

The development of the technologies that provide the foundation for analyzing and designing protein [the establishment of technologies enabling prediction of the three-dimensional structures of proteins from their primary structures, i.e., amino acid sequences (2003) and the establishment of technologies enabling prediction of the functions of proteins from their higher-order structures (2006)] is being steadily advanced. This is considered to create the basis of the applications such as the artificial synthesis of useful proteins.

3.3.7 Database and bioinformatics

The combination of life science and computer science is being established as a new special area called "bioinformatics." For instance, recently in artificial intelligence, the research into the genetic algorithm, which models the ideal structure and development of a biological gene, is being spotlighted. Further, effective use of the data, which will be accumulated as the research progresses, will be an important international task.

3.4 Outer space

Since the 1970s when the survey was started, outer space development in Japan has been promoted for the purpose of scientific observation and peaceful utilization. Since the first half of the 1980s, partly due to the easing of the cold war between the United States and the Soviet Union, international cooperation in outer space development has become a major task in Japan. What impact the collapse of the old Soviet Union and the birth of Russian Federation will have upon outer space development in the future cannot be predicted. Based on the situations described above, in the present survey, attention was given mainly to the effect of investment in outer space development, the future of manned outer space activities, and the role of Japan in international cooperation.

As the areas which are expected to draw attention in the field of outer space, the following two areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.4.1 Progress of manned outer space development

Outer space development has been progressing primarily in the fields of communication/broadcasting and observation of the earth using artificial satellites, and other fields which utilize the perspective of space. In the future, however, a field utilizing the space environment itself, which is not available on the earth, is expected to grow, in addition to the conventional fields.

In the space environment field, diverse experiments carried out in minute gravity are being implemented with aircraft, small rockets, recoverable satellites, and space shuttles.

Particularly, the space station plan involves permanent, multi-purpose, expandable manned facilities where material experiments, life science experiments, engineering experiments, and other experiments will be performed [the experiments on humans remaining in weightless space environments for an extended period of time (2015)]. Industrial applications are also planned [space factories for commercial production utilizing the environment of space (2013)].

To help promote the development and utilization of space, it will be necessary to establish full-scale space transportation systems [space planes (2013) and manned inter-orbit transportation systems (2009)].

3.4.2 International development of space science and technology

Space science and technology will play an important role for the living and existence of man. It covers a wide range of fields, from those having a relatively short time scale such as the global monitoring of the earth environments [the technology for measuring in real time the distribution and movement of atmospheric pollutants (2002), the worldwide air traffic control systems (2001), and the navigation satellites for supporting automobile traffic (2003)] to those having a longer time scale that will lead to expanding the activity sphere of man.

International cooperation is essential for the growth of space science and technology. The rate of high necessity for international joint development activities exceeded a majority on about half of the questions in this field. The rate was especially high on the practical use of manned spacecraft designed to land on Mars and return (92%).

An important task will be to seek measures for solving various problems related to the technology for actually utilizing space stations and the manned moon and Mars planet investigation, a topic that is expected to be achieved in the 21st century [a permanent, manned space observation base on the lunar surface (2015) and landing and return of Mars manned spacecraft (2018)]. Further, it is anticipated that, in the 21st century, the space science and technology will not only be for advanced countries but for developing countries also. With this in mind, it is necessary to promote international cooperation.

3.5 Particles

The growth of natural science, which functions as the basis of today's technological growth, is deeply rooted in basic understanding of the existence of substances, which has been brought by progress in the basic sciences like a particle physics. On the other hand, these basic sciences have been pioneered one after another by the technological innovation of accelerators or measuring equipment. Science and technology stimulate each other to grow together, thus achieving today's progress.

The research into particles always requires state of the art equipment including accelerators and particle detecting technology. At present, in a certain aspect, the technology is approaching its limit, and the development of more sophisticated new technologies is needed. At the same time, it can be said that the research into particles has reached a new development phase where elucidating the phenomena that took place at the beginning of the universe is directly connected to elucidating the essence of a substance. It is also becoming obvious that the research into particles itself is very likely to create new technologies, or the large accelerators, experiment apparatuses or other apparatuses for the research into particles are very likely to be utilized also for the research approaches, the development of new technologies or other purposes in an extensive range of other fields.

As the areas which are expected to draw attention in the field of particles, the following two areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.5.1 State of the art developed by the research into particles and the repercussion results

The important state of the art technologies developed in the course of the research into particles particularly include the technologies related to particle accelerators. The accelerators are expected to be utilized extensively for the development of the state of the art in industries, medical treatment field, etc. in the future. The use of emitted light has brought innovation in lithography technology for semiconductor integrated circuits, and it is also expected to lead to the development of a fine processing technology [the practical use of technologies for creating any desired patterns of 10 nanometers or less (2004)]. The use of accelerators for the diagnosis or treatment of cancers is predicted to have a significant social impact. Development of the accelerator is being implemented throughout the world. In the near future, treatment by accelerator is expected to grow quite widespread, saving the lives of many people [the widespread use of subminiature proton and heavy ion accelerators for medical treatment and diagnosis of deep-body cancers (2004)]. Also, the widespread use of free electron lasers is hoped for as a monochrome, high-intensity light source with variable wavelength having applications in many fields including materials science, medical science and industries. Development of an accelerator provided with state of the art performance for that purpose is being called for [the widespread medical use of free electron lasers with variable wavelengths (2007)].

3.5.2 Dramatic change in the world view brought by the point of contact of research into particles and research into outer space

Particles and outer space are the most basic foundation of the existence of substances and they are closely related. Researching the reaction of particles by creating high energy using an accelerator is equivalent to researching the origins of the universe by going back in time. The current standard theory of particles enables us to foresee that there is something beyond the standard theory; this, typically, is indicated by the fact that it gives no answers for the origin of mass. Thus, breaking through the present situation is strongly hoped for. Advances in accelerator technology are essential to the attainment of such an objective, and the possibility of realizing an electron/positron collider with center-of-mass system energy of 1 TeV or more (2008) is the focus of great interest as the first gateway to higher energy. The point of contact of the research into particles and the research into outer space has a high potentiality for bringing entirely unpredictable surprises and dramatic changes in the world view. The purpose of the researches is purely basic science, but it provides strong motivation for promoting development of the state of the art.

3.6 Marine science and earth science

In the previous survey conducted in 1986, marine science and earth science were set as independent fields. In the present survey, however, the idea that both fields should be handled together on a global scale prompted the combining of both fields into one survey field. Also, the questions were decided based primarily on the observation and forecast of atmosphere to ecosphere.

As the areas which are expected to draw attention in the field of marine science and earth science, the following two areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.6.1 Development of nature observation on the earth --- Field of marine science

In the 1990s, diverse satellites for the observation of the earth are being launched, and the collection of various data on oceans including wind, waves, and ocean wind has become possible. Due mainly to the development of satellite-based observation, nature observation of the earth is expected to develop steadily [the practical use of tsunami forecasting systems (2001)].

There is a possibility that various types of accurate data on oceans will be obtained by the use of investigation ships or artificial satellites by the year 2005, and the elucidation of impacts on the ecosystem arising from marine development (2010), etc. is expected to be implemented.

It is predicted that, in shallow sea areas, continuous monitoring by remote sensing technology or long-term automatic observation systems installed in positions ranging from the bottom of the sea to near the sea surface will be advanced, making it possible to know environmental changes [the practical use of satellite remote sensing technology capable of yielding highly precise information on sea temperature, currents, and chlorophyll concentration (2005), the development of forecasting technology for the fluctuation of marine resources (2006), the development of remote sensing technology using sea bottom stations that monitor temperature, current direction and speed, salinity, oxygen concentration, and other parameters (2003), and the practical use of technologies for predicting and forecasting changes in the ocean currents in the seas adjoining Japan (2002)].

Further, the development of the element technologies necessary for observing ocean depths is anticipated to be promoted [the practical use of fuel cells that last for long periods of time (2003)], making it possible to perform automatic observation of abyssal depths over long periods of time [the development of technologies for monitoring sudden environmental changes on ocean floors on a long-term, selective basis, requiring no maintenance (2008)]. It may become possible to implement long-term observation of abyssal creatures which cannot be performed by SHINKAI 2000 or SHINKAI 6500.

3.6.2 The utilization of mass information processing and the systematization and globalization of education -- Field of earth science

Heretofore, in the field of the earth science, individual scientists and engineers have tended to accumulate their job experiences within their own spheres, and the data to which each scientist or engineer has access is limited. In recent years, media enabling interchange of large volumes of information have developed; in this survey, therefore, attention should be given not only to the utilization of mass information processing but also to the systematization of education and the implementation of international mutual education, which go beyond the limitations of individual researchers.

Topics related to the utilization of mass information processing may be roughly divided into three groups:

(1) Topics related to specific technologies [the widespread use of meteorological information service systems capable of providing detailed meteorological information in small areas in response to requests from individuals (1999), the nationwide installation of bore-hole observation equipment integrating various types of gauges for use in earthquake forecasting (2004), and the identification of three-dimensional structures of strata, rocks and fossils from meter-size CT images (2005)].

(2) Topics related to computer simulation [the laboratory replication of pressure and temperature conditions in the lower mantle (2002), the determination of atomic structures of materials in the depth of the earth by advanced computer science (2003), and the determination of the atomic fluctuations that allow slow changes to be traced such as fossilization of organic corpses being gradually replaced by silica (2007)].

(3) Topics related to extensive observation and information processing [the observation technologies that help elucidate the generating and emitting mechanisms of volcanic gases (2003) and the conservation of the global environment based on the elucidation of the whole aspect of the movement and storage of carbon dioxide (2011)].

Among the above topics, those with high levels of importance related to seismic forecasts and carbon dioxide should be promoted through policies [the nationwide installation of bore-hole observation equipment integrating various types of gauges for use in earthquake forecasting (2004) and the conservation of the global environment based on the elucidation of the overall aspect of the movement and storage of carbon dioxide (2011)].

Some of the topics related to the systematization and globalization of education require the establishment of new organizations [the inauguration of international global science and technology education organizations (2001)]. They are regarded as very important, and it is considered that they must be promoted through international cooperation.

3.7 Mineral and water resources

The recent progress in the technologies for looking into the ground, the depths of the earth, and the sea bottoms may be said to open up new possibilities for the development of mineral resources. On the other hand, underground mining calls for drastic change in the approaches for technological development so that miners can survive.

With respect to water resources, it is desired to develop technologies for controlling and utilizing water for creating a better environment while minimizing the impact to the environment by identifying the characteristics of water circulation. On the other hand, however, the impact of global warming on water circulation is a matter of concern.

As the areas which are expected to draw attention in the field of mineral and water resources, the following two areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.7.1 Labor saving and unmanning in the development of resources

In underground mining, it is becoming increasingly difficult to secure necessary labor force and to maintain or improve productivity primarily due to the high-temperature, high-humidity working environment and the danger of the work. For this reason, the technologies for achieving labor saving or unmanning are hoped for [the practical use of unmanned mining methods combined with mining robot technology (2005)]. To realize such methods, efforts must be made to improve underground operating methods or styles that will permit easy introduction of remote control or automation. Also, it will be necessary to develop sensors and control equipment that will survive severe operating environments. On the other hand, the practical use of solution mining technology (2011) is predicted due to progress in the technologies for loosening rock mass by automatic, large-scale cracking (2006) based on water- pressure crushing technologies or other similar technologies. In this respect, the development of underground resources may advance toward labor saving and unmanning. In addition, the technologies for enabling remote control and unmanned operation is essential for the development, investigation or gathering of abyssal mineral resources which are regarded as important metal resources in the future [the practical use of technology for mining manganese nodules from the deep sea bottom (2010) and the practical use of techniques for exploiting new sea-bottom mineral resources such as deep-sea hydrothermal deposits and cobalt-rich crust (2012)]. The realization of those topics involves difficult technical and financial problems.

3.7.2 Forecast of water circulation and, in particular, the elucidation of and measures for the impacts caused by the global warming phenomenon

The warming of the earth, a recent major concern, is not only changes in temperature but a profound change in the atmospheric and water spheres, and it is considered to seriously affect water circulation. Identifying the phenomenon is needed so that measures may be about the occurrence of the phenomena of abnormal precipitation caused by global warming (2007)]. It is necessary to promote worldwide consolidation of the observation system under international cooperation.

3.8 Energy

For this survey, the field of energy was roughly divided into three groups: primary energy, secondary energy, and energy system. Further, the details of each group were classified to emphasize the demand side and system technologies.

The topics in the production and utilization aspects are the core of the questionnaire. There are many topics on environmental measures, reflecting the increasing concerns about recent global environmental problems.

Comparison with the previous survey has revealed that the forecast time of realization of topics has been delayed a few years, implying that the progress in energy technologies takes time.

As the areas which are expected to draw attention in the field of energy, the following two areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.8.1 Technological shift to non-fossil fuel system

The results of this survey truly reflect the situations and visions of the energy and environmental preservation which are major concerns common to all countries including Japan. Specifically, nuclear power is the greatest concern in discussing energy problems. As a matter of fact, four out of the top ten topics with high levels of importance are related to nuclear energy; three out of the top four topics are associated with nuclear energy [the practical use of technology for the safe disposal of highly radioactive solid wastes (No. 1), the development of nuclear fusion power generating reactors (No.2), and the practical use of fast breeder reactor (FBR) systems (No.4)].

In the new energy field, great expectations are placed on the practical use of high-performance solar cells [the practical use of large-area, thin-film solar cells providing conversion efficiencies of at least 20% (2004)]. Some respondents commented that the practical use depends on reduced cost of the entire system, including high-performance peripherals.

Environmental issues associated to the production and use of energy include the protection of the ozone layer [the domination of non-Freon type air-conditioning systems (2001)], car-related problems [the widespread use of electric cars with driving performance equal to that of gasoline motorcars (2007)], and the carbon dioxide problem [the practical use of technologies for producing methane or methanol from carbon dioxide collected from the exhaust gas of large boilers at thermal power plants and the like by using hydrogen (2008)].

The development and utilization of energies such as nuclear energy and natural energies is important, but achieving higher efficiency of energy conversion and use, and promoting the development of technologies for saving energies are expected to become even more important [The practical use of large-scale compound cycle power generation by high-efficiency gas turbines with the entrance temperature above 1500°C(2006), establishment of the concept of a thermal industrial complex aimed at total, efficient use of energy (2006), and the practical use of superconductive power transmission using high-temperature superconductive materials (2020)].

3.8.2 Technologies for efficiently utilizing energy by considering required energy quality

The conventional energy flow in Japan is often defined in terms of the energy supply structure in which the power- generation energy and non-power-generation energy are positioned in parallel. Because the cascade utilization of energy is a technology that ensures effective utilization of energy from the thermodynamic point of view, it is desirable to use waste heat for applications requiring low-quality heat. For instance, fuel cells or the waste heat resulting from power generation by heat engines can be used in such applications, thus creating a supply structure by which both electricity and heat are simultaneously generated in series. It is necessary to build an energy system which incorporates such a concept [The widespread use of solid electrolytic fuel cells for local cogeneration and distributed electric utility (2011) and the widespread use of fuel cells in the home for on-site cogeneration (2009)].

It is also worth giving attention to the development of energy equipment for utilizing energy that is not yet utilized in the low-temperature area (temperatures near the environmental temperature), including high-performance heat pumps [The dissemination of the efficient power generating technology for the low-temperature area including heat generation and discharge (2003)].

A future system should combine the cascade utilization of energy with resource recycling, and it should be designed to separate, solidify or recycle carbon dioxide to preserve environments. To prepare for the coming age of the cascade utilization, it will be necessary to consider an institution that will permit freer flexible systems for various types of energy along with technological development.

3.9 Environment

For the field of environment in this survey, many topics related to the global environment were established (the number was increased from 3 in the previous survey to 50 in this one), 31 topics being associated with global environmental issues. Such a significant increase in the number of topics indicates that the importance of global environmental issues is rapidly coming to be recognized through steady scientific observation, elucidation of phenomena, and forecasting work related to the global environment.

On the other hand, the importance of recycling is again being recognized as part of the efforts to improve our global environment. Based on this trend, the technologies for recycling resources and for recycling wastes as energy have been chosen for this survey.

As the areas which are expected to draw attention in the field of environment, the following two areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.9.1 Monitoring, elucidating, and forecasting of changes in the global environment

It was in 1986 when the existence of ozone holes was reported, and it was at the international conference on the changing atmosphere held in Toronto in 1988 that the problem of global warming was spotlighted.

In 1985 when the forecasting work of the previous survey was begun, we could not predict the degree to which global environmental issues would seize the public's attention, and therefore, we were unable to prepare many topics related to global environmental issues. In this survey, concerning the global warming, the topics aiming to elucidate principles and phenomena are regarded as very important; their realization before the next century, however, has proved difficult in terms of the forecasted realization time [the elucidation of precise mechanisms of the emission and extinction of carbon dioxide in the atmosphere (2004), the possibility of accurate forecast of a rise in sea level caused by global warming (2005), and the determination of impacts of global warming on the entire world's agricultural production (2004)].

Even more negative results have been obtained on countermeasures; many technologies for such countermeasures take more than 20 years to develop. Although great expectations are placed on corrective measures, based primarily on the growth of the technology for utilizing solar energy, some respondents were skeptical about the effectiveness [the creation of coral reefs capable of fixing carbon dioxide at the rate of 5kg/m2 per year or more (2018) and the development of a technique for fixing carbon dioxide in flue gases by using algae (2011)].

It is forecasted that the elucidation of the acid rain phenomenon will be realized relatively early, but development of the technologies for recovering from the damage caused by acid rain is forecasted to take longer [the development of technologies for recovering the lakes and forests damaged by acid rain (2007)].

In the field of environment, it has been pointed out that many topics have restrictions in the aspects of funding, human resources and R&D systems in addition to those in the technological aspect. Also, it is necessary to organize a number of researchers in different fields and to develop a crosswise system.

3.9.2 Technology for realizing a recycling society

The global environmental issue has become a global concern and the phrase "Think globally, act locally" has become popular throughout the world.

In response to such a trend, for this survey, we have selected four topics including the technologies for recycling resources and for recycling wastes as energy.

We may be able to expect energy saving and environmental preservation effects by promoting recycling. The recycling rate at present is about 50% for paper and 37% for steel; greater efforts are required to raise these rates.

The development and widespread use of technologies for sorting that will lead to an improved recycling rate and new technologies for preventing, at the production stage, substances that would cause environmental pollution from being contained are expected to be implemented [the widespread use of product design techniques that consider easily recoverable and separable materials in discarded durable consumer goods for recycling purposes (2002)].

According to the results of the present survey, the topics on recycling from the viewpoint of heat recovery are not accorded the same importance as that given to the topics on the recycling of resources. Recycling efforts for maximum recovery and utilization as resources seems to be considered important [the achieving of heat efficiency for waste fuel power generation plants that exceeds twice the current value (2003)].

3.10 Agriculture, forestry, and fisheries

For the present survey in the field of agriculture, forestry, and fisheries, many topics related to environmental assessment and control have been selected in addition to the topics related to cultivating and raising, management, and breeding in agriculture, forestry, and fisheries.

This is considered to indicate that the growth of science and technology in the field of agriculture, forestry, and fisheries related to environmental control and preservation issues could take the following two directions:

One direction is the growth of science and technology that will support the role of the industries of agriculture, forestry and fisheries in the efforts of continuing sustainable production activities. The other direction is the growth of science and technology for reducing environmental pollutants and environmental disruption for which the industries of agriculture, forestry, and fisheries are responsible.

As a topic which is expected to draw attention in the field of agriculture, forestry, and fisheries, the harmony between improved productivity and environmental preservation common to the industries of agriculture, stock raising, forestry, fisheries, etc. has been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.10.1 Agriculture

The number of crops resulting from successful characteristic conversion through gene manipulation is increasing, and the techniques are expected to be increasingly applied to the improvement of breed in the future. Few of the agriculturally useful genes such as high-harvest characteristic and cold resistance have been isolated as yet; therefore, progress in the development of technologies for accurately and efficiently cloning plant genes is strongly called for [the widespread use of technologies enabling the storage and use of genetic resources (2006)]. It is also hoped that the development of ecologically harmonized technologies will show progress. The technologies include the use of biological agricultural chemicals since, in recent years, more people are interested in the obtaining of safer food and the development of new crops for the greening of deserts [the widespread use of biological insecticides and insect repellents (2004) and the development of salt-resistant crops for greening deserts (2006)].

3.10.2 Stock raising

To reduce the costs and improve the safety of stock farm products, it is necessary to develop innovative technologies applying biotechnology. The technologies of external fertilization and embryo transplants by means of techniques for artificially manipulating reproductive cells have already been realized. The development of more sophisticated technologies is called for in the future [the practical use of techniques for genetic improvement of domestic animals by introduction of genes with desirable traits into the fertilized ovum or embryo of mammals (2005)]. Also, with regard to methane, one of the substances responsible for global warming, it has been pointed out that ruminant livestock are a major source of methane. There is a pressing need to take corrective measures for the methane problem.

3.10.3 Forestry

Recently, in addition to the conventional research aimed to produce forest resources, the development of technologies for identifying the functions of forests as a biological group and developing their characteristics is being regarded as an important new field. With this background, in the development of the forestry technologies emphasizing environmental preservation, it is predicted that the changes in forests and woods in large areas will be accurately grasped quickly by using high-resolution remote sensing technology, thus permitting sophisticated forest handling along with the conventional researches that will be deepened [the development of comprehensive control systems based on elucidation of the mechanisms of control of pathogenic bacteria and harmful insects in natural forest ecosystems and on the establishment of techniques to prevent the appearance of major pests (2010)].

3.10.4 Fisheries

Both coastal fishery and offshore fishery have been developing, but the fishery environment is deteriorating due primarily to the contamination of fishing grounds and the contamination of water and sea bottom qualities due to the remaining feed. To enable fishery to continue and develop in the future, it is important worldwide to maintain the ecosystem and consolidate a production system that is harmonized with the natural environment [the restoration of organism productions by environmental improvement technologies relying on seawater replacement and wave energy (2010)].

In fishery, it is necessary to develop a series of technologies for avoiding the catching of small fish and for maintaining the ecosystem. To achieve this, it is essential to promote balanced research into hardware such as observation equipment and fishing tools and the software which covers the forms, distributions, behaviors, and other characteristics of marine creatures. This is expected to require considerable time.

3.10.5 Food and others

In the food-related field, the efficiency of production and the improvement of quality are expected to be promoted through overall production control and quality control.

To implement overall production and quality control, the technologies for evaluating the quality of products quickly and accurately and the technologies for maintaining the high quality that products have will be needed [the practical use of general-purpose taste measuring equipment equipped with taste sensor capable of sensing taste components, capable texture sensor (2003), and the practical use of the technology for thoroughly sterilizing food at an ultra-high pressure of about 3000 atm. (2000)].

Other topics related to environmental control or preservation issues are regarded as very important overall, and many respondents agreed on the high degree of necessity for international joint development. This indicates that the topics are concerned with environmental issues on a global scale.

3.1.1 Production

The field of production is undergoing dramatic technological innovation. Today, major technological development tasks related to ideal production involve (1) Increased possibility of creating new materials by the manufacture under new environments and hyper-fine work, (2) More sophisticated personified or intelligent equipment through the analysis of biological functions, (3) International cooperation activities related to uses that are gentle to the earth, and (4) Proper production that respects humans. From these viewpoints, new technologies and facilities or systems should be developed.

As the areas which are expected to draw attention in the field of production, the following two areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.11.1 Involvement with human society

Industrial production is an act that enables human society to enjoy specifically the results of science and technology. It may be said, therefore, that production is the field where people take a great interest in whether predicted new technologies will further add to the richness of society and human welfare.

Regarding development harmonized with human society, the survey results clearly indicate the need of the times, i.e., balanced progress should be made so that careful consideration is given to both the positive and negative impacts of science and technology. In other words, the tasks associated with environmental issues and safety draw much attention [the widespread use of measures for preserving the global environment including the absorption of carbon dioxide (2011) and the widespread use of a safety system for an industrial complex designed to operate in response to initial subtle trends (2006)].

Regarding production engineering, which alters with changes in people and society, measures are called for to deal with the decreasing availability of young labor and the changing sense of values of the labor force. It is expected that the technologies for supplementing the labor force with machinery and for actively employing the aged and the physically handicapped will be developed [the development of intelligent walk-around robots for unmanned plants (2006) and the widespread use of a production system with comprehensive support for faculties of aged workers mentally and physically (2005)].

3.11.2 Technologies that direct future production engineering

The main purposes of conventional production engineering that are based primarily on mechanical technologies are to achieve strength or performance that is superior to that of human fingers or limbs or to make it possible to handle something that humans cannot. In recent years, however, production engineering is being developed to provide systems with monitoring or controlling functions that are similar to those of humans. This trend is expected to grow stronger in the future, and development efforts are likely to realize machines equipped with (1) Advanced decision-making capabilities like that of a human [the development of production and office automation systems applying computers equipped with functions similar to those of biological brains (2009)], (2) A capability of self-preservation, self-healing and self-duplication like those of an organism, a capability for flexibly adapting themselves to environments, a capability of efficiently converting energy, and other similar capabilities [the development of machines which apply the mechanism of biological energy conversion to provide high energy conversion efficiency (2010) and the development of devices and machines equipped with functions for self-repair (2003)], and (3) A capability of operating at extreme scales or situations [the practical use of micro-machines working on a minute scale (2004)].

3.12 Urbanization and construction

The field of urbanization and construction is characterized by its inclusion of system technologies that combine diverse technologies and also many technologies that are closely related to the changes in the social environment or human mental states. In other words, factors important to the realization include changes in the public's awareness, psychological acceptance, harmony between environment and regions, and restricted social systems. Thus, many of the technologies are long-term, and in this respect, this field may be considered one for which an accurate forecast of realization time is difficult.

As the areas which are expected to draw attention in the field of urbanization and construction, the following three areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.12.1 Community in the information society --- Virtual city

A society that exists only in an information space, as opposed to being in a physical space, is called a "virtual city." A community in the age of information is being established with the development of advanced transportation and communications systems. In such a community, people with a common sense of values are connected through communications on a global scale [the promotion of distribution of job functions by dramatic progress in information communication and transportation systems (2003)]. As technologies advance, the dominant form of information will be voices and images (animations) and further a television conferencing technology which provides a high level of realism by the use of a virtual reality technology [the field of communication: the widespread use of three-dimensional video equipment providing a high level of realism (2011)], allowing us to project the arrival of an age when we will be able to talk freely with people living on the other side of the earth.

3.12.2 Development into a new-frontier space

In recent years, the population has been concentrating remarkably in large cities, leading to serious social problems such as overpopulation on the ground and resultant soaring land prices. As part of the efforts to solve these problems, plans for developing new-frontier spaces including the air and underground are being developed to effectively utilize unused spaces [the construction of super-high-rise buildings with comfortable living spaces which are at least 1000 meters high (2015) and the realization of deep underground cities where people can reside (2016)]. This involves important technological tasks such as the expansion of spaces used and the securing of new resources and energy in addition to merely solving urban problems. Also, approaches to long-term topics on the tasks of utilization, which is harmonized with the whole earth environment including oceans and space are expected to be implemented [the realization of marine cities (2009) and the realization of facilities by which ordinary citizens can remain in space for extended periods of time (2019)].

3.12.3 Securing improved productivity and safety

An important task is the steady improvement of housing and social overhead capital, the public's living foundation, so that a good social foundation may be handed on to the next generation. In the construction industry in Japan, important tasks to be accomplished include the improvement of productivity to successfully deal with the shortage of labor, aging of labor, and the securing of safety to reduce labor accidents, which seem to be increasing. Due to the development of advanced electronic technologies in recent years, various types of working robots have been developed to improve productivity and to enable safe construction by fewer workers. The task is expected to be further promoted by introducing advanced intelligent robots [Dramatic progress in the efficiency and safety of construction work by the introduction of intelligent robots and large-scale construction machinery (2001); and Incorporation of intelligent robots anywhere on construction sites, enabling safe and fast construction (2004)].

3.13 Communications

Both communications and broadcasting are developing rapidly. New physical phenomena, hardware, methods, and algorithms plant seeds that develop into needs, thus opening up new services and usages. With such a background, communications and broadcasting are playing an increasingly important role in the economy, society and homes of the world.

Successful communications technologies depend heavily on an improved cost/performance ratio, successful standardization, and proper regulations and policies. Technological seeds and needs together cannot smoothly bloom unless those social factors are met.

As the areas which are expected to draw attention in the field of communications, the following four areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.13.1 Personalization of communications

The personalization of communications toward the 21st century is likely to be steadily promoted. At the same time, the connection between network systems and individuals will grow closer, and it is predicted that a great variety of information communications services, which were not available in the past, will be available [the practical use of small, long-lasting, and easy-to-charge portable telephones (capacity: 50cc; service hours: 3hrs.) (1998) and the practical use of tracking connection exchanges using personal ID codes (2001)].

On the other hand, there is a danger that malfunctions or failures with network systems will directly affect users. For this reason, the research and development of safety and reliability as well as convenience will be important [the widespread use of security communications systems offering intensive confidentiality through use of identify verification technology (2006)].

3.13.2 Competition of network services and intelligent networks

During the deregulation of the telecommunication system in April 1985, the principle of competition was introduced into the telecommunications field in Japan. As a result, many new carriers were born. After that, the reduction of service charges and diversification of the services have steadily been promoted. Typical examples are the reduced communication charges for telephone services, competition among carriers, radio paging in mobile communications, expansion of the competition area of car telephones and portable telephones, and competition on satellite communications services.

The diversification in the telephone services [the practical use of videophone and other two-way video communications with access provided to parties in various types of mobile vehicles (2005) and the practical use of low-orbit satellite communications systems, with applications in wireless, mobile communication systems for automobiles, shipping, and aircraft (2004)], diversification in the personal computer text services [the widespread use of ATM-based switches by the formation of B-ISDN (2003) and the practical use of electronic mail communications and data base systems capable of automatically converting between multimedia (2003)], and intelligent networks [the development of automatic Japanese-English and vice-versa interpretation telephones (2008) and advancements in the autonomous decentralized control in wide-area communication network management, leading to no breakdown of communication networks (2001)].

3.13.3 Development of an advanced broadcasting technology

In the 1990s, high-definition television (HDTV) is finally reaching the stage of practical use, and broadcasting technology is showing the kind of dramatic development that is said to occur only once every 30 years; the last such surge was the development of color television. Experiments with this technology are being performed for practical application not only in the broadcasting industry but also in various fields such as publishing, printing, medical, and fine art applications. It has become important to develop a technology for achieving a stable, ultimate image quality for high-definition televisions at moderate cost [the practical use of high-definition large color flat displays that can be optionally wall-hung (2001)].

It is difficult to forecast what research and development will be like following high-definition television; however, three-dimensional televisions are the likeliest candidate [the practical use of stereoscopic broadcasting that requires no glasses for viewing (2008)].

3.13.4 New communication technologies opening up the future

The demand for communications is projected to continue increasing, and the introduction of the B-ISDN, which permits the transmission of animation images, is being considered. The need for a system of such greater capacity is expected to further increase with the growth of advanced information, and technologies taking advantage of the characteristics of light are being developed [the practical use of coherent communications technologies based on optical heterodyne modes, etc. (1999)].

3.14 Transportation

Survey results have revealed that specific prospects are being brought forward in the fields of high-speed railways, which have advanced in specific R&D projects, control technologies that apply information technologies, and environmental measures. Judging from the results of the survey, it is expected that this trend will still be active in the next survey.Improved safety and environmental preservation will be pursued by application of the currently developing information technologies and intelligence technologies; also likely to be pursued are such characteristics as the level of comfort and efficiency that transportation facilities should provide by introducing new concepts. Technological development is being implemented in both hardware and software aspects.

As the areas which are expected to draw attention in the field of transportation, the following five areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.14.1 Traffic control technologies and corresponding re-configuration of transportation systems

The technologies that we have selected for this survey are classified into the following five groups: (1) Technologies for achieving higher speed and higher density [the practical use of superconductive magnetic levitation railways with a maximum speed on the order of 500 km/hr. (2007)], (2) Technologies for intelligent movable bodies [the development of intelligent vehicles designed to react in response to the conditions of railways, etc. (2000)], (3) Technologies for automatic driving [the practical use of systems that automatically sense when to brake trains by using lasers or ultrasonic technology (1999)], (4) Control systems [the widespread use of traffic control systems on roads for optimum control of the flow of traffic in cities (2003)], and (5) Technologies for information detectors for transportation facilities [the practical use of technologies to give advance warning of bridge failures caused by fatigue (2002)].

All the technologies classified as shown above are closely connected to control technologies, and innovations in control will be an important key for supporting the transportation services in various aspects Most advances in control technology that are projected to be realized at the beginning of the 21st century will be due to the rapidly accelerating development of information-related technologies. Control technology is one of the areas in the transportation field to which we should give the most careful attention.

3.14.2 Progress in and higher performance of materials

Looking back over the history of changes in the materials used for transportation facilities during the past 30 years, one of the most remarkable trends has been the reduction in weight. The factors involved in weight reduction may be divided into two types; one is related directly to improved performance such as higher speed, while the other type indirectly aims for improvement in other aspects than performance. A typical example of the former type is supersonic aircraft, which has introduced an advanced technology for accomplishing reduced weight. In supersonic aircraft, the iron which had been employed for the components subjected to local application of high force has now been replaced by titanium, which is as strong as iron but only weighs as much as aluminum. Components such as wings made of thin aluminum plates have been replaced by compound materials which are lighter and yet stronger than aluminum.

What developments will we see in the future? All the above-listed technologies for reducing weight should be further advanced. This will lead to the realization of passenger planes or trains that will travel at higher speeds than any accomplished in the past. In the present survey, it was forecast that passenger planes with a speed of Mach 4, meaning transpacific flights would last only 2 hours, will be developed in 2009 and that magnetic levitation railways having a maximum speed of 500 km/hr. (made in both the superconductive magnetic type and the normal electrical conduction type) will be in practical use in 2015 to 2017. The technologies for reducing weight, which are aimed at pursuing performance as mentioned above, are regarded as the key to success.

3.14.3 Development of faster transportation means

Speed, as well as safety, is a basic function that transportation means should provide. In the present survey, research and development aimed at realizing faster transportation services is regarded as an important goal. For instance, research and development in the field of railways and tracks is primarily based on linear motors which is a highly practical propulsion system. Since motorcars designed for relatively short travel are dominant in road transportation, the demand for higher speed is not particularly noticeable.

Regarding the surface and underwater systems, high-speed vessels of the 50-knot, 1,000-dead-weight tonnage class, which are significantly faster than conventional container ships and cost considerably less than aircraft in international voyages are projected to be realized in 2003. Similar vessels traveling at 100 knots are forecast to be realized in 2017. Regarding aircraft, the development of aircraft capable of flying between Japan and the United States in about two hours has already been publicly announced. The development of commercial ultrasupersonic airplanes is projected to be realized in 2011; this is regarded as a long-term project.

3.14.4 Traffic friendly to the environment

As the economy grows and people's life improves, the demand for transportation in the field of both passengers and freight. This trend is forecast to continue. In Japan, the plan for controlling the global warming includes a goal to reduce the discharge of carbon dioxide per person to the level of 1990. The emission from transportation is responsible for approximately 20% of the total discharge of carbon dioxide.

Also, the energy used for transportation amounts to 23% of total energy consumption, 38% of petroleum, in particular, and efforts must be made to conserve energy and reduce dependence on petroleum from the viewpoint of the preservation of resources. The results of the present survey indicate that the topics on environmental conservation, saving of resources, and saving of energy are regarded as very important.

3.14.5 Transportation systems based on new concepts

Research and development of the linear motor type of magnetic levitation railways is being implemented in Japan and Germany. Magnetic levitation railways are expected to reach the stage of practical use in the near future (the forecasted realization time is between 2006 and 2010). The forecasted realization time for the dual-mode type automobile transportation systems is a little later, 2015.

Many respondents predicted that short-distance transportation systems and transportation systems for people who require support when using traffic means will be realized around 2000 or possibly earlier. For physical support systems, it is considered that there is a large gap between the needs of healthy young people and those of the aged or physically handicapped. The need for such transportation systems may exceed the predictions of the present survey, considering that the aging of society is accelerating.

3.15 Health and medical care

In the field of health and medical care in the 20th century, the structure of diseases has been undergoing a drastic change due to the changes in the social background including the improved level of public health, the realization of an enriched society, and the aging of the population. In recent years, particularly, the growth of bioscience and the progress in the development of pharmaceuticals have led to dramatic advancements in medical technologies. This has also given rise to social issues of medical ethics.

As the areas which are expected to draw attention in the field of health and medical care, the following six areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.15.1 Conquering diabetes

The prevention of diabetes is presently regarded as most important. For that purpose, the causes of diabetes must be elucidated. It must first be determined how lesion of the B cells of the pancreas progresses; also the actual states of the structure and functional lesion of the insulin target cells in the body must be understood. Both involve genes and environments, but for genes, the connection with MHC is important.

To prevent the onset, however, it is necessary to make drastic corrections to the diet of the Japanese people which is increasingly oriented toward higher calories and higher fat. A computer-based diet control method is expected to be available in about five years, but it is still necessary to correct the actual life-style of the Japanese. In the prevention of blood vessel complications, it seems vital to make efforts to improve the diet and increase the amount of exercise at the nationwide level; we are facing a rising percentage of arteriosclerotic blood vessel lesions among all causes of death.

3.15.2 Conquering neural and myonosus diseases

The greatest concern in this area now is the elucidation of the diseases classified as retroplasia diseases and the development of methods for their prevention and treatment. This category includes many disease, but Alzheimer's disease accounts for the greatest number of cases, and it is likely to become an even more serious social issue, reflecting the accelerating aging of population in Japan. According to the epidemiology survey conducted throughout Japan, 4 to 5% of those aged 65 years or older are suffering from dementia.

The results of the present survey reveals a strong interest in the elucidation of the onsetting mechanism (the elucidation of the onsetting mechanism of Alzheimer's disease) and the development of methods for prevention and treatment (the development of effective treatment for Alzheimer's disease). For Alzheimer's disease, there has recently been progress in the approach to elucidation of the onsetting mechanism in the area of molecular, genetic research into beta-protein and its precursor protein. Many experts, however, forecast that the elucidation will take 15 years at least, and development of methods for prevention and treatment will take even longer.

3.15.3 Prospect of the research into aging

Elucidation of the mechanism whereby biological functions decline, as caused by aging, is one of the important goals of basic research into aging. Recent years have seen remarkable progress in the research at the cellular and molecular level, into the functions of nerves and into immunity and internal secretion which are vital for retaining biological homeostasis. In the present survey, the forecasted realization time for the topic, the elucidation of individual aging mechanism and its application for prevention of aging, is 2018, showing that many experts consider it as a long-term task.

3.15.4 Progress in artificial internal organs

Artificial internal organs that may be substituted for or supplement biological internal organs are considered essential treatment equipment and technologies. Even if transplant medical treatment based on cerebral death progresses, the actual number of patients who will benefit from it will be small, judging from the supply and demand relationship. Transplant and artificial internal organs are closely related, and they should be developed in parallel.

In the past, research with the final goal of developing mimetic artificial internal organs that may be used as biological internal organs has been considered important. The development based on modules, however, seems more successful since it emphasizes ease of use and safety rather than clinging to the form. From that viewpoint, it appears that for the near future, the more useful approach will be technological innovation which allows materials and equipment that have been field-proven in various medical fields to be re-configured into artificial internal organs.

3.15.5 Prospect in bioscience

Thanks to the progress and dissemination of the genetic analysis method based primarily on the recent PCR method, it has theoretically become possible to determine a DNA structure by the amplification of the gene even if only one gene is contained in a sample. This has contributed greatly to the widespread use of technology applying the genetic diagnosis method in clinical work. Also, the use of the technology has enabled quick identification of etiogenic microorganisms in infectious diseases. Furthermore, a series of genetic abnormalities causing diseases are being identified, and people have come to expect that it will not be long before genetic treatment, in which such genetic abnormalities are drastically corrected using gene manipulation, will be introduced in actual therapies. This has influenced the forecast of the topics.

3.15.6 Improved level of preventive medical science

Medical science in the 21st century is expected primarily to emphasize the improvement of health and the prevention of diseases. More specifically, in contrast to medical science and treatment up to the 20th century which was "follow-up" based on diagnosis and treatment, medical science in the next century should be oriented toward "beforehand" measures for attaining improved health and preventing diseases.

With that background, it should be noted that 75% of the respondents regarded the topic "predominance of preventive medicine in medical science" as very important. They also forecast realization of achievement by 2010, indicating their earnest desire for earlier realization than expected.

3.16 Lifestyles and culture

The 20th century is an age in which progress in science and technology has made people's dreams come true, bringing about a convenient and enriched life. Thus, life styles of the past have undergone innovation, to be replaced by a new life culture. As we near the 21st century, people are discussing many of the possibilities that they expect advanced science and technology to provide. On the other hand, however, people are more aware of the need to review, with a new sense of values, what science and technology has already brought to society and humanity.

As the areas which are expected to draw attention in the field of lifestyles and culture, the following five areas have been selected as representing a general view of the present condition and the vision based on the results of this survey.

3.16.1 Development in science and technology; changes in the public's sense of values and behaviors

The following presents the results of analyzing the topics which were rated extremely important among the forecast topics.

There are eight topics which 51% or more of the respondents have rated "high level" of importance; they have in common (1) Safety and (2) Reduction of nuisances in living environments. Nine topics received the rating of "high level" of importance by between 40% and 50% of the respondents. These topics have in common (1) Respect for humanity and (2) Harmony with nature or improved interfaces for machine systems and humans. Ten topics were rated by between 30% and 40% of the respondents as having a "high level" of importance. These topics have in common (1) Measures for coping with the aging population, (2) Support of physically handicapped persons, and (3) Solutions to problems resulting from urban life.

The above results may be summarized by pointing out that the topics considered very important for achieving safer and more comfortable life have been ranked high. This indicates that people are expecting science and technology to provide service functions to mankind and to society. Originally, people expected science and technology to provide innovative or advanced functions rather than the functions for retaining current states or service-oriented functions. The survey results show that what people expect of the functions provided by science and technology is changing, or that people expect to see a well-balanced mix of the two different functions described above.

3.16.2 For realizing leisure and the sense of fulfillment

The 20th century is an age in which progress in science and technology has realized a rich and convenient life, creating a new life culture. On the other hand, however, people are more aware of the need to review, with a new sense of values, what science and technology has brought to society, to life, and to humanity.

In this age, people's wish to expand or improve their own functions or to have other devices substitute for their own functions has been almost satisfied. Important tasks to be attained by science and technology as we near the next century probably include the elucidation of human awareness and wishes to realize greater leisure and a sense of fulfillment. They also include successful balance between the needs in the new age, which is typically represented by environmental issues, and people's new wishes in life, thereby pursuing new possibilities.

3.16.3 Breaking with the conventional sense of values --- Creating a new culture

Japan today has accomplished a remarkable degree of economic growth, which many other countries envy. The economic growth in Japan probably appears to have reached a satisfactory level to most other countries, and its economic activities may be striking enough. When we turn our eyes to the quality of our life, however, we are not so sure that it is enviable. We are witnessing the arrival of an age in which we may use science and technology for pure play and enjoyment, even if it is not useful for productive activities.

It is unlikely that we will be able to continue restricting the children or youth who enjoy games, by imposing our conventional sense of values upon them. Perhaps it is time for us to ready ourselves for a new direction and a new sense of values for the coming age. In coping with various problems such as the increase in the number of the aged, difficulties in recruiting workers, and the continuing decline in birth rate, we will probably create a new sense of values.

3.16.4 Science & technology and a psychological border

Among the considerations in technology forecast survey, the field of lifestyules and culture inevitably includes a great variety of topics since it is related to our daily life. Thus some delicate topics are included such as "the development of robotic baby nursing systems capable of memorizing the specific characteristic of mothers and baby-sitting for them when necessary."

In these topics, it seems that the areas into which technologies are planned to be introduced involves a sensitive border area between high technology and high touch. There is still a strong impression that the development of such technologies will lead directly to adverse influences on human dignity. Even experts appear to retain a certain sense of taboo against the growth of science and technology.

3.16.5 Configuration of educational information networks

The education-related technology forecast is difficult because it involves many problems requiring solutions in addition to the need for technological development of hardware. Such problems and assignments include the scientific elucidation of human thinking and behaviors, difficulties in achieving specific applications to the field that involve the phenomenon of growth, and cost efficiency.

In the present survey, many respondents have rated the following three topics as extremely important: the development of ability-evaluation systems focusing on comprehensive personal ability (such systems to replace Japan's present system of school entrance examinations), the development of an educational system that enables responses to diverse stages of human development through scientific elucidation of the human life cycle, and the development of systems to alleviate emotional disorders in autistic children through the elucidation of the mechanism of autism. All these topics require the scientific elucidation of human ability and human nature because human ability and comprehensive human nature have not yet been identified. The forecasted realization time for the topics ranges from 2006 to 2010, indicating that they are important but not easy to realize.

Chapter 4 Full text of questions on 1,149 topics and processed responses to the questions

- Explanatory notes

In this Chapter, shown are the full text of questions on 1,149 topics and statistically processed responses to them by field. Please take note of the following (1) to (8) before viewing Tables of the detailed results.

Statistical compilation of responses to each technology development topic

(1) The topics with circled numbers in column A consist of the texts from the first round of the questionnaire which have been updated for the second round of the questionnaire.

(2) In category column B, the top column [1] refers to the first round of the questionnaire, the middle column [2] to the second round of the questionnaire, and the bottom column [X] to the results of the responses which rated the level of specialty as high in the second round of the questionnaire. Concerning the forecasted realization time by the respondents who rated the level of specialty as high, the upper figures show the results of the first round of the questionnaire and the lower figures show the results of the second round of the questionnaire.

(3) The figures in column C are the numbers of respondents for each topic and they show the total number of respondents who rated the degree of expertise as high, medium, and low (the number of respondents who answered "None" is not included).

(4) The figures in column D indicate the percentages of respondents to the degree of expertise, including the respondents who answered "None."

(5) The figures in columns E and G show the percentages of the numbers of respondents shown in column C (the total may not be 100% if invalid responses or no responses are included).

(6) Column F illustrates the distribution of the forecasted realization time. The graph was created according to the method shown below by using, as the population parameter, the total number of the persons who responded to one of [- 1995] to [not realized before 2020]. This excludes the persons who responded "Don't know" about the forecasted realization time.

(When a small number of persons rated the degree of expertise as high, the variations in the forecasted realization time sometimes increase or decrease significantly or the distribution of the time varies greatly between the first round and second round of the questionnaires.)

Q1: The realization time forecasted by the response at the 25th percentile among all responses after arranging them chronologically by forecasted realization time.

M: The realization time forecasted by the response at the 50th percentile among all responses after arranging them chronologically by forecasted realization time.

Q2: The realization time forecasted by the response at the 75th percentile among all responses after arranging them chronologically by forecasted realization time.

The distribution here shows, therefore, the distribution of the forecasted realization time given by a half of the respondents positioned around the middle. The survey based on the questionnaire is conducted every five years, and thus, the forecasted realization time is calculated on the assumption that the respondents who responded with the same year are distributed uniformly over the five years.

(7) Conditions on the responses

1) In principle, the topics covered by the questionnaire relate to major technological developments which are projected or expected to be implemented under the leadership taken

by the researchers or research organizations in Japan during the next three decades from now to 2020. Those topics that are expected to be used in Japan, however, are also included if the introduction of technologies is involved or if their R&D is implemented under international joint development or other similar activities.

2) It is assumed that no worldwide wars or convulsions of nature that would overturn the Japanese economic society will happen for the next 30 years.

3) The respondents were to give answers not just as personal wishes but as objective predictions taking into account economic and social restrictions and other restrictions.

(8) Definitions of the terms used in the topics and questions

1) Topics

The topics include ones that have already been realized in foreign countries but not yet in Japan; however, unless otherwise specified, the realization of topics means the realization in Japan. They include the topics realized through introduction of technologies from foreign countries or by international joint development or other similar activities.

"Elucidation"

To scientifically and theoretically identify principles or phenomena.

"Development"

To attain a specific goal in the technological aspect. For instance, this refers to the completion of a prototype No. 1.

"Practical use"

To be practically used after being proved economically acceptable. For instance, this refers to the completion of the first object that can be actually presented for practical use.

"Widespread use"

To be widely and commonly used after an object is put to practical use.

2) Degree of expertise

"High"

Presently engaged in research or a job related to the topic (Research study based on literature is included). Or the respondent has a great deal of expertise related to the topic because he/she is engaged in research or a job in an adjoining field.

"Medium"

Used to engage in research or a job related to the topic. Or the respondent has acquired some expertise through reading technical books or documents related to the topic.

"Low"

Has knowledge obtained through reading newspapers, general magazines, etc. or hearing from associated persons.

"None"

Has no expertise.

Note: When a respondent answers "None" to the level of specialty on a topic, he/she does not have to answer other questions on that particular topic.

3) Degree of importance

The respondents are asked to rate the degree of importance of promoting the R&D of the topics not from the personal wish but by judging the social situations in Japan.

"High"

Extremely important topic (a topic that has an extremely high repercussion effect in technological development, industries or society).

"Medium"

Important topic (a topic that has a high repercussion effect in technological development, industries or society).

"Low"

Not very important (a topic that does not have a high repercussion effect in technological development, industries or society).

"Unnecessary"

Not an important topic, and it is almost meaningless to make predictions about R&D on the topic.

4) Degree of certainty

The respondents are asked to answer on the degree of his/her certainty (confidence) about his/her forecasted realization time.

"High"

The range of the forecasted realization time of the topic is about three years or less.

"Medium"

The range of the forecasted realization time of the topic is about five years or less.

"Low"

The range of the forecasted realization time of the topic exceeds five years.

5) Necessity of international Joint development

"High"

Cannot be realized without international joint development.

"Medium"

International joint development is not essential but far better results would be obtained through international joint development.

"Low"

International joint development is not necessary in particular, but there is a possibility of international joint development.

"None"

There is no need of international joint development.

6) Comparison of current R&D level between Japan and other countries

This question was newly added to the second round of the questionnaire.

"Japan is more advanced"

Japan is more advanced than other countries on the R&D topic.

"Equivalent"

There is no difference between Japan and other countries in R&D level on the topic.

"Other countries are more advanced"

Other country or countries are more advanced than Japan on the R&D topic.

"Don't know"

Have no knowledge by which to decide which is more advanced. Or no R&D activities on the topic are being implemented anywhere in the world.

7) Constraints on realization

The respondents are asked to name two or fewer constraints (or the constraints that are expected to be obstructing) in realizing (or failing to realize) the topic in Japan, regardless of realizing or failing to realize.

"Technical constraints"

Various technological factors, which are difficult to resolve, are expected to hinder the realization of the topic.

"Institutional constraints"

The restrictions placed by law and regulations or unimproved standards or requirements are expected to hinder the realization of the topic.

"Cultural constraints"

The sense of values of society, cultural and climate factors or other similar factors are expected to hinder the realization of the topic.

"Constraints in cost"

The difficulty of reducing costs for reinforcing market competitiveness or for opening up markets is expected to hinder the realization of the topic.

"Constraints in funding"

Insufficient funding is expected to hinder the realization of the topic.

"Constraints in fostering/securing human resources"

Inadequate fostering/securing of human resources is expected to hinder the realization of the topic.

"Constraints in R&D system"

Inadequate interactive cooperation between research organizations or researchers, or inadequate consolidation of other R&D systems is expected to hinder the realization of the topic.

"Other constraints"

Other factors are expected to hinder the realization of the topic.

Appendix 1 Assessment of the results of the first survey carried out in 1971

(1) Although there are significant differences between different departments or fields, the rate of realization or partial realization amounted to 64%. (See Table 1-1.)

Table 1-1 Assessment and analysis of the results of the first technology forecast survey

(2) Discussions were held on the topics which were predicted as realizable or unrealizable to find the reasons; however, they often involve combinations of complex factors, making it difficult to identify the causes. Among these, the topics having reasons which were relatively clear were divided into several categories for the purpose of analysis. (See Tables 1-2 and 1-
3.)

Table 1-2 Examples of topics forecasted to be realized

Table 1-3 Examples of topics forecasted to be unrealizable

Appendix 2 Chronological table of future technologies

The chronological table below shows 120 topics which have higher levels of important or to which attention should be paid. They have been selected from all the 1,149 topics. The numbers preceding the descriptions indicate the topic numbers in the corresponding fields.

Table 1-1 Responses to the questionnaire and characteristics of the respondents

Field	Number of topics	Responses						Details of respondents (second questionnaire)												Unit: Number of persons	
		First questionnaire			Second questionnaire			Sex		Age group						Occupation					Occupational category	
		Number of questionnaires distributed	Number of responses	Response rate (%)	Number of questionnaires distributed	Number of responses	Response rate (%)	Male	Female	20's	30's	40's	50's	60's	70's or older	Working for private companies	Working for universities	Working for public research institutes	Working for organizations	Others	Engaged in R&D	Others
1. Materials and processing	108	334	252	75	252	203	81	198	1	0	3	65	92	37	2	83	92	14	9	1	175	24
2. Information and electronics	106	265	187	71	187	151	81	146	1	2	14	60	60	11	0	91	44	5	5	2	130	16
3. Life science	98	286	217	76	217	181	83	174	2	0	16	60	77	23	0	51	93	29	2	1	167	9
4. Outer space	46	310	294	95	294	248	84	242	0	1	12	88	110	29	2	109	74	23	33	2	198	43
5. Particles	40																					
6. Marine science and earth science	82	315	288	91	288	255	89	253	1	0	11	62	105	68	8	71	116	39	16	11	188	64
7. Mineral and water resources	39	107	103	96	103	89	86	88	0	0	2	20	43	18	5	25	21	13	25	4	44	44
8. Energy	51	173	156	90	156	144	92	142	0	0	4	31	78	28	1	62	39	6	32	3	100	41
9. Environment	50	172	150	87	150	119	79	115	3	0	5	39	50	24	0	32	35	39	8	4	93	24
10. Agriculture, forestry, and fisheries	74	255	232	91	232	201	87	195	1	0	4	46	102	41	3	7	73	103	11	2	171	25
11. Production	72	164	128	78	128	116	91	113	0	1	3	31	55	20	3	54	45	2	9	3	76	36
12. Urbanization and construction	65	167	137	82	137	123	90	122	1	3	7	49	49	13	2	67	36	14	6	0	104	19
13. Communications	65	149	133	89	133	115	86	113	0	0	6	50	49	8	0	79	19	7	8	0	96	17
14. Transportation	62	220	202	92	202	182	90	177	0	1	8	61	79	26	2	95	34	17	27	4	114	63
15. Health and medical care	109	219	164	75	164	139	85	134	1	0	5	27	60	41	2	13	84	28	8	2	95	40
16. Lifestyles and culture	82	198	138	70	138	119	86	100	16	0	11	35	45	23	2	40	59	10	4	3	83	33
Total	1,149	3,334	2,781	83	2,781	2,385	86	2,312	27	8	111	724	1,054	410	32	879	864	349	203	42	1,834	498

Note: Some respondents left blank the columns of "Sex," "Age group," "Occupation," and "Occupational Category." The total, therefore, does not coincide exa with the number of responses. (The difference in total from the number of respondents indicates the number of persons who left the blanks.) The fields outer space and of particles were combined in the same questionnaire sheet for this surve

Table 1-1 Assessment and analysis of the results of the first technology forecast survey

Department	Number of topics	Number of realized topics	Number of partially realized topics	Number of unrealized topics	Realization rate (%)	Realization rate including the partially realized topics (%)
Social development	119	23	47	49	19	59
Information	96	40	35	21	42	78
Health and medical care	73	21	36	16	29	78
Food and agriculture	92	22	45	25	24	73
Industry and resources	150	41	30	79	27	47
Total	530	147	193	190	28	64

Table 1-2 Examples of topics forecasted to be realized

Reason	Topic examples
Growth in the basic technology	Commercial production of polymeric physiological activating substances (e.g., insulin) by a biological cell tissue cultivating method.
Established institutional framework	Realization of a world-scale weather observation system utilizing artificial satellites.
Reduced cost	Possibility of economical mining of petroleum in continental shelf slopes at a depth of 200 meters or more.
Breakthroughs in the limitations of existing technologies	Practical use of plasma-cell type, EL-device type, and LCD-cell type displays for information system or the like.
Strong needs	Establishment of information processing networks for monitoring, measuring, forecasting, and alarming pollutions for each region (Tokyo Metropolis and some adjacent prefectures).

Table 1-3 Examples of topics forecasted to be unrealizable

Reason	Topic examples
Technological difficulty	Practical use of optical memories using laser holography for realizing large-capacity memories for information retrieval.
Social, institutional and cultural restrictions	Establishment of medical data for intensively managing patients' charts held by all hospitals and doctors in each region (prefectural scale).
Problem with market competitiveness	Reduction of the consumption of synthetic paper to 50% of that of paper.
Availability of competing (alternate) technologies	Practical use of a digging technology using plasma to achieve higher efficiency in tunnel digging or the like.
Weak needs	Practical use of special technologies that will enable construction of high-rise buildings without adversely affecting adjoining buildings.

Appendix 2 Chronological table of future technologies

The chronological table below shows 120 topics which have higher levels of important or to which attention should be paid. They have been selected from all the 1,149 topics. The numbers preceding the descriptions indicate the topic numbers in the corresponding fields.

Year	(Field)	Topic
1998	(Environment)	4. Practical use of materials that replace fluorocarbon and halon, that do not damage the ozone layer and cause no global warming problem.
	(Transportation)	5. Practical use of railcars capable of continuous operation at a speed of 300 km/h while still meeting environmental standards, using today's Shinkansen facilities and equipment.
1999	(Marine science and earth science)	46. Widespread use of accurate, short-time forecasting of very intense rainfall, snowfall, and other sharply localized phenomena based on improvement of the radar observation network and the development of data processing technology.
	(Communications)	3. Practical use of large-capacity optical fiber communications based on optical heterodyne modes and other types of coherent optical transmission technology.
	(Health and medical care)	67. Development of agents to suppress rejcctive reactions, superior to ciclosporin.
2000	(Information and electronics)	9. Development of large scale-integrated memory silicon devices with an access time of 1 ns.
	(Urbanization and construction)	21. Simplification and sophistication of architectural designs by improvement of man-machine interfaces by introducing artificial intelligence and virtual reality technologies.
	(Lifestyles and culture)	27. Widespread use of comprehensive home security systems that check for overheating, short circuits, gas leakages, etc. and if necessary, automatically activate safety devices to enable inhabitants, including the elderly, to feel secure even during their absence.
2001	(Life science)	41. Development of highly sensitive techniques for simple and early diagnoses of cancers, using blood serums or others .
	(Outer space)	11. Practical use of worldwide air traffic control systems using artificial satellites.
	(Marine science and earth science)	71. Practical use of technology for predicting and forecasting landslides or rockslides due to intense rainfall.

Year	(Field)	Topic
2001	(Marine science and earth science)	81. Inauguration of global science and technology education organizations in the broad sense for fostering international scientists and technologists contributing to conservation of global environment, development and maintenance of global resources, etc.
	(Mineral and water resources)	19. Practical use of economical methods of segregating valuable substances in city garbage for their retrieval.
	(Urbanization and construction)	24. Drastic progress in efficiency and safety of construction work, by introducing intelligent robots and large-scale construction machinery for tunneling, underwater work, and operations at elevated area on the construction site.
	(Health and medical care)	86. Performance of kidney, heart, lung, and other organ transplantation in Japan with a regularity on the order of that in Europe and in North America.
2002	(Information and electronics)	3. Practical use of VLSI with memory capacities on the order of I Gb/chip.
	(Outer space)	17. Practical use of technology for measuring in real time the distribution and movement of atmospheric pollutants, based on observation from space.
	(Marine science and earth science)	21. Inauguration of long-term integrated observation for the investigation mechanisms of coral reef as growth useful for carbon dioxide fixation by installing large-scale artificial reefs.
	(Marine science and earth science)	40. Elucidation of the mechanisms of the formation, change and extinction of the ozone layer surrounding the earth.
	(Environment)	30. Development of biodegradable water-holding materials, for recovering desertification .
	(Environment)	38. Widespread use of product design techniques easy to recover and separate materials of disposed durable consumer goods for recycling purposes.
	(Agriculture, forestry, and fisheries)	2. Practical use of improved crop varieties (higher yield and more disease- and cold-resistance) created by plant gene manipulation.
	(Urbanization and construction)	44. Development of compact waste water treatment systems applying biotechnology, enabling highly efficient processing of substances not readily decomposed and harmful substances.
2003	(Information and electronics)	2. Practical use of technology easily enabling processing of patterns with line-spacing down to 10 nm.
	(Life science)	2. Establishment of technologies enabling prediction of the three-dimensional structures of proteins from their amino acid sequences.
	(Agriculture, forestry, and fisheries)	69. Widespread and general use of biodegradable packing materials that can be decomposed naturally to harmless substances by microorganisms, enzymes or the like.
	(Urbanization and construction)	50. Widespread use of technological systems for automatic separation of combustible materials, metal, glass, and other substances in city garbage and other general waste by hardness, specific gravity, moisture, and color, etc.

Year	(Field)	Topic
2003	(Communications)	40. Widespread use of transmission of images and knowledge bases for emergency medical treatment between ambulances and hospitals.
	(Transportation)	14. Practical use of ceramic engines which primarily consist of structural ceramic components, contributing to lighter weight and smaller size of motorcars.
	(Transportation)	52. Development of four-dimensional control systems based on aircraft location and time, including on-board collision prevention systems, to address increased flight service frequency and safety.
	(Health and medical care)	12. Development of an HIV vaccine.
	(Health and medical care)	14. Enhancement of secondary cancer prevention (early detection) system and social awareness of importance of same, resulting in an average survival rate exceeding 70% five years after outbreak for all types of cancer (current rate: 50%).
	(Lifestyles and culture)	4. Practical use of systems that enable preliminary medical examinations and check-ups of the state of health at home without visiting a clinic.
	(Lifestyles and culture)	39. Widespread use of at-home performance of work in general office divisions (excluding interviews and negotiations) based on advances in video telephones, on-line computer systems, and facsimile equipment.
	(Lifestyles and culture)	51. Practical use of multipurpose nursing robots that take care of the personal hygiene and bathing requirements of bedridden elderly and handicapped persons in a manner that suits each person needing care.
2004	(Materials and processing)	13. Practical use of function-gradient materials which have sufficient thermal stability and mechanical strength based on continuous composition from metal and cerarmic .
	(Particles)	72. Practical use of computers with a throughput exceeding 10TFlops.
	(Mineral and water resources)	21. Establishment of technologies for forecasting rainfall with good accuracy, and the effective use of precipitation.
	(Environment)	6. Elucidation of precise mechanisms of the emission and extinction of carbon dioxide in the atmosphere.
	(Agriculture, forestry, and fisheries)	13. Widespread use of biological insecticides and insect repellents (natural microbial enemies, pheromones, etc.) as the principal method of pest control.
	(Production)	9. Practical use, in minute-scale areas, of micro-machines for various operations which were regarded impossible in many fields including biotechnology, fine machining/assembly, and the manufacture of semiconductors.
	(Production)	28. Widespread use of designing, producing, collecting and recycling systems which make it possible to recycle most used materials through legally establishing manufacturers' responsibilities for collection and disposal of disused products.

Year	(Field)	Topic
2004	(Urbanization and construction)	51. Development of waste recycling technology, enabling the amount of city waste (i.e., that must be disposed of) to be reduced to half its current level.
	(Transportation)	24. Widespread use of electric-powered automobiles capable of running in urban traffic, based on the development of batteries with a charged capacity sufficient for commuter trips.
	(Health and medical care)	48. Development of an effective insulin that can be administered orally.
	(Health and medical care)	91. Development of rapid and sure methods of determining the efficacy and safety (i.e., mutagenicity teratogenicity, and toxicity) of pharmaceuticals.
2005	(Materials and processing)	85. Development of technology for controlling the structures and properties of solid interfaces at atomic level .
	(Particles)	81. Determination of the presence of neutrino mass.
	(Mineral and water resources)	18. Practical use of fully-automated (i.e., unmanned mining methods combined with robot technologies).
	(Mineral and water resources)	31. Practical use of water purification technology for rivers lakes, and marshes, spurring environmental improvement and more effective water use.
	(Environment)	9. Possibility of accurate forecast of the sea level rise caused by global warming.
	(Agriculture, forestry, and fisheries)	25. Development of technologies for directly converting cellulose into starch by using enzymes or the like, enabling effective use of biomass resources for foods.
	(Agricultue, forestry, and fisheries)	35. Development of technologies for manufacturing foods, which do not invoke allergy, by elucidating and modifying the antigenic structures of livestock products (milk, eggs, etc.).
	(Production)	15. Practical use of technologies for producing glucide by artificial photosynthesis systems applying the mechanism of photosynthesis .
	(Production)	69. Widespread use of a production system with comprehensive support for faculties of aged workers mentally and physically.
	(Health and medical care)	77. Development of attachable or implantable artificial kidneys to replace blood dialysis for patients with chronic renal failures.
2006	(Materials and priocessing)	51. Practical use of high-polymer materials which have advanced molecule recognition ability comparable to those of enzymes or antibody/cell receptors in the fields of medical treatment, diagnosis, and chemical industry.
	(Life science)	3. Establishment of technologies enabling prediction of the functions of proteins from their higher-order structures.
	(Marine science and earth science)	76. Realization of forecasting volcanic eruptions with certainly 2 to 3 days in advance.

Year	(Field)	Topic
2006	(Mineral and wate resources)	11. Development of semiquantitative prospecting technology for mineral resources using the artificial satellite.
	(Mineral and water resources)	38. Quantitative determination of the influences of acid rain on the water system, allowing corrective measures to be formulated.
	(Production)	72. Diffusion of systems to prevent damage at such facilities as oil complexes or nuclear power generation plants due to earthquakes or other disasters, e.g., incorporating safety equipment triggered by first slight tremors.
	(Urbanization and construction)	45. Improvement of water quality by building various water treatment facilities, seawater exchanging faccilities, etc in estuaries and bays near metropolitan area! severe pollution and contamination.
	(Health and medical care)	45. Establishment of cure for AIDS.
2007	(Materials and processing)	57. Practical use of signal-responsive missile drugs capable of efficiently reaching affected parts such as tumor cells.
	(Life science)	42. Practical use of effective means to prevent metastasis of cancer.
	(Outer space)	41. Development of technologies for full recycling of water and oxygen at space stations.
	(Energy)	15. Widespread use of solar cells for residential power supply.
	(Environment)	28. Development of effective recovering technologies for reproducing damaged tropical forest ecosystem.
	(Urbanization and construction)	58. Establishment of nationwide networks for detecting earthquakes, enabling dissemination of disaster preventing systems which transmit information on earthquakes at distances of about 50 km or more in advance.
	(Communications)	24. Realization of personal telephone numbers, leading to practical use of personal mobile communication that enables communication with desired parties from anywhere in the world.
	(Transportation)	2. Practical use of superconductive magnetic levitation railways with a maximum speed on the order of 500km per hour.
	(Health and medical care)	5. Elucidation of the onsetting mechanism of Alzheimer's disease.
	(Health and medical care)	68. Practical use of extremely effective treatment for atherosclerosis.
2008	(Life science)	11. Elucidation of the mechanisms of the immune response at the level of molecular biology.
	(Life science)	59. Clinical application of organ implants by multiplication and regeneration of their own cells.
	(Particles)	65. Development of portable particle accelerators that can be mounted on aircraft and the like for repairing ozone holes.
	(Communications)	51. Development of automatic Japanese-English (and vice-versa) interpretation telephones operating in real time.

Year	(Field)	Topic
2008	(Communications)	64. Practical use of stereoscopic broadcasting based on development of displays for stereoscopic home television, which can be viewed without glasses.
	(Lifestyles and culture)	79. Widespread use of local disaster prediction and prevention systems against earthquakes, land-slides, etc.
2009	(Information and electronics)	102. Advances in software inspection and verification technology, enabling short-term development of error-free, large-scale software.
	(Life science)	12. Identification of all genes inhibiting cancer and elucidation of the relationships between those genes and carcinogenesis.
	(Life science)	29. Practical use of technologies enabling solar energy to be converted into, or stored as biochemical energy.
	(Life science)	61. Elucidation of the outlines of the molecular mechanisms of development and differentiation.
	(Life science)	94. Practical use of (breeding methods to produce) plants with drought and salt tolerance at a high degree to stop the spread of desert environments.
	(Production)	26. Practical use of non-electric methods of refining for use in a aluminum manufacture, through the direct deduction of bauxite.
	(Health and medical care)	18. Development of mental health techniques, enabling the prevention of mental disorders from stresses.
	(Health and medical care)	74. Development of totally implantable artificial hearts powered by high-output energy sources.
2010	(Materials and processing)	22. Practical use of multi-layer solar cells with a conversion efficiency of more than 50%.
	(Materials and processing)	45. Development of intelligent materiais which incorporate sensor functions, storage functions and effector f unctions.
	(Information and electronics)	82. Elucidation and modeling of human memorizing, recognizing and learning mechanisms such an extent that allow to apply to computer science.
	(Life science)	7. Determination of the entire DNA base sequences in human chromosomes.
	(Life science)	60. Development of neuro-computers that have new logical structures based on advanced brain functions.
	(Marine science and earth science)	73. Development of technology capable of forecasting the occurrence of major earthquakes (magnitude 7 or above) a few days in advance.
	(Production)	21. Development of machines which apply the biological energy converting mechanism to provide high energy converting efficiency.
	(Health and medical care)	4. Elucidation of mechanism of canceration for virtually all types of malignant neoplasms.
	(Health and medical care)	24. Predominance of preventive medicine in medical science.

Year	(Field)	Topic
2011	(Materials and processing)	7. Production of automobiles powered by hydrogen fuel stored in hydrogen-occlusive alloys exceeds 10% of the total automobile production.
	(Life science)	93. Possibility of increased food production by dramatical improvement of photosynthetic ability in plants.
	(Marine science and earth science)	80. Development of technologies for maintaining good balance between the use of fossil fuels and the conservation of the global environment, based on elucidation of the whole aspect of the movement and storage of carbon dioxide extending over the air, oceans and sea bottoms.
	(Transportation)	44. Development of passenger planes with a speed of Mach 4 (twice as fast as the Concord) and a seating capacity of 300 (triple that of the Concord) that are capable of transpacific flights in 2 hours or less.
	(Health and medical care)	16. Development of effective methods of preventing Alzheimer's disease.
2012	(Transportation)	30. Practical use of ships with superconductive electro-magnetic thrusts.
2013	(Life science)	40. Development of medicines preventing the development of cancers.
	(Life science)	63. Elucidation of the mechanisms of aging.
	(Outer space)	24. Realization of space factories for commercial production of semiconductors or pharmaceuticals, utilizing the environment of space.
	(Outer space)	37. Practical use of space planes that fly between the ground and space stations like airplanes.
2014	(Life science)	10. Elucidation of the morphogenic and developmental processes of the brain at the molecular level.
2015	(Information and electronics)	40. Development of technology enabling molecular-level write and read memory of great quantities of information (capacity of at least 1012 b/cm2).
	(Life science)	23. Common use of medical treatments for dysdifferentiating carcinogenic cells.
	(Outer space)	5. Realization of a permanent, manned space observation base on the lunar surface equivalent to the Showa Base on the South Pole.
	(Environment)	12. Worldwide reduction of the emission of carbon dioxide (per year) by 209;~o of the current level.
	(Environment)	44. Determination of presence or absence of trans-generation effects of environmental contamination on human beings.
	(Urbanization and construction)	12. Construction of super-high-rise buildings with comfortable living spaces which are at least 1,000 meters high.
2016	(Health and medical care)	84. Practical use of gene therapy for a number of gene disorders.

Year	(Field)		Topic
2017	(Materials and processing)	38.	Development of superconductive materials with a transition temperature around room temperature.
	(Energy)	22.	Practical use of fast breeder reactor systems with an operation including the nuclear fuel cycle.
	(Health and medical care)	47.	Realization of complete cures for virtually all types oi autoimmune diseases.
2018	(Agriculture, forestry, and fisheries)	61.	Development of production regulation systems as a step toward management of resources and fisheries once it becomes possible to predict the long term (10 to 20 years) changes major fishery resources.
2019	(Energy)	41.	Practical use of superconductive energy storage systems with a capacity (1 million KWh) as large as that of pumped storage hydroelectric plants.
2020	(Health and medical care)	109.	Development of methods for storing living bodies by hibernation or the like.

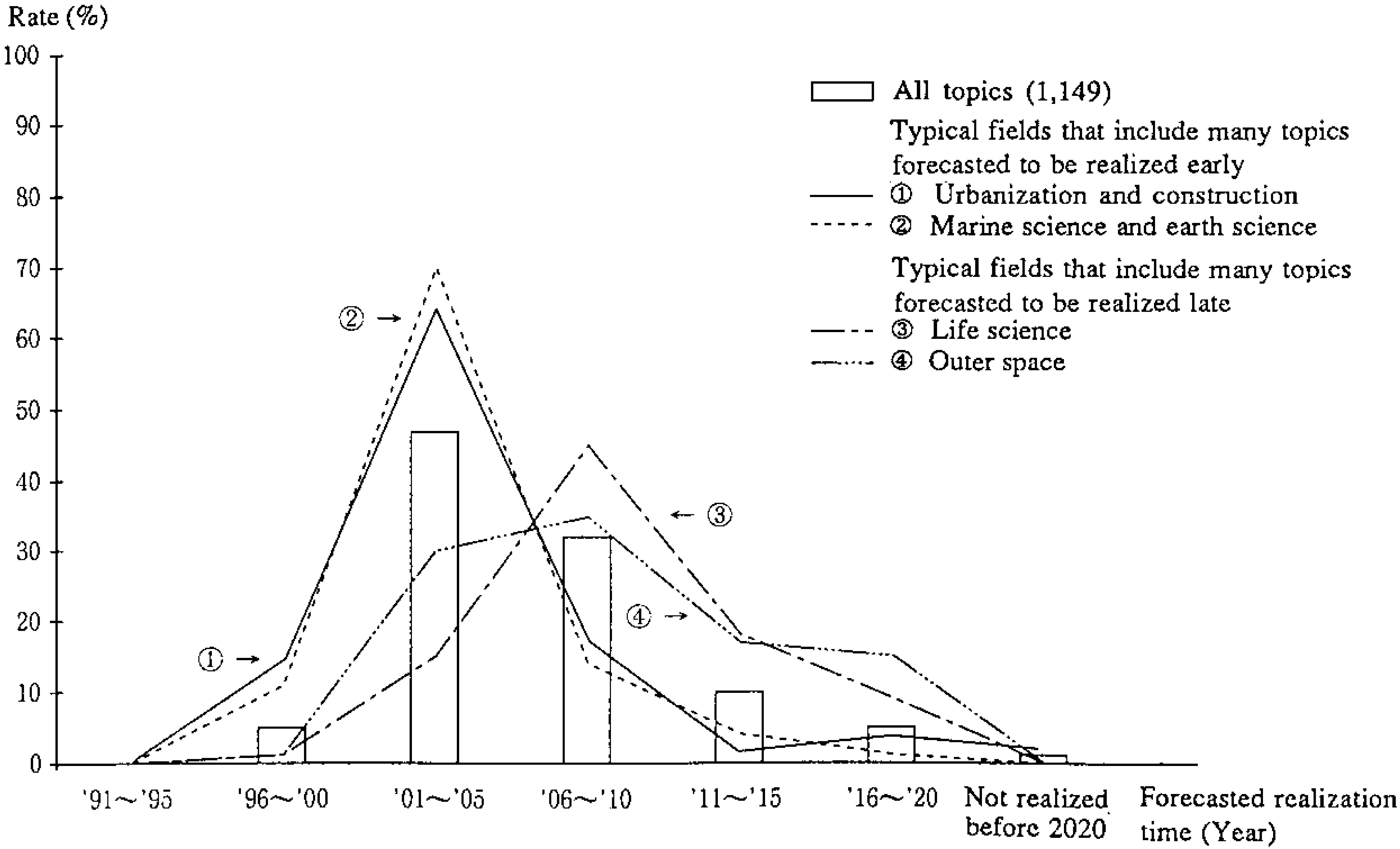
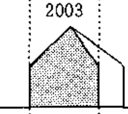
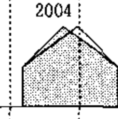
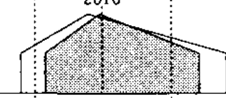
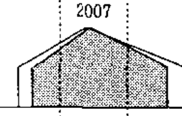
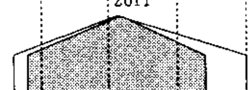
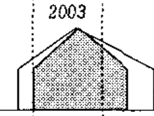
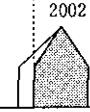


Fig. 2-1 Distribution of forecasted realization time

(All topics and typical fields that include many topics forecasted to be realized relatively early/late)

Table 2-1 Topics with high level of importance in all areas (Ten most important topics)

Topic	Degree of importance [High] (%)	Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Necessity of international joint development [High] (%)	Comparison of current R&D level between Japan and other countries (%): Japan is more advanced	Equivalent	Other countries are more advanced	Constraints on realization(%): Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system
(Lifestyles and culture) 10. Practical use of technologies that will eliminate NOx, and other pollutants that cause today's air pollution.	94	2003 	70	46	24	12	57	13	1	55	31	9	18
(Particles) 72. Practical use of computers with throughput exceeding 10TFlops.	93	2004 	15	41	43	9	93	1	0	24	21	4	10
(Health and medical care) 4. Elucidation of mechanism of canceration for virtually all types of malignant neoplasms.	93	2010 	82	2	54	37	75	1	0	6	46	25	36
(Life science) 42. Practical use of effective means to prevent metastasis of cancer.	92	2007 	61	1	44	39	79	2	0	7	31	26	20
(Production) 30. Progress in the development of technologies including those for absorbing carbon dioxide, artificial photosynthesis, turning wastes into harmless substances and preventing desertification, leading to world-wide implementation of measures for global environmental preservation.	91	2011 	94	14	41	20	71	14	9	48	30	1	7
(Information and electronics) 2. Practical use of technology easily enabling processing of patterns with line-spacing down to 10 nm.	90	2003 	13	57	30	4	88	1	0	41	25	7	6
(Information and electronics) 3. Practical use of VLSI with memory capacities on the order of 1 Gb/chip.	90	2002 	6	75	12	4	84	1	2	57	25	2	5

(Continued from Table 2-1)

Topic	Degree of importance [High] (%)	Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Necessity of international joint development [High] (%)	Comparison of current R&D level between Japan and other countries (%): Japan is more advanced	Equivalent	Other countries are more advanced	Constraints on realization (%): Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system
(Marine science and earth science) 73. Development of technology capable of forecasting the occurrence of major earthquakes (magnitude 7 or above) a few days in advance.	88	2010	42	38	48	5	81	1	3	8	47	18	30
(Mineral and water resources) 19. Practical use of economical methods of segregating valuable substances in urban refuse for their retrieval.	88	2001	7	37	40	5	42	30	14	74	18	2	5
(Outer space) 11. Practical use of worldwide air traffic control systems using artificial satellites.	87	2001	91	5	56	34	14	51	3	45	58	1	7
(Life science) 12. Identification of all cancer inhibiting genes and elucidation of the relationships between those genes and carcinogenesis.	87	2009	71	1	44	42	62	3	1	2	37	39	30
(Life science) 75. Possibility of healing of senile dementias such as Alzheimer's disease.	87	2015	81	1	25	56	78	3	2	4	24	34	18

Constraints on realization	Rate of the topics selected by the majority (%)	Field with great constraints (Top two)	
Technical	83	Materials and processing	(100%)
		Particles	(100%)
Institutional	2	Urbanization and construction	(12%)
		Communications	(6%)
Cultural Lifestyles and culture	1	Lifestyles and culture	(7%)
		Urbanization and construction	(7%)
Cost	32	Energy	(82%)
		Transportation	(69%)
Funding	16	Outer space	(93%)
		Marine science and earth science	(51%)
Postering/securing human resources	1	Life science	(6%)
		Environment	(4%)

Notes: 1. The aspect of R&D system is omitted from the table because it was not seen in the topics selected by the majority.
2. The questionnaire permits multiple answers (2 or fewer); therefore, the total of the rates exceeds 100%.

Fig. 2-2 Trend of the responses in constraints on realization

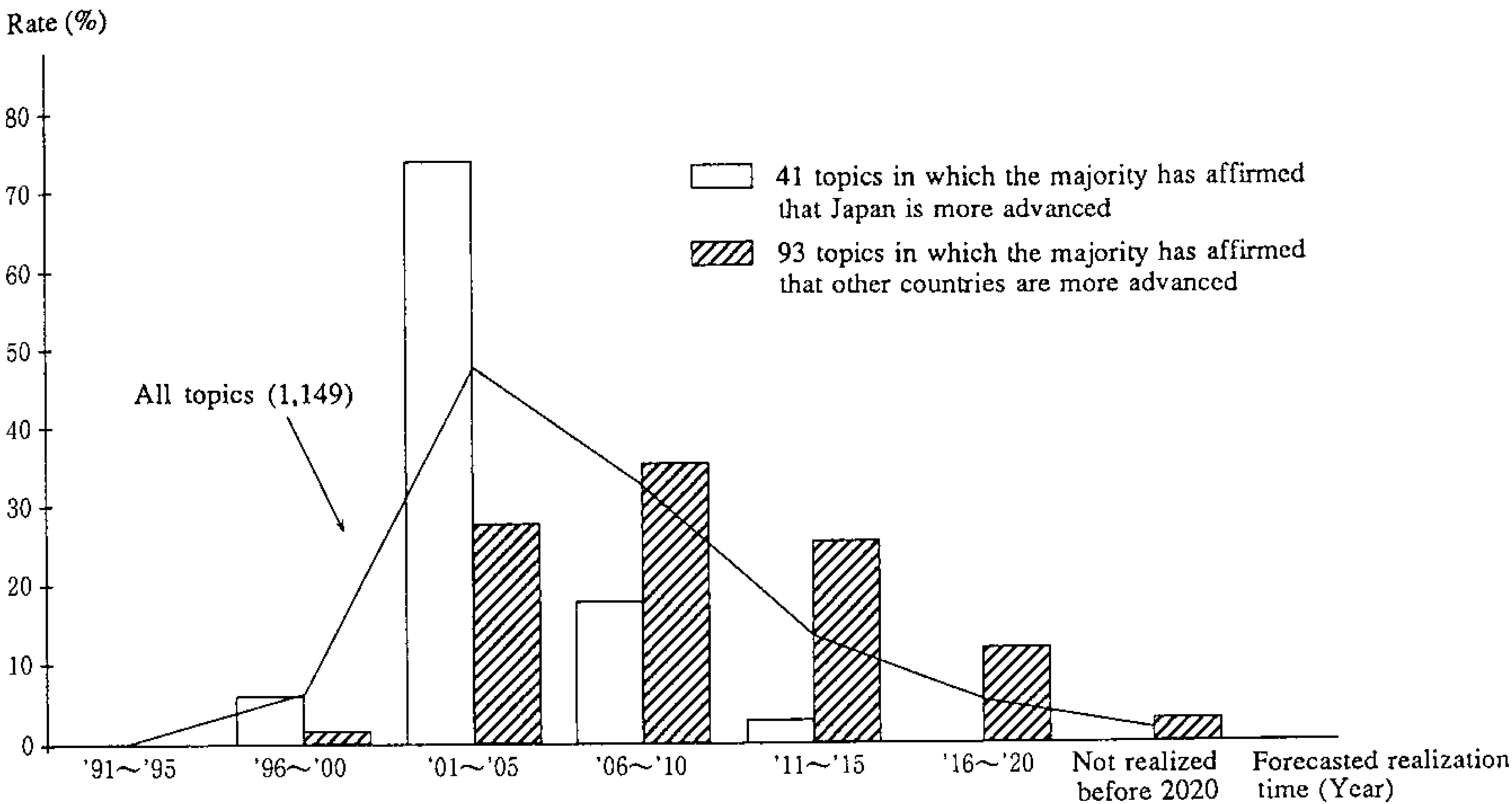
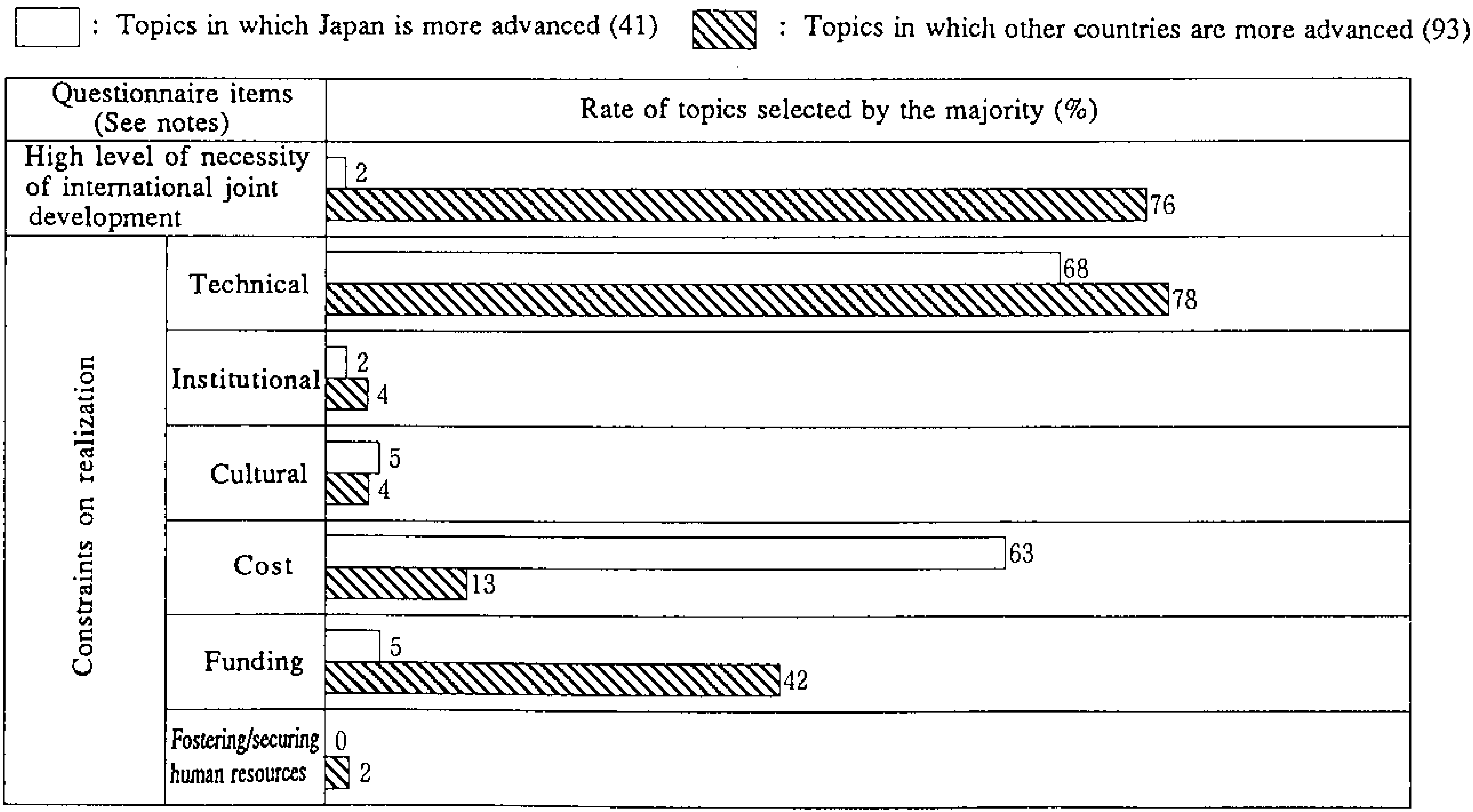
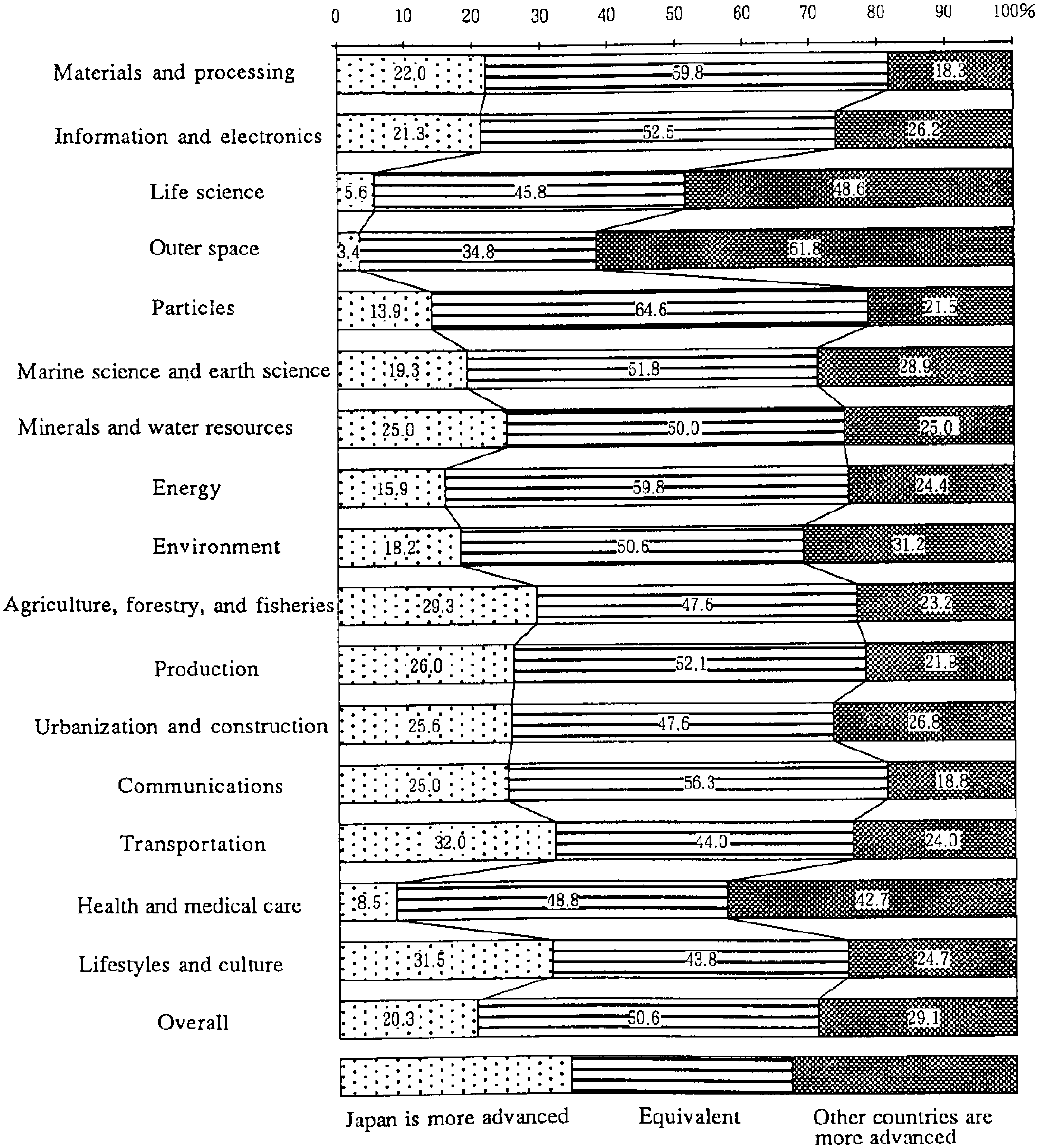


Fig. 2-3 Distribution of forecasted realization time for the topics in which Japan/other countries are more advanced



Notes: 1. The constraints included in the questionnaire included the R&D system and others in addition to the above factors; however, those two constraints are omitted because neither is applicable to the topics.
2. Multiple answers (two or fewer) are allowed for the constraints; therefore, the total of the rates of the constraints from "Technical" to "Fostering/securing human resources" exceeds 100%.

Fig. 2-4 Trend of the responses in the questionnaire items related to the R&D promotion of the topics in which Japan/other countries are more advanced

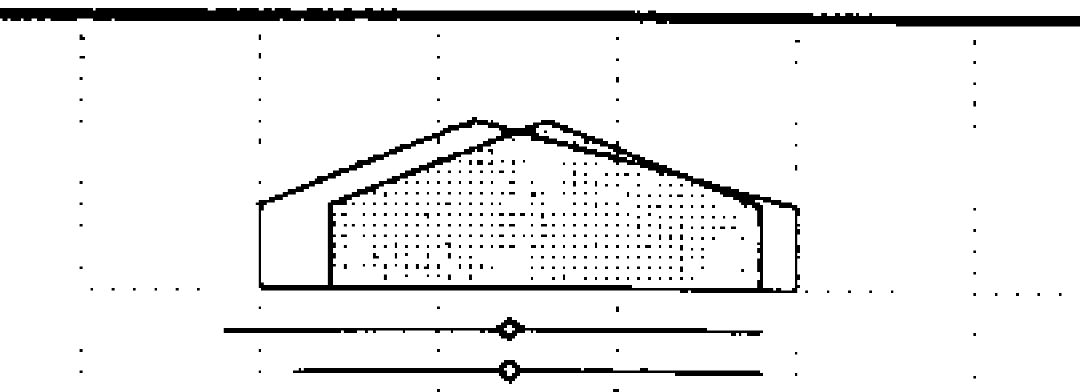
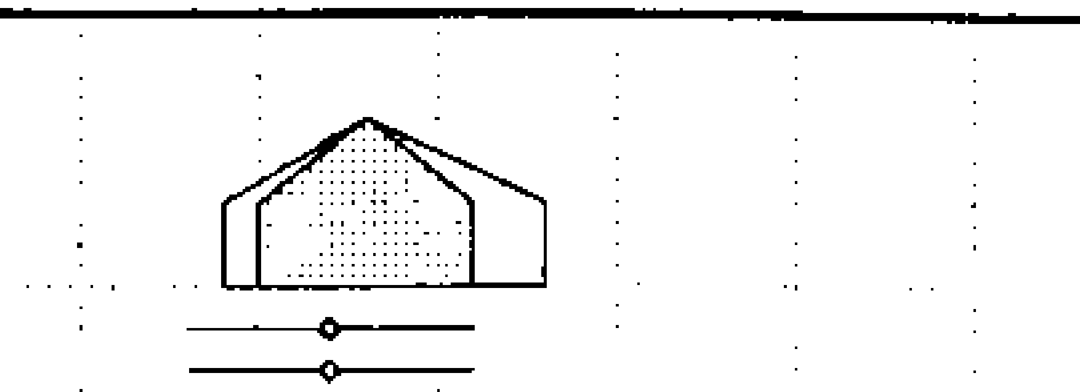


Note: The percentage rates shown above have been obtained by dividing the total of the answered rates of the individual choices, excluding "Don't know" and no response, by the number of questions.

Fig. 2-5 Trend in each field in the comparison of current R&D level between Japan and other countries

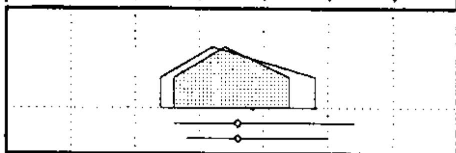
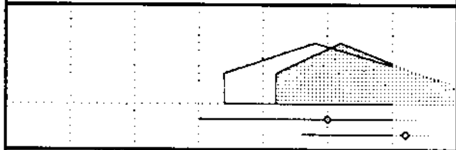
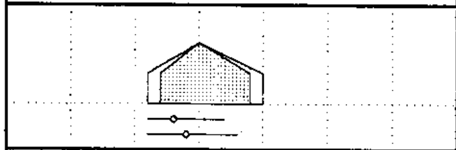
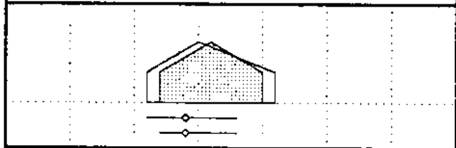
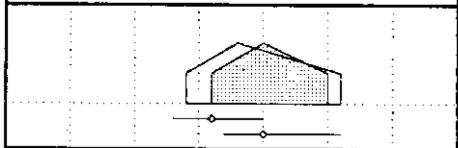
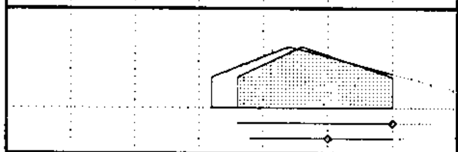
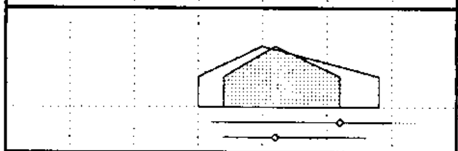
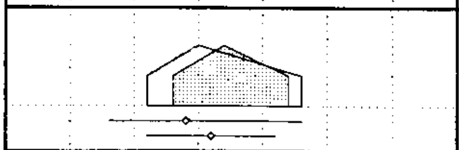
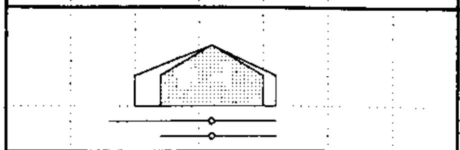
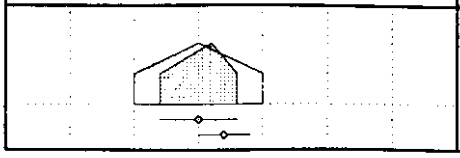
Statistical compilation of responses to each technology development topic

Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
1. Elucidation of relationships between the higher-order structures and functions of the nuclei of eukaryotic cells.	1	175	22	41	20	17	54	39	6	0
	2	144	20	42	21	17	60	37	3	0
	X	34					85	15	0	0
2. Establishment of technologies enabling prediction of the three-dimensional structures of proteins from their amino acid sequences.	1	198	23	43	26	8	71	27	2	0
	2	164	23	43	28	7	76	23	1	0
	X	40					88	13	0	0
A	B	C	D				E			

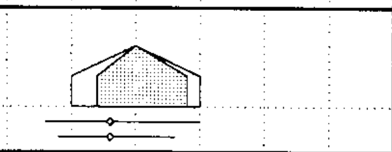
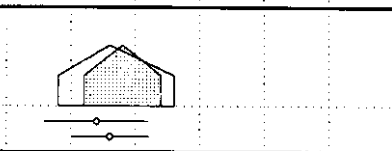
Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	50	28	46	34	13	5					61	6	1	5	33	41	23	0
	11	58	26	51	37	8	2	1	26	58	11	69	3	1	3	30	51	17	1
	29	47	21	65	32	3	0	0	29	71	0	59	12	0	6	29	47	29	0
	22	54	21	40	44	11	4					61	4	0	7	33	38	23	2
	20	62	16	42	43	9	3	3	44	42	7	66	3	0	4	34	48	24	0
	45	53	3	38	50	10	3	3	58	38	0	65	3	0	5	35	50	33	0
F	G																		

4.1 Materials and processing

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Characteristics of materials	Thermal characteristics	1. Use of engines emloying high-strength, heat-resistant ceramics as main material in more than 10% of all automobile production. (Ceramic-engine-loaded automobiles exceed more than 10% of automobile production.)	1	207	17	24	43	17	30	54	14	1
			2	167	15	26	44	16	28	60	10	1
			X	29					52	41	7	0
		2. Development of ceramic materials for high-temperature gas turbines (1,400°C or higher), which have a self-repairing characteristic for damage (e.g., preventing cracks,corrosion, etc. from developing) in a combustion atmosphere.	1	166	13	19	35	33	37	46	12	2
			2	139	12	22	37	29	32	56	9	2
			X	23					61	22	9	9
		3. Widespread use of high-temperature, heat-resistant intermetallic compounds in mechanical components (aircraft, engines, turbines, etc.).	1	181	11	27	36	26	23	59	18	0
			2	144	9	27	38	27	24	65	10	0
			X	17					65	29	6	0
		4. Development of heat-resistant engineering plastics capable of continuous use at temperatures of up to 450°C.	1	147	9	20	32	40	44	44	9	3
			2	117	7	20	33	40	39	50	10	0
			X	13					54	31	15	0
		5. Development of light-heat energy conversion systems (light energy storing system) which utilize organic compounds that allow stable operation over a five year period.	1	106	5	15	24	56	33	41	24	2
			2	78	6	12	23	59	29	44	26	1
			X	11					27	45	27	0
		6. Development of glass (or metals) with nearly identical thermal expansion coefficient (maximum difference is less than 1×10^{-6} K) at temperatures ranging from liquid helium's temperature to 600°C.	1	123	5	15	30	49	20	46	28	5
			2	99	4	16	32	49	14	59	21	5
			X	7					43	57	0	0
		7. Production of automobiles powered by hydrogen fuel stored in hydrogen-occlusive alloys exceeds 10% of the total automobile production.	1	181	9	21	43	26	36	45	15	2
			2	148	6	26	44	24	36	48	12	2
			X	11					64	36	0	0
	Mechanical characteristics	8. Development of Si_3N_4 sintered material having robustness equivalent to better than cast iron at room temperatures.	1	168	17	24	27	32	27	54	15	2
			2	135	17	22	29	31	23	63	10	3
			X	34					53	38	3	6
		9. Development of high temperature alloys able to tolerate a tensile strength of 150 N/mm^2 at temperatures of up to 1,200° C for a prolonged use lasting more than 1,000 hours (presently up to 1,050°C).	1	141	13	20	25	43	46	45	8	1
			2	112	11	20	27	42	44	50	4	1
			X	22					77	23	0	0
		10. Practical use of organic adhesives with a tensile strength of at least 15 N/mm2 at 400°C for use in adhesion of organic materials or organic materials to metals.	1	109	5	16	23	56	32	58	9	1
			2	87	6	16	23	55	31	57	11	0
			X	11					55	27	18	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	6	56	34	9	22	41	24					77	2	1	64	7	2	5	4
	4	63	29	7	26	43	22	46	40	4	8	81	1	1	71	6	4	3	4
	3	76	17	14	38	38	10	52	38	7	0	83	0	0	76	14	3	7	0
	6	31	55	22	31	28	11					86	0	0	22	13	4	17	3
	6	30	59	21	40	26	10	18	39	10	30	92	0	0	29	11	4	17	4
	9	48	35	26	48	17	4	9	57	4	26	91	0	0	13	17	13	26	4
	12	45	39	15	34	32	17					82	1	1	50	8	6	11	1
	9	52	36	13	38	35	13	18	51	19	11	84	2	0	59	6	2	11	0
	29	65	6	24	29	29	18	35	53	12	0	88	0	0	59	18	0	6	0
	10	48	36	18	31	33	13					86	2	3	31	12	5	10	3
	8	50	41	18	38	32	11	9	46	30	14	91	1	0	44	7	2	8	5
	46	46	8	31	38	15	15	8	23	69	0	69	0	0	38	23	0	15	23
	3	38	54	18	42	25	11					88	1	0	35	10	9	8	4
	5	36	55	10	53	26	9	9	50	13	24	88	1	0	37	13	4	5	3
	27	45	27	18	27	27	27	9	82	0	9	91	0	0	36	27	0	0	0
	7	33	50	11	33	29	17					80	2	1	9	12	6	7	2
	8	29	59	7	41	27	21	8	35	14	38	91	1	0	15	16	2	10	3
	29	43	29	0	29	14	57	14	29	14	43	100	0	0	14	14	0	0	14
	10	36	46	22	37	23	12					65	13	3	63	11	1	7	3
	7	45	44	16	42	22	16	18	51	11	15	74	9	1	70	7	0	8	3
	27	45	27	27	45	18	9	36	55	9	0	82	27	9	55	18	0	0	0
	10	50	37	11	35	33	17					79	2	1	30	17	4	10	4
	8	50	39	8	36	36	16	30	47	7	12	87	1	1	41	10	1	10	2
	21	62	12	18	29	35	12	41	50	3	0	91	0	0	32	15	0	12	0
	14	49	34	16	42	24	13					81	2	0	27	20	10	10	3
	8	54	36	18	40	26	13	15	50	17	13	87	0	1	35	17	4	13	3
	32	59	9	41	36	14	9	18	55	14	9	91	0	5	36	14	5	14	0
	7	50	38	17	31	36	14					91	2	0	23	11	5	10	1
	6	48	46	8	38	34	18	11	49	17	18	95	1	0	30	9	3	5	2
	18	64	18	9	45	18	27	18	64	9	9	91	0	0	9	27	9	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Characteristics of materials	Mechanical characteristics	11. Practical use of polymeric fiber with a tear resistance of 40% of the theoretical and a modulus of 90% of the theoretical value. (The theoretical values are assumed to be 20 GPa for resistance and 250 GPa in modulus of elasticity.)	1	88	8	14	15	64	30	60	9	0
			2	71	7	13	16	64	28	62	8	0
			X	14					43	50	0	0
		12. Practical use of the technology for producing a metal-ceramic bond at the atomic level, which maintains the strength at temperatures of 1,000° C or more.	1	172	13	18	39	30	41	52	5	1
			2	142	14	15	43	27	42	52	4	1
			X	28					68	32	0	0
		13. Practical use of function-gradient materials which have sufficient thermal stability and mechanical strength based on continuous composition from metal and ceramic.	1	189	16	25	35	24	39	48	12	1
			2	157	15	27	37	21	34	57	7	1
			X	29					45	52	3	0
		14. Practical use of oxidation-resistant carbon-fiber reinforced carbon composite materials.	1	152	9	21	31	38	32	49	18	1
			2	128	8	21	35	35	24	59	15	2
			X	16					63	38	0	0
		15. Development of a material having a flexible function equivalent to that of human muscles.	1	111	4	10	32	54	41	44	13	0
			2	85	5	10	29	56	38	49	13	0
			X	9					33	33	33	0
		16. Development of structural materials which can indicate residual service life.	1	144	9	18	33	41	44	38	15	3
			2	116	9	14	36	41	47	41	9	3
			X	18					61	33	0	6
	Photo-electromagnetic characteristics	17. Development of ceramics-based, solid electrolytes with superior performance to beta-alumina.	1	111	8	15	23	55	23	57	18	2
			2	91	7	15	24	54	19	69	9	2
			X	13					38	54	0	8
		18. Practical use of super lattice semiconductor devices with two- or three-dimensionally controlled structure.	1	144	10	24	25	40	56	38	3	1
			2	116	12	21	27	41	57	36	5	1
			X	23					74	22	4	0
		19. Development of high-performance non-linear optical devices of third-order.	1	129	10	20	23	47	29	54	13	1
			2	103	10	21	21	47	26	62	9	1
			X	20					50	50	0	0
		20. Practical use of beam processing technology which achieves a memory capacity of 1 Gb per chip.	1	148	11	19	31	39	68	23	7	0
			2	115	10	18	31	41	74	18	4	0
			X	19					89	11	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	11	53	31	14	35	33	17					80	0	1	38	9	7	13	2
	8	59	28	14	34	28	23	8	58	14	15	90	0	0	44	7	4	7	3
	29	57	14	21	21	21	36	21	43	29	7	93	0	0	29	14	7	14	0
	12	52	33	16	37	31	13					83	1	1	30	20	6	10	0
	9	59	30	11	39	34	14	18	51	11	18	89	0	0	34	13	3	12	0
	25	64	11	18	36	29	18	36	50	7	7	89	0	0	39	14	0	14	0
	19	54	23	17	35	24	19					80	1	1	39	15	5	8	2
	14	57	26	13	45	22	16	35	45	8	11	89	1	1	48	8	3	12	1
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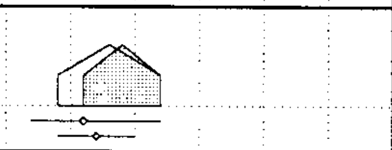
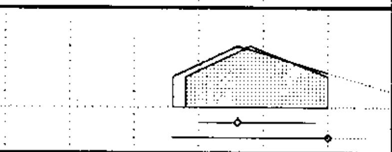
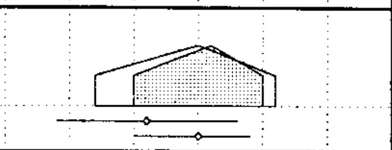
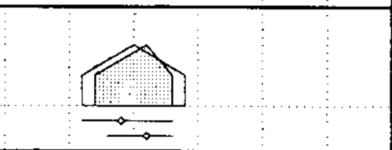
	16	46	33	14	34	32	15					79	2	1	39	14	5	7	1
	10	52	37	7	38	38	16	27	45	16	9	88	0	1	52	9	2	8	0
	31	69	0	25	31	25	19	31	50	19	0	100	0	0	69	19	0	6	0
	9	34	50	29	34	24	8					83	4	3	15	14	12	11	2
	8	29	58	28	45	19	6	7	45	15	27	93	1	1	14	11	14	11	0
	22	44	33	33	44	22	0	22	33	22	22	89	0	0	33	11	56	0	0
	10	38	44	21	37	27	10					78	1	1	15	17	10	13	3
	5	41	52	22	42	23	9	16	36	10	29	91	3	2	15	15	11	6	2
	22	44	28	28	33	28	6	33	33	11	17	83	6	0	17	22	17	11	0
	13	43	36	17	31	31	14					77	0	2	24	20	5	10	1
	8	54	35	9	43	33	11	18	53	9	15	87	0	1	26	25	5	8	1
	23	69	0	8	54	15	15	23	62	0	8	85	0	0	38	38	0	8	0
	28	45	24	19	33	26	18					80	0	0	34	17	6	13	1
	23	52	22	16	40	25	16	46	38	5	8	89	0	2	53	9	2	6	1
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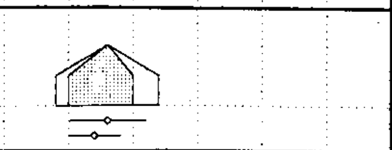	16	46	32	19	37	23	16					81	0	1	18	18	12	16	2
	12	55	31	20	44	22	11	21	52	17	7	90	0	1	22	16	9	9	1
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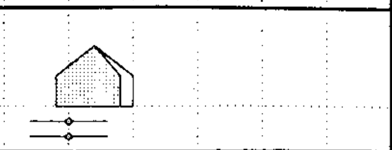
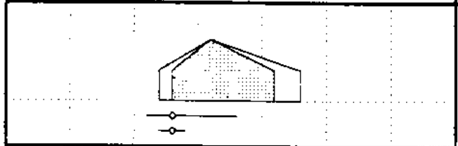
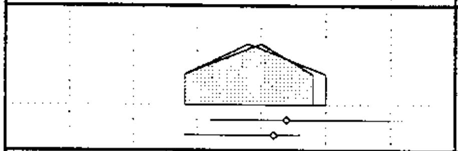
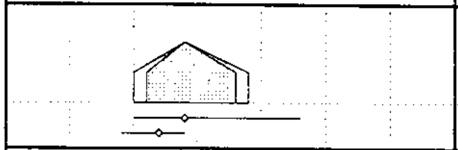
	32	39	26	9	30	32	24					78	1	0	29	26	5	9	1
	31	47	17	7	37	31	21	67	17	5	4	86	0	2	40	21	1	3	1
	63	37	0	11	42	26	21	89	5	5	0	89	0	0	53	16	5	5	5

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Characteristics of materials	Photo-electromagnetic characteristics	21. Practical use of logic integrated circuits capable of use at a high-temperature up to 500^{o}C.	1	115	5	15	27	52	22	52	23	2
			2	89	5	16	25	54	15	61	22	0
			X	9					0	78	22	0
		22. Practical use of multi-layer solar cells with a conversion efficiency of more than 50%.	1	162	7	22	37	34	71	22	4	1
			2	128	6	23	37	34	80	16	2	0
			X	12					67	25	8	0
		23. Practical use of large-area amorphous silicon solar cells with a conversion efficiency of more than 20%.	1	164	7	22	38	33	68	28	2	1
			2	133	6	24	39	31	71	23	3	0
			X	11					82	9	9	0
		24. Development of quantum-effect interferometer for flux measurement.	1	79	5	12	15	67	32	56	10	0
			2	61	5	12	15	68	23	64	10	0
			X	9					33	67	0	0
		25. Practical use of semiconductor blue lasers.	1	127	9	17	26	48	34	55	9	0
			2	105	9	17	28	46	28	64	6	0
			X	17					35	65	0	0
		26. Pracxtical use of an ultraviolet sensor materials for heavy duty use in the ozone-rich environment.	1	86	4	10	22	64	28	42	24	3
			2	67	2	10	23	65	19	54	24	1
			X	4					0	100	0	0
		27. Development of magnetic materials with a maximum energy of at least 70 MGSOe. (Iron-, neodymium- or boron-based magnetic materials: 64 MGSOe)	1	108	9	14	22	55	32	57	7	0
			2	82	7	14	22	57	28	63	7	0
			X	14					71	29	0	0
		28. Practical use of magnetic fluids with a saturation magnetization of at least 1,500 G.	1	83	7	10	17	66	14	52	25	2
			2	65	6	10	18	66	14	58	22	2
			X	12					25	67	8	0
		29. Development of bulk magnetic materials with saturation magnetization of 3 tesla or more. (Currently known maximum value: 2.4 tesla.)	1	93	8	11	19	62	28	58	11	0
			2	69	6	11	19	64	26	64	9	0
			X	12					50	50	0	0
		30. Practical use of polymer materials with electrical conductivity greater than copper at room temperature.	1	144	7	18	34	41	43	42	11	2
			2	112	8	19	31	42	40	44	13	2
			X	16					56	44	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	9	45	38	21	30	28	15					82	2	0	18	14	7	15	1
	4	53	38	19	39	29	9	25	42	10	18	93	0	0	29	10	3	15	0
	11	78	11	11	44	33	11	11	78	11	0	100	0	0	22	0	0	0	0
	9	36	48	30	28	27	11					83	1	2	36	19	4	10	1
	6	34	54	33	30	25	8	34	46	4	10	91	1	1	53	8	2	8	0
	8	50	42	33	33	17	17	17	75	0	8	92	0	8	42	25	0	8	0
	10	55	31	23	28	33	13					79	3	2	45	18	4	9	1
	8	58	32	17	42	29	10	47	40	3	6	89	3	1	59	8	2	5	1
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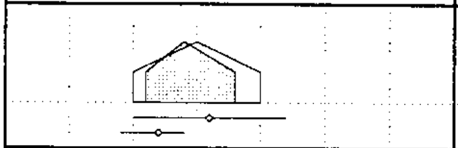	18	44	32	29	32	20	13					81	0	1	19	18	13	9	0
	16	43	33	25	46	13	8	13	61	8	11	89	0	2	25	15	7	5	0
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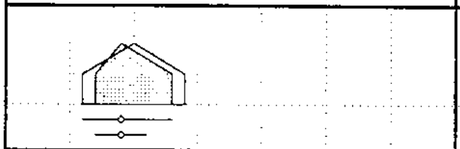	27	52	17	7	31	37	21					84	0	1	28	17	5	9	0
	21	64	11	4	36	37	19	27	46	18	5	92	0	0	39	10	1	8	0
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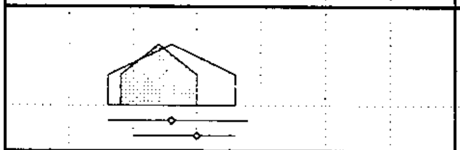	12	50	29	26	33	22	10					77	2	1	19	13	3	12	0
	4	57	31	27	39	19	7	6	54	13	19	90	0	0	28	9	7	6	0
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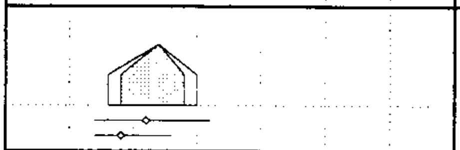	19	47	29	9	25	31	31					79	0	0	22	14	10	7	0
	15	55	23	5	32	29	28	48	32	7	5	85	0	0	34	13	9	6	0
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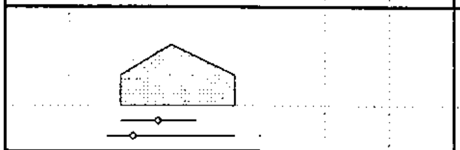	18	41	30	7	27	35	18					73	0	0	25	17	5	7	1
	14	49	26	3	34	32	18	28	42	12	9	83	2	0	42	9	6	5	2
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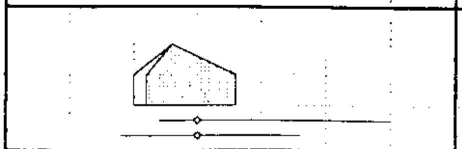	15	48	30	13	30	30	20					80	0	0	22	12	10	6	1
	13	49	32	7	36	30	20	43	39	7	4	87	0	0	28	12	6	6	0
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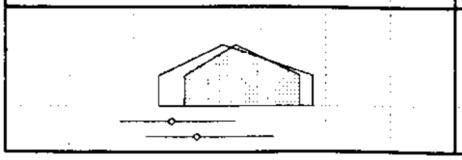
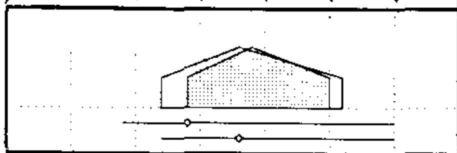
	13	39	39	18	34	23	19					79	0	0	25	15	7	8	1
	10	43	38	14	45	21	8	12	54	16	9	86	0	0	31	14	6	4	3
	38	50	6	19	44	19	13	19	50	25	0	88	0	0	38	25	6	19	0

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Characteristics of materials	Photo-electromagnetic characteristics	31. Development of organic superconductor having a transition temperature higher than 77 K.	1	139	8	16	34	42	46	34	17	0
			2	116	8	16	36	40	46	40	12	0
			X	15					73	27	0	0
		32. Practical use of high-polymer materials offering a reversible coloring and luminescence when supplied with energy, capable of sustaining this effect for 3,000 hours.	1	99	6	16	20	58	19	55	25	0
			2	78	7	13	20	59	13	67	18	1
			X	14					14	64	21	0
		33. Practical use of organic materials with the photosensitivity and resolution of silver chloride.	1	93	5	14	21	61	24	57	17	0
			2	67	6	11	19	65	24	58	15	0
			X	11					45	45	9	0
		34. Practical use of organic ferromagnetic substances.	1	93	4	13	22	61	26	48	24	0
			2	77	5	12	24	59	12	60	25	0
			X	10					40	40	20	0
		35. Practical use of high-polymer ferroelectrics whose piezoelectric modulus is as high as PZT.	1	101	5	13	24	58	14	53	30	1
			2	81	5	11	27	57	10	59	28	0
			X	9					22	67	11	0
		36. Practical use of chargeable polymer batteries having a volume-specific capacity of 400 Wh/liter. (Capacity of current Ni-Cd batteries: 180 Wh/liter)	1	91	5	11	22	62	35	47	13	1
			2	74	6	9	23	61	32	53	11	1
			X	12					50	42	0	8
		37. Widespread use of industrial electric machines which employ superconductive materials having a critical temperature of liquid nitrogen (77 K) or more.	1	178	13	20	42	25	64	31	3	1
			2	150	12	19	46	23	66	31	1	1
			X	24					71	25	0	0
		38. Development of superconductive materials with a transition temperature around room temperature.	1	180	14	21	41	25	79	16	2	1
			2	146	13	21	41	25	84	13	1	0
			X	26					92	4	0	0
		39. Development of simple operational circuits comprising Josephson junction devices which use oxide superconductors.	1	143	11	18	31	40	36	50	13	0
			2	120	10	20	32	38	31	58	10	0
			X	20					35	60	5	0
		40. Practical use of a technique for formation of p-n junctions in diamonds.	1	133	8	22	26	44	27	50	21	0
			2	113	6	22	31	41	22	57	19	0
			X	11					45	27	18	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	7	31	52	29	34	16	13					82	1	1	11	19	14	12	1
	7	37	49	25	41	16	10	5	59	17	10	89	0	0	14	18	12	9	2
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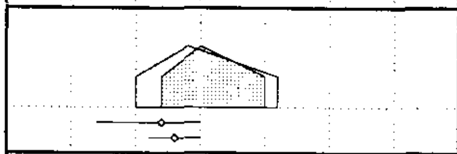
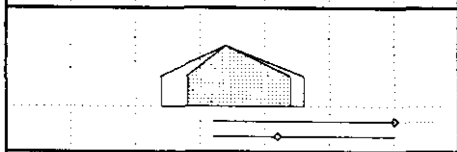
	7	51	35	9	32	35	20					82	0	2	22	14	9	10	0
	9	49	40	4	38	37	17	14	63	6	12	88	0	0	26	12	10	5	0
	36	50	7	7	43	21	29	21	64	14	0	79	0	0	36	29	14	0	0
	8	44	39	9	28	29	28					88	1	0	28	11	3	10	1
	10	40	45	4	37	31	22	19	55	9	13	88	0	0	39	9	6	3	0
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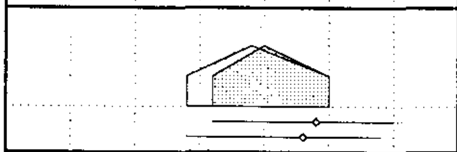	9	41	44	16	31	25	22					84	1	0	24	14	8	8	1
	6	44	45	12	43	23	17	10	64	10	12	91	0	0	27	12	9	3	1
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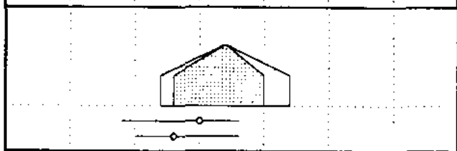	6	37	47	10	33	30	18					78	0	1	24	12	6	10	3
	7	36	52	9	38	31	14	16	53	9	16	88	0	0	26	10	7	6	1
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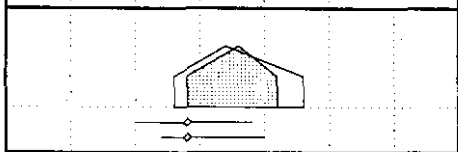	4	40	46	12	32	29	20					81	0	1	35	10	5	4	2
	4	49	42	9	45	24	16	20	54	8	11	91	0	0	43	8	7	1	1
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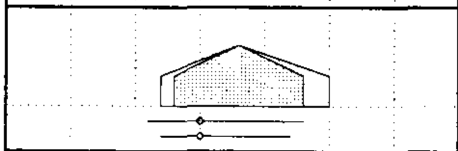	9	49	37	25	35	21	12					80	2	0	41	16	3	8	1
	8	53	36	21	45	19	11	28	55	5	7	90	1	0	46	13	4	5	1
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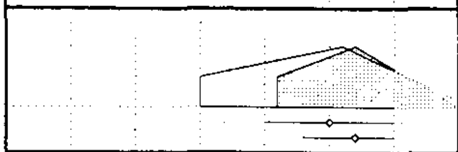	9	30	49	43	25	15	10					82	1	0	8	18	9	11	2
	9	32	54	45	27	14	9	12	57	11	14	91	0	0	8	23	9	8	3
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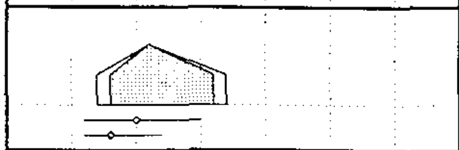	21	50	25	18	29	29	17					77	1	0	19	17	8	9	0
	20	53	26	17	34	32	13	28	51	10	8	93	0	0	23	17	8	3	1
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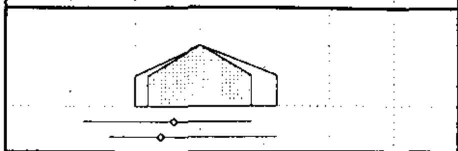
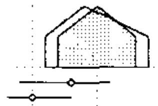
	13	42	38	20	28	29	17					80	0	0	29	20	7	7	0
	10	47	40	17	39	27	12	24	50	7	12	94	0	1	31	12	6	5	0
	36	45	9	27	36	27	0	18	64	9	0	91	0	0	18	9	9	9	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Characteristics of materials	Photo-electromagnetic characteristics	41. Development of microwave cathode elements able to operate at 7 $A \cdot cm^{-2}$ for a life-time of one year.	1	31	1	3	9	87	13	68	16	0
			2	25	1	3	9	87	0	80	16	0
			X	2					0	100	0	0
		42. Realization of storage density of 100 Gb/cm^2 by the use of PHB (Photochemical Hole Burning) devices.	1	95	4	11	25	60	24	64	8	1
			2	73	4	9	25	62	21	68	8	1
			X	7					29	57	14	0
		43. Development of long-distance, ultra high-speed transmission optical fibers enabling an optical transmission on the order of 100 Gbps (currently 20 to 30 Gbps).	1	79	4	8	21	67	44	49	3	3
			2	66	5	8	22	66	41	55	0	2
			X	9					67	33	0	0
		44. Development of materials with variable optical refraction indices within 0.1 or more around its average value by applying electric or magnetic fields.	1	80	3	14	17	66	28	59	11	0
			2	64	3	14	16	67	23	66	8	0
			X	6					17	83	0	0
		45. Development of intelligent materials which incorporate sensor functions, storage functions and effector functions.	1	108	6	13	26	55	39	39	17	3
			2	84	6	12	27	56	35	51	12	2
			X	11					45	55	0	0
	Biochemical characteristics	46. Practical use of semi- or all-synthetic materials for artificial organ implants which cause no undesirable reactions including the reaction to foreign body.	1	106	5	9	32	55	65	32	3	0
			2	83	5	8	30	57	69	28	4	0
			X	10					80	20	0	0
		47. Practical use of hybrid artificial organs in which cells are fixed on materials such as high polymers.	1	78	5	6	22	67	44	49	8	0
			2	58	5	6	19	69	45	48	7	0
			X	9					78	11	11	0
		48. Practical use of artificial organ implants or biosensor implants which employ highly antithrombus, molecule-specific and material permeating membranes.	1	76	5	6	21	68	45	46	9	0
			2	58	4	5	21	70	45	50	5	0
			X	8					63	38	0	0
		49. Practical use of synthetic materials which promote development of biological tissues and organogenesis.	1	65	4	3	20	73	34	49	17	0
			2	50	4	3	19	74	36	56	8	0
			X	8					75	25	0	0
		50. Practical use of composite systems capable of garbage disposal based on the high-temperature methane fermentation technology and of waste combustion disposal.	1	81	2	8	25	66	40	49	10	1
			2	58	2	4	25	70	34	60	3	2
			X	3					67	33	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	0	45	45	13	26	35	19					87	0	0	23	10	10	13	0
	0	48	44	20	20	40	12	16	28	24	28	84	0	0	24	16	4	4	0
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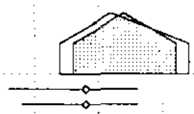
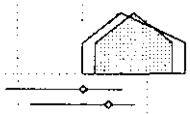
	5	37	46	18	35	23	18					86	0	0	19	8	5	8	0
	10	36	48	15	37	25	18	21	37	22	15	92	1	0	22	7	4	4	0
	43	43	14	14	29	29	29	14	29	57	0	86	14	0	29	14	0	0	0
	8	43	43	14	29	30	22					85	0	0	23	14	8	8	1
	11	45	42	15	30	32	20	36	33	6	23	89	0	0	36	5	5	6	0
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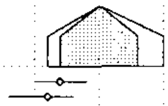	6	41	45	18	28	31	19					80	3	0	8	16	10	6	0
	5	47	42	14	33	30	17	13	48	13	22	86	0	0	11	16	8	6	2
	50	50	0	17	50	17	17	17	50	33	0	83	0	0	33	0	17	17	17
	11	32	44	30	35	19	6					81	0	0	15	13	9	15	1
	7	38	51	31	38	15	12	15	38	18	27	93	0	0	18	10	8	14	1
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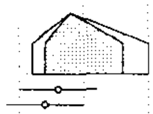	14	39	40	34	37	19	7					81	14	14	13	17	5	11	0
	12	43	43	34	43	17	5	10	45	30	14	95	12	14	16	14	5	10	1
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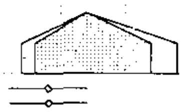	15	33	42	29	41	19	5					76	14	13	15	17	6	6	0
	14	40	45	29	50	16	3	9	43	31	17	95	16	10	21	10	7	5	2
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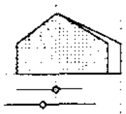	16	29	46	24	43	25	5					78	14	8	21	12	7	5	0
	14	33	50	21	52	21	5	14	48	28	10	95	14	3	24	10	5	5	2
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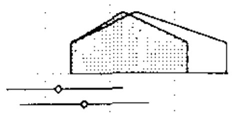	15	26	51	22	45	25	6					72	14	9	11	11	8	5	0
	18	28	52	22	52	18	6	6	48	28	16	96	12	2	14	10	2	4	0
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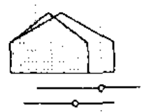
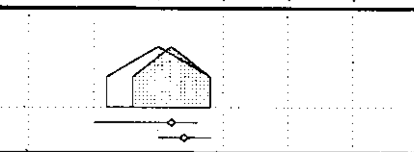
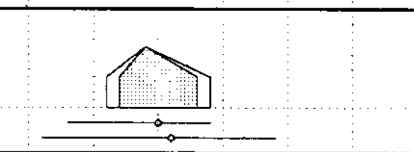
	12	54	30	19	23	32	23					42	19	9	42	17	6	9	2
	14	60	24	14	28	31	24	31	43	5	19	66	10	7	48	14	2	10	2
	33	67	0	33	0	33	0	33	33	0	0	67	0	0	33	0	33	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Characteristics of materials	Biochemical characteristics	51. Practical use of high-polymer materials which have advanced molecule recognition ability comparable to those of enzymes or antibody/cell receptors in the fields of medical treatment, diagnosis, and chemical industry.	1	66	3	8	17	72	36	56	5	2
			2	52	4	5	18	73	33	63	2	0
			X	7					57	29	14	0
		52. Practical use of noninvasive (bloodless) blood component monitors.	1	46	3	5	12	81	28	48	20	2
			2	38	3	5	13	80	18	55	21	3
			X	5					60	20	20	0
		53. Development of self-healing high polymers mimetic to animal skin.	1	62	2	5	19	74	31	47	19	2
			2	48	2	4	19	75	31	52	15	0
			X	4					25	50	25	0
		54. Elucidation of the biocompatibility of materials for living bodies.	1	95	5	7	28	60	59	35	6	0
			2	72	4	6	27	62	61	33	6	0
			X	8					88	13	0	0
		55. Development of fire-extinguishing materials capable of replacing the etching powder and carbo-halogen extinguishers.	1	61	1	5	19	74	21	44	31	2
			2	44	1	4	18	77	18	48	32	0
			X	2					50	0	0	0
		56. Development of sensors directly connectable to sensory nerves.	1	67	2	5	21	72	42	45	12	0
			2	54	2	4	23	72	31	56	11	0
			X	3					67	33	0	0
		57. Practical use of signal-responsive missile drugs capable of efficiently reaching affected parts such as tumor cells.	1	74	3	4	25	69	70	28	1	0
			2	55	3	3	23	71	75	24	2	0
			X	5					100	0	0	0
		58. Development of artificial bone materials capable of repairing and recovering fractured bones by totally assimilating the functions of natural bones in approximately the same healing time as that of natural bones.	1	86	2	9	25	64	45	45	8	0
			2	69	2	7	27	64	42	51	6	0
			X	4					75	25	0	0
		59. Practical use of membranes that are similar to those in living bodies, and which have an active transport function and receptors for signals.	1	60	3	5	17	75	18	67	12	0
			2	45	4	6	14	76	16	71	11	0
			X	7					43	43	14	0
Process	Designing and compounding	60. Development of a technique enabling solid-phase sintering process using ultra fine particles at temperatures around 800°C to produce SiC-based or Si_3N_4 -based heat-resistant ceramics.	1	170	15	21	33	30	20	56	22	1
			2	143	15	19	38	27	16	61	22	1
			X	30					37	43	17	3

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	12	38	42	12	48	23	11					82	6	2	26	8	6	9	3
	13	25	60	10	56	21	10	4	69	10	13	96	4	0	23	10	6	6	0
	57	29	14	43	43	14	0	0	71	14	0	100	0	0	0	14	14	14	0
	17	33	39	17	41	20	17					80	2	2	20	9	2	11	2
	16	29	50	13	42	24	16	11	63	8	13	89	3	0	18	5	5	11	3
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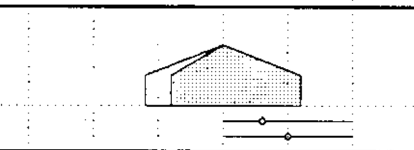	6	31	52	21	44	21	10					79	10	6	16	11	8	8	2
	8	29	58	21	50	21	6	2	52	13	29	92	8	4	6	10	8	4	0
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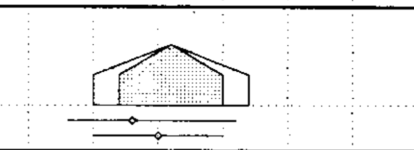
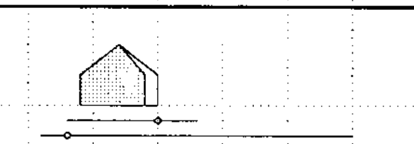
	11	38	44	34	39	18	6					73	3	3	6	17	15	16	1
	10	42	49	32	51	11	4	8	42	26	19	89	6	3	4	17	14	11	0
	63	13	25	38	38	13	0	25	38	25	0	88	0	0	0	13	25	0	0
	11	38	43	20	28	39	10					70	10	0	38	11	2	7	3
	11	48	39	20	36	36	5	14	50	14	16	84	5	0	41	9	0	7	0
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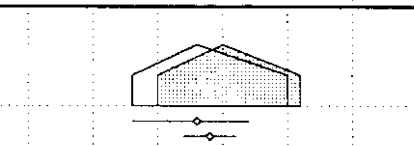	7	30	54	31	42	21	3					82	4	7	7	19	7	12	1
	6	31	59	33	41	17	7	7	54	11	24	96	2	9	4	15	7	9	2
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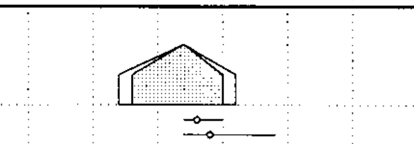	12	38	42	35	39	16	7					82	14	3	11	15	5	8	1
	9	44	44	31	47	16	4	5	55	16	18	93	13	0	11	13	4	11	0
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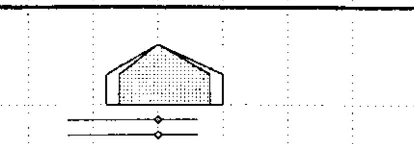	8	45	41	21	35	26	13					74	10	1	14	15	7	10	1
	12	54	33	10	42	32	10	10	48	17	20	87	12	0	16	20	6	7	0
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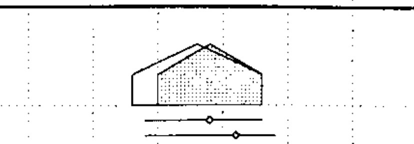
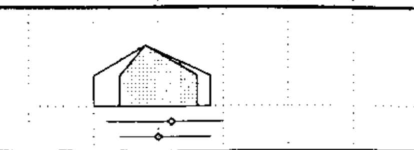
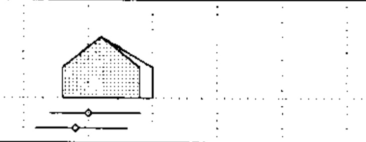
	10	28	50	18	42	23	10					78	8	2	15	8	7	8	2
	7	33	58	16	42	27	9	9	47	18	20	96	2	2	13	9	7	7	0
	29	43	29	0	71	29	0	14	71	14	0	100	0	0	14	29	0	14	0
	11	44	38	11	25	35	22					84	1	0	21	16	4	7	2
	8	50	38	9	26	42	17	29	50	3	12	92	1	0	31	8	4	8	3
	20	63	13	10	30	27	20	37	43	3	7	83	3	0	37	7	10	10	7

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Process	Designing and compounding	61. Practical use of a technique producing CBN (cubic boron nitride) tools using vapour deposition coating.	1	160	10	21	34	34	20	50	28	0
			2	128	9	21	36	34	15	60	23	0
			X	17					59	24	18	0
		62. Development of compound semiconductors by molecular beam epitaxy in space.	1	137	8	18	31	43	7	34	44	12
			2	108	9	15	31	44	4	40	45	9
			X	18					17	28	28	28
		63. Widespread use of atomic-layer epitaxy and atomic-layer etching in all compound semiconductors.	1	137	13	18	26	43	39	52	8	0
			2	109	12	19	25	44	37	54	8	0
			X	24					63	38	0	0
		64. Development of heteroepitaxial growth on silicon wafers regardless of the type of materials.	1	134	11	21	24	44	39	47	10	2
			2	108	12	19	24	45	39	51	8	1
			X	23					57	39	4	0
		65. Development of a technique for fabrication of large-area compound semiconductor single crystal film on glass substrates.	1	131	10	21	23	45	30	59	8	2
			2	104	10	22	22	46	23	68	6	1
			X	19					42	47	5	5
		66. Development of heteroepitaxial technology for growing large-area diamond thin films on hetero-substrates.	1	143	10	21	28	41	30	52	15	1
			2	110	8	22	27	44	28	57	13	0
			X	16					69	31	0	0
		67. Development of technology for embedding impurities, and repairing defective crystallized silicon surfaces by STM-associated technololgy.	1	143	14	20	26	40	29	48	20	1
			2	113	13	17	29	41	26	59	12	1
			X	24					42	54	4	0
		68. Development of an economical manufacturing process for iron of high purity of 6-N class (99.9999% pure).	1	127	12	16	26	47	13	49	35	2
			2	101	10	14	29	47	10	53	33	2
			X	20					30	45	20	5
		69. Development of new titanium refining process lowering the manufacturing cost on a par with that of aluminum.	1	124	9	15	28	48	30	52	16	0
			2	104	8	16	31	46	31	55	13	0
			X	15					47	53	0	0
		70. Widespread use of new alloys utilizing the principle of mechanical alloying.	1	132	13	17	25	45	15	60	22	2
			2	108	11	18	26	45	11	69	19	0
			X	22					23	64	14	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Degree of certainty (%) Medium	Degree of certainty (%) Low	Necessity of international joint development (%) High	Necessity of international joint development (%) Medium	Necessity of international joint development (%) Low	Necessity of international joint development (%) None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Comparison of current R&D level between Japan and other countries (%) Equivalent	Comparison of current R&D level between Japan and other countries (%) Other countries are more advanced	Comparison of current R&D level between Japan and other countries (%) Don't know	Constraints on realization (%) Technical	Constraints on realization (%) Institutional	Constraints on realization (%) Cultural	Constraints on realization (%) Cost	Constraints on realization (%) Funding	Constraints on realization (%) Fostering/securing human resources	Constraints on realization (%) R&D system	Constraints on realization (%) Others
	13	54	28	4	24	36	28					74	1	1	37	16	4	5	2
	9	63	25	3	25	38	31	35	45	5	11	85	0	0	52	8	3	5	2
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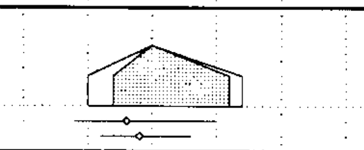	13	37	30	52	20	9	3					48	4	0	33	29	4	18	3
	11	46	35	63	15	10	5	6	27	53	7	67	1	1	51	27	2	14	5
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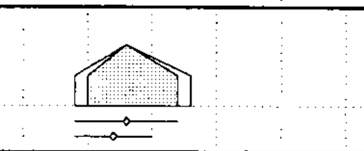	13	55	26	18	34	28	14					80	1	0	27	19	7	7	1
	13	60	26	17	40	22	17	34	49	9	6	89	0	0	31	15	6	4	2
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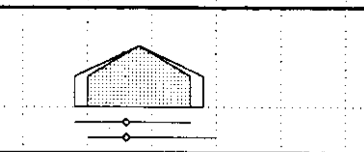	13	45	31	13	32	29	16					78	1	0	14	21	4	10	2
	15	46	35	7	41	33	14	27	55	5	8	95	0	0	16	26	3	6	0
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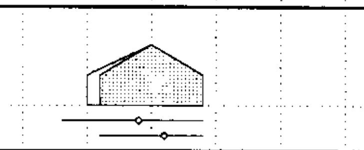	14	43	36	13	31	27	19					75	0	1	16	18	5	7	0
	13	50	34	8	38	33	16	26	50	4	13	93	0	0	17	22	4	4	0
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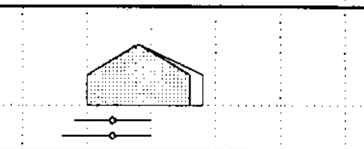	15	43	36	13	31	31	18					80	0	1	20	22	4	6	0
	15	48	35	9	35	35	17	34	50	6	6	92	0	0	24	22	4	5	1
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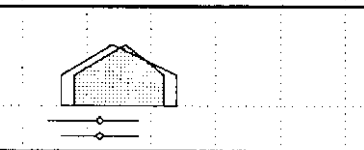	16	48	28	18	34	25	14					77	0	0	20	17	5	9	1
	17	52	27	17	42	25	12	14	55	21	6	88	0	1	32	13	3	6	1
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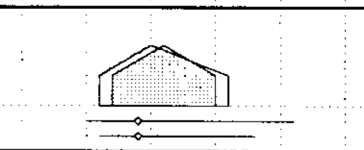	14	39	37	6	21	38	28					68	0	1	46	13	6	8	2
	12	45	40	4	23	40	29	43	32	5	14	81	0	0	67	8	2	4	2
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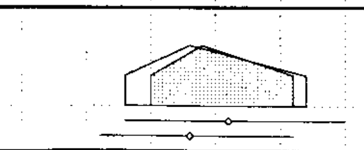	10	35	46	11	24	35	21					81	0	0	37	15	7	5	0
	7	39	50	9	37	36	14	16	41	19	17	85	0	0	52	15	0	5	0
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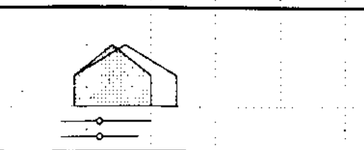
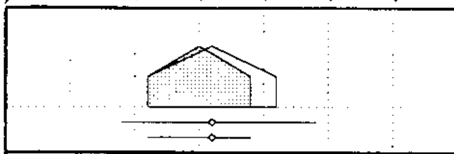
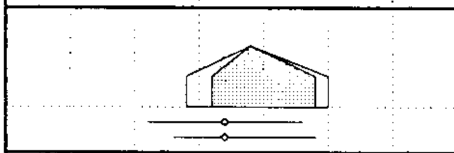
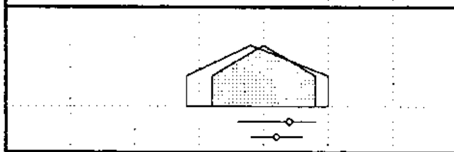
	20	42	31	16	23	33	21					67	0	1	44	16	10	7	0
	18	54	27	13	23	41	20	15	61	12	9	80	0	1	63	10	5	8	0
	50	41	9	18	32	27	18	23	59	18	0	77	0	5	50	23	0	14	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Process	Designing and compounding	71. Development of aptional polymer processing technology for controlling the microstructure in the range of 10-100Å.	1	99	7	13	20	59	34	43	17	1
			2	72	8	12	17	63	32	56	11	0
			X	16					75	25	0	0
		72. Development of technology enabling complete control of two- and three-dimensional of protein structures.	1	64	4	6	16	73	44	45	9	2
			2	48	5	6	15	75	46	42	13	0
			X	9					67	11	22	0
		73. Practical use of technology enabling higher performance and refinement of bio-devices by implementing two- and three-dimensional arrangement of proteins on artificial materials in a sophisticated manner.	1	64	4	7	16	73	33	52	14	2
			2	49	4	8	14	74	31	57	12	0
			X	7					29	57	14	0
		74. Practical use of technology for synthesizing amino acids of 100% natural form.	1	51	4	3	14	79	29	43	25	0
			2	39	4	4	13	79	26	41	31	0
			X	7					57	14	14	0
		75. Development of photocatalysts for synthesizing ethylene glycol (including oxygen containing compounds) and oxygen from carbon dioxide and water.	1	71	4	9	16	71	42	38	18	0
			2	51	4	8	14	73	47	31	20	0
			X	8					50	13	38	0
		76. Development of photocatalysts for synthesizing hydrogen peroxide and hydrogen from water.	1	75	4	11	17	69	43	32	24	0
			2	57	4	9	17	70	42	37	19	0
			X	7					57	29	14	0
		77. Development of catalysts synthesizing linear alcohol chains by l-alkene hydrate.	1	56	4	6	14	77	18	43	36	2
			2	40	3	4	14	79	18	38	40	3
			X	6					67	17	17	0
		78. Development of organic hybrid composite materials of controlled structure at monomolecular layer level.	1	99	7	14	20	59	22	60	17	1
			2	75	6	13	20	61	19	64	17	0
			X	12					33	50	17	0
		79. Development of organic and inorganic composite materials composed with constituents on the order of several ten to several hundred Å.	1	126	8	18	26	48	26	58	15	0
			2	94	6	17	26	51	21	62	16	0
			X	12					50	42	8	0
		80. Practical use of computer-aided material design methods for obtaining solid catalysts with specified composition, organization, and physical properties.	1	90	5	12	20	63	33	56	11	0
			2	67	5	9	20	65	39	49	12	0
			X	10					70	20	10	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	11	44	35	17	32	27	15					82	0	0	16	14	6	6	0
	15	53	29	17	35	29	15	15	51	14	15	94	1	0	18	15	7	3	0
	44	50	6	25	38	25	13	13	56	19	6	94	0	0	13	38	6	6	0
	9	34	50	30	38	20	8					80	0	2	13	16	13	6	2
	8	46	46	31	33	27	6	0	54	35	8	98	0	2	8	10	10	6	0
	44	56	0	11	33	56	0	0	44	33	11	89	0	0	0	22	22	0	0
	8	33	52	17	44	31	3					81	0	3	14	14	11	6	0
	6	45	49	22	47	22	4	6	59	22	10	98	0	2	16	10	8	8	0
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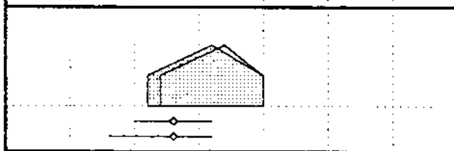	8	35	47	14	29	37	12					78	4	2	35	8	4	6	0
	13	44	44	10	41	41	3	28	49	5	15	95	3	0	33	3	5	8	0
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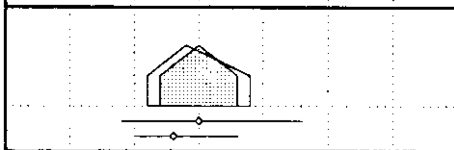	8	45	42	21	37	21	20					79	0	0	24	18	6	10	0
	4	47	47	18	37	22	20	6	69	8	16	92	0	0	24	20	6	2	2
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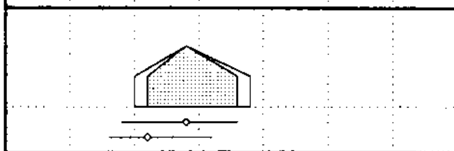	7	40	49	21	31	29	17					76	0	0	21	17	7	7	0
	4	46	51	14	35	33	14	5	67	9	18	91	0	0	21	14	9	4	2
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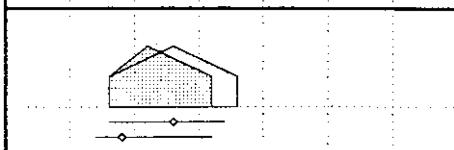	13	38	46	7	23	38	29					77	0	0	27	20	9	4	0
	10	43	45	5	28	38	25	8	63	8	18	90	0	0	15	28	3	0	3
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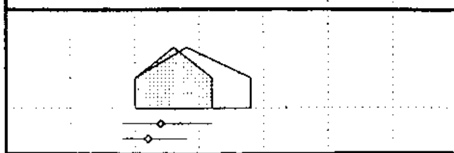	12	46	32	7	38	34	14					79	0	0	19	16	6	12	1
	8	59	31	5	40	32	17	9	63	11	12	89	0	0	19	13	8	11	3
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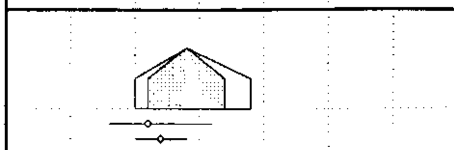	12	45	38	12	38	32	14					83	0	0	14	19	6	10	1
	9	51	39	5	40	34	15	15	56	16	9	88	0	0	19	19	5	9	2
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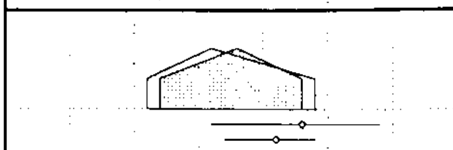
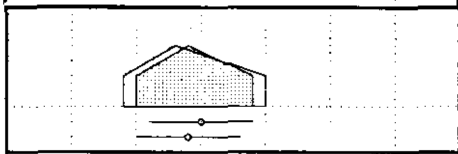
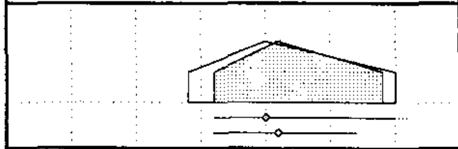
	12	40	47	31	29	27	10					77	1	1	12	20	16	16	4
	9	49	42	28	37	19	12	6	40	42	9	85	0	0	16	21	12	12	4
	10	40	50	50	20	20	0	20	30	50	0	80	0	0	10	20	10	30	20

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Process	Designing and compounding	81. Practical use of computer simulation technology for growing thin films according to the primary principle computation.	1	117	8	17	24	52	28	47	21	3
			2	92	8	15	25	52	29	49	18	2
			X	16					50	44	6	0
		82. Development of computer simulation technology enabling the precise prediction of structures and physical properties in an isothermal equilibrium state, provided element compositions are given in materials made from more than one element.	1	161	11	21	34	34	44	41	12	2
			2	137	11	23	37	29	41	47	11	1
			X	21					71	29	0	0
		83. Development of techniques for synthesizing substances (e.g., high-polymer crystals with super weak bonds) with new functions based on combination of numerous types of bonds at the atomic level.	1	119	7	13	30	50	26	61	13	0
			2	98	8	12	31	49	20	69	8	0
			X	16					56	38	6	0
		84. Practical use of technology inducing, on a priority basis, the chemical reaction needed for synthesis of the target substance with an excitation control on the fs order.	1	89	5	12	21	63	22	54	20	3
			2	74	5	10	23	61	19	62	15	4
			X	10					20	60	20	0
		85. Development of technology for controlling the structures and properties of solid interfaces at atomic level.	1	189	21	27	29	23	50	46	3	1
			2	157	19	27	34	19	52	45	4	0
			X	37					73	27	0	0
		86. Development of technology for manufacturing long fibers of diamond.	1	120	6	15	29	50	20	49	27	2
			2	91	5	16	27	53	14	60	23	0
			X	9					44	44	11	0
		87. Development of technology for bonding metals and ceramics that are capable of surviving thermal fatigue from repetitious exposure to temperature differences of 500°C or above. (Presently 400°C or below)	1	151	10	19	33	38	37	54	8	0
			2	123	9	19	36	37	34	58	7	0
			X	17					59	41	0	0
		88. Mass-production of new materials constructed through employment of ions and particle beams with controlled characteristics.	1	135	10	21	25	44	24	58	16	1
			2	113	10	21	27	41	24	56	19	1
			X	20					45	45	5	5
		89. Development of X-ray free electron lasers with a wave-length of a few dozen Å.	1	92	4	13	22	62	30	53	15	0
			2	77	4	16	20	60	25	65	9	0
			X	7					14	71	0	0
		90. Practical use of equipment employing ultra short pulsed lasers adjustable over the region between ultraviolet and infrared (e.g., on-line measurement devices for super short-time decomposition and material synthesis devices).	1	92	6	12	20	61	18	66	13	1
			2	75	7	12	20	61	19	65	15	0
			X	14					21	71	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	46	31	25	35	21	11					64	1	1	18	30	18	9	1
	18	50	28	22	45	20	11	7	42	36	12	82	1	1	20	28	17	9	1
	50	44	6	25	50	6	19	0	56	38	6	94	0	0	44	25	25	0	0
	16	35	40	35	36	14	9					66	1	1	10	27	19	21	2
	14	40	44	36	43	11	8	7	41	34	16	88	1	1	9	28	18	13	1
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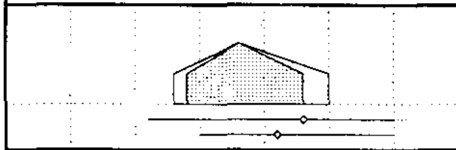
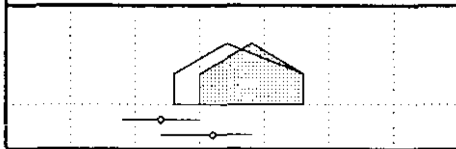
	9	30	53	26	39	18	8					73	1	1	5	23	13	13	2
	8	27	62	28	48	15	6	7	53	12	24	90	0	0	7	28	7	10	0
	38	25	38	38	44	6	13	13	50	25	13	88	0	0	6	31	6	0	0
	6	35	47	24	33	24	8					79	1	0	13	12	7	11	0
	3	34	57	26	35	26	7	7	46	18	24	93	0	0	14	20	4	7	0
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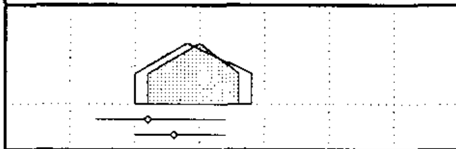	16	48	30	30	37	14	10					79	1	0	9	26	11	14	1
	9	59	31	32	43	12	11	14	56	20	8	93	1	0	9	34	8	9	0
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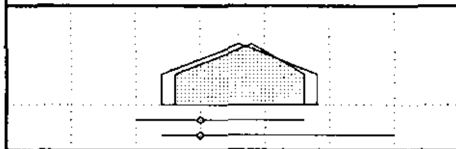	9	33	45	18	23	34	14					76	0	0	13	25	3	12	4
	9	36	51	14	29	38	14	22	46	12	14	91	0	0	10	30	3	12	3
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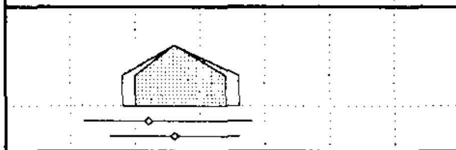	11	58	28	13	35	32	15					81	0	0	21	22	6	9	1
	9	63	25	11	43	32	12	28	49	14	7	90	1	0	22	20	4	4	1
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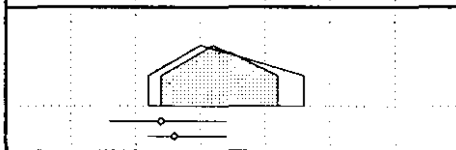	12	49	33	16	31	34	13					69	1	1	39	23	4	7	1
	12	47	37	12	37	34	13	20	50	10	15	83	0	0	49	16	1	6	0
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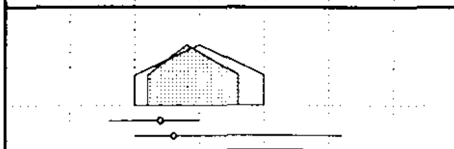	9	50	36	36	33	21	8					77	1	0	13	37	10	8	0
	10	53	36	38	43	12	6	10	47	36	5	94	0	0	17	40	5	6	0
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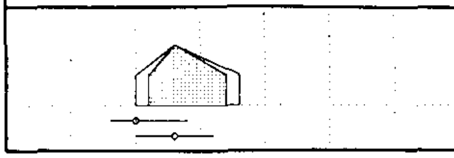
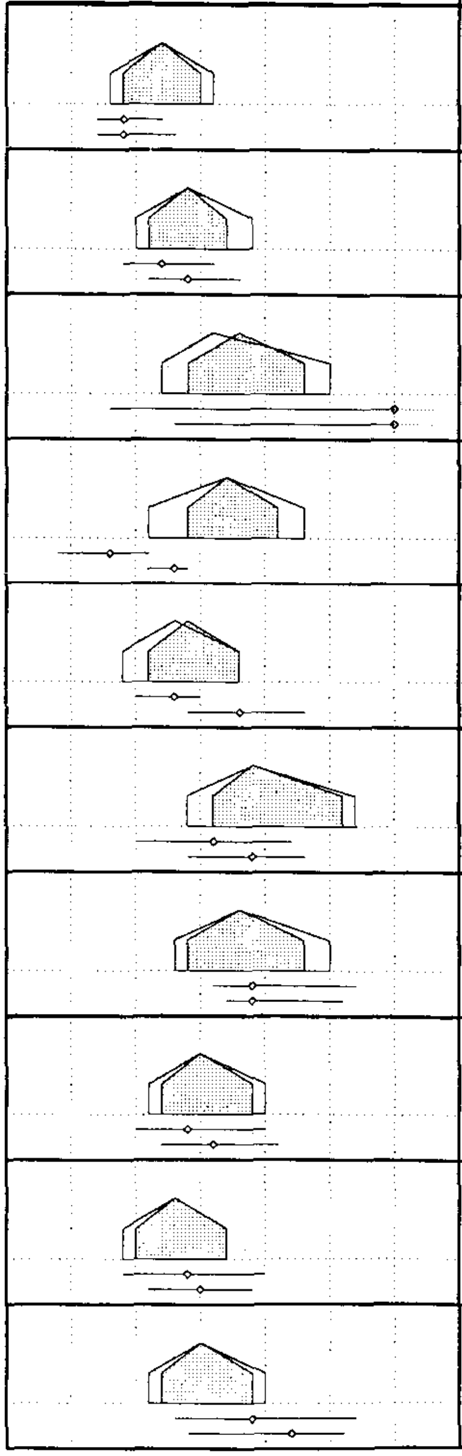
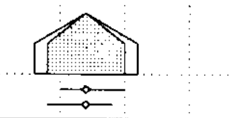
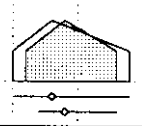
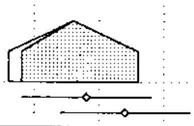
	10	49	34	18	36	34	8					78	0	0	24	21	4	10	0
	9	51	40	13	48	29	8	9	52	27	9	88	0	0	37	20	4	5	0
	36	57	7	29	50	14	0	0	57	36	0	79	0	0	43	21	14	7	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Process	Designing and compounding	91. Perfection of industrial equipment incorporating systems applying high-power excimer lasers (on the order of 10 kW) high-power excimer lasers for industrial use.	1	99	5	12	24	59	29	62	7	0
			2	79	5	13	22	59	24	72	4	0
			X	10					50	50	0	0
		92. Practical use of technology inducing ultra high vacuums (on the order of 10^{-14} Torr).	1	135	10	18	28	44	33	52	14	1
			2	111	10	18	29	43	32	58	11	0
			X	19					47	47	5	0
		93. Development of magnetic freezers capable of operating from room temperature.	1	56	1	8	15	77	13	61	27	0
			2	42	2	7	13	78	14	52	33	0
			X	4					25	75	0	0
		94. Practical use of laser isotope separation for enrichment of uranium.	1	91	3	8	27	62	31	52	14	3
			2	77	3	10	26	60	31	51	16	1
			X	6					83	0	0	0
		95. Development of highly selective oxidation processes using biomimetic catalysts (modelled like enzymes in biochemical reactions).	1	63	4	7	15	74	17	62	19	0
			2	44	3	7	13	77	25	52	23	0
			X	6					67	17	17	0
		96. Practical use of processes for water decomposition by sunlight.	1	117	7	14	28	51	60	31	8	2
			2	92	7	12	29	52	65	28	4	2
			X	13					69	23	8	0
		97. Practical use of carbon dioxide fixation technology necessary for protecting global environments.	1	140	6	17	35	42	66	25	6	2
			2	116	6	14	39	41	78	16	4	2
			X	12					83	8	0	8
	Processing	98. Practical use of a figuring technology for processing of structural ceramics (e.g., alumina, zirconia, silicon nitride, and silicon carbide).	1	149	16	20	26	38	32	56	11	1
			2	123	14	18	32	37	25	59	14	1
			X	27					33	63	4	0
		99. Practical use of processing technology for supersmooth metal mirrors with a surface roughness of nm order (the current limit is the 0.1 μ order).	1	135	8	18	30	44	26	51	21	0
			2	105	7	15	31	46	20	59	19	0
			X	14					50	50	0	0
		100. Development of continuous operation processes for casting and rolling of titanium alloys.	1	98	7	12	22	59	15	57	26	0
			2	84	6	14	24	56	13	60	25	0
			X	11					36	64	0	0



Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	18	41	32	13	36	30	13					75	0	0	28	25	4	5	0
	16	49	33	14	42	32	11	13	48	29	9	89	0	1	43	23	1	4	0
	60	40	0	10	40	50	0	20	30	50	0	80	0	0	70	10	0	0	0
	13	49	32	20	37	25	13					76	0	0	33	27	4	5	1
	13	56	31	17	44	24	14	16	51	16	14	89	0	0	42	23	4	5	1
	42	26	32	11	32	26	32	21	63	5	0	84	0	0	47	21	0	0	0
	2	43	50	13	23	43	14					77	0	2	18	16	4	2	0
	7	33	60	10	31	43	17	19	50	17	12	95	0	0	24	12	2	2	0
	50	50	0	0	50	0	50	25	50	0	0	75	0	0	50	0	0	0	0
	10	46	34	31	36	15	11					66	3	8	26	26	3	14	3
	10	48	40	26	51	12	10	3	35	48	10	81	3	6	36	23	1	8	3
	67	33	0	33	17	33	17	0	33	50	17	67	17	17	17	33	0	17	0
	10	43	37	13	32	30	17					76	0	2	13	27	8	3	2
	5	48	48	11	41	34	14	7	68	7	18	91	0	2	11	23	5	2	2
	33	33	33	0	67	33	0	17	83	0	0	83	0	0	0	33	0	0	0
	15	33	46	31	35	21	9					74	0	1	47	25	3	8	0
	12	37	50	35	41	17	5	8	63	11	14	87	0	0	54	17	3	7	0
	31	54	15	15	69	15	0	8	85	8	0	85	0	0	38	15	15	8	0
	11	37	45	56	24	11	3					70	5	1	34	21	4	14	0
	9	42	47	65	26	4	2	9	57	16	15	82	2	3	53	16	2	6	2
	33	25	33	58	17	17	0	8	67	8	8	67	0	0	42	17	0	8	0
	17	48	28	15	35	30	15					75	0	0	28	19	5	7	2
	11	57	26	14	42	30	11	26	47	10	12	86	0	0	41	14	2	9	1
	26	56	15	26	41	22	7	48	33	4	4	74	0	0	41	11	4	19	4
	15	41	36	9	24	39	17					75	0	0	26	15	5	4	1
	13	47	35	7	29	44	17	30	47	7	13	88	0	0	40	9	4	4	1
	50	36	0	7	43	21	21	36	57	0	0	79	0	0	36	0	0	7	0
	9	50	33	8	30	39	15					76	0	0	36	23	3	6	0
	7	60	31	5	39	38	13	36	32	14	12	85	0	0	50	15	2	7	0
	45	45	9	18	36	18	27	73	18	9	0	73	0	0	45	27	0	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Process	Processing	101. Elucidation of adhesion mechanisms of metal-polymer interface.	1	130	6	19	29	45	26	54	18	1
			2	107	8	20	28	44	22	59	17	0
			X	15					60	33	7	0
		102. Practical use of on-line estimation and control systems of dimensions and shape in machining process with an accuracy on the order of 10Å.	1	101	4	11	28	58	28	58	9	2
			2	84	4	11	28	56	25	62	10	1
			X	8					63	38	0	0
	Evaluation and measurement	103. Practical use of non-destructive testing technology detectable minute cracks of less than 10μm in ceramics.	1	148	11	21	29	39	34	58	6	1
			2	123	8	25	30	37	29	62	7	0
			X	16					69	31	0	0
		104. Establishment of means for estimation of the residual life of metallic materials using perfect compilation of metal corrosion data bases.	1	141	7	22	29	42	36	52	9	1
			2	114	7	22	30	42	34	56	8	0
			X	13					62	31	8	0
		105. Practical use of technology for non-destructive testing of fatigue and estimation of remaining life for metallic materials.	1	147	9	21	30	40	48	46	4	0
			2	117	8	23	30	40	50	45	3	0
			X	15					93	7	0	0
		106. Widespread use of technology for analyzing molecular structures in any dispersed system by utilizing STM or AFM.	1	149	12	23	26	38	33	54	11	1
			2	122	14	22	28	36	27	61	9	1
			X	26					50	46	0	0
		107. Practical use of instrumentation technology capable of determining ppb order gaseous components such as oxygen, carbon, and nitrogen, and analyzing their distribution.	1	117	5	16	28	51	22	58	18	1
			2	100	7	19	27	48	21	60	17	1
			X	13					38	31	23	8
		108. Practical use of supersmall-sized medical accelerators with an energy of 200 MeV and a diameter of less than 5 m.	1	89	3	11	23	63	27	55	17	1
			2	69	2	12	22	64	22	65	12	1
			X	4					75	25	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	12	55	28	12	35	32	16					78	1	1	4	18	14	13	1
	9	65	22	11	38	33	15	13	50	18	16	85	0	0	4	21	14	15	1
	27	60	7	7	47	27	13	27	47	13	7	73	0	0	0	13	27	20	7
	16	44	35	11	27	36	19					75	0	1	22	17	5	5	1
	10	50	36	13	29	42	12	25	46	11	13	90	0	1	36	8	5	5	1
	38	50	0	13	25	50	0	25	50	13	0	88	0	0	50	0	13	0	0
	14	51	28	16	35	27	16					77	0	1	22	21	5	8	1
	12	58	26	10	41	33	13	21	52	8	15	89	0	0	27	15	3	9	2
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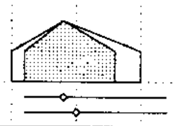	15	50	28	35	28	21	10					55	8	4	17	27	12	24	1
	11	60	26	39	33	19	4	15	50	22	10	66	9	3	18	29	10	26	1
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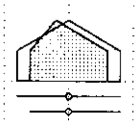
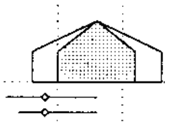
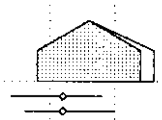
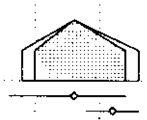
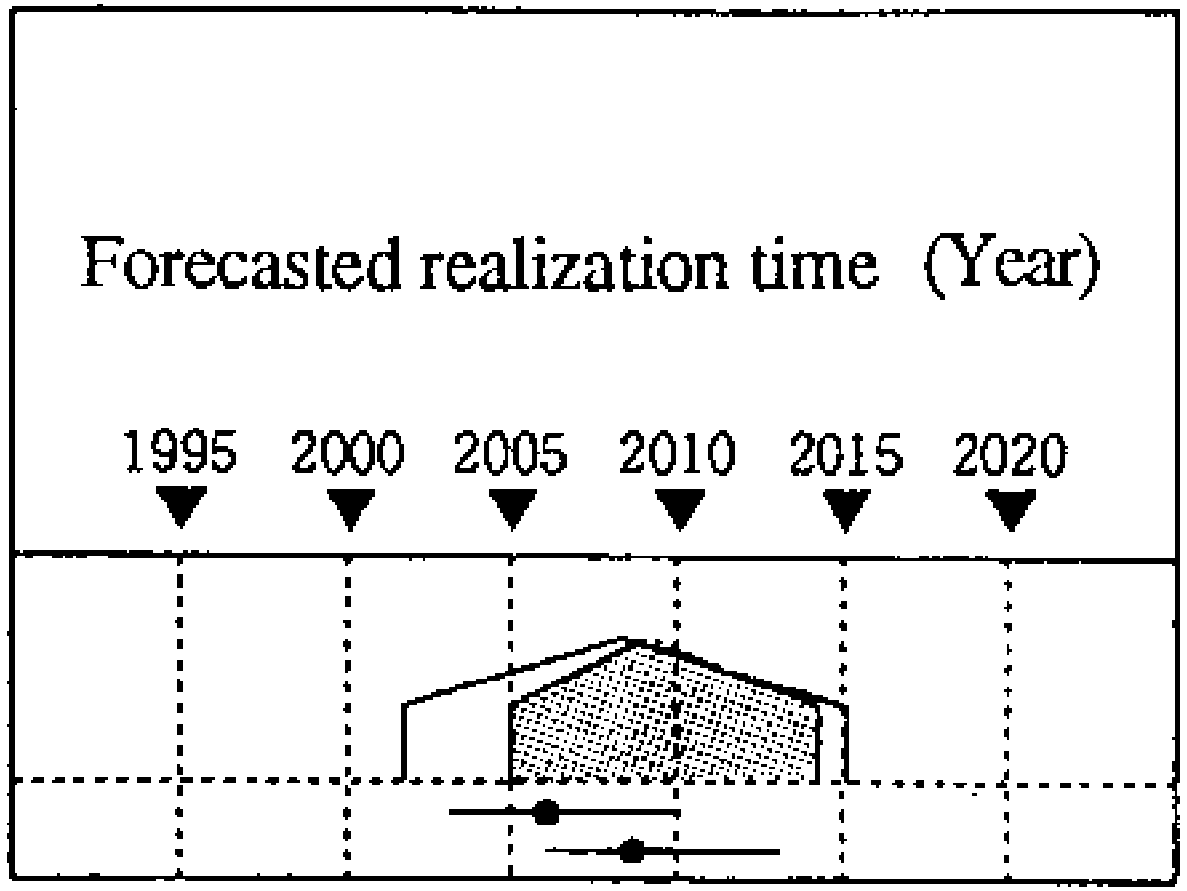
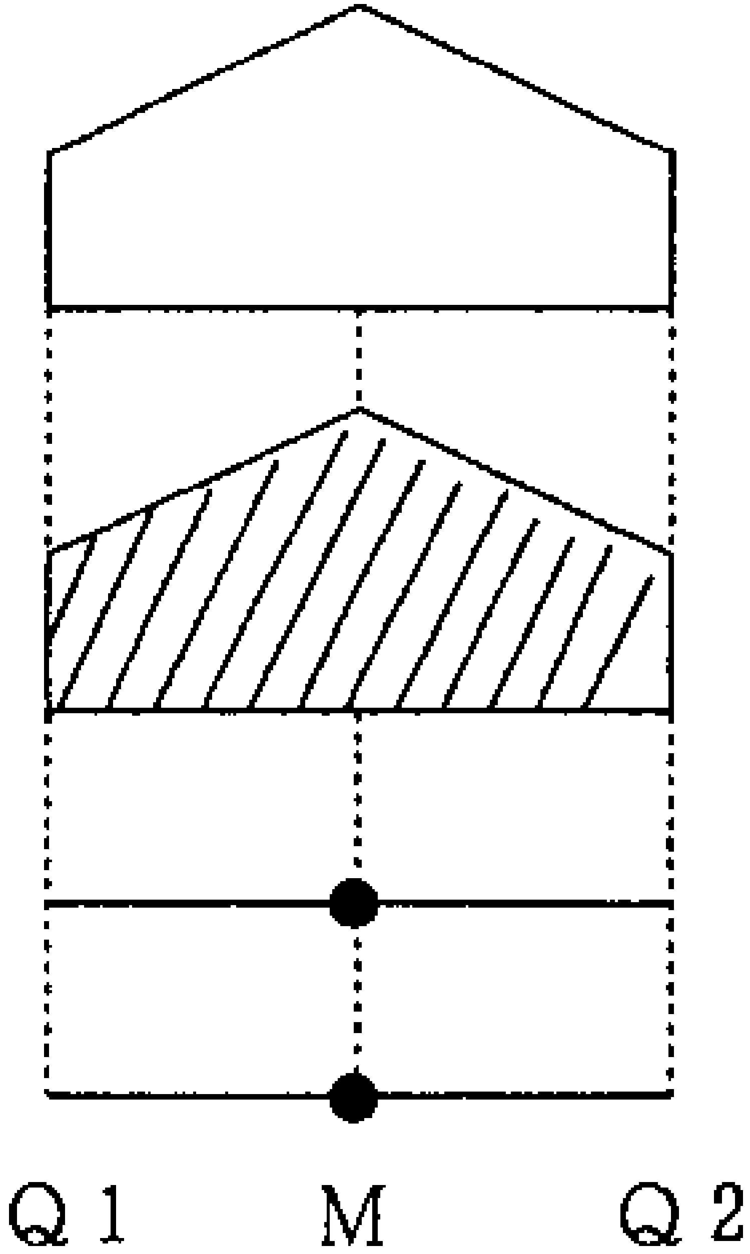
	11	53	30	27	32	27	8					73	4	1	10	25	13	17	1
	9	62	26	29	38	25	4	15	55	15	11	79	3	1	11	32	9	20	0
	20	73	0	60	20	13	0	27	47	7	13	67	7	0	7	20	20	27	0
	20	46	24	20	36	24	11					72	0	0	22	23	7	9	1
	15	52	30	17	50	20	9	11	48	29	9	89	0	0	22	22	5	5	0
	46	38	8	27	42	12	12	12	58	23	0	85	0	0	12	19	12	4	0
	14	51	31	15	32	33	15					78	2	0	25	21	7	7	0
	7	68	22	14	41	28	14	17	52	12	16	90	0	0	30	21	1	2	0
	23	62	0	15	23	31	15	23	54	8	0	85	0	0	15	15	8	8	0
	9	53	36	15	37	30	16					65	3	1	42	27	6	6	0
	7	62	28	13	45	28	12	19	45	20	10	78	6	0	55	17	0	4	0
	25	50	0	25	25	0	25	25	25	0	25	75	0	0	25	0	0	25	0

<Key to the forecasted realization times>





: Distribution of respondents to the first round of the questionnaire

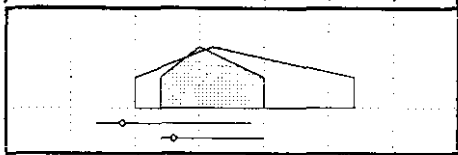
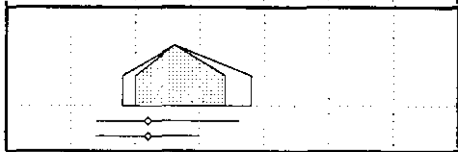
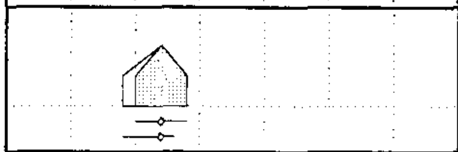
: Distribution of respondents to the second round of the questionnaire

: Distribution of the persons who rated the level of specialty as high in the first round of the questionnaire

: Distribution of the persons who rated the level of specialty as high in the second round of the questionnaire

4.2 Information and electronics

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Microelectronics	1. Development of high-sensitivity detectors capable of detecting and tracking single atoms or molecules of hydrogen and other elements within substances.	1	69	3	13	22	62	30	55	13	1
		2	58	3	13	25	59	28	57	16	0
		X	4					75	25	0	0
	2. Practical use of technology easily enabling processing of patterns with line-spacing down to 10 nm.	1	121	19	22	25	34	83	17	0	1
		2	102	20	27	24	29	90	9	0	1
		X	29					93	7	0	0
	3. Practical use of VLSI with memory capacities on the order of 1 Gb/chip.	1	148	20	24	38	18	87	11	2	0
		2	128	19	30	38	13	90	9	1	0
		X	28					100	0	0	0
	4. Practical use of non-volatile, erasable 100 Gb random access semiconductor memories measuring a few centimeters square.	1	123	17	23	29	32	67	28	3	2
		2	104	15	29	29	27	69	28	2	1
		X	21					81	19	0	0
	5. Widespread use of multilayer VLSI devices with at least 10 layers of devices.	1	118	12	27	27	35	36	47	13	4
		2	101	13	30	28	30	37	47	13	4
		X	18					33	39	17	11
	6. Practical use of extremely small devices advancing under their own power within blood vessels.	1	106	4	15	40	41	50	43	7	0
		2	92	5	14	46	34	54	42	3	0
		X	7					71	29	0	0
	7. Practical use of integrated logic circuit devices with a switching speed of 1 ps or less.	1	119	17	20	29	34	58	37	4	1
		2	96	15	25	28	32	61	35	3	0
		X	21					67	29	5	0
	8. Practical use of wide-band solid-state amplifiers capable of boosting high frequency of at least 1,000 GHz.	1	103	12	22	24	43	33	49	17	2
		2	86	11	22	28	39	34	52	12	2
		X	16					38	38	25	0
	9. Development of large scale-integrated memory silicon devices with an access time of 1 ns.	1	116	16	17	32	35	70	24	4	1
		2	96	15	22	31	32	79	18	3	0
		X	21					95	5	0	0
	10. Widespread use of logic memory devices employing super lattices structures.	1	96	12	17	24	47	22	44	31	2
		2	79	13	19	24	44	23	44	29	3
		X	18					33	33	28	6

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	23	36	36	12	41	29	12					75	0	0	16	25	10	20	4
	16	43	41	14	47	33	5	3	45	22	24	91	0	0	10	28	10	16	2
	50	50	0	25	50	25	0	0	50	25	25	75	0	0	0	25	75	25	0
	22	47	26	12	37	26	20					79	0	0	36	22	9	9	2
	21	61	18	13	41	30	14	57	30	4	4	88	1	0	41	25	7	6	1
	38	59	3	17	48	21	14	59	28	7	3	90	0	0	52	31	3	7	0
	39	37	22	9	25	32	33					78	1	0	45	29	5	6	3
	36	49	14	6	31	38	23	75	12	4	5	84	1	2	57	25	2	5	1
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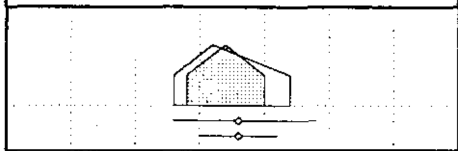	12	41	39	11	41	20	23					86	0	0	40	25	4	7	2
	7	54	38	9	41	29	17	53	30	4	9	88	0	1	45	30	4	1	1
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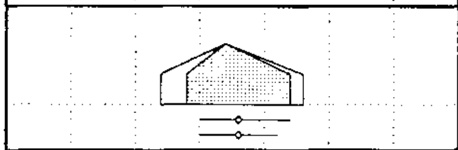
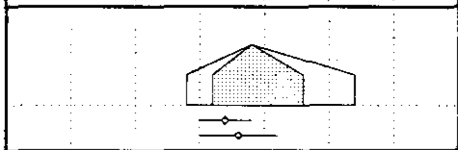
	10	36	44	14	31	26	22					84	0	0	43	19	5	6	2
	5	44	46	15	38	24	19	44	42	1	6	92	0	0	52	19	2	2	1
	17	39	39	22	28	22	22	61	28	0	6	89	0	0	72	22	0	6	0
	7	41	48	41	33	17	6					86	3	11	15	21	13	15	2
	5	48	47	46	39	11	3	8	45	25	20	93	0	10	21	22	12	14	0
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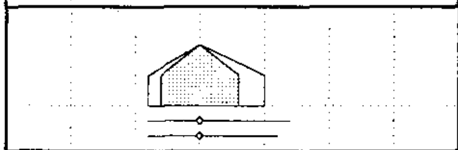	20	44	30	16	37	21	22					82	2	1	27	24	10	9	1
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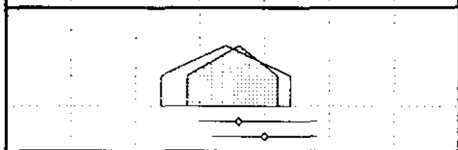	10	43	44	14	40	22	18					85	0	1	22	20	13	6	3
	8	50	40	13	48	22	13	16	45	14	17	93	0	1	23	23	9	3	2
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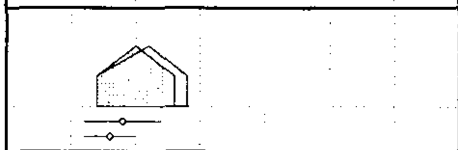	32	41	24	9	25	30	33					78	0	0	28	31	7	5	1
	33	42	24	8	27	33	28	47	38	6	4	88	0	0	27	34	4	1	1
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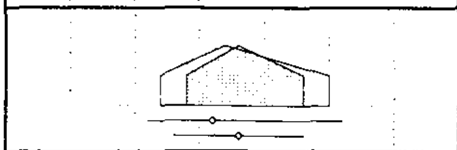
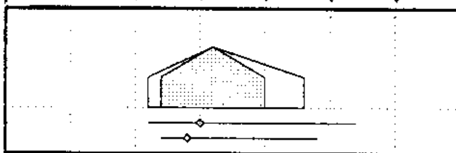
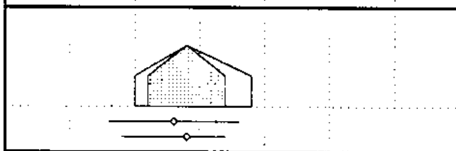
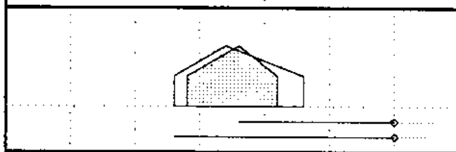
	10	38	44	16	38	20	19					75	1	0	36	24	7	5	3
	10	42	46	19	47	15	16	18	57	8	11	91	0	1	43	25	5	1	1
	33	56	6	22	44	11	17	17	61	11	6	89	0	0	50	28	0	6	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Microelectronics	11. Practical use of superconductive devices with three terminals.	1	82	9	14	23	54	23	54	22	0
		2	70	6	22	22	50	24	57	17	1
		X	9					33	44	22	0
	12. Practical use of VLSIs operating at a low energy on the order of 1 pJ per gate at liquid nitreogen temperature.	1	83	13	17	16	53	29	46	20	4
		2	58	13	20	17	51	28	51	18	3
		X	18					33	56	6	6
	13. Widespread use of X-ray microscope like present use of electron microscopes.	1	86	1	18	29	51	10	65	22	1
		2	74	1	20	32	47	12	66	20	1
		X	2					0	50	0	50
	14. Development of integrated circuits achieving advanced functions through self-organization adapted to the given tasks.	1	121	13	24	30	32	45	46	7	2
		2	100	10	27	33	30	50	39	10	1
		X	14					50	43	7	0
	15. Practical use of heat-resistant logic ICs capable of application in high-temperature environments up to 500 °C.	1	90	7	21	23	49	17	51	29	3
		2	76	4	27	23	46	16	55	26	3
		X	6					50	17	33	0
	16. Practical use of radiation-resistant ICs capable of application for control of nuclear reactors, where radiation level is on the order of 10^7 rads in case of emergency (the level in space is 10^6 rads.)	1	78	8	16	20	56	15	55	26	4
		2	63	6	19	20	55	21	52	25	2
		X	8					38	63	0	0
	17. Widespread use of multiprocessor systems equipped with advanced self-recovering capabilities.	1	127	13	28	30	29	46	46	6	2
		2	108	12	27	37	24	46	47	6	0
		X	17					59	29	12	0
	18. Practical use of voice recognizing one-chip integrated circuits incorporating a learning function capable of identifying different speakers.	1	139	15	30	32	22	41	47	11	1
		2	121	13	34	37	16	36	50	14	0
		X	19					47	32	21	0
	19. Widespread use of solar cells with at least 30% efficiency.	1	106	11	19	29	41	64	34	2	0
		2	89	11	22	30	37	66	31	2	0
		X	15					73	27	0	0
	20. Development of technology capable of continuous LSI production on semiconductor substrates in a sheet form.	1	88	11	20	19	50	27	47	19	7
		2	77	11	23	21	45	29	49	16	6
		X	16					38	44	13	6

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	12	44	39	33	34	20	9					83	0	1	30	26	11	5	2
	10	51	39	36	36	21	6	19	54	13	10	94	0	1	33	29	7	1	1
	44	11	44	44	44	11	0	22	56	22	0	89	0	0	33	22	11	0	0
	16	43	33	11	42	18	22					67	2	1	45	19	7	4	5
	15	49	34	16	43	18	19	29	49	7	7	74	1	1	51	24	4	0	3
	44	33	17	11	50	11	22	56	22	17	0	50	0	0	67	22	11	0	11
	5	37	50	19	47	15	14					70	3	2	42	28	9	9	3
	5	39	51	16	51	19	11	9	46	19	22	76	1	1	49	32	4	4	4
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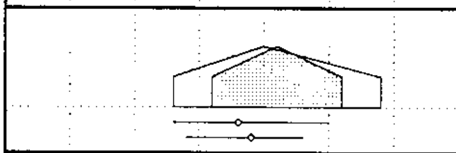	15	36	43	36	37	11	12					81	3	4	17	18	16	12	2
	14	37	48	43	37	9	9	6	48	22	19	89	1	4	23	23	18	9	0
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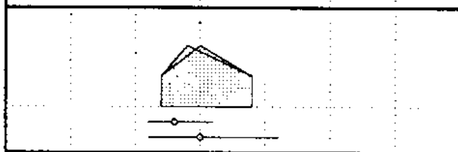	13	41	40	21	41	21	13					76	1	1	29	22	7	13	4
	11	47	39	25	39	25	8	16	43	20	16	88	1	0	38	20	1	5	1
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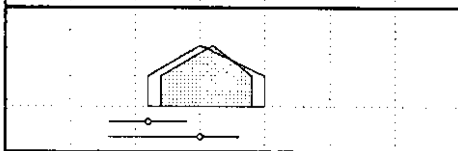	10	41	42	32	38	14	10					71	10	4	33	19	6	15	3
	3	51	46	41	35	14	10	6	29	48	14	83	8	3	40	17	3	10	2
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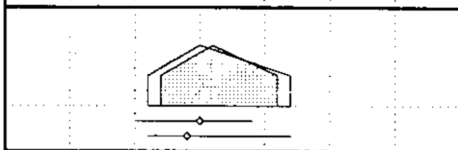	13	46	37	27	36	21	13					75	2	2	27	21	13	13	1
	10	50	39	30	42	17	11	3	38	41	15	85	0	1	39	17	11	7	1
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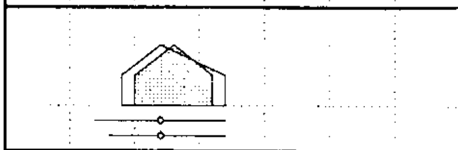	22	53	24	9	29	32	28					80	4	4	35	14	9	4	1
	16	58	25	5	38	35	21	26	55	7	10	90	1	4	48	12	5	2	1
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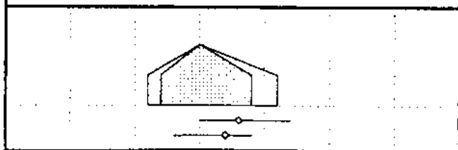	11	53	35	20	43	25	10					72	5	3	63	17	6	5	0
	9	62	29	18	46	27	8	42	43	3	9	82	2	2	74	11	1	1	0
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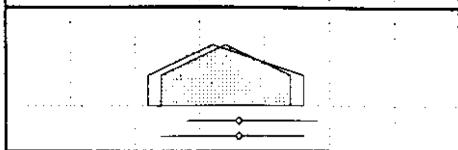
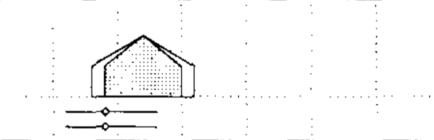
	15	35	39	6	38	28	19					74	0	0	39	22	1	6	3
	12	49	36	5	36	36	17	44	30	4	17	86	0	0	47	21	3	1	1
	19	56	25	6	25	44	25	44	25	6	25	94	0	0	50	13	6	6	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Micro-electronics	21. Practical use of CAD technology capable of IC design using high-level system specification language.	1	132	18	25	31	26	60	38	2	0
		2	111	15	25	38	22	68	30	2	1
		X	22					82	18	0	0
Optoelectronics	22. Development of digital optical logic circuits carring out binary operation using phase information of light.	1	108	10	25	25	39	20	53	25	2
		2	86	10	25	28	38	17	52	30	0
		X	14					29	14	57	0
	23. Development of technology for controlling the quantum state of light, achieving, for example, light detection sensitivity that exceeds the shot noise limit.	1	85	11	16	21	52	21	58	18	4
		2	72	13	15	24	48	26	49	24	0
		X	18					50	39	6	0
	24. Practical use of optical ICs integrating numerous optical devices with wave guide connections on a semi-conductor substrate.	1	112	17	22	24	37	46	42	13	0
		2	93	17	26	24	33	52	39	9	1
		X	23					70	22	9	0
	25. Practical use of three-dimensional optical electronic ICs for image processing with a resolution of 500 x 500 pixels.	1	114	17	19	28	36	38	50	11	1
		2	95	17	24	27	32	35	58	7	0
		X	24					58	33	8	0
	26. Widespread use of color video display panels with a resolution of at least 2,000 x 2,000 pixels.	1	123	16	21	33	31	57	35	8	0
		2	99	19	23	30	28	65	31	4	0
		X	26					85	15	0	0
	27. Development of optical memories with a recording density of 10^{11}b/cm^2 through photochemical hole-burning.	1	80	8	15	21	55	20	58	21	0
		2	67	9	17	23	52	24	61	15	0
		X	12					42	33	25	0
	28. Practical use of all-optic, integrated logic devices with a switching period of 1 ps or below.	1	110	12	23	27	38	28	56	13	3
		2	89	11	26	27	36	26	58	15	1
		X	15					47	47	7	0
	29. Practical use of information processing systems with optical interchip connections.	1	133	16	26	33	25	44	46	10	0
		2	106	17	28	32	24	49	45	6	0
		X	23					74	26	0	0
	30. Development of light frequency division multiplex communication equipment capable of multiplexing 100 channels of signals of 10 Gb/sec. and transmitting them via one optical fiber.	1	108	15	19	27	39	59	37	4	0
		2	86	17	18	27	38	63	36	1	0
		X	23					78	22	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	28	43	27	26	39	16	17					72	2	3	25	20	23	11	0
	23	51	24	22	50	15	11	5	33	51	6	84	1	2	28	16	24	8	0
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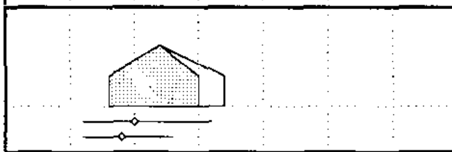
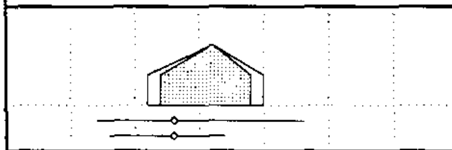
	19	43	35	12	43	23	19					84	1	1	14	21	14	6	5
	13	55	31	14	51	20	14	8	59	21	9	92	0	0	17	23	17	5	0
	50	43	7	0	43	21	36	7	64	7	7	93	0	0	21	14	14	7	0
	18	39	41	27	38	14	18					78	1	1	11	24	16	7	2
	19	39	40	18	44	18	18	13	51	26	7	86	0	0	15	29	21	1	1
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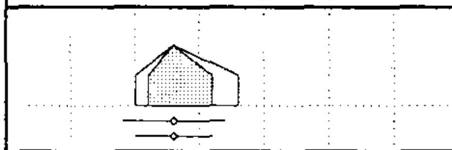	26	46	28	11	37	28	23					86	2	2	41	23	6	5	2
	26	49	25	11	46	26	17	30	49	9	9	94	1	0	49	16	4	1	0
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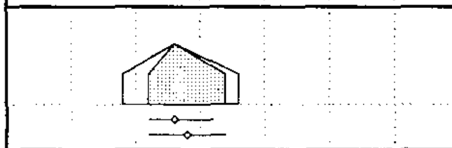	18	47	33	9	31	39	19					81	1	0	43	22	6	8	0
	17	59	24	5	46	32	16	46	39	6	5	89	0	0	56	16	2	1	0
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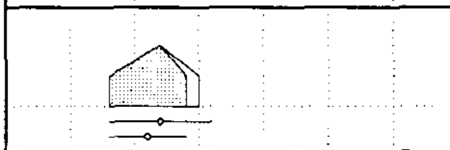	31	46	23	7	20	36	33					72	2	2	64	20	4	4	1
	29	52	19	6	27	36	28	72	12	9	5	89	2	2	71	18	1	0	1
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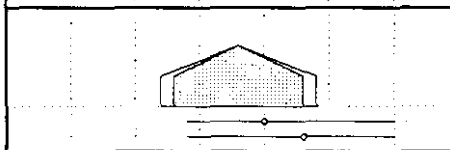	9	41	44	28	34	19	15					91	0	0	23	19	11	6	1
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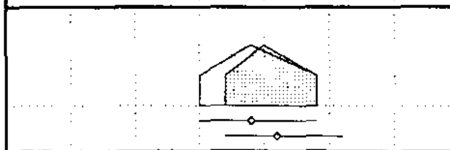	6	44	44	27	34	23	13					87	2	1	20	24	9	7	4
	7	43	48	27	43	18	11	13	65	10	8	93	0	1	29	26	3	4	0
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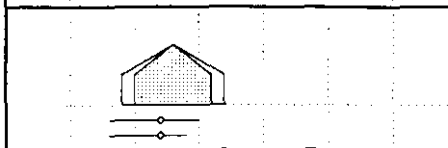
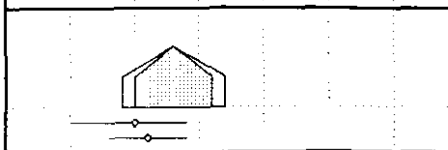
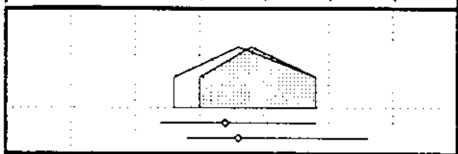
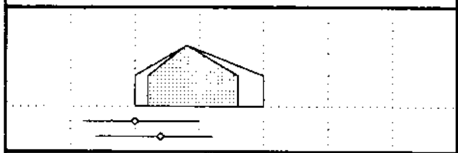
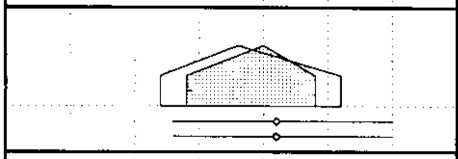
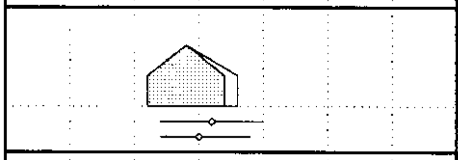
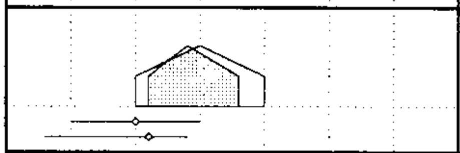
	20	44	35	17	37	25	20					83	2	2	43	20	5	5	1
	19	49	32	14	45	25	16	15	60	11	10	92	1	1	51	14	3	2	0
	52	43	4	9	48	17	26	17	39	22	13	96	0	0	52	22	0	0	0
	23	41	32	16	28	33	20					76	5	2	34	21	8	8	2
	22	45	33	13	44	28	14	40	40	12	7	90	3	1	44	19	5	1	1
	48	43	9	4	30	30	35	74	4	9	4	87	4	4	48	22	0	4	4

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Optoelectronics	31. Practical use of optical neuro computers.	1	136	16	22	38	24	30	43	25	1
		2	111	16	23	38	22	26	46	26	2
		X	23					48	26	22	4
	32. Practical use of high-output semiconductor lasers that can be used also for conventional laser beam machining.	1	102	14	16	27	42	28	51	20	1
		2	86	15	19	27	38	27	56	17	0
		X	21					48	38	14	0
	33. Practical use of luminescent single device capable of emitting any wave-length controlled by means of electrical signals.	1	99	13	15	29	44	42	40	16	0
		2	82	16	14	30	41	44	49	7	0
		X	22					59	36	5	0
	34. Widespread use of semiconductor lasers by means of quantum fine lines or quantum boxes.	1	81	15	14	17	54	26	59	14	1
		2	69	18	15	17	50	23	61	16	0
		X	25					32	60	8	0
	35. Development of soft X-ray lasers oscillating at wavelengths in the order of 10/Å.	1	69	5	13	22	61	28	58	13	0
		2	58	6	14	23	58	22	62	14	0
		X	8					63	25	13	0
	36. Practical use of repeater-free optical communications systems over very long distances (e.g., trans-Pacific).	1	105	10	21	29	41	49	42	8	2
		2	87	12	21	30	37	54	40	3	2
		X	16					56	44	0	0
	37. Widespread use of automobile navigation equipment employing optical fiber gyros.	1	103	9	22	27	42	18	50	29	2
		2	89	10	21	32	36	18	57	21	3
		X	14					21	57	14	7
	38. Development of optical exchangers capable of switching 10,000 video terminals.	1	87	10	19	20	51	46	44	8	2
		2	76	12	19	25	45	41	47	9	3
		X	16					81	19	0	0
	39. Widespread use of optical communication among satellites.	1	98	7	16	32	44	18	51	28	3
		2	84	9	16	35	40	13	57	26	4
		X	13					54	46	0	0
Bio-electronics	40. Development of technology enabling molecular-level write and read memory of great quantities of information (capacity of at least 10^{12}b/cm^2).	1	70	4	9	26	61	47	34	17	0
		2	63	6	11	29	54	52	33	14	0
		X	8					88	13	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	13	35	44	28	35	21	12					83	3	3	26	24	11	8	1
	14	36	46	24	47	16	8	9	56	17	14	91	0	2	31	29	7	6	0
	43	39	17	30	30	13	22	9	52	17	13	91	0	4	43	26	13	9	0
	25	38	31	9	25	40	25					78	2	1	38	25	6	4	0
	21	44	35	3	35	36	24	30	41	14	10	81	1	0	48	21	2	3	0
	52	38	10	10	33	19	38	38	29	19	5	71	5	0	43	33	5	0	0
	5	39	47	21	30	28	16					89	0	0	16	24	6	4	0
	9	41	48	20	33	27	18	20	45	13	17	95	0	0	21	26	2	2	0
	32	41	27	32	18	23	27	27	41	9	14	100	0	0	27	32	5	0	0
	11	54	33	11	43	26	20					81	0	1	30	25	10	4	1
	14	51	35	10	43	26	19	30	46	9	9	87	0	0	36	26	4	0	0
	32	48	20	16	28	20	36	32	44	12	4	84	0	0	40	28	4	0	0
	12	46	38	25	46	14	10					78	0	0	13	38	13	9	0
	14	50	33	26	45	14	9	7	41	29	12	81	0	0	12	41	9	7	0
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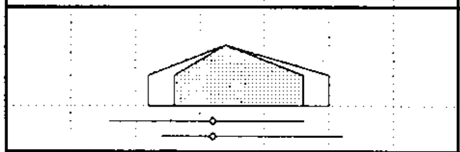
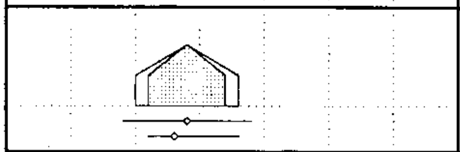
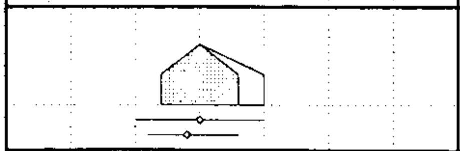
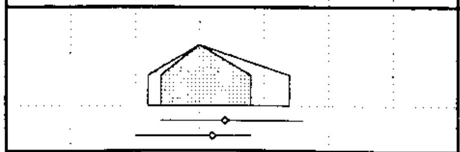
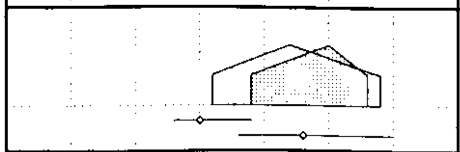
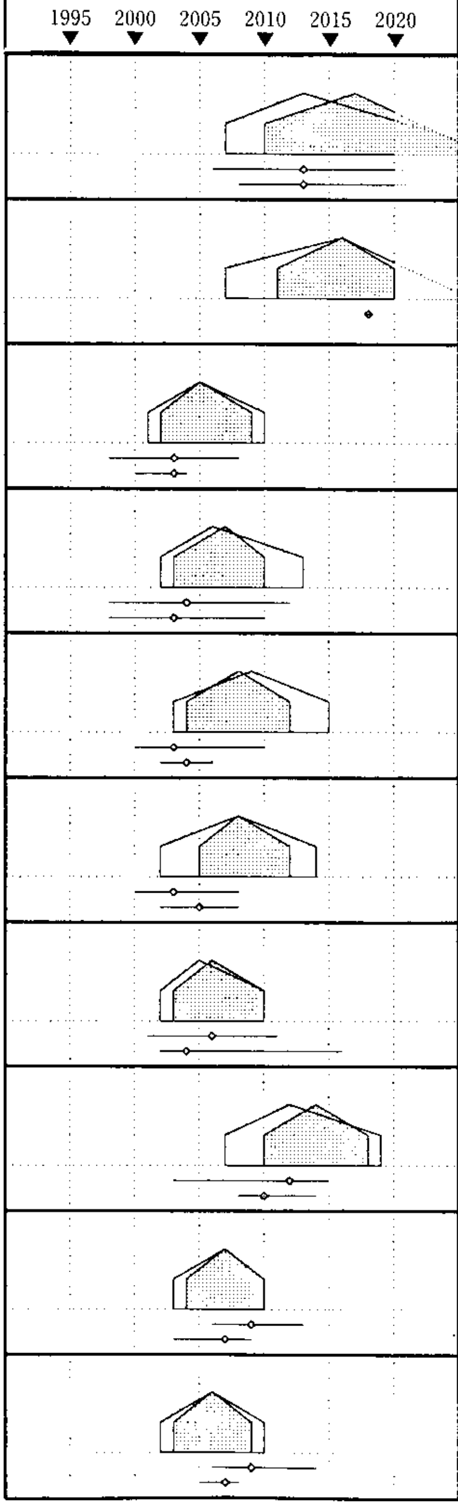
	16	39	39	41	22	21	11					72	6	1	31	26	0	8	0
	15	38	46	41	32	17	7	29	45	10	8	87	2	0	40	26	1	1	0
	44	38	19	44	31	6	19	31	44	6	6	94	0	0	50	31	0	6	0
	18	47	33	5	30	33	30					58	7	9	67	15	2	2	2
	17	55	28	1	30	36	31	26	48	10	11	62	7	6	74	13	0	0	3
	36	50	14	0	29	29	43	21	43	7	14	57	14	0	86	14	0	0	0
	16	43	38	8	41	26	22					80	3	0	45	20	3	3	1
	13	50	34	5	49	24	18	30	46	11	7	91	1	0	50	12	1	3	0
	25	56	19	6	25	25	44	25	44	6	13	88	0	0	50	25	0	6	0
	11	40	43	46	33	8	5					62	7	1	35	27	3	14	4
	11	43	44	42	42	7	4	2	43	36	12	79	2	1	50	17	2	12	1
	38	38	23	46	38	8	8	8	54	8	15	92	8	0	46	15	0	8	0
	9	36	51	51	29	16	0					83	3	1	13	24	23	9	0
	8	32	60	51	33	13	2	3	41	27	25	94	0	2	17	22	16	8	0
	25	25	50	75	13	13	0	0	63	0	25	100	0	0	13	25	25	0	0

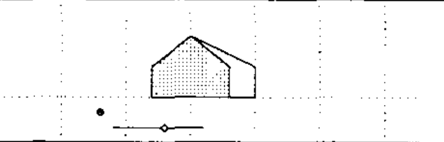
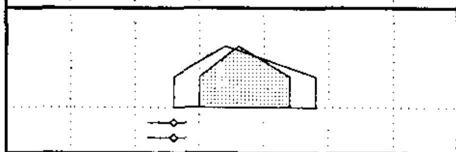
Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Bioelectronics	41. Development of artificial brains with cells in the order of 10^4, based on elucidation of the inter-connection of the cerebral nerve system.	1	83	6	11	30	54	49	33	10	4
		2	67	4	11	32	52	48	37	10	3
		X	6					50	50	0	0
	42. Development of stimulous-response learning methods for converting pains to other sensations to be applied in medical treatment of neuralgia and other diseases.	1	33	1	4	14	81	27	45	18	3
		2	32	0	4	20	77	16	63	19	0
		X	0					0	0	0	0
	43. Widespread use of super small sensors by the use of biochemical reactions.	1	81	3	12	31	54	32	58	9	0
		2	68	4	11	35	51	29	66	4	0
		X	5					0	100	0	0
	44. Practical use of tactile sensors with a sensitivity and density comparable with human tactile sensation.	1	80	6	9	30	55	34	49	14	3
		2	72	6	11	35	49	33	53	13	1
		X	8					50	38	13	0
	45. Practical use of flavor sensors with a sensitivity comparable with human sense of taste.	1	80	4	9	31	56	19	50	26	4
		2	69	5	9	35	51	19	57	23	1
		X	7					29	71	0	0
	46. Practical use of odor sensors with a sensitivity comparable with human sense of smell.	1	79	4	9	30	56	18	54	23	4
		2	68	6	9	34	51	15	63	21	1
		X	8					25	75	0	0
	47. Development of sophisticated odor sensors with a sensitivity comparable with or greater than canine sense of smell for specified odors.	1	75	6	7	29	58	19	53	27	0
		2	68	5	9	35	51	13	72	15	0
		X	7					14	86	0	0
	48. Development of biosensors with auto-reproductive capability.	1	59	5	9	20	66	22	63	14	0
		2	52	4	8	25	62	13	71	15	0
		X	6					33	67	0	0
	49. Development of biosensors continuously usable for at least 3 years.	1	62	4	9	22	65	24	56	16	2
		2	55	4	8	28	60	20	64	16	0
		X	6					50	33	17	0
	50. Practical use of implanting device for carring out diagnoses, medical treatments, and health management.	1	77	3	9	31	57	51	39	5	0
		2	59	3	10	29	58	53	42	3	0
		X	4					75	25	0	0

Forecasted realization time (Year)



Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
7	25	54	54	27	6	4					73	6	11	6	16	19	19	2
7	31	52	61	22	6	4	1	34	37	18	84	4	9	4	15	19	19	1
33	50	17	67	33	0	0	0	67	33	0	100	0	0	17	17	0	50	0
6	12	67	48	18	15	6					67	3	27	6	12	18	15	0
3	16	75	56	22	16	0	0	22	41	31	88	3	19	6	9	16	16	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	38	42	22	41	23	10					80	2	4	33	11	14	7	0
10	44	43	31	47	16	6	10	47	19	19	91	1	3	35	9	15	7	0
40	60	0	0	80	20	0	20	60	20	0	100	0	0	20	0	40	0	0
9	39	46	15	40	25	10					81	1	1	28	10	19	8	0
11	44	44	19	51	21	7	10	53	14	19	99	0	0	38	4	13	6	0
50	25	25	0	50	50	0	25	75	0	0	88	0	0	63	0	38	0	0
11	34	45	24	34	19	11					80	1	4	23	18	13	10	0
10	39	48	25	46	17	9	12	46	7	30	93	0	3	25	13	13	10	0
43	43	14	14	71	14	0	57	43	0	0	100	0	0	29	29	14	0	0
11	37	42	19	38	22	10					78	0	5	20	16	15	9	0
10	40	49	26	49	16	6	9	46	15	26	93	0	3	26	12	12	9	0
38	50	13	13	88	0	0	38	50	13	0	100	0	0	25	25	13	0	0
13	31	51	20	41	24	7					84	0	5	13	21	20	7	0
6	37	54	18	54	22	3	3	51	12	28	96	0	3	15	19	19	6	1
29	29	43	0	86	14	0	14	86	0	0	100	0	0	0	43	29	0	14
8	34	53	36	39	19	3					90	2	3	10	15	20	10	0
2	35	60	29	46	21	0	2	38	27	25	98	0	0	8	15	19	6	0
17	50	33	0	67	33	0	0	67	33	0	100	0	0	0	50	33	0	0
10	31	52	26	44	19	3					87	2	2	18	18	13	6	0
5	33	58	24	45	24	4	7	44	16	22	98	0	0	18	15	11	5	0
0	67	33	0	83	17	0	33	50	17	0	100	0	0	17	33	17	0	0
6	45	40	35	39	10	4					70	13	14	26	9	13	14	3
7	51	39	29	51	12	5	0	44	31	20	86	12	19	29	7	12	10	0
25	50	25	50	25	0	25	0	75	25	0	75	0	50	0	0	25	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Bioelectronics	51. Development of computer tomographic devices capable of picking up excited cerebroneural states in real time with a resolution on the 1 mm order.	1	58	1	12	20	67	47	48	3	0
		2	48	2	12	21	65	54	46	0	0
		X	3					100	0	0	0
	52. Development of sensors that could be substituted for human sensation, capable of directly stimulating nerves.	1	50	1	7	20	72	28	44	20	6
		2	43	1	7	23	68	26	53	19	2
		X	2					0	100	0	0
Information system equipment	53. Development of three-dimensional television that can be viewed without special glasses.	1	136	6	24	46	24	27	41	29	2
		2	107	9	21	46	24	28	44	26	2
		X	13					62	31	8	0
	54. Development of new modes of communication applying radio waves or media (neutrino, etc.) other than electromagnetic waves, or electromagnetic waves outside the range of radio wave, infrared rays and visible rays.	1	81	3	13	30	54	21	33	33	10
		2	66	4	13	32	51	17	30	44	9
		X	6					0	17	50	33
	55. Practical use of personal computers capable of calculation with a clock cycle of 10 ps or less.	1	127	13	25	33	29	39	46	11	3
		2	109	14	24	41	22	31	55	11	2
		X	19					53	26	16	5
	56. Practical use of computers with a computing speed exceeding 10 TFlops.	1	124	14	24	33	30	56	35	7	0
		2	102	13	24	36	27	62	32	6	0
		X	18					83	17	0	0
	57. Practical use of a parallel-processing general-purpose computer composed of one million processors.	1	129	15	26	31	28	45	46	8	1
		2	104	15	24	36	25	47	45	7	1
		X	21					62	29	10	0
	58. Development of super parallel-processing computers composed of 1,000 million processors.	1	128	15	26	31	28	34	46	17	2
		2	103	17	22	36	26	33	53	11	3
		X	23					39	39	17	4
	59. Widespread use of large (screen size in the order of 100 inches) color panel displays with a contrast ratio of at least 1:10.	1	109	9	21	31	39	38	48	12	1
		2	91	9	22	35	34	31	58	10	1
		X	13					46	46	0	8
	60. Development of a storage cell with completely polymerized electrodes and electrolyte.	1	51	1	7	20	71	20	59	18	0
		2	42	1	9	20	69	24	67	10	0
		X	2					100	0	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	3	34	57	43	36	9	9					83	3	5	9	34	9	9	0
	6	44	48	42	40	15	2	13	48	19	17	92	2	4	8	40	6	8	0
	33	67	0	0	33	33	33	33	33	33	0	100	0	0	0	33	33	0	0
	0	34	50	32	34	12	10					78	0	12	6	18	12	6	0
	0	40	53	42	37	12	2	2	42	28	21	88	5	12	7	26	12	5	0
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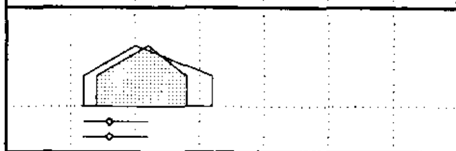
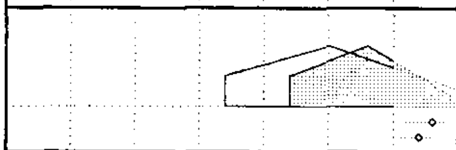
	19	43	35	13	24	30	30					71	2	7	32	21	4	1	4
	23	46	30	7	30	36	27	31	42	6	18	82	0	2	43	20	4	3	3
	77	23	0	15	23	38	23	23	62	8	8	85	0	0	46	38	0	0	8
	9	19	56	33	21	16	12					77	1	0	7	20	10	5	4
	15	15	61	45	29	11	9	6	20	30	35	88	0	0	12	21	11	8	6
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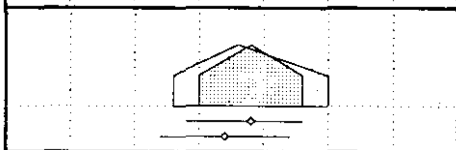	12	46	36	17	27	31	19					83	0	1	35	26	3	2	1
	11	48	39	12	33	37	17	18	53	17	7	86	0	2	50	22	4	2	0
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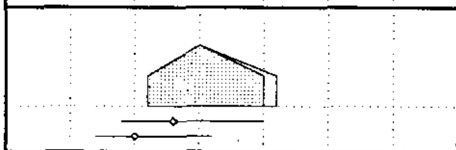	19	41	33	21	39	23	11					73	0	0	31	32	6	6	0
	15	49	33	23	41	25	8	14	51	25	5	86	0	0	36	35	4	4	1
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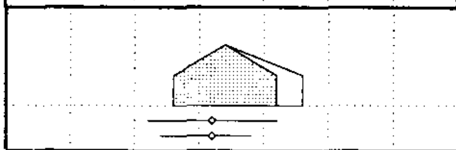	20	40	37	34	36	18	9					74	0	1	34	33	11	7	1
	13	48	36	29	48	15	5	6	36	47	6	83	0	0	40	34	9	7	1
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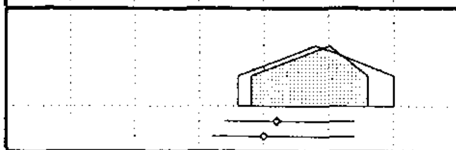
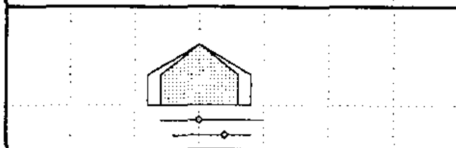
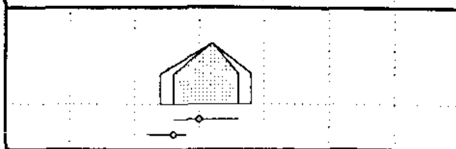
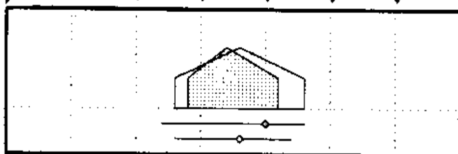
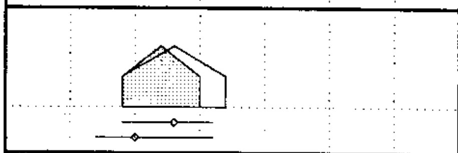
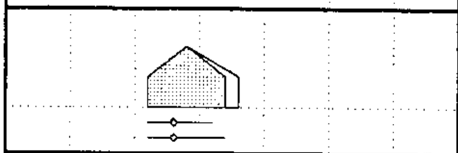
	9	27	56	39	29	17	6					73	1	1	22	36	9	4	1
	11	28	56	42	35	15	6	6	30	44	15	84	0	0	28	45	6	5	1
	22	35	43	43	35	13	9	9	35	43	13	78	0	0	52	39	4	0	4
	11	50	34	4	18	41	32					67	2	6	64	19	3	4	0
	8	56	34	2	27	42	27	64	21	3	8	80	0	2	74	18	1	3	0
	31	54	8	0	0	46	54	85	0	8	8	85	0	8	62	23	0	0	0
	8	31	53	22	27	35	8					90	0	0	29	18	16	10	0
	7	31	60	14	50	26	7	5	57	12	19	93	0	0	45	19	2	5	0
	100	0	0	0	50	50	0	50	50	0	0	100	0	0	50	0	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Information system equipment	61. Widespread use of next-generation cable TVs capable of transmitting programs on 300 channels or more by means of data compression technology to the extent of more than 50% of households.	1	109	9	14	39	38	21	46	24	8
		2	93	9	17	41	33	18	52	23	8
		X	12					33	42	8	17
	62. Completion of networks enabling interconnection from anywhere in Japan through pocketbook-size telephones.	1	145	11	27	44	19	49	43	6	1
		2	121	9	30	46	15	53	42	5	0
		X	13					85	15	0	0
	63. Widespread use of electronic document communication (electronic newspaper, etc.) in households.	1	148	12	29	42	17	23	47	27	2
		2	120	13	27	44	15	25	49	23	3
		X	18					61	28	6	6
	64. Widespread installation of sophisticated equipment designed to prevent crimes which exert a great influence on the populace (e.g., violent or destructive behavior associated with terrorism or hijacking).	1	86	2	11	35	51	44	41	12	1
		2	69	3	14	33	50	43	42	10	3
		X	4					50	25	0	25
	65. Practical use of technology for identifying individuals with no contact, in the field of security management.	1	126	7	22	40	30	29	48	22	0
		2	103	9	21	43	27	30	49	20	1
		X	13					46	46	0	8
	66. Widespread use of a fire alarm system with new sensors to detect and identify odors or vibrations associated with fires.	1	90	6	12	33	48	32	49	18	0
		2	76	7	12	38	44	26	58	14	1
		X	9					44	44	0	11
	67. Incorporation of fire-fighting robots capable of extinguishing fires at industrial complexes and detecting and rescuing human beings in the process.	1	109	8	15	38	38	47	44	8	0
		2	96	7	20	42	31	45	47	7	0
		X	10					70	30	0	0
	68. Development of high-function, high-performance sensors capable of searching for buried victims of earthquakes, landslides, and avalanches.	1	84	5	13	30	52	29	57	13	0
		2	71	5	16	31	48	23	66	11	0
		X	7					29	71	0	0
	69. Widespread use of three-dimensional image processing technology capable of detecting moving objects and recognizing moving patterns and changes in shapes.	1	133	13	27	35	26	35	53	10	2
		2	115	13	27	41	19	30	64	6	0
		X	18					44	56	0	0
	70. Practical use of work robots capable of handling virtually all types of jobs in the home or hospitals.	1	122	7	19	41	32	51	41	7	1
		2	102	6	24	43	27	57	37	5	1
		X	8					63	13	13	13

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	10	36	41	13	21	33	20					40	18	19	61	13	0	3	1
	14	35	45	12	27	38	19	16	42	23	12	57	14	17	71	8	0	1	2
	42	50	0	17	33	17	25	25	33	17	8	50	17	0	75	8	0	8	0
	25	46	26	16	23	31	26					43	32	10	59	26	1	2	1
	24	51	24	10	27	36	26	23	53	12	8	56	26	7	68	22	0	0	1
	85	15	0	23	46	0	31	31	38	8	8	62	8	8	77	31	0	0	0
	18	41	36	6	26	32	32					24	23	32	65	11	1	0	1
	14	52	33	4	22	43	29	16	48	20	13	31	23	34	71	10	1	0	1
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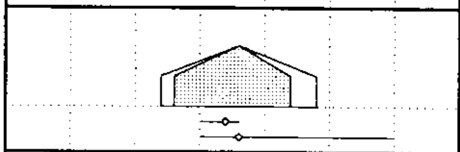	8	28	56	43	21	20	9					31	40	24	40	17	1	12	2
	9	38	49	42	28	19	9	4	28	39	23	36	46	32	49	6	1	3	3
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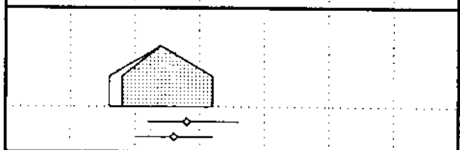	13	48	34	14	25	34	23					53	20	24	49	8	1	2	2
	12	56	31	12	30	36	20	7	42	27	21	72	20	17	58	4	0	0	2
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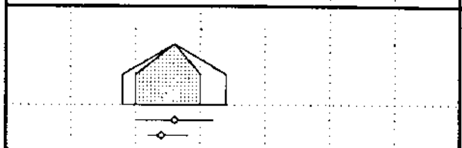
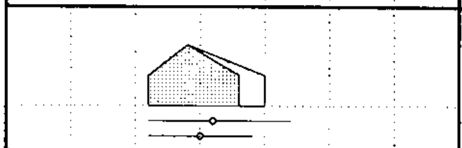
	16	34	46	4	24	38	28					60	8	1	56	14	2	8	0
	14	41	45	3	22	51	24	13	42	12	30	68	7	1	67	9	0	4	0
	44	56	0	0	22	56	22	22	33	22	22	89	0	0	56	11	0	0	0
	9	45	41	13	40	33	11					64	9	4	39	32	7	6	0
	9	48	40	10	41	42	7	20	45	14	20	83	4	3	52	17	3	3	0
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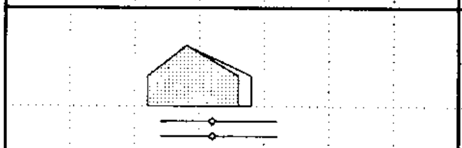	8	38	48	14	32	36	13					80	1	5	18	33	8	13	0
	8	48	44	10	41	41	8	8	56	4	28	89	1	4	28	35	4	6	0
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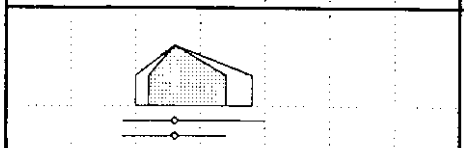	17	44	35	8	48	23	17					73	0	2	44	24	8	5	1
	14	49	37	9	56	25	10	11	48	26	10	86	0	0	57	16	3	1	0
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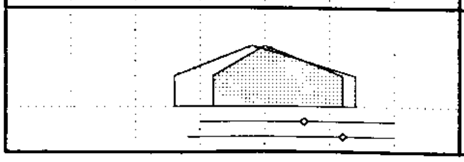
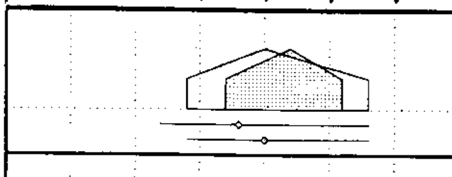
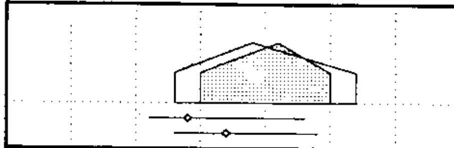
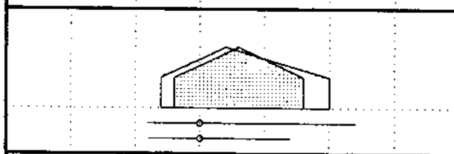
	11	43	39	23	38	23	13					72	11	17	46	23	2	7	0
	10	42	47	26	44	22	8	28	34	14	21	87	3	16	67	15	1	0	0
	13	88	0	38	25	13	25	50	13	25	13	63	0	38	88	0	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Information system equipment	71. Practical use of intelligent robots with visual, auditory, and other types of sensors, capable of judging their environment and making decisions autonomously.	1	119	16	17	34	34	43	43	13	1
		2	101	15	18	39	28	38	50	12	1
		X	21					62	29	5	5
	72. Development of robots capable of identifying and repairing their own faults by themselves.	1	111	13	14	34	38	29	50	18	3
		2	94	14	16	37	33	27	56	14	3
		X	20					45	50	0	5
	73. Development of computers equipped with memories based on distributed expression of data such as seen in brains and in holography.	1	112	12	19	32	37	30	50	14	3
		2	91	11	16	39	35	25	64	10	1
		X	15					60	33	7	0
	74. Widespread use of portable electronic notebook having the same contrast as that of paper and sustaining the contrast after power-off.	1	114	7	16	40	36	25	39	27	4
		2	100	7	17	48	28	25	52	20	3
		X	10					70	30	0	0
	75. Widespread use of home computer systems usable as information system terminals as well (for control of home equipment, management of household finances and family health, and use as dialogue-type study aids).	1	139	14	28	35	23	25	47	26	1
		2	117	10	32	41	18	16	60	21	3
		X	14					14	50	36	0
	76. Practical use of portable motorless record-playback equipment capable of operating for approximately one hour at a time.	1	98	6	20	30	45	9	52	35	2
		2	82	5	24	31	40	11	60	29	0
		X	7					43	43	14	0
	77. Widespread use of general-purpose ID card systems capable of decoding, with no contract, almost all information socially requisite for individuals.	1	117	10	21	35	34	23	46	21	9
		2	96	7	24	38	31	19	53	22	6
		X	10					40	50	10	0
	78. Development of copying systems capable of erasing copies after their use, so that the paper is to be reused.	1	97	3	12	40	45	32	39	24	4
		2	82	1	17	43	40	33	44	21	2
		X	1					0	100	0	0
	79. Practical use of sound field shielding technology enable to isolate a specific space area from surrounding noise.	1	67	5	12	21	62	22	58	16	1
		2	56	4	10	27	59	18	66	14	2
		X	6					50	33	17	0
	80. Development of environment-adaptive information processing systems in which plural value systems are allowed to exist and superior-subordinate relationships are to be altered depending on circumstances.	1	82	12	13	22	53	18	52	24	1
		2	69	9	14	27	50	13	64	20	1
		X	13					38	46	15	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	14	43	35	25	36	20	13					78	4	6	35	22	6	8	0
	12	40	48	27	42	23	8	15	49	19	14	90	3	4	51	17	5	2	0
	43	52	5	29	52	5	14	19	38	38	5	90	0	0	62	10	14	0	0
	11	38	41	20	35	23	12					79	3	3	26	23	5	6	0
	10	38	50	20	43	27	10	19	44	13	19	90	0	1	36	21	3	2	0
	35	60	5	25	45	15	15	25	45	25	5	90	0	0	50	15	5	5	0
	9	37	44	35	33	17	6					88	1	1	13	21	10	7	1
	8	45	47	44	36	14	4	8	41	29	20	97	0	0	16	29	8	4	0
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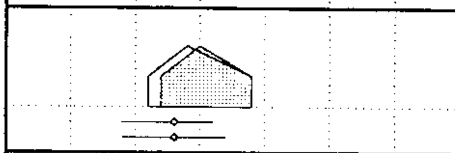	8	41	38	5	18	32	34					64	0	11	51	17	4	0	2
	5	47	45	3	22	42	29	41	24	5	25	78	0	7	67	10	1	0	0
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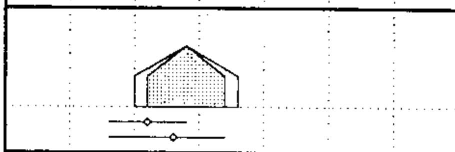	22	45	28	6	21	33	34					29	12	34	72	5	1	1	2
	16	53	29	2	24	37	33	13	41	23	19	36	12	39	81	3	0	0	1
	50	50	0	0	21	21	57	21	50	14	14	36	14	36	100	0	0	0	0
	24	43	23	2	16	37	34					49	1	6	62	6	1	0	2
	18	59	22	1	23	39	34	52	27	2	15	67	0	7	84	0	0	0	0
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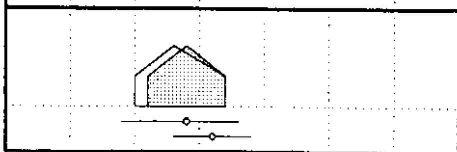
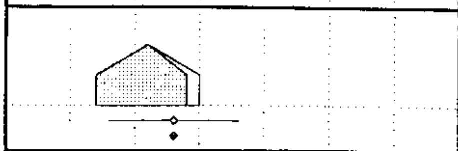
	17	37	36	10	26	30	24					32	38	38	38	7	1	2	1
	14	46	38	11	29	35	21	20	48	13	16	38	44	47	49	1	0	0	0
	20	60	10	20	20	0	50	30	30	30	0	40	40	30	50	0	0	0	0
	14	26	49	8	24	34	25					63	3	8	52	10	3	1	3
	13	35	49	9	29	37	22	22	38	9	27	74	1	10	68	7	0	0	0
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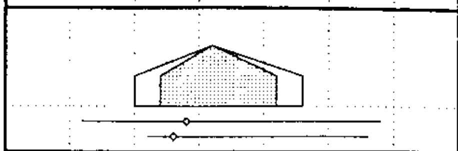
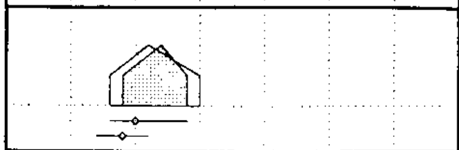
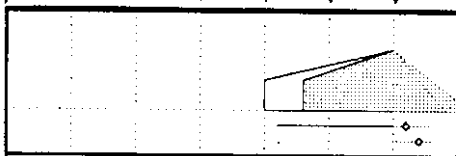
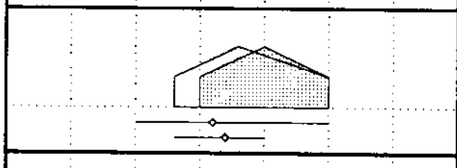
	10	37	45	10	28	30	24					78	3	6	42	12	1	3	1
	9	50	38	7	41	25	21	14	54	5	23	84	2	4	55	5	0	2	0
	17	67	17	17	50	0	33	17	67	17	0	83	0	0	67	17	0	0	0
	9	40	40	24	39	17	9					67	4	6	12	18	9	9	2
	10	43	41	23	51	14	6	3	42	26	22	83	3	10	9	22	9	7	3
	54	46	0	31	46	23	0	8	31	31	23	92	0	0	8	31	8	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Software	81. Elucidation of human decision making mechanism from the chemical and physical aspects of brains.	1	88	8	14	28	50	67	24	3	5
		2	74	6	12	35	47	70	26	3	1
		X	8					88	13	0	0
	82. Elucidation and modeling of human memorizing, recognizing and learning mechanisms such an extent that allow to apply to computer science.	1	116	16	20	29	35	66	30	3	0
		2	97	13	22	33	32	69	25	5	1
		X	19					84	16	0	0
	83. Elucidation of human creative mechanism to such an extent that allows to apply to computer science.	1	111	13	18	31	38	55	34	9	2
		2	91	13	15	35	36	62	30	7	2
		X	19					68	16	11	5
	84. Development of methods, based on elucidation of human taste mechanism, of evaluating sense of taste and smell which are not dependent on human sensual tests.	1	76	5	11	27	57	22	57	18	3
		2	68	4	9	36	51	18	59	19	4
		X	6					17	33	17	33
	85. Development of technology for performing automatic maintenance of computer networks by utilizing a principle similar to computer virus infection.	1	99	6	22	29	43	27	54	11	5
		2	84	6	22	33	39	26	61	7	6
		X	8					50	38	13	0
	86. Practical use of technology capable of retrieving complex two-dimensional patterns (such as photographs) at a speed comparable with that of humans.	1	116	13	26	27	34	47	47	7	0
		2	100	14	29	29	29	46	52	2	0
		X	19					63	37	0	0
	87. Development of systems capable of retrieving any information out of a data base of a 1 TB capacity within 10 seconds.	1	113	13	28	24	35	50	50	1	0
		2	93	10	30	26	34	46	54	0	0
		X	14					71	29	0	0
	88. Practical use of computer networks with virtual realities, which enable many and unspecified persons, who are scattered geographically, to share a virtual space.	1	111	11	24	28	37	19	52	23	5
		2	93	9	25	33	33	15	61	19	4
		X	12					33	67	0	0
	89. Practical use of systems to keep information safe from destruction or loss due to natural disasters or human intention.	1	98	7	18	31	44	59	33	4	2
		2	81	5	19	35	41	58	36	4	1
		X	7					100	0	0	0
	90. Widespread use of highly reliable security systems to eliminate leakage of information or invasion of privacy for individuals or groups.	1	108	11	20	30	39	60	35	3	0
		2	96	9	22	38	30	58	36	4	0
		X	12					92	8	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	31	47	68	20	2	1					86	1	7	2	15	26	18	0
	14	31	50	76	18	1	3	3	31	4,7	15	89	1	3	3	14	31	15	0
	50	25	25	100	0	0	0	0	38	50	13	100	13	0	0	0	38	13	0
	16	36	44	59	25	5	5					79	0	1	5	16	25	16	2
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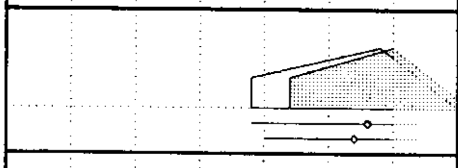	13	31	48	58	24	5	5					82	0	5	3	14	25	13	2
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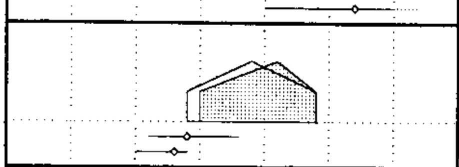	4	37	53	34	29	14	16					79	0	7	7	18	17	13	1
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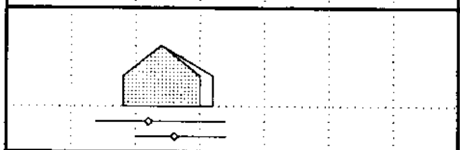	15	40	30	34	32	10	11					70	13	6	14	12	13	10	2
	12	46	33	37	40	8	6	0	26	50	14	82	12	7	13	11	14	2	0
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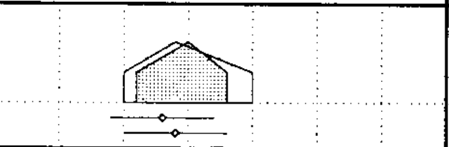	10	53	34	16	42	24	15					86	0	2	36	16	7	3	2
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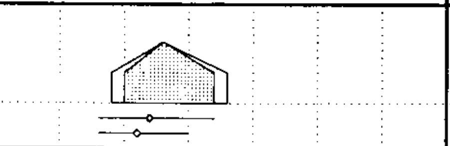	19	49	28	12	35	33	15					85	1	0	37	26	4	3	0
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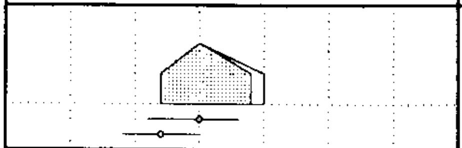	13	43	35	25	45	13	6					71	6	6	38	19	5	5	0
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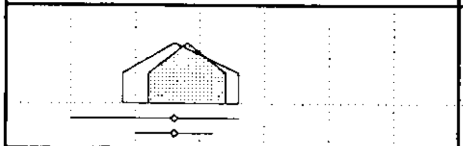	16	37	35	31	32	16	11					57	13	4	40	20	2	5	0
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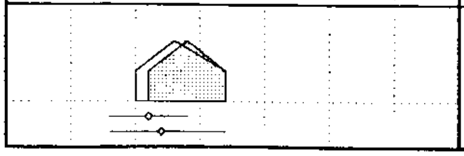
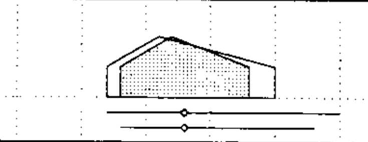
	19	43	33	29	28	24	13					49	26	29	40	13	4	5	0
	16	46	35	24	41	25	7	1	30	47	16	61	18	31	51	7	3	1	0
	33	58	8	50	33	17	0	8	17	75	0	42	25	58	42	0	8	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Software	91. Practical use of systems capable of understanding text that includes drawings (e.g., summary of patent information).	1	126	16	27	28	29	41	55	4	0
		2	106	16	28	32	24	38	59	3	0
		X	22					36	64	0	0
	92. Widewpread use of general-purposes"speech-input" typewriters, converting input of spoken Japanese (continuous speech, by undersignated speaker) into regular Japanese text (including "kanji" characters).	1	132	15	25	35	26	33	48	16	3
		2	113	13	27	40	20	30	53	16	1
		X	18					39	39	22	0
	93. Commercialization of portable automatic interpretation machines i.e., with speech input and output, capable of interpreting simple conversation for both sides.	1	129	15	21	37	28	38	49	12	2
		2	109	13	23	42	23	37	49	14	1
		X	18					39	33	22	6
	94. Development of equipment for automatic preparation of summaries and abstracts of books and other documents (degree of condensation can be adjsuted as necessary).	1	117	14	19	33	34	36	51	12	1
		2	99	13	18	39	30	25	67	7	1
		X	18					39	50	6	6
	95. Development of computers capable of processing vague information by applying "common sense" inference.	1	124	17	20	33	30	32	48	18	2
		2	105	14	25	35	26	29	55	13	3
		X	20					60	25	10	5
	96. Practical use of knowledge bases which increase their knowledge by automatic learning.	1	122	18	21	29	31	42	48	7	2
		2	105	16	24	35	25	39	54	5	2
		X	23					61	35	4	0
	97. Widespread use of equipment capable of reading Japanese text written by hand in a cursive script for office work.	1	131	13	22	38	26	17	52	24	7
		2	110	11	23	44	22	11	65	18	6
		X	16					6	75	13	6
	98. Widespread use of special-purpose information systems designed for the comfort of senior citizens or the disabled.	1	105	7	22	30	41	34	50	11	3
		2	91	6	21	38	35	31	59	9	1
		X	9					67	22	11	0
	99. Practical use of portable conversation equipment converting the volition of disabled into speech.	1	109	6	20	35	39	37	50	12	0
		2	91	5	18	42	35	32	59	9	0
		X	7					71	29	0	0
	100. Elucidation of sensations such as wearing, riding and of coziness, and development of technology for quantitatively measuring them.	1	81	6	12	28	54	11	53	33	1
		2	68	4	12	33	51	7	60	31	1
		X	6					0	83	0	17

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	18	48	32	21	33	29	12					80	3	2	33	16	11	5	0
	12	50	37	19	44	28	7	12	56	19	9	90	1	1	52	10	6	2	0
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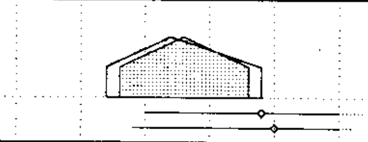	18	40	38	8	20	35	34					79	1	11	53	9	5	2	2
	13	42	43	9	16	39	35	65	24	0	8	85	0	7	66	5	2	0	2
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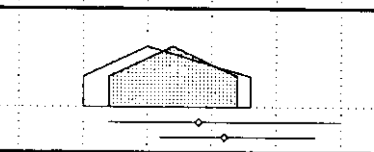	17	46	29	26	33	18	18					78	0	10	58	9	5	2	0
	13	50	36	30	40	15	14	37	43	5	13	86	0	8	66	7	4	0	0
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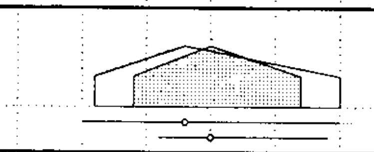	15	39	38	12	38	26	17					80	1	5	20	17	9	9	1
	10	42	45	12	45	24	14	6	52	24	13	92	1	3	33	18	4	5	0
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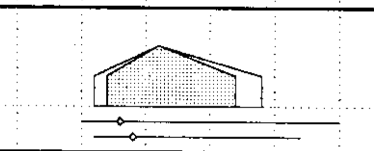	14	44	35	24	35	24	8					81	2	7	11	18	13	10	1
	10	46	40	25	38	26	5	5	50	24	12	87	3	6	13	24	8	8	1
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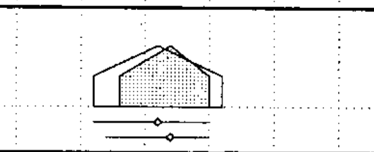	12	40	41	22	39	21	7					74	2	4	16	16	13	11	2
	10	47	39	23	49	19	4	1	42	40	9	89	1	2	23	17	10	5	0
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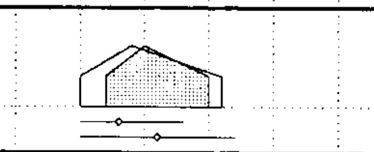	15	43	32	2	11	28	47					69	2	7	43	10	2	2	1
	8	50	35	4	10	31	50	68	15	2	7	81	0	4	64	7	1	0	1
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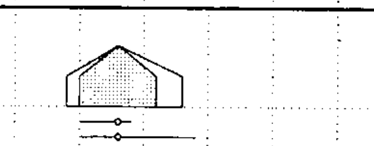	15	47	32	24	21	30	15					45	12	14	53	19	6	6	0
	13	53	32	23	30	29	16	7	38	31	20	64	10	19	65	14	4	0	0
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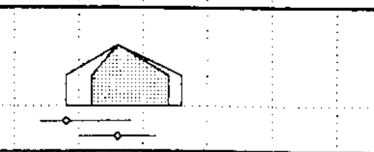	13	37	41	25	31	19	14					56	3	7	52	21	5	6	0
	12	46	41	19	44	19	18	10	37	31	19	77	2	7	71	12	3	2	0
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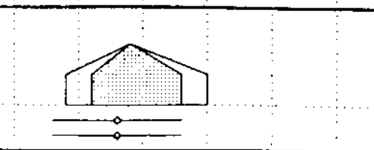
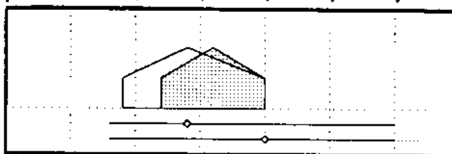
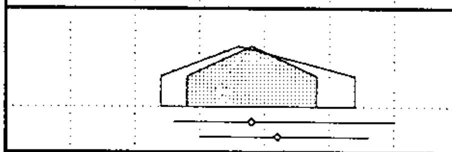
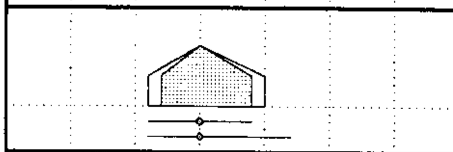
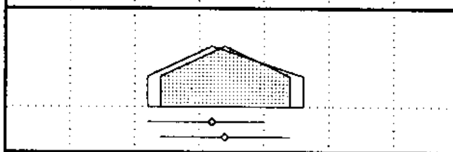
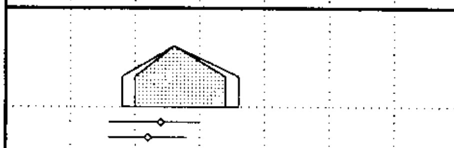
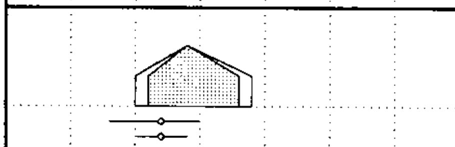
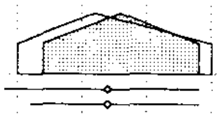
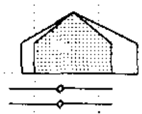
	11	30	51	16	22	38	14					74	1	14	15	15	12	10	1
	13	32	53	12	41	29	16	9	40	16	32	84	1	10	22	15	9	7	1
	50	33	17	17	50	17	17	0	33	17	50	83	0	0	17	33	17	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Software	101. Development of technology to scientifically measure machine operability (i.e., ease of use).	1	86	7	14	28	52	27	37	33	2
		2	72	6	15	32	47	22	40	36	1
		X	8					50	25	13	13
	102. Advances in software inspection and verification technology, enabling short-term development of error-free, large-scale software.	1	108	22	22	17	39	73	22	4	0
		2	94	20	24	24	32	76	19	4	1
		X	28					93	4	0	4
	103. Advances in standardization of knowledge representation, enabling short-term development of large-scale expert systems utilizing existing knowledge data.	1	102	18	21	18	43	40	49	10	1
		2	90	17	23	25	35	33	58	7	2
		X	23					52	43	0	4
	104. Development of general-purpose, super high-level language by which problems can be described using texts or charts.	1	105	19	20	20	41	44	45	10	2
		2	90	17	21	27	35	37	51	11	1
		X	23					52	39	4	4
	105. Widespread use of software data bases enabling reuse of much softare.	1	103	22	18	17	42	61	29	8	1
		2	89	19	22	22	36	66	28	6	0
		X	27					81	15	4	0
	106. Widespread use of a new programming method usable through only the expertised knowledge of applications without conventional programming language.	1	97	23	15	17	45	41	44	11	1
		2	82	20	20	20	41	41	50	9	0
		X	28					61	36	4	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	12	30	47	27	24	28	8					64	1	14	9	13	12	15	1
	13	32	53	25	38	26	10	7	38	24	29	81	1	17	17	10	7	15	1
	50	38	13	38	38	13	13	0	50	25	25	75	0	25	13	13	0	25	0
	22	38	32	45	32	9	6					81	2	3	13	12	19	14	1
	18	46	34	53	34	9	3	1	31	54	11	91	1	2	21	9	24	7	0
	43	43	14	64	25	0	11	0	36	57	7	93	4	4	14	11	36	7	0
	16	43	31	37	38	12	5					75	9	9	20	15	12	15	2
	13	54	28	41	46	8	3	3	36	51	8	93	4	6	29	12	9	7	0
	48	48	4	52	35	9	4	4	17	65	13	96	0	9	26	9	13	17	0
	18	44	30	35	36	16	8					80	3	6	11	10	19	12	3
	13	54	31	37	47	13	3	1	31	58	8	93	1	9	18	4	23	7	0
	26	61	13	30	52	13	4	0	43	43	13	100	0	13	9	0	22	4	0
	21	47	27	37	36	11	11					57	24	16	21	9	11	11	3
	13	62	24	40	45	8	6	0	37	53	8	79	29	15	25	10	8	6	0
	41	52	7	41	44	4	11	0	44	48	7	81	26	19	26	11	4	7	0
	23	41	29	34	34	13	10					69	4	10	15	5	14	10	4
	18	56	22	43	43	5	6	1	32	54	11	88	0	7	22	6	15	11	1
	46	46	7	50	39	0	11	0	43	46	11	93	0	14	21	4	7	7	4

4.3 Life science

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Molecule	1. Elucidation of relationships between the higher-order structures and functions of the nuclei of eukaryotic cells.	1	175	22	41	20	17	54	39	6	0
		2	144	20	42	21	17	60	37	3	0
		X	34					85	15	0	0
	2. Establishment of technologies enabling prediction of the three-dimensional structures of proteins from their amino acid sequences.	1	198	23	43	26	8	71	27	2	0
		2	164	23	43	28	7	76	23	1	0
		X	40					88	13	0	0
	3. Establishment of technologies enabling prediction of the functions of proteins from their higher-order structures.	1	195	24	42	25	9	73	24	3	1
		2	161	23	43	26	9	78	20	1	0
		X	40					93	8	0	0
	4. Elucidation of molecular mechanisms of particular interactions between proteins or between proteins and nucleic acids.	1	196	31	41	20	8	68	29	2	0
		2	162	29	43	20	8	79	20	0	0
		X	51					90	10	0	0
	5. Elucidation of molecular mechanisms of the heat resistance of proteins.	1	175	17	35	29	19	24	58	17	0
		2	145	15	39	29	17	26	63	10	1
		X	26					50	42	8	0
	6. Completion of a comprehensive human protein data library.	1	191	16	40	32	11	58	30	9	2
		2	162	16	44	31	8	61	29	9	1
		X	29					83	10	7	0
	7. Determination of the entire DNA base sequences in human chromosomes.	1	199	20	43	30	7	61	31	8	1
		2	165	20	44	30	5	65	27	8	0
		X	35					80	14	6	0
	8. Development of methods determining directly DNA base sequences by physical means including X rays.	1	157	13	23	37	27	37	41	17	4
		2	130	11	24	39	26	39	47	12	1
		X	20					55	30	15	0
	9. Thorough elucidation of the structures and functions of signal transducing molecules.	1	191	26	39	24	11	68	30	2	0
		2	156	25	41	23	11	71	27	1	0
		X	44					93	7	0	0
	10. Elucidation of the morphogenic and developmental processes of the brain at the molecular level.	1	170	16	32	31	21	72	23	3	1
		2	144	16	32	34	18	79	19	1	1
		X	28					96	4	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	50	28	46	34	13	5					61	6	1	5	33	41	23	0
	11	58	26	51	37	8	2	1	26	58	11	69	3	1	3	30	51	17	1
	29	47	21	65	32	3	0	0	29	71	0	59	12	0	6	29	47	29	0
	22	54	21	40	44	11	4					61	4	0	7	33	38	23	2
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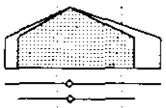	14	55	27	48	37	8	4					64	4	0	7	30	36	25	0
	12	60	25	57	34	6	2	1	39	47	10	73	2	0	3	29	48	22	1
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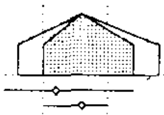	26	52	19	48	35	10	4					56	5	0	7	35	39	22	0
	22	59	15	54	35	4	2	1	37	51	7	65	2	0	3	33	46	23	0
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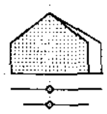	22	53	22	22	46	23	6					54	3	1	9	32	29	19	1
	16	63	18	21	57	14	3	9	58	16	14	65	1	0	4	37	39	18	1
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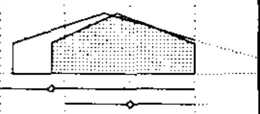	20	34	37	84	9	2	1					36	5	3	20	45	30	34	1
	15	41	39	91	4	0	0	1	28	57	7	43	2	1	19	54	29	33	1
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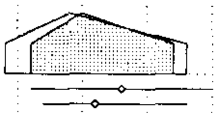	23	41	31	85	10	2	2					36	5	4	24	49	27	35	1
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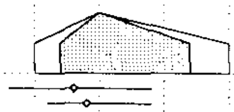	11	35	39	38	36	11	5					64	1	1	14	28	24	12	1
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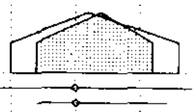	18	45	31	51	34	8	4					53	3	1	6	38	38	18	1
	14	54	28	58	30	6	3	3	45	37	10	67	1	0	5	37	50	12	0
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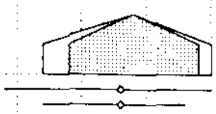
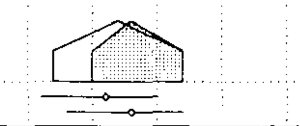
	12	38	38	64	25	3	2					56	3	4	6	32	40	21	1
	11	37	44	75	17	2	2	1	25	57	11	67	2	3	3	28	55	15	1
	25	50	25	96	4	0	0	4	21	68	0	71	4	4	11	21	54	18	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Molecule	11. Elucidation of the mechanisms of the immune response at the level of molecular biology.	1	181	13	35	37	15	78	18	1	0
		2	156	13	33	42	12	84	12	1	0
		X	23					87	13	0	0
	12. Identification of all genes inhibiting cancer and elucidation of the relationships between those genes and carcinogenesis.	1	183	14	36	36	14	78	17	3	0
		2	156	11	36	41	11	87	10	1	0
		X	20					85	15	0	0
	13. Elucidation of the mechanisms of complex effects by more than one compound as seen in herbal medicines.	1	134	5	24	33	37	20	54	24	1
		2	116	5	23	39	34	21	60	19	0
		X	8					25	38	38	0
	14. Elucidation of the whole aspect of the mechanisms of sleep.	1	135	5	18	40	37	27	53	14	1
		2	111	3	19	41	37	22	60	13	2
		X	5					60	20	20	0
	15. Practical use of bioreactor technologies to produce new physiologically active substances without relying on cell culture techniques.	1	154	13	29	30	28	39	50	8	1
		2	130	13	28	32	26	38	56	4	1
		X	23					57	43	0	0
	16. Development of organic catalysts with better functional characteristics than enzymes.	1	134	12	19	32	38	34	49	13	1
		2	111	10	21	32	37	31	57	9	1
		X	17					41	47	12	0
	17. Development of biodevices (protein transistors, for example) that can be used in electronics.	1	111	7	13	31	48	29	45	22	2
		2	88	5	14	31	50	27	53	15	2
		X	9					56	33	11	0
	18. Widespread use of highly integrated biosensors.	1	113	7	15	31	47	28	58	11	0
		2	92	5	14	34	47	25	63	8	0
		X	9					44	56	0	0
	19. Development of biomimetic devices (stable molecules which have the same functions as those of biological molecules and which are made up of components other than peptide).	1	99	7	11	29	53	31	52	12	1
		2	80	5	10	31	54	30	56	8	1
		X	8					38	63	0	0
	20. Systematization of the basic concepts of bio-computer architecture.	1	96	3	15	28	55	42	43	13	1
		2	76	2	14	28	56	41	47	11	0
		X	3					33	67	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	9	50	32	55	29	7	2					52	1	1	4	32	40	27	1
	10	51	33	64	22	5	1	1	45	38	9	56	3	1	2	34	47	26	0
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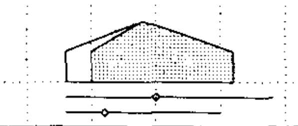	13	48	31	58	27	5	2					51	3	0	7	34	37	30	1
	10	54	31	71	19	3	1	1	44	42	7	62	3	1	2	37	39	30	0
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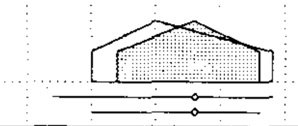	7	32	44	22	36	25	8					57	8	5	9	25	31	25	1
	6	35	53	28	41	21	6	28	35	9	21	61	7	5	3	28	47	22	0
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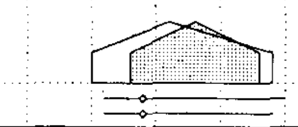
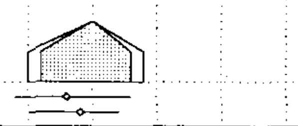
	7	31	51	34	40	10	6					63	2	2	6	21	36	18	1
	4	30	59	37	44	5	5	2	29	36	23	69	2	0	3	21	49	17	0
	20	60	20	60	0	0	40	20	40	40	0	80	0	0	20	0	60	40	0
	13	44	34	24	34	24	10					57	1	0	31	27	15	16	0
	10	50	37	27	39	22	6	20	45	15	11	68	2	2	32	29	19	14	0
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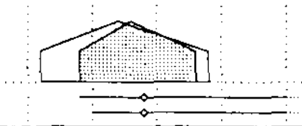	16	37	33	25	33	21	10					67	2	1	22	17	22	15	0
	10	46	38	22	44	20	8	4	39	25	23	73	1	0	21	16	35	12	1
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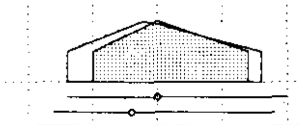	13	39	36	27	32	21	9					70	1	1	22	13	21	17	0
	8	40	42	24	44	20	3	11	32	28	18	77	2	0	24	13	24	19	0
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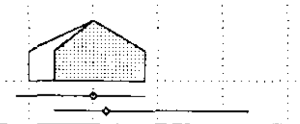	12	41	35	28	36	13	12					59	1	1	31	20	12	20	1
	8	46	36	24	48	15	5	14	39	15	21	73	3	1	33	25	9	21	0
	33	67	0	33	44	22	0	22	44	11	0	67	0	0	22	33	0	44	0
	14	34	41	27	37	18	6					66	2	1	17	19	22	20	1
	10	40	43	26	50	19	0	6	43	20	24	81	5	0	14	20	33	21	0
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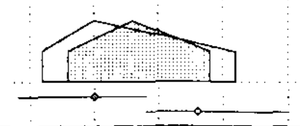	14	33	40	39	34	10	3					64	3	1	9	17	24	25	2
	9	42	39	46	37	8	1	3	46	22	18	79	3	0	4	18	34	26	0
	67	33	0	33	67	0	0	0	67	33	0	100	0	0	0	0	0	67	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Cell	21. Elucidation of the functions of immunocytes responsible for the distinguishment between self and not-self.	1	170	10	36	34	20	66	31	1	0
		2	143	10	32	39	19	70	25	1	0
		X	17					94	6	0	0
	22. Elucidation of the whole aspect of the signal transduction in the carcinogenesis of cells.	1	172	16	41	23	19	77	20	1	0
		2	142	15	41	24	19	82	16	1	0
		X	26					96	4	0	0
	23. Common use of medical treatments for dysdifferentiating carcinogenic cells.	1	171	18	33	29	20	75	18	3	2
		2	143	16	32	34	19	83	10	3	1
		X	28					71	18	4	7
	24. Elucidation of the mechanisms of replication and (cell) division of eukaryotic cells.	1	173	25	33	23	18	58	33	6	1
		2	146	23	38	23	16	60	29	8	0
		X	40					90	10	0	0
	25. Development of technologies for developing germinal stem cells (germinal cells in the very early stage) to individuals by themselves.	1	154	16	25	32	27	42	36	12	6
		2	128	16	25	33	26	40	43	9	5
		X	28					68	25	4	4
	26. Elucidation of the mechanisms of signal perception in plants.	1	133	14	14	34	38	36	44	17	1
		2	104	11	13	35	41	38	45	13	0
		X	19					74	26	0	0
	27. Elucidation of the molecular mechanisms of morphogenesis and being possible to control them artificially controlling them.	1	179	23	33	28	16	52	36	8	1
		2	148	23	30	32	15	61	30	5	1
		X	40					78	23	0	0
	28. Elucidation of weightless physiological actions and development of measures for preventing deterioration in biological functions caused by the weightless state.	1	93	2	8	34	56	17	28	45	6
		2	72	2	7	32	59	15	28	51	3
		X	4					100	0	0	0
	29. Practical use of technologies enabling solar energy to be converted into, or stored as biochemical energy.	1	127	7	15	38	40	77	18	2	1
		2	106	6	15	40	39	83	12	1	1
		X	11					82	9	0	9
	30. Development of engineering technologies, such as biomotors, using the biological energy conversion mechanisms.	1	116	5	15	34	46	38	44	16	1
		2	93	3	14	36	47	35	49	12	2
		X	5					60	20	20	0

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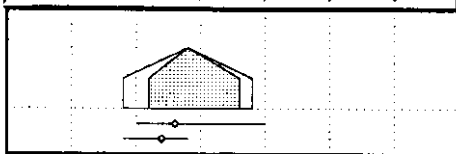
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	49	29	55	31	8	2					54	2	1	4	31	38	24	1
	13	58	24	61	30	3	2	1	34	47	12	65	1	0	1	31	48	21	1
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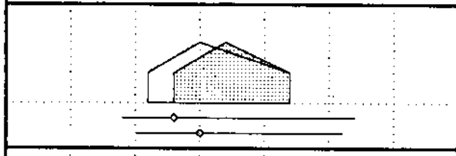
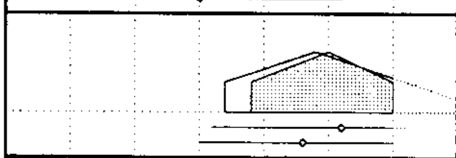
	14	49	31	60	31	4	2					54	2	1	7	35	37	22	0
	11	56	28	71	23	2	1	1	39	46	8	64	3	0	4	33	44	20	0
	35	50	15	85	15	0	0	0	46	54	0	46	4	0	8	42	54	35	0
	10	33	43	56	27	8	2					65	6	3	7	27	25	20	2
	8	37	48	66	24	3	2	2	33	42	16	71	3	0	3	29	38	19	2
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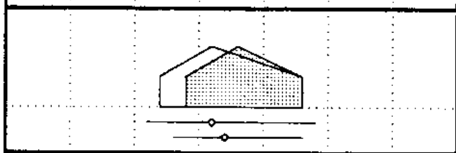	13	51	28	45	36	9	5					57	1	1	7	35	39	14	1
	10	58	27	49	34	8	3	2	34	45	12	63	2	0	1	38	51	10	1
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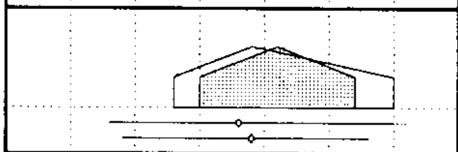	18	32	36	44	30	10	5					57	5	10	6	25	31	18	1
	14	37	41	51	34	8	2	2	32	34	21	70	2	9	2	28	42	11	0
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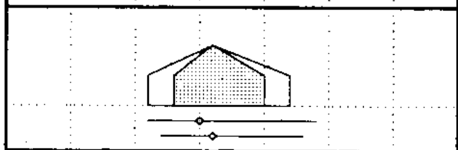	13	41	36	42	38	9	4					52	0	1	7	31	42	16	2
	9	44	39	48	38	5	3	1	26	38	25	64	1	0	5	29	56	13	1
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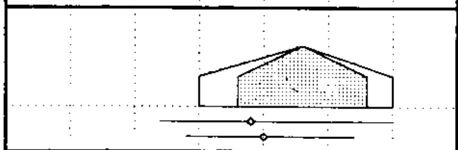	12	40	35	52	27	10	4					60	2	8	2	30	36	18	0
	11	43	39	62	24	7	3	1	30	46	15	66	2	5	1	28	49	16	1
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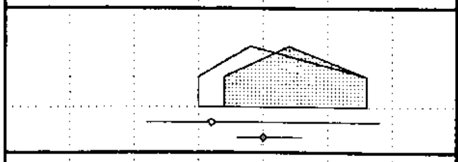	6	31	44	66	14	3	2					41	4	0	16	26	27	32	2
	4	32	51	74	15	0	3	0	10	60	21	51	1	0	10	33	26	42	1
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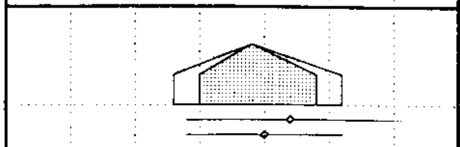	5	37	46	55	26	6	2					57	0	0	30	27	21	20	1
	3	40	50	63	26	3	1	2	28	32	25	66	0	0	34	30	20	17	0
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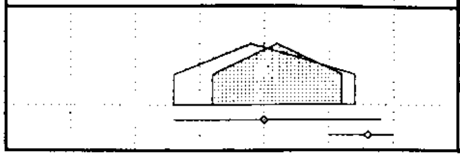
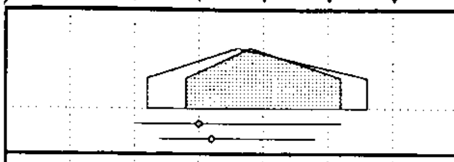
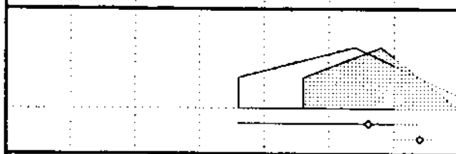
	6	37	41	35	31	12	8					63	3	0	18	22	25	14	1
	4	40	48	46	32	9	6	1	34	26	26	75	3	0	16	18	31	20	0
	40	60	0	60	20	0	20	0	60	40	0	80	20	0	0	20	40	20	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Cell	31. Development of technologies enabling the introduction of foreign genes or chromosome fragments into any desired position in a chromosome in *in vivo*.	1	179	20	32	32	16	58	30	4	4
		2	149	18	33	34	15	62	28	1	3
		X	32					91	6	0	0
	32. Development of technologies for synthesizing artificial cells that replace cellular functions.	1	142	7	23	36	34	36	42	13	6
		2	120	6	22	40	32	34	47	12	3
		X	11					36	45	9	9
	33. Development of technologies for synthesizing organisms that have self-multiplication functions.	1	111	6	9	36	48	13	48	29	9
		2	87	6	6	38	50	11	51	26	9
		X	11					36	27	0	36
	34. Development of production systems utilizing functions of three-dimensional molecular aggregate such as chloroplasts and other organelles.	1	138	10	19	35	36	36	51	9	1
		2	111	9	15	40	36	32	59	5	0
		X	16					56	44	0	0
	35. Practical use of technologies for producing useful materials such as amino acids by fixing nitrogen.	1	134	12	18	33	37	44	43	8	2
		2	107	12	18	33	37	47	42	7	2
		X	21					62	24	5	10
	36. Development of technologies for synthesizing membranes having active transport function that are similar to cellular membranes.	1	149	12	26	31	31	31	56	10	1
		2	123	11	23	36	30	29	58	11	0
		X	19					58	42	0	0
	37. Development of artificial membranes with the similar ability to convert energy as biological membranes.	1	142	14	22	30	34	33	55	10	1
		2	116	12	20	34	34	30	63	5	0
		X	21					57	43	0	0
	38. Development of artificial membrane systems mimicking the ability of living organisms to receive and transmit information.	1	142	13	21	33	33	30	57	10	1
		2	114	13	17	36	35	32	59	6	1
		X	22					55	41	5	0
	39. Development of experimental techniques for recording a single unit activity from alarge numbers of neurons simultaneously during several days.	1	121	14	19	23	43	44	44	9	1
		2	92	14	17	22	47	42	50	3	1
		X	24					63	29	4	0
Tissue and organ	40. Development of medicines preventing the development of cancers.	1	171	13	28	39	20	82	12	3	2
		2	143	13	28	40	19	85	10	1	1
		X	23					96	0	0	4

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	20	42	25	48	27	9	4					58	15	35	3	16	21	13	0
	12	51	30	60	25	4	4	1	23	56	10	64	11	37	1	17	26	12	2
	31	50	16	78	16	0	3	0	25	72	0	66	6	25	0	25	28	28	0
	8	32	44	35	28	14	5					65	3	4	10	24	23	11	1
	7	33	50	48	24	13	4	3	22	30	33	76	1	3	7	22	27	15	1
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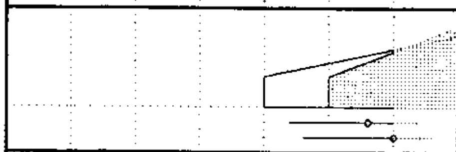	6	23	41	28	21	15	5					51	3	5	5	14	16	12	3
	2	26	49	41	26	8	2	1	14	28	33	63	0	2	3	22	26	15	2
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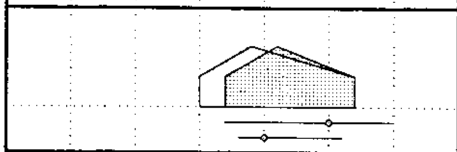	7	39	42	28	38	18	6					65	1	1	20	21	24	12	0
	5	39	48	34	45	10	3	3	28	18	41	73	1	1	18	24	33	10	0
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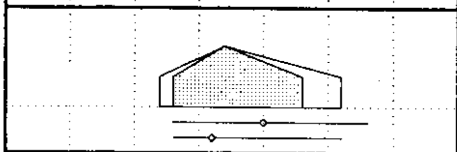	10	41	35	26	37	16	4					55	3	1	32	20	13	16	0
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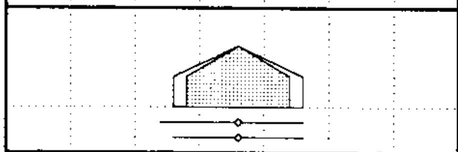	10	43	38	28	44	14	5					64	1	1	14	28	21	13	0
	6	50	41	29	52	11	2	2	45	20	24	75	1	0	9	30	30	14	0
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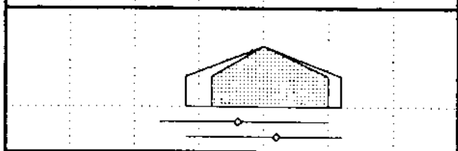	6	44	39	32	42	12	3					65	1	1	13	24	25	12	0
	4	47	44	34	47	9	3	3	41	25	22	78	1	0	5	27	33	10	0
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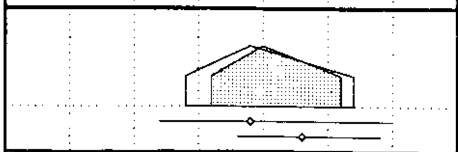	7	38	41	30	42	10	3					59	1	0	8	27	26	14	0
	5	45	40	39	43	7	3	4	35	27	23	76	0	0	4	31	33	13	0
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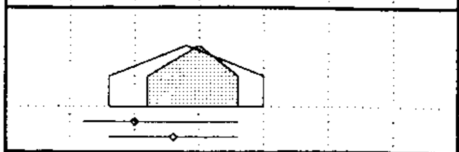	21	39	31	34	36	12	8					60	1	1	13	36	29	12	0
	18	48	28	43	43	4	3	9	46	27	12	71	0	0	7	47	35	14	0
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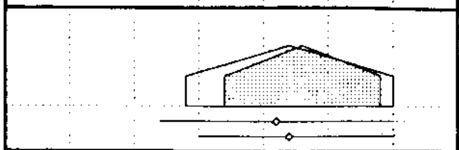
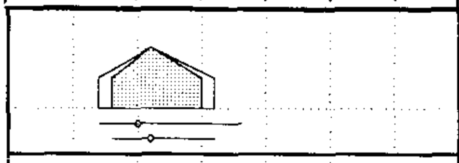
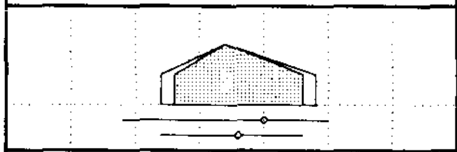
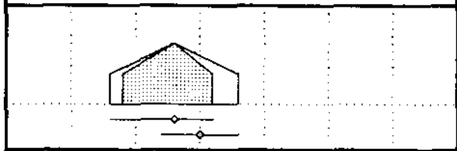
	15	36	34	52	23	9	4					61	5	1	8	29	24	16	3
	13	37	41	65	22	3	2	3	41	28	18	73	5	0	3	32	30	16	2
	30	35	22	57	30	0	4	0	61	26	9	83	4	0	9	26	22	26	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Tissue and organ	41. Development of highly sensitive techniques for simple and early diagnoses of cancers, using blood serums or others.	1	174	14	34	35	18	80	15	1	0
		2	147	13	34	39	15	85	12	1	0
		X	22					91	9	0	0
	42. Practical use of effective means to prevent metastasis of cancer.	1	163	15	31	30	23	89	6	1	1
		2	138	14	29	36	20	92	4	0	1
		X	24					92	4	0	4
	43. Development of noninvasive encephalometry technologies for analyzing macro brain activities.	1	104	8	20	21	51	56	35	5	2
		2	77	5	18	22	55	57	36	3	1
		X	9					67	33	0	0
	44. Elucidation of the encoding and retrieval mechanisms of memories in the brain.	1	124	11	16	31	42	66	28	2	1
		2	93	9	14	31	46	74	24	0	1
		X	15					93	7	0	0
	45. Elucidation of the mechanism of logical reasoning by the brain.	1	113	8	15	29	47	58	37	2	1
		2	86	6	13	31	50	63	35	0	1
		X	11					82	18	0	0
	46. Elucidation of basic molecules concerning with higher order functions in the brain.	1	126	11	17	31	41	62	31	2	2
		2	100	9	14	35	42	72	25	0	1
		X	16					94	6	0	0
	47. Elucidation of the molecular mechanisms of concerning with organ regeneration.	1	135	9	26	29	37	57	36	3	0
		2	112	9	23	32	35	65	28	4	0
		X	16					75	19	0	0
	48. Use of technologies for long-term (semipermanent) culture and preservation of organs.	1	138	8	23	33	35	54	38	6	1
		2	111	8	25	31	36	61	32	3	1
		X	13					100	0	0	0
	49. Elucidation of the action mechanisms of neuropeptides and other substances in the central nervous system.	1	155	15	31	26	28	56	40	1	0
		2	124	15	30	27	28	65	33	0	0
		X	25					88	12	0	0
	50. Development of artificial peripheral nerves.	1	94	6	14	24	55	35	50	6	5
		2	75	5	12	26	56	39	51	7	3
		X	9					67	33	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	25	48	21	42	35	13	5					64	3	0	18	24	21	23	1
	18	56	24	49	36	7	3	9	51	20	16	76	1	0	13	27	26	24	1
	32	59	9	45	45	0	5	14	50	23	14	82	0	0	32	14	27	14	0
	11	52	29	50	31	10	2					69	4	0	12	28	20	20	1
	7	62	26	61	26	6	1	1	44	39	10	79	2	0	7	31	26	20	1
	21	75	0	71	17	4	4	0	33	58	4	88	0	0	4	21	13	29	4
	15	51	23	41	35	5	9					54	2	4	16	32	21	15	2
	10	58	26	51	38	0	5	4	39	34	13	73	0	4	16	35	35	14	0
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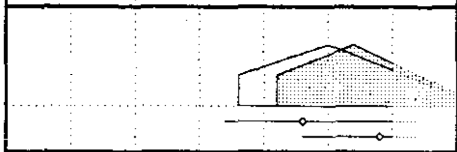	12	32	41	45	33	4	6					60	2	3	10	29	33	17	0
	9	31	54	65	24	2	3	1	29	47	15	70	1	0	4	30	52	12	0
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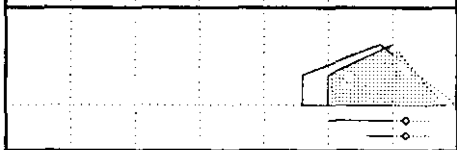
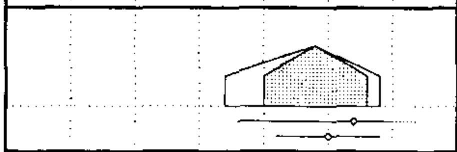
	12	35	36	50	25	5	4					54	2	4	9	28	31	19	0
	8	37	44	64	22	3	2	1	27	37	23	65	1	2	2	29	44	16	1
	45	55	0	55	27	9	9	0	27	64	0	73	0	0	9	36	45	27	0
	13	36	36	51	27	5	3					57	1	2	6	35	33	17	0
	9	35	51	63	26	2	2	1	31	46	14	72	1	1	2	39	48	10	0
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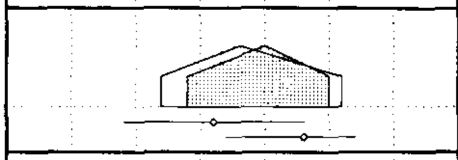
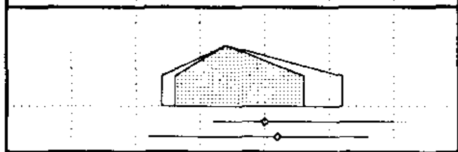
	11	47	31	47	27	11	4					59	6	3	5	27	33	16	0
	9	46	40	62	23	8	1	3	38	34	18	71	4	2	4	29	47	15	0
	19	56	19	81	13	0	0	0	56	38	0	75	6	6	0	19	44	13	0
	11	41	39	48	30	6	4					59	13	17	18	18	13	19	1
	12	45	37	61	28	2	2	2	28	49	14	67	9	14	14	24	19	25	0
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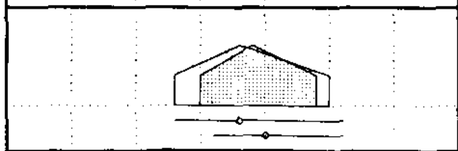	12	45	35	46	34	10	3					60	3	1	6	36	32	17	1
	10	48	40	54	32	6	2	2	44	35	10	69	1	1	2	44	44	11	2
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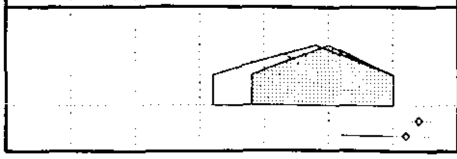
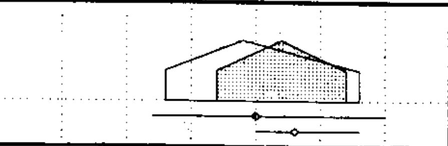
	9	30	45	41	32	11	3					61	3	2	9	33	29	17	0
	8	31	56	56	29	5	3	0	29	32	29	72	0	1	1	36	41	13	1
	22	56	22	78	22	0	0	0	11	67	22	100	0	0	0	11	44	22	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Tissue and organ	51. Establishment of technologies that link computers to biological sensory organs.	1	107	9	8	33	50	33	49	11	4
		2	80	5	8	34	53	34	51	9	4
		X	9					78	0	0	22
	52. Development of devices with self-assembling, self-organizing, and self-recovering capabilities.	1	67	3	8	20	68	34	42	19	1
		2	48	2	9	18	71	35	52	10	2
		X	3					67	0	33	0
	53. Development of bio-sensors capable of processing information.	1	103	8	10	31	51	29	60	6	2
		2	79	7	8	31	53	32	61	4	1
		X	12					83	17	0	0
	54. Elucidation of the mechanisms of self-organization of neural networks.	1	119	11	16	29	43	48	42	8	0
		2	90	9	15	28	47	52	43	3	0
		X	16					75	25	0	0
	55. Elucidation of the elasticity of neural networks in interaction with the environment.	1	110	13	15	25	48	41	47	7	1
		2	85	9	15	26	50	41	52	5	0
		X	16					69	25	6	0
	56. Development of self-organizing electric circuits.	1	50	2	6	15	76	22	38	26	4
		2	36	1	5	15	79	17	58	17	3
		X	2					50	0	50	0
	57. Development of materials similar to organisms, which have self-recognizing and judging functions.	1	70	4	7	23	67	19	51	21	4
		2	54	3	4	25	68	26	59	11	2
		X	5					80	0	20	0
	58. Practical use of artificial organs (pancreases, kidneys, livers, etc.) incorporating human cells and tissues.	1	138	8	14	44	35	59	35	4	1
		2	116	7	14	47	32	64	30	3	1
		X	12					75	17	8	0
	59. Clinical application of organ implants by multiplication and regeneration of their own cells.	1	135	9	21	34	36	69	27	1	0
		2	115	7	22	38	32	76	21	1	0
		X	12					92	8	0	0
	60. Development of neuro-computers that have new logical structures based on advanced brain functions.	1	93	6	10	28	56	55	32	6	1
		2	74	2	11	30	56	62	31	4	0
		X	4					100	0	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	7	35	37	33	33	13	7					61	2	4	12	30	19	11	1
	5	36	44	44	35	5	5	3	35	20	31	73	1	3	8	39	28	9	0
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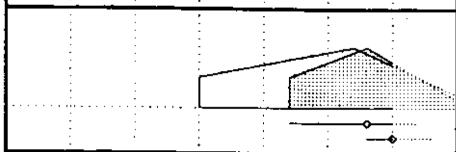
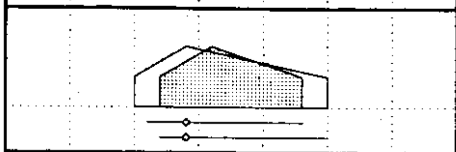
	6	30	49	37	37	10	1					60	1	4	19	22	25	13	1
	2	33	54	46	48	2	0	0	35	19	38	79	0	0	10	27	38	15	0
	33	67	0	33	67	0	0	0	33	0	67	67	0	0	0	67	33	33	0
	16	40	32	29	36	19	5					64	2	1	25	19	18	18	1
	10	49	35	34	47	11	3	10	54	10	19	80	0	0	28	29	19	18	0
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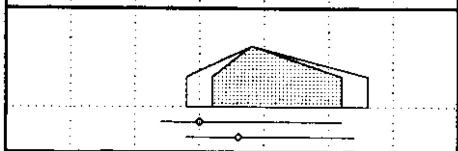	11	39	41	52	26	10	3					56	2	0	6	39	33	19	0
	3	56	36	66	22	6	3	1	39	36	20	74	0	1	3	42	36	12	0
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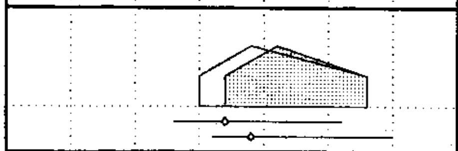	8	41	37	45	32	10	2					54	2	1	7	35	35	16	1
	6	46	39	53	33	5	2	2	26	36	28	71	0	0	4	38	47	13	0
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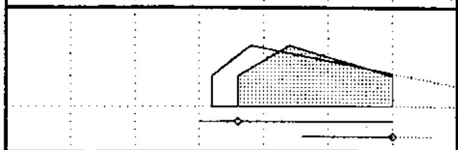	6	24	48	26	26	20	4					44	2	2	14	20	30	20	2
	6	31	53	36	33	17	0	6	25	17	39	64	0	0	3	31	39	17	0
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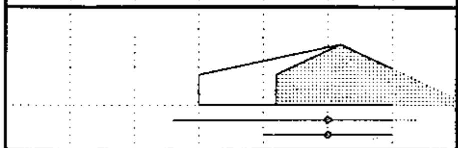	4	31	47	36	33	10	4					60	1	4	10	20	21	19	1
	4	31	52	41	37	11	0	0	30	22	39	76	0	0	4	24	31	19	0
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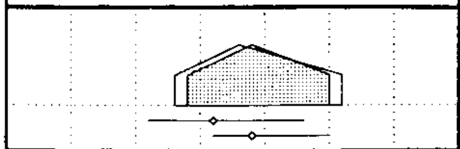	12	40	38	44	36	5	4					64	6	14	20	20	14	15	1
	9	47	36	59	28	4	1	3	36	34	19	77	3	10	17	28	22	15	0
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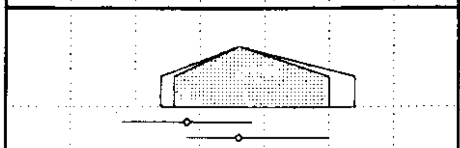	11	45	36	47	36	6	3					65	13	13	12	23	12	21	0
	10	54	31	61	29	4	1	3	26	46	17	76	8	9	9	29	26	15	0
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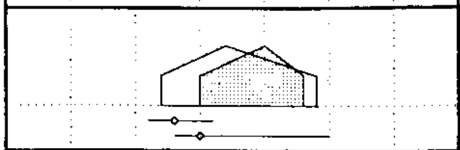
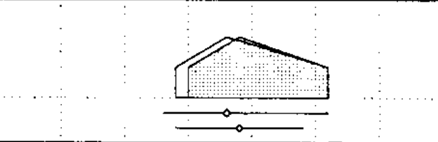
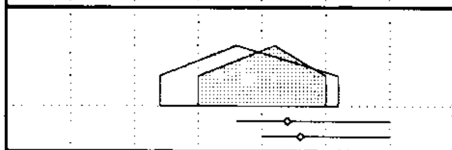
	11	43	31	41	33	8	4					60	1	0	19	23	22	23	2
	5	50	35	47	41	1	3	9	35	23	19	68	0	1	14	23	35	18	5
	0	100	0	50	25	0	25	25	25	25	25	75	0	0	25	25	25	50	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Individual	61. Elucidation of the outlines of the molecular mechanisms of development and differentiation.	1	181	35	27	23	15	69	25	4	0
		2	148	35	26	24	15	75	20	3	0
		X	61					93	3	2	0
	62. Elucidation of the mechanisms which determine the size and shape of a tree.	1	105	10	13	26	51	22	47	27	0
		2	76	9	11	24	56	18	58	20	0
		X	16					50	50	0	0
	63. Elucidation of the mechanisms of aging.	1	186	16	41	30	13	77	18	4	0
		2	149	14	35	36	15	80	15	3	0
		X	25					100	0	0	0
	64. Elucidation of the whole aspect of the functions of homeobox genes in a vertebrate.	1	149	19	26	26	29	44	48	5	0
		2	120	19	22	29	29	44	51	3	0
		X	33					70	30	0	0
	65. Elucidation of the relationship between the brain's neuron activities and the thinking processes.	1	130	7	17	37	39	56	36	3	1
		2	98	5	17	35	43	60	36	2	0
		X	9					100	0	0	0
	66. Development of artificial intelligence technologies that imitate the thinking processes of the brain.	1	106	3	14	33	50	42	46	7	2
		2	78	2	12	32	54	40	55	3	1
		X	3					67	33	0	0
	67. Development of technologies that distinguish and recognize three-dimensional and other complex patterns at close to human speeds.	1	97	4	8	34	54	44	44	6	1
		2	77	2	6	36	55	45	48	3	1
		X	4					75	25	0	0
	68. Elucidation of the mechanisms of higher mental activity responsible for intuitive solutions of problems (e.g., the intuition).	1	93	4	12	28	56	28	43	20	4
		2	70	2	9	29	60	21	54	17	6
		X	4					75	25	0	0
	69. Scientific elucidation of the presence of "ki" (psychic energy) such as in "sakki" (psychic atack).	1	85	4	7	30	60	11	38	31	18
		2	60	3	5	27	65	15	38	30	15
		X	5					60	20	0	20
	70. Elucidation of neuro-biological basis of feelings.	1	109	5	14	32	49	31	45	17	4
		2	81	2	11	34	53	28	48	16	5
		X	4					100	0	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%): High	Medium	Low	Necessity of international joint development (%): High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%): Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%): Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	21	46	26	56	27	8	3					57	2	1	7	39	36	17	1
	16	51	28	69	21	4	1	1	33	50	7	62	2	1	2	43	47	13	1
	31	56	10	79	18	0	0	3	39	54	0	51	2	2	2	49	54	18	0
	14	38	32	30	30	22	7					53	2	0	9	33	31	18	0
	14	39	38	43	34	13	1	1	28	28	37	67	1	0	3	32	33	18	0
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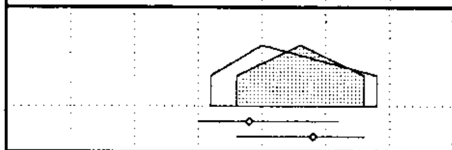	13	44	34	56	29	5	2					60	1	2	7	33	34	23	1
	6	50	38	67	25	1	2	1	36	40	15	73	1	1	3	31	48	17	0
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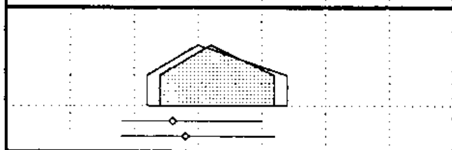	15	51	25	58	28	5	2					52	1	1	5	40	32	19	0
	13	52	30	68	21	4	2	0	23	60	9	64	3	0	1	38	45	13	0
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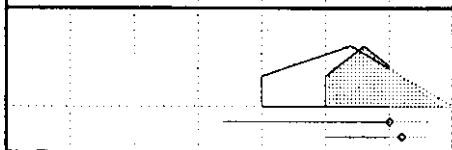	15	28	42	51	22	7	5					59	1	4	6	32	30	15	0
	11	35	45	63	21	3	3	1	29	41	19	70	1	2	3	33	45	9	1
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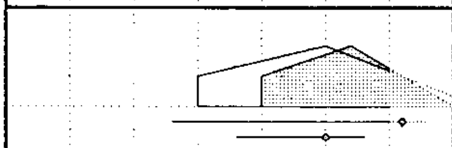	11	39	34	40	30	11	6					60	1	5	10	24	26	17	1
	6	41	42	55	29	6	3	4	35	19	28	72	0	5	8	26	40	14	1
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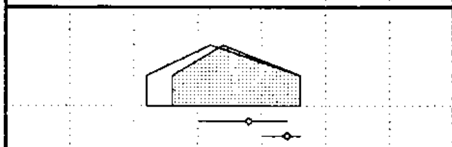	16	44	29	40	23	14	10					57	0	0	22	25	23	15	2
	6	61	29	56	25	8	5	9	34	30	19	74	0	0	16	30	35	10	3
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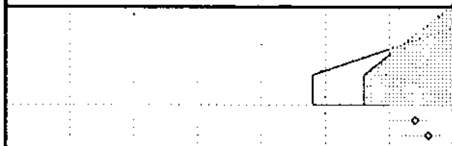	17	29	37	33	28	11	10					54	1	2	4	26	29	17	0
	11	29	54	40	34	7	10	3	24	26	39	71	0	0	1	27	39	17	0
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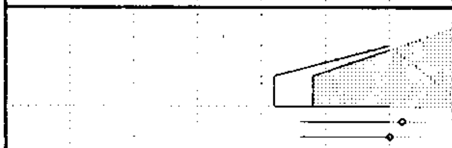	12	21	39	20	19	16	15					48	1	11	4	14	22	15	2
	8	27	53	33	22	18	13	12	18	13	42	62	0	12	2	12	38	20	3
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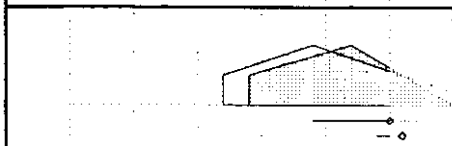
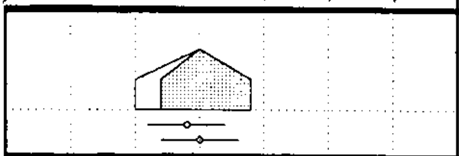
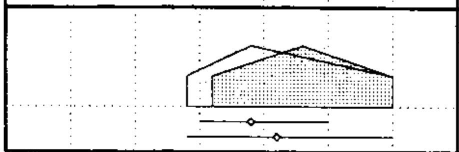
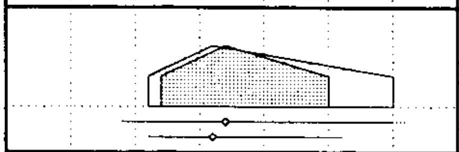
	9	35	39	36	28	8	11					57	1	6	5	28	32	14	1
	7	27	57	47	33	2	6	1	22	26	38	64	0	4	4	23	48	11	1
	50	25	25	25	50	0	25	0	50	50	0	75	0	0	0	25	50	50	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Individual	71. Establishment of methods enabling identification of threshold values for the cellular and genetic toxicity of environmental mutagens.	1	122	7	22	29	42	43	39	14	2
		2	93	7	21	26	46	44	43	11	1
		X	12					67	25	0	8
	72. Development of technologies for noninvasive measurement the expression of only desired genes in living state of higher organisms.	1	133	9	23	32	37	42	42	10	3
		2	103	8	23	29	39	45	45	7	2
		X	14					64	21	14	0
	73. Development of test methods that can replace to the use of test animals.	1	161	14	29	33	24	54	33	7	3
		2	128	12	28	35	26	61	31	5	2
		X	20					75	20	0	5
	74. Possibility of prevention of Alzheimer's disease.	1	147	9	25	34	31	78	19	1	0
		2	123	8	21	41	29	86	12	1	0
		X	14					100	0	0	0
	75. Possibility of healing of senile dementias such as Alzheimer's disease.	1	144	9	25	33	32	76	20	2	0
		2	119	8	22	38	32	87	11	2	0
		X	14					93	7	0	0
	76. Elucidation of the cause of manic-depressive psychosis at the molecular level.	1	124	6	21	31	42	57	35	6	0
		2	99	5	18	35	43	63	33	3	0
		X	8					50	50	0	0
	77. Elucidation of the cause of schizophrenia at the molecular level.	1	123	6	20	31	42	59	33	7	0
		2	97	5	17	34	44	66	27	6	0
		X	8					63	13	25	0
	78. Full-fledged medical application of the generic manipulation of genetic disorders.	1	168	13	26	40	21	62	29	6	1
		2	141	13	23	45	19	69	25	5	0
		X	22					95	5	0	0
	79. Being possible to use artificial manipulation in the expression of genetic information in higher organisms at the individual level.	1	173	25	26	32	18	48	40	9	1
		2	146	22	23	39	16	51	40	7	1
		X	39					72	23	5	0
	80. Establishment of controlling technologies and practical application of technologies that use complex system of microorganisms to produce useful substances.	1	119	11	21	24	44	39	48	11	0
		2	96	12	20	24	44	40	51	7	0
		X	20					55	30	15	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	16	38	39	46	34	11	3					52	12	4	8	28	24	28	1
	12	48	39	59	31	5	2	8	45	22	23	61	11	3	4	38	26	26	1
	17	58	25	50	42	0	8	8	67	25	0	58	17	0	0	25	42	50	0
	12	31	41	34	36	14	4					61	1	4	8	28	23	11	1
	12	40	42	46	42	6	3	0	24	34	38	75	3	1	5	33	31	13	1
	21	57	14	71	14	0	7	0	21	57	14	71	0	0	0	21	57	43	0
	26	35	24	47	28	11	4					56	9	5	12	21	20	19	1
	22	45	27	67	21	8	1	1	35	39	18	72	7	3	10	23	27	20	1
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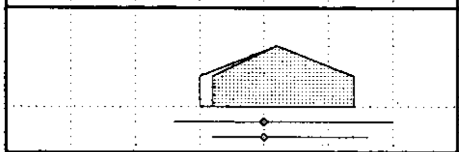
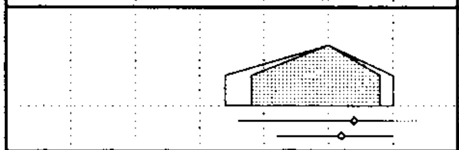
	10	40	39	67	20	4	1					68	3	2	10	25	22	22	1
	5	50	41	80	15	1	1	0	28	54	11	77	4	2	4	24	37	19	1
	21	64	14	86	14	0	0	0	43	57	0	93	0	0	21	14	14	29	0
	10	35	40	65	19	5	1					69	1	3	10	25	22	19	1
	4	49	44	81	15	1	0	1	25	56	12	78	3	2	4	24	34	18	2
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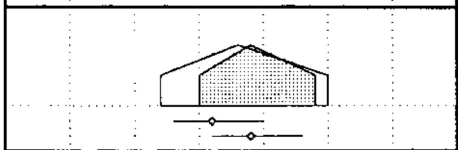	10	46	35	49	31	9	3					61	1	5	5	34	31	19	0
	3	53	41	68	21	6	2	0	29	35	27	67	3	3	3	28	41	18	0
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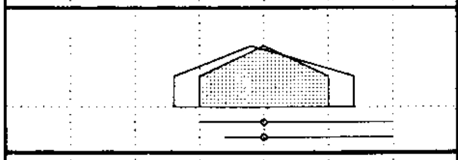
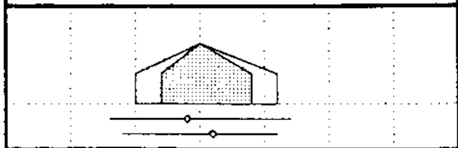
	7	39	44	52	27	10	3					63	2	7	5	33	30	16	0
	3	49	43	67	20	6	3	1	24	38	29	68	2	5	2	30	38	15	0
	0	50	50	75	13	0	13	13	25	63	0	88	0	13	0	25	38	25	0
	24	46	22	58	27	5	3					51	23	49	5	16	12	14	1
	19	52	23	72	18	4	1	0	16	72	6	63	19	50	3	14	14	13	1
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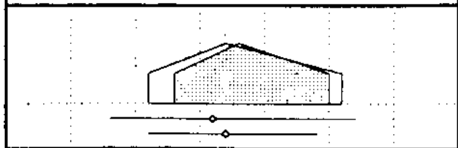	23	44	26	52	30	9	2					59	12	27	4	22	18	13	1
	15	55	23	66	25	3	2	0	32	49	12	71	8	25	2	27	22	11	0
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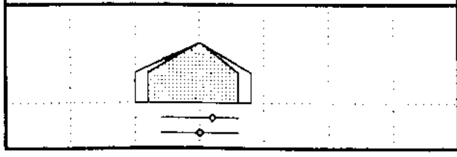
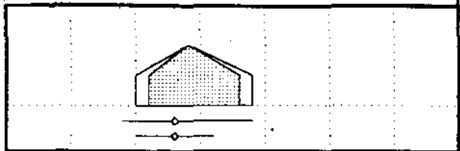
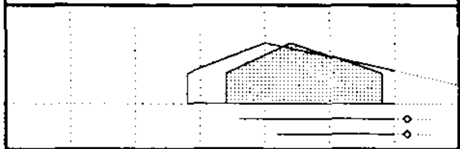
	18	56	20	24	44	18	5					57	3	1	30	26	19	18	1
	11	66	20	34	47	11	3	26	38	13	17	67	2	1	33	23	23	19	1
	30	65	5	40	55	5	0	35	45	20	0	60	0	0	35	25	30	20	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Individual	81. Development of plants, microorganisms, and other organisms that can concentrate specific ions.	1	125	7	19	33	42	24	58	14	2
		2	96	6	18	31	45	23	65	9	2
		X	11					36	64	0	0
	82. Practical use of plants storing carbohydrates in high concentrations as a fuel source.	1	102	7	14	27	52	41	40	12	4
		2	81	5	13	29	53	44	42	9	2
		X	9					78	22	0	0
	83. Development of technologies for breeding and cultivating organisms in (cosmo) space.	1	100	5	8	34	53	14	27	44	12
		2	75	4	8	31	56	15	29	47	5
		X	7					57	14	14	14
	84. Widespread use of new plants, produced through gene manipulation, as foods.	1	170	16	25	38	20	44	40	12	2
		2	141	18	21	42	18	50	38	9	1
		X	31					81	13	6	0
	85. Elucidation of biological homeostasis and development of automatic controllers applying biological homeostasis.	1	118	8	12	36	44	25	51	17	3
		2	95	6	12	37	44	24	58	12	3
		X	11					55	45	0	0
	86. Elucidation of the mechanisms of biorhythms in living organisms.	1	145	11	19	38	32	26	46	25	1
		2	109	9	17	37	37	23	50	24	1
		X	15					53	33	13	0
	87. Possibility of local control over immunity systems.	1	144	9	24	35	32	56	36	3	1
		2	120	10	20	39	31	64	30	3	1
		X	17					82	18	0	0
	88. Development of artificial placentas or development of technologies for complete *in vitro* culture system fetuses of small mammals.	1	117	7	15	33	45	26	50	11	9
		2	91	6	13	34	47	25	58	8	7
		X	11					55	36	0	9
	89. Development of interfaces enabling direct linkage between the computer and the brain.	1	86	5	10	25	59	36	31	19	12
		2	59	2	7	25	66	37	41	15	5
		X	4					75	25	0	0
Group	90. Establishment of technologies enabling prediction of the effects of human activities on natural ecosystems.	1	101	3	12	33	52	68	27	2	1
		2	73	2	9	31	57	78	19	0	1
		X	4					100	0	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	10	46	34	26	43	14	6					56	2	1	18	34	26	13	0
	7	54	33	34	44	17	1	7	36	16	35	70	1	0	18	38	26	16	0
	27	64	9	9	64	27	0	9	73	0	18	82	0	0	0	55	18	18	0
	10	34	43	38	36	11	5					55	0	2	36	21	17	17	1
	7	35	49	43	46	5	1	5	25	33	31	68	1	0	38	27	17	19	0
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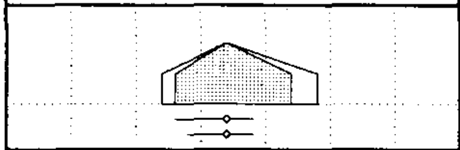	14	30	35	64	12	3	2					40	1	0	24	38	15	23	0
	11	45	33	80	8	1	0	0	7	63	19	59	0	1	21	49	12	23	0
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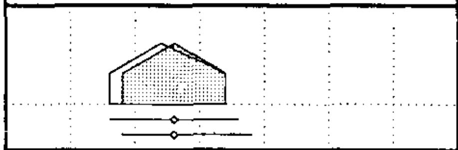	27	49	16	35	38	11	6					35	26	38	25	12	11	9	3
	27	54	14	40	43	9	3	4	44	35	9	48	23	43	21	10	13	13	1
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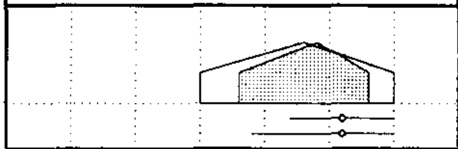	10	27	45	25	40	11	6					55	1	0	14	25	24	14	1
	5	33	55	35	49	5	3	2	31	22	36	71	1	1	9	34	28	18	1
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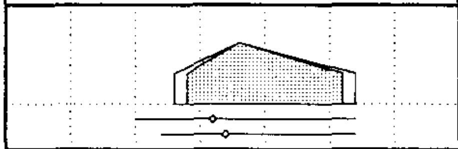	10	37	41	32	34	14	9					52	1	2	6	33	32	17	2
	6	39	50	43	44	6	5	1	29	33	30	72	1	3	3	38	42	13	0
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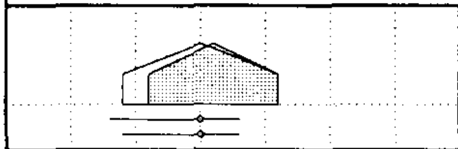	15	47	28	44	34	6	3					64	0	1	10	28	20	17	0
	11	53	31	58	32	3	3	3	38	35	15	78	2	0	7	27	30	14	0
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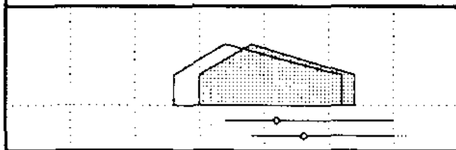	8	41	32	31	38	7	5					50	14	20	12	23	18	12	0
	8	44	37	45	33	5	7	4	22	42	21	67	9	19	9	26	23	10	0
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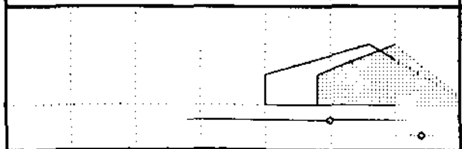	15	20	44	42	23	7	5					53	2	14	8	22	24	9	1
	3	24	64	59	27	3	2	3	20	39	27	76	2	14	7	29	36	10	0
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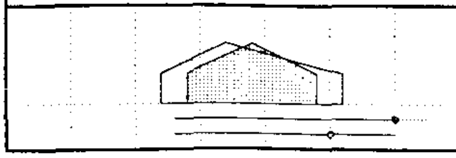
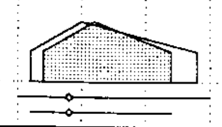
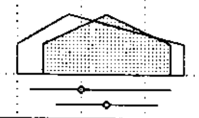
	10	38	43	74	13	3	1					43	6	9	8	34	27	34	2
	7	47	41	88	8	0	0	1	40	38	16	56	1	5	3	51	23	36	0
	50	25	25	75	25	0	0	0	75	25	0	100	0	0	0	25	25	50	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Group	91. Elucidation of the relationship between molecular evolution and morphogenetic evolution.	1	152	15	24	33	28	31	47	18	2
		2	120	12	25	32	31	32	52	14	1
		X	21					67	19	14	0
	92. Elucidation of the molecular basis of animals' actions such as contacting, sexual behaviors and migrations.	1	139	9	19	37	34	30	52	14	1
		2	107	8	15	40	38	30	56	12	0
		X	14					64	29	7	0
	93. Possibility of increased food production by dramatical improvement of photosynthetic ability in plants.	1	136	10	19	35	36	65	26	6	1
		2	106	10	15	36	38	77	17	3	1
		X	18					83	11	6	0
	94. Practical use of (breeding methods to produce) plants with drought and salt tolerance at a high degree to stop the spread of desert environments.	1	124	10	12	36	42	68	30	2	0
		2	96	12	10	34	44	83	15	1	0
		X	20					100	0	0	0
	95. Elucidation of the mechanisms of extinction of endangered species and establishment of corrective measures.	1	94	4	13	28	55	30	37	23	4
		2	70	4	11	26	59	30	40	23	4
		X	6					83	17	0	0
	96. Possibility of classification at the DNA level and clarification of the concept of species.	1	182	22	28	35	15	27	41	26	4
		2	151	21	29	37	14	25	48	23	3
		X	37					51	30	16	3
	97. Elucidation of the behaviors of microorganisms in the biosystem and practical use of genetically engineered microorganisms released into environments.	1	144	15	26	26	33	39	42	11	7
		2	112	17	23	25	35	38	47	11	4
		X	29					66	24	10	0
	98. Elucidation of the role of the biosphere with respect to the behaviors of atmospheric carbon, existing in the form of carbon-dioxide and others.	1	112	7	12	34	47	59	32	5	1
		2	88	7	12	33	49	69	26	2	0
		X	12					83	17	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	11	34	44	42	31	13	6					51	2	1	5	38	41	17	1
	7	42	47	53	34	7	3	5	34	40	17	61	1	1	3	37	54	17	0
	24	52	19	57	43	0	0	5	43	43	10	57	0	0	0	33	71	14	0
	9	42	38	45	31	10	4					58	1	3	4	37	35	21	1
	5	40	50	60	28	6	3	1	30	36	29	64	0	1	3	42	50	16	0
	14	64	21	79	21	0	0	0	43	43	7	79	0	0	0	21	64	36	0
	13	38	37	49	33	7	3					63	5	3	17	28	22	14	0
	8	42	42	66	23	5	0	3	41	30	20	68	1	2	17	36	27	18	0
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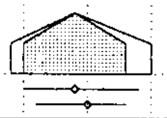	11	45	33	69	19	2	1					54	3	1	22	31	21	23	1
	9	47	41	83	13	1	0	6	38	34	18	69	3	0	18	46	21	21	0
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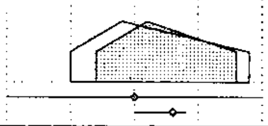	9	30	44	62	18	5	1					36	3	4	10	34	33	19	2
	4	29	59	74	17	3	0	3	20	46	26	50	1	6	7	39	44	24	0
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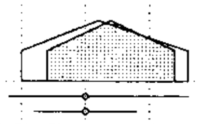	23	39	27	52	24	10	3					38	3	3	10	41	35	17	1
	21	46	29	68	21	4	4	2	40	38	13	49	2	2	6	47	44	19	1
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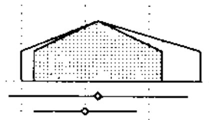	18	41	28	51	29	8	3					40	30	33	10	18	8	14	2
	15	52	28	62	29	2	2	2	30	47	13	48	35	42	4	17	11	14	3
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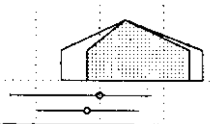
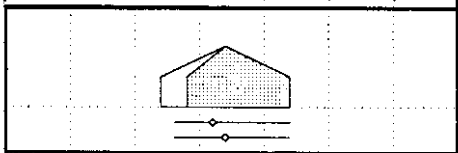
	13	38	39	74	16	2	1					46	5	1	6	43	25	29	1
	9	45	41	83	14	0	0	2	31	41	20	57	2	0	6	52	27	28	0
	42	42	17	75	25	0	0	8	42	50	0	42	0	0	17	67	42	33	0

4.4 Outer space

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Outer space	Probing and observation	1. Launching a multiple rendez-vous satellite probe to the main belt asteroids.	1	149	14	21	27	38	15	54	28	2
			2	133	12	20	31	37	10	59	31	1
			X	26					27	65	8	0
		2. Extended observation of the Venus atmosphere using balloons and investigation of the surface of Venus using an unmanned rover (probing vehicle).	1	176	15	23	35	27	19	50	30	1
			2	152	12	24	36	27	14	57	28	1
			X	26					31	50	15	4
		3. Realization of landing of unmanned satellite probes on Mars, which analyse materials on the surface, observe the meteorology, and lay a network for seismic observation.	1	185	18	27	32	24	31	51	16	1
			2	161	17	26	34	24	26	59	15	0
			X	35					51	43	6	0
		4. Landing and return of Mars manned spacecraft.	1	191	17	26	35	21	29	37	31	3
			2	167	16	27	36	21	27	40	30	4
			X	34					41	35	21	3
		5. Realization of a permanent, manned space observation base on the lunar surface equivalent to the Showa Base on the South Pole.	1	191	21	30	28	21	47	35	15	3
			2	166	20	32	27	21	48	35	15	2
			X	42					67	26	5	2
		6. Installation of optical or radio telescopes on the far side of the moon.	1	178	16	25	32	27	33	47	17	2
			2	156	14	23	37	26	30	47	21	1
			X	30					40	43	13	3
		7. Erection of manned laboratory facility on Mars.	1	183	16	27	34	24	21	34	33	10
			2	160	15	26	35	24	19	38	33	10
			X	32					38	34	22	6
		8. Development of space technologies including drag-free (free from aerodynamic forces) satellite equipped with ultra-precision acceleration sensors, and gravity wave detecting equipment utilizing space structures.	1	128	7	15	31	47	22	44	32	2
			2	116	4	16	35	45	19	47	32	2
			X	8					63	13	25	0
		9. Forecast of solar radiation activity to enable astronauts to stay in space for an extended period of time.	1	173	14	25	33	29	47	36	14	2
			2	151	12	25	35	28	52	34	11	2
			X	26					81	15	4	0
	Use of position	10. Development of moon-earth system communication networks using satellites in an orbit (halo orbit) which is on the line connecting the earth and the moon and which is around the balance point (Lagrange's point) located on the far side of the moon.	1	154	10	28	26	36	21	55	23	1
			2	138	9	28	29	34	17	62	21	0
			X	19					42	53	5	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	12	48	32	38	36	18	3					28	1	9	19	74	7	19	3
	8	55	36	48	35	14	2	0	23	71	5	37	2	8	18	83	7	22	2
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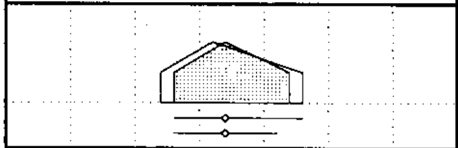	10	50	35	43	34	16	3					49	2	7	18	74	5	16	2
	7	60	32	51	39	8	1	1	11	84	3	59	1	6	18	86	3	9	1
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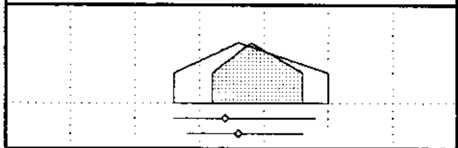	13	53	30	66	23	5	2					40	2	6	21	78	8	22	1
	6	65	27	76	19	3	0	0	10	87	2	48	1	6	19	88	6	16	1
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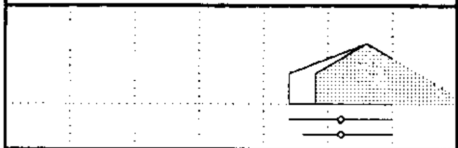	12	36	44	82	10	2	0					55	4	7	15	74	10	15	1
	8	44	45	92	5	1	0	0	4	92	1	65	1	5	11	85	6	11	2
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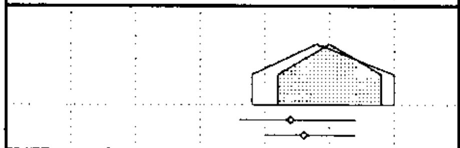
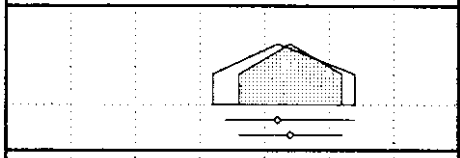
	14	43	38	81	13	0	0					51	5	4	18	78	10	15	1
	11	50	37	91	6	0	0	0	12	83	2	61	2	4	13	89	5	10	1
	19	52	26	90	7	0	0	0	17	83	0	60	0	2	12	95	7	19	2
	8	43	46	65	22	8	1					44	3	4	19	83	4	16	1
	5	49	45	74	19	4	1	1	25	64	8	53	2	6	15	88	3	12	2
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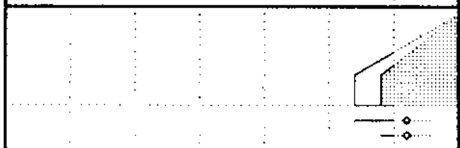
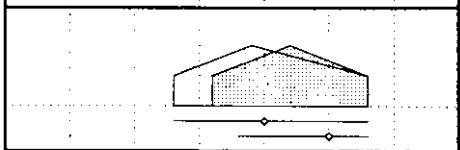
	15	26	48	84	5	1	0					55	3	4	15	73	5	13	2
	12	29	53	88	4	1	1	0	9	79	8	65	2	5	9	84	4	8	3
	22	31	44	91	6	0	0	0	16	84	0	63	0	6	9	94	6	22	0
	9	38	44	47	30	16	2					63	2	4	15	63	9	9	2
	3	41	52	53	33	9	3	1	34	41	21	72	0	4	12	72	8	8	2
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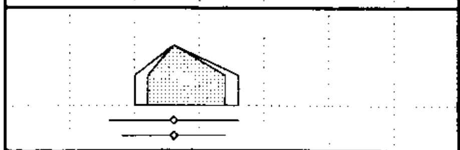
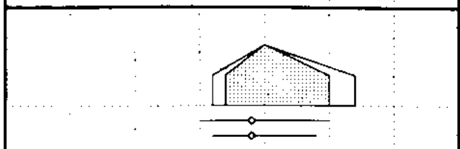
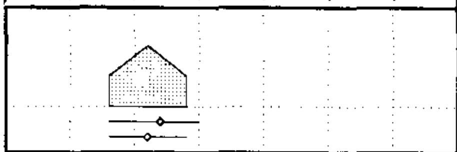
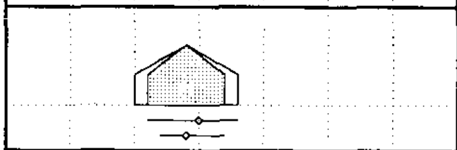
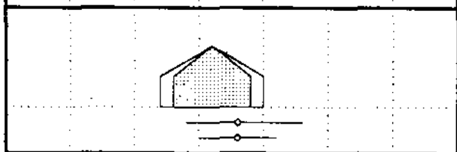
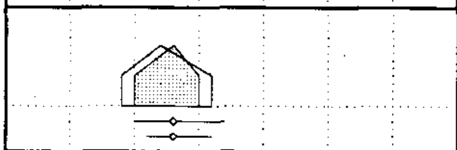
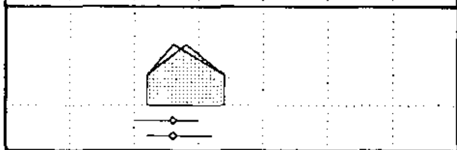
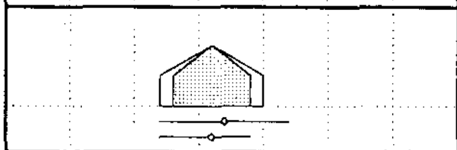
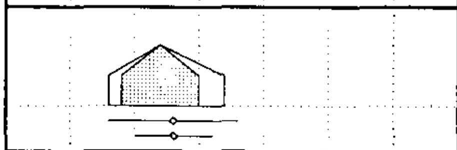
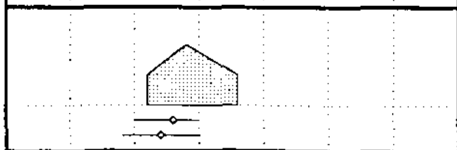
	24	51	21	54	25	13	2					32	8	3	14	54	14	25	3
	15	64	19	65	23	8	2	7	59	26	4	40	6	5	9	75	9	26	1
	46	46	8	58	35	0	4	15	58	23	0	23	0	0	12	77	31	42	0
	8	47	42	59	26	10	1					34	6	3	24	69	4	16	3
	8	50	41	69	22	6	1	1	40	46	9	43	4	5	20	83	3	14	1
	16	53	32	53	37	11	0	0	47	47	0	37	0	0	21	79	0	37	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Outer space	Use of position	11. Practical use of worldwide air traffic control systems using artificial satellites.	1	173	17	22	32	28	82	17	1	0
			2	151	14	27	31	28	87	13	0	0
			X	30					93	7	0	0
		12. Practical use of direct broadcast satellite systems based on multibeam technology with a service area of prefecture size.	1	154	14	19	31	36	18	39	30	13
			2	132	14	19	30	37	14	45	31	9
			X	29					10	48	28	14
		13. Application of multipurpose stationary platforms over the Pacific Ocean for international use.	1	176	20	27	27	26	46	45	5	3
			2	153	17	29	27	26	44	49	5	1
			X	35					51	37	6	6
		14. Development of navigation satellites for supporting automobile traffic.	1	179	16	23	34	26	37	41	15	6
			2	154	15	25	34	26	40	42	14	4
			X	31					48	45	6	0
		15. Development of technologies for operating cluster of satellites (aggregated satellites flying in formation).	1	140	16	22	21	42	27	45	23	4
			2	124	13	23	23	41	23	48	27	2
			X	27					41	41	15	4
		16. Development of technology for assembly of artificial satellites with large-scale antennae (several tens of meters in diameter) at permanent manned space stations in low-altitude orbits around the earth.	1	174	20	27	26	28	44	47	8	1
			2	156	19	28	28	26	43	52	5	0
			X	39					64	33	3	0
		17. Practical use of technology for measuring in real time the distribution and movement of atmospheric pollutants, based on observation from space.	1	177	16	25	32	27	71	25	2	1
			2	157	16	26	33	25	78	21	1	1
			X	33					94	6	0	0
		18. Practical use on artificial satellite of a scattero-meter for measuring wind velocity at sea with a minimum precision of 1 m/s.	1	123	9	21	21	49	29	55	13	2
			2	107	7	20	25	49	23	65	11	0
			X	14					50	50	0	0
		19. Practical use on artificial satellites of a microwave sensor for measuring the sea and ground surface temperature with a resolution of 0.1 degrees or less.	1	126	10	17	24	48	37	48	12	2
			2	113	8	17	28	46	33	56	10	2
			X	17					47	53	0	0
		20. Practical use on artificial satellites of a sea color sensor with a spectral resolution of 10 nm or less.	1	119	11	16	23	50	36	51	11	1
			2	106	9	17	25	50	31	58	11	0
			X	19					47	47	5	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	34	45	18	83	12	2	0					14	40	3	38	48	5	14	3
	32	53	14	91	7	1	0	5	56	34	3	14	51	3	45	58	1	7	1
	60	37	0	97	0	0	0	7	57	33	0	13	60	3	40	67	0	10	0
	16	37	33	2	10	29	45					18	28	10	51	27	3	3	2
	9	51	30	5	6	27	52	28	46	11	4	15	37	9	60	33	1	2	2
	17	59	10	10	7	21	48	28	55	3	0	24	38	14	59	28	0	0	3
	17	51	26	62	23	9	1					33	22	4	31	58	1	12	2
	16	56	27	74	17	7	0	6	47	40	5	37	18	3	29	76	3	8	3
	31	49	14	71	17	6	0	6	46	43	0	40	11	0	31	80	3	9	6
	23	45	21	15	20	37	21					28	20	2	56	38	3	5	1
	22	55	19	9	28	39	19	8	53	30	5	30	19	1	64	51	1	2	1
	45	48	6	10	39	26	26	6	48	45	0	45	26	0	61	58	0	0	0
	19	43	32	19	34	24	16					36	6	1	31	53	4	10	4
	15	46	38	16	38	27	16	3	39	52	4	44	4	2	31	74	3	7	4
	33	48	15	4	37	33	22	7	52	37	0	52	4	0	19	78	4	7	0
	19	49	29	40	33	17	8					48	2	1	30	68	5	14	1
	14	54	31	45	31	15	7	4	38	53	3	62	1	0	24	76	3	11	1
	31	59	10	51	18	15	15	5	41	54	0	56	0	0	28	82	5	18	0
	24	55	18	55	28	11	3					44	6	5	26	64	8	14	2
	17	70	12	64	26	6	3	3	65	26	4	56	6	3	25	73	6	12	0
	45	52	3	76	18	0	6	0	58	39	0	64	3	0	12	82	15	12	0
	17	46	31	26	38	22	11					63	2	2	21	48	7	10	1
	12	58	29	24	43	23	8	4	50	36	8	74	3	1	22	62	5	8	0
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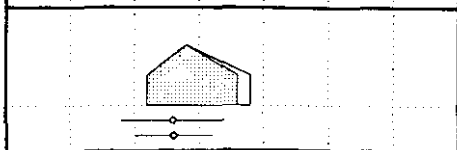	17	52	24	25	37	22	11					64	3	1	18	48	7	10	2
	10	59	27	21	48	22	5	6	51	29	9	79	1	0	19	63	4	6	2
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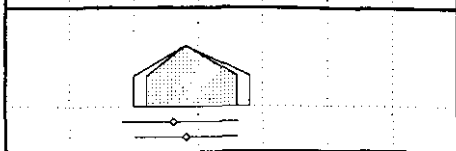
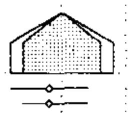
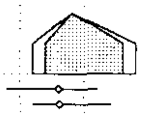
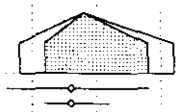
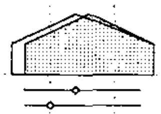
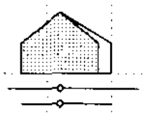
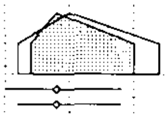
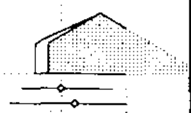
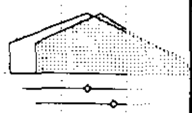
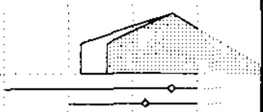
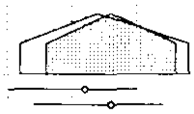
	18	46	31	24	38	21	13					65	2	1	21	45	5	12	0
	10	56	33	19	48	23	8	3	54	31	11	81	0	0	21	67	4	3	0
	32	58	11	21	42	21	16	5	53	37	0	79	0	0	16	68	11	5	0

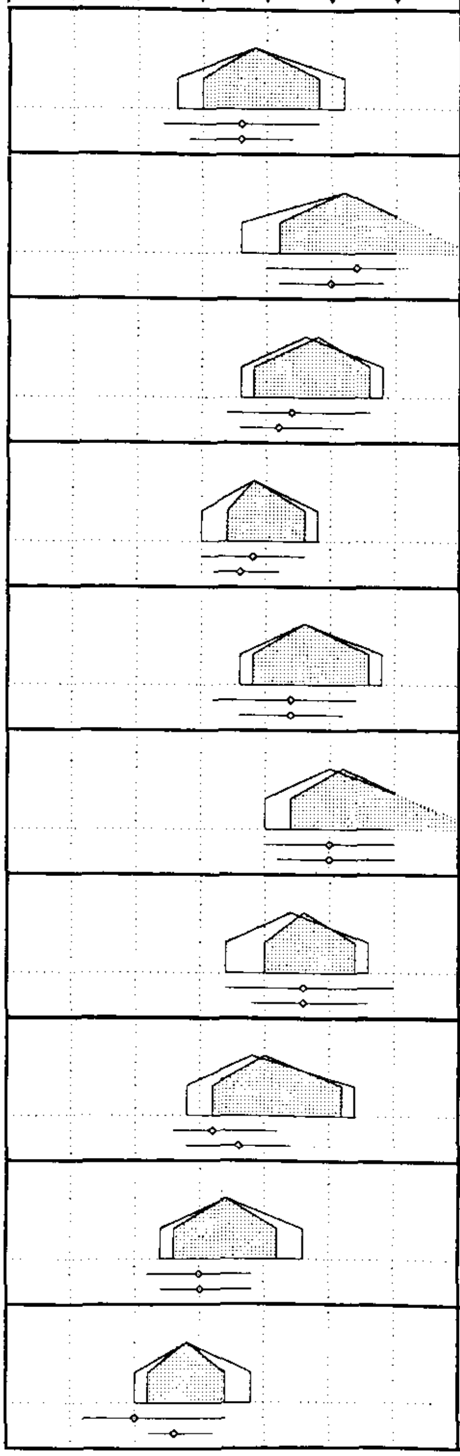
Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Outer space	Use of position	21. Practical use of microwave radiometers to be mounted on satellites, which are designed for measuring water, soil moisture, salt deposit concentration, and ice/snow distribution on land over the entire earth with a space resolution of 1 km or less.	1	128	10	18	26	46	48	46	5	0
			2	116	7	16	32	45	47	50	3	0
			X	15					33	67	0	0
		22. Realization of accuracy down to 1 cm or less in measurement of crustal movements based on very long baseline inter-ferometers (VLBI), satellite lasers, and inverse laser ranging, improving the precision of earthquake forecasting.	1	154	12	19	34	36	56	37	6	0
			2	136	8	19	38	35	58	38	4	0
			X	17					59	41	0	0
	Use of environment	23. Development of life support technology applied to a closed ecosystem, able to self-supply vegetable, grain, animal protein, and other food.	1	146	10	20	30	39	52	33	15	0
			2	132	10	21	32	37	58	30	11	0
			X	21					62	38	0	0
		24. Realization of space factories for commercial production of semiconductors or pharmaceuticals, utilizing the environment of space.	1	180	17	25	32	25	44	43	13	0
			2	157	14	27	33	25	45	42	13	0
			X	30					57	33	10	0
		25. Practical use of a robot equipped with sophisticated artificial intelligence and flexible arms for performing difficult tasks in space.	1	187	20	22	37	22	59	35	5	0
			2	164	17	21	40	22	65	30	4	0
			X	36					81	17	0	0
	Use of substance and energy	26. Practical use of isotope batteries for probing deep space.	1	137	10	20	28	43	49	39	11	0
			2	118	8	21	27	44	54	36	9	0
			X	17					82	12	6	0
		27. Practical use of lunar materials (e.g., Si, O_2 and ^3He) as natural resources.	1	175	11	23	38	27	41	37	17	5
			2	152	9	24	40	28	44	39	14	3
			X	18					50	39	11	0
		28. Practical use of nuclear power generating system at lunar bases.	1	169	10	20	40	30	27	42	21	9
			2	147	9	20	40	30	23	52	18	7
			X	19					58	26	11	5
		29. Capability for transmission of electrical power to earth by microwave from solar power generation plants with huge solar cell panels, constructed in space.	1	200	14	31	36	18	47	32	15	7
			2	173	14	32	36	18	49	30	13	8
			X	29					66	21	7	7
	Transportation	30. Development of super heat-resistance technologies that can be utilized for solar fly-by (swing-by).	1	126	7	20	25	48	30	32	33	5
			2	112	6	20	28	47	21	40	35	3
			X	12					42	25	33	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	13	49	33	29	36	21	11					58	2	2	21	55	6	13	1
	9	53	37	28	43	20	9	5	52	31	11	71	2	0	17	74	7	6	0
	33	53	13	27	33	27	13	7	60	27	0	67	0	0	7	73	13	13	0
	14	47	34	45	30	17	5					51	4	1	16	66	8	14	2
	6	55	38	48	36	13	4	10	67	14	9	64	1	1	16	80	8	10	0
	29	65	6	53	24	18	6	12	76	12	0	47	0	0	12	76	18	29	0
	12	45	39	38	38	18	3					51	5	8	18	53	10	20	1
	6	59	35	37	47	14	2	2	31	58	8	63	2	4	17	70	8	13	2
	14	67	19	52	38	10	0	10	43	48	0	57	5	5	14	71	19	19	0
	12	44	38	38	29	18	11					39	4	1	63	47	8	8	2
	11	47	41	34	37	18	10	5	27	59	8	44	2	0	66	55	6	5	3
	30	47	20	40	30	13	17	7	20	73	0	40	0	0	60	77	10	0	3
	18	48	32	21	36	30	11					60	1	1	25	61	7	11	3
	15	56	29	15	41	35	8	23	53	19	3	71	0	1	20	76	5	5	1
	31	56	11	22	47	19	8	19	67	11	0	72	0	0	19	78	8	6	0
	14	42	33	20	29	28	18					42	26	23	16	29	3	15	4
	6	50	38	14	39	28	15	0	20	69	7	49	29	19	15	42	4	12	3
	29	59	12	18	29	29	18	0	18	82	0	41	35	35	6	47	0	12	0
	7	30	52	62	25	5	3					53	5	4	38	51	5	11	3
	8	32	59	64	27	4	3	2	28	56	13	64	2	3	39	68	3	6	1
	28	39	33	50	39	0	11	6	50	44	0	61	6	0	39	67	6	17	0
	9	25	50	50	27	6	6					44	20	18	19	42	2	8	4
	5	30	58	54	27	7	4	1	22	57	11	56	18	14	19	54	2	5	5
	26	42	26	58	21	5	11	5	32	53	5	53	5	21	32	42	5	11	11
	11	33	45	61	21	6	5					55	7	5	42	49	2	8	6
	9	39	47	68	18	4	3	5	40	35	12	63	6	2	39	59	1	5	4
	34	48	14	72	14	3	0	17	45	31	3	62	14	0	45	52	0	10	0
	6	30	56	25	33	25	11					75	1	2	13	48	2	13	2
	2	28	67	23	35	27	12	4	48	29	16	85	0	0	8	67	3	8	2
	8	42	50	17	42	8	33	8	58	33	0	75	0	0	8	67	0	33	8

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Outer space	Transportation	31. Use of a method in which two satellites or a space station and a satellite are connected with long tethers for variable gravity, power generation, payload acceleration, etc.	1	145	13	23	24	40	20	44	35	0
			2	127	12	23	25	40	17	48	35	1
			X	25					20	56	24	0
		32. Practical use of nuclear propulsion systems.	1	160	11	22	33	34	35	44	18	3
			2	137	7	25	34	35	36	47	13	3
			X	14					64	21	14	0
		33. Development of manned inter-orbit transportation systems for trips to and from geostationary orbits and the moon.	1	177	19	22	33	27	45	39	15	1
			2	155	18	23	33	26	50	38	12	0
			X	38					66	29	5	0
		34. Development of high-performance inter-orbit transportation equipment to transfer large structures between low and geostationary orbits.	1	179	21	23	30	26	55	39	4	1
			2	158	19	24	32	25	63	32	4	1
			X	40					75	23	3	0
		35. Expansion of space stations enabling them to serve as relay stations to the moon and Mars.	1	189	21	28	29	22	49	38	10	3
			2	164	22	30	27	22	59	32	7	1
			X	46					72	22	4	2
		36. Emergence of business of spacecraft tours of space in vicinity of earth.	1	175	13	20	39	28	15	26	45	14
			2	154	12	22	39	27	18	25	45	12
			X	26					46	15	27	12
		37. Practical use of space planes that fly between the ground and space stations like airplanes.	1	187	22	23	31	23	60	29	10	1
			2	161	18	26	33	23	67	27	6	0
			X	37					76	22	3	0
		38. Reduction of the space transportation cost of 1/10 or less of the current cost by using heavier booster rockets.	1	163	21	18	28	33	71	23	5	1
			2	142	18	21	28	33	77	20	2	1
			X	39					90	10	0	0
		39. Development of slush hydrogen (sherbet-like solid hydrogen) as rocket fuel.	1	117	12	16	20	52	39	44	15	2
			2	101	10	16	23	52	38	50	11	0
			X	20					55	40	5	0
	Technologies related to human activities	40. Development of technologies for removing micro-organisms that lead to uncomfortable factors in space life such as mildew and offensive smells in space stations.	1	127	7	17	29	48	47	40	12	1
			2	111	8	13	31	47	51	41	8	0
			X	17					65	35	0	0

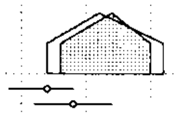
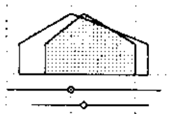
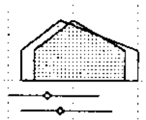
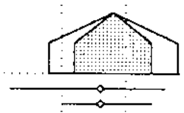
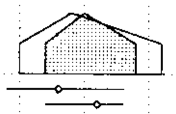
Forecasted realization time (Year)

1995 2000 2005 2010 2015 2020



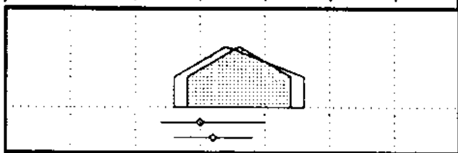
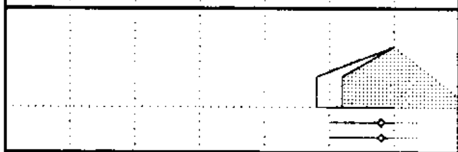
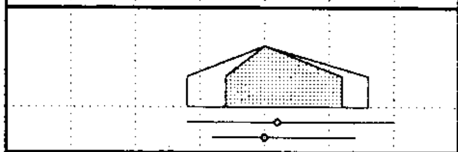
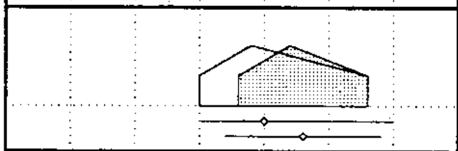
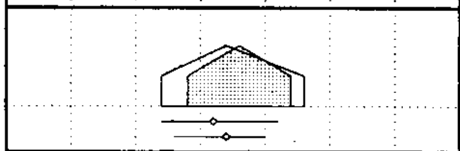
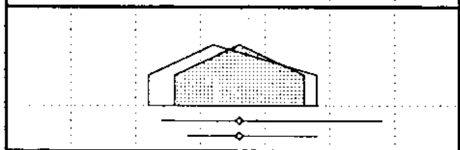
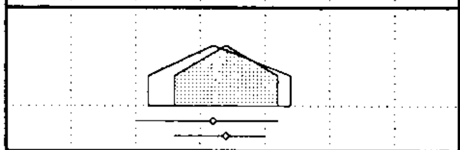
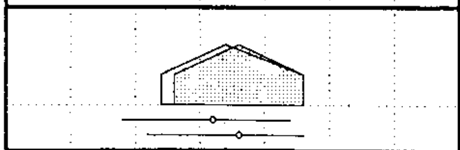
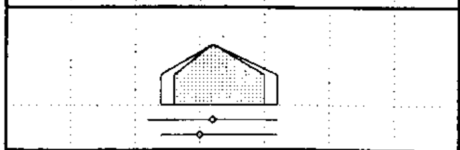
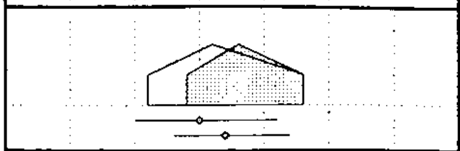
Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
7	41	45	28	39	21	10					61	1	1	17	49	8	12	6
6	50	43	23	50	19	8	1	33	49	17	70	1	0	13	73	6	7	4
28	48	24	16	56	8	20	0	48	52	0	56	4	0	12	72	20	12	4
12	27	49	46	27	15	6					43	21	30	13	44	3	9	7
10	29	56	48	34	12	4	0	15	75	7	57	17	31	9	58	4	3	4
29	50	21	57	21	7	14	0	7	93	0	64	21	29	0	50	14	7	7
12	43	39	66	23	6	2					56	3	3	23	73	6	7	2
6	56	36	73	21	4	1	0	11	86	1	68	2	2	15	89	3	3	2
11	79	11	71	18	5	5	0	24	76	0	68	0	0	13	97	5	3	3
17	48	32	51	28	13	4					49	3	1	26	78	5	8	2
8	64	27	58	30	9	2	1	13	82	3	64	1	0	21	86	3	3	1
20	68	13	45	38	13	5	3	28	70	0	70	3	0	23	83	5	10	0
15	42	37	86	8	2	1					42	4	3	22	75	5	11	3
11	55	32	89	7	1	1	0	10	85	3	53	2	2	21	87	2	5	2
20	61	17	89	2	2	2	0	17	78	2	50	2	0	24	89	4	4	2
15	27	46	39	23	13	14					27	15	11	64	27	3	4	4
10	33	50	44	24	14	12	1	16	58	18	38	12	10	69	34	1	3	5
31	38	31	58	15	0	27	0	15	73	12	46	19	12	58	38	8	8	8
18	38	40	57	29	9	3					63	2	1	30	71	1	11	1
14	45	42	70	24	5	1	0	12	84	2	76	0	1	25	76	2	4	1
35	38	27	70	19	5	3	0	14	86	0	84	0	0	19	76	3	11	0
15	40	36	36	33	14	10					53	6	1	29	57	4	13	4
13	46	38	44	37	9	6	0	18	73	4	59	1	1	28	74	3	7	2
31	51	18	38	38	15	8	0	28	69	3	51	3	3	38	69	5	10	5
9	42	37	21	38	22	15					64	2	1	21	48	6	12	2
6	42	50	21	43	23	11	0	32	41	25	77	2	0	14	61	5	9	0
25	50	25	20	35	30	15	0	45	50	5	75	5	0	15	45	10	30	0
18	39	39	23	35	28	12					50	3	2	20	44	6	18	2
13	49	36	18	47	29	3	2	40	45	12	64	2	3	15	57	5	14	1
35	65	0	18	35	47	0	6	53	41	0	53	12	6	12	59	6	29	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Outer space	Technologies related to human activities	41. Development of technologies for full recycling of water and oxygen at space stations.	1	168	12	21	37	31	73	24	3	0
			2	150	10	22	39	29	79	21	1	0
			X	22					86	14	0	0
		42. Development of high-pressure flexible suits for working outside spaceships.	1	139	7	20	31	43	51	40	9	0
			2	124	5	20	34	41	54	43	3	0
			X	11					73	27	0	0
		43. Development of self-diagnosing and self-recovering space robots.	1	150	13	19	30	38	65	29	6	1
			2	136	11	20	33	35	71	26	2	0
			X	24					79	17	4	0
		44. Possibility of observing minute space debris (space dust, broken pieces of satellites and rockets, and space refuse such as coating chips, etc.) that are harmful to space stations, etc., and development of technologies for avoiding such dangers.	1	159	15	27	24	34	67	28	4	0
			2	143	14	25	29	32	77	22	1	0
			X	30					93	7	0	0
		45. Implementation of experiments on humans remaining in weightless space environments for more than 500 days.	1	178	12	21	41	27	39	42	15	4
			2	155	10	24	40	26	43	43	12	3
			X	21					52	38	10	0
		46. Realization of facilities where ordinary people can stay for an extended period of time (approximately 1 year or more) in space.	1	176	12	22	39	28	29	34	27	10
			2	154	10	25	38	26	31	39	23	7
			X	21					33	48	10	10

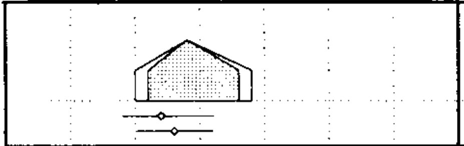
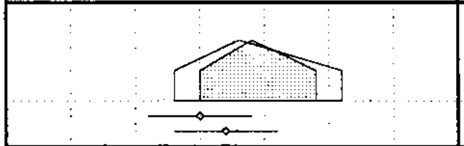
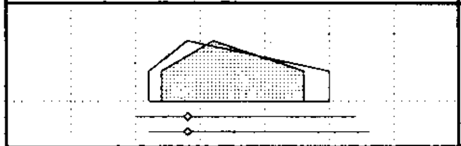
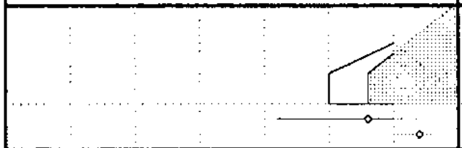
Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	18	45	34	39	35	18	7					51	1	4	27	55	7	18	2
	14	51	34	39	42	13	4	1	33	57	8	64	1	1	23	67	3	17	2
	45	45	9	36	36	18	9	5	45	50	0	64	5	0	23	68	0	23	0
	15	44	39	35	39	20	4					60	1	1	22	57	7	12	2
	10	48	40	31	48	16	2	1	12	83	2	76	1	0	18	66	3	7	2
	36	45	18	45	45	9	0	0	36	64	0	73	0	0	18	82	0	9	9
	13	43	41	26	40	24	8					70	1	1	17	56	5	11	3
	5	48	46	24	45	27	2	14	59	21	5	83	1	0	13	67	3	7	2
	21	58	17	25	33	38	0	13	67	13	4	83	0	0	13	75	0	8	0
	13	47	35	61	26	7	2					67	4	1	18	57	4	13	2
	7	58	32	68	24	3	1	1	20	68	8	87	2	0	10	68	2	6	1
	20	60	20	67	27	3	3	0	23	63	13	87	3	0	10	63	3	13	3
	17	45	30	63	24	5	3					39	7	15	8	43	21	10	7
	10	55	30	70	20	5	2	0	2	93	1	50	5	13	8	61	17	8	7
	33	57	5	76	19	0	0	0	5	90	0	48	10	19	5	62	19	14	0
	13	34	39	66	16	3	2					38	9	12	23	50	8	6	4
	5	38	49	75	14	2	3	1	5	82	4	49	4	10	27	70	4	3	2
	14	43	29	71	10	0	5	5	10	67	0	57	5	0	29	57	0	5	0

4.5 Particles

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Particles	Accelerator	47. Realization of electron/positron collider with center-of-mass system energy of 1 TeV or more.	1	121	27	17	16	40	50	35	13	0
			2	99	25	17	16	42	54	32	13	0
			X	43					72	23	5	0
		48. Realization of proton/proton collider with center-of-mass system energy of 1,000 TeV or more.	1	116	24	18	17	42	34	36	22	7
			2	95	22	18	16	44	33	42	19	5
			X	37					38	51	8	3
		49. Practical use of radio frequency accelerators with about 1 GV/m accelerating gradient.	1	108	21	17	15	47	55	31	12	1
			2	89	20	17	15	48	62	30	6	0
			X	35					74	23	0	0
		50. Practical use of subminiature accelerators utilizing plasma waves.	1	96	15	15	18	52	38	49	10	1
			2	81	14	16	18	52	42	47	7	1
			X	23					70	26	0	0
		51. Practical use of linear accelerators utilizing high-temperature superconducting technologies.	1	135	17	25	25	33	48	42	7	2
			2	113	18	26	22	34	56	41	3	1
			X	31					65	32	3	0
		52. Practical use of electron or positron storage rings with stored currents of 10 Å or more.	1	123	23	22	17	39	33	44	17	4
			2	100	23	21	15	42	36	52	8	1
			X	39					41	46	8	3
		53. Practical use of electron or positron storage rings with an emittance of 0.1 nanometer radian or less.	1	109	22	19	14	46	39	47	11	0
			2	90	21	19	12	48	36	56	6	0
			X	36					42	56	0	0
		54. Development of high intensity and ultra cold neutron sources that enable measurement of neutron life time with an accuracy of about 0.1 sec.	1	82	9	18	14	58	34	44	21	0
			2	66	10	16	14	60	26	50	21	0
			X	16					38	56	6	0
		55. Practical use of X-ray free electron lasers with a wavelength of 0.1 Å to 100 Å.	1	122	20	20	21	39	63	30	6	1
			2	102	20	19	21	41	69	25	6	0
			X	34					79	12	9	0
		56. Practical use of technologies for deflecting and focusing particle beams, utilizing new technologies such as channeling.	1	94	13	19	16	53	23	48	21	5
			2	76	12	18	15	55	22	53	21	3
			X	20					35	55	10	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	20	50	25	64	26	4	1					64	2	1	14	74	8	8	3
	18	57	23	77	18	2	1	7	58	26	3	71	3	0	11	83	7	9	2
	30	65	5	79	16	2	2	9	72	14	2	81	5	0	12	79	12	5	0
	16	23	46	78	7	2	3					62	2	0	17	66	5	5	4
	11	28	54	83	7	1	1	3	28	44	14	75	1	1	14	79	2	3	3
	22	30	46	95	3	0	3	0	22	62	16	81	3	3	14	78	5	3	3
	12	33	44	49	31	6	8					82	1	0	10	34	12	8	2
	7	44	43	61	30	2	2	3	55	26	9	91	0	0	10	44	10	4	1
	11	51	34	63	29	0	6	6	60	26	0	94	0	0	6	37	20	6	0
	7	25	57	38	31	20	5					81	0	0	11	24	18	6	3
	2	27	63	46	33	15	1	2	43	28	17	90	0	0	6	31	14	9	2
	9	39	48	52	35	4	4	0	57	22	9	96	0	0	0	26	22	17	0
	7	43	43	31	33	23	8					80	2	0	18	28	10	8	1
	8	43	47	35	36	23	4	15	67	0	13	92	0	0	14	42	10	5	2
	10	61	29	48	35	16	0	19	68	0	10	100	0	0	6	29	16	3	3
	12	41	39	34	35	14	11					80	0	0	16	37	7	5	2
	8	44	43	34	39	17	7	7	68	9	10	91	1	0	10	52	2	3	2
	13	51	28	46	31	10	8	3	82	5	3	90	3	0	10	46	5	5	0
	15	41	39	34	40	14	8					83	1	0	10	41	13	5	2
	12	41	43	31	47	16	4	8	64	11	10	94	0	0	8	49	10	3	2
	22	50	25	33	50	8	6	8	75	6	6	94	0	0	6	39	17	8	0
	9	38	48	33	34	17	11					73	1	5	6	44	9	7	2
	8	41	48	35	36	20	6	0	56	23	14	86	0	0	9	45	9	6	3
	13	69	19	56	31	6	6	0	63	25	6	94	0	0	19	31	19	6	0
	13	45	36	36	31	20	7					86	0	0	8	40	10	7	3
	14	44	39	33	44	13	7	6	53	26	9	89	0	0	9	50	7	6	4
	24	47	29	53	26	12	9	6	53	29	9	94	0	0	6	47	18	15	0
	7	39	43	23	28	22	15					74	0	1	9	19	13	10	2
	5	42	46	28	34	22	12	0	45	26	20	88	0	0	5	28	11	7	3
	20	55	25	40	40	10	10	0	50	30	15	95	0	0	5	20	20	15	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Particles	Accelerator	57. Practical use of technologies for creating any desired patterns of 10 nanometers or less by lithography, using synchrotron orbital radiation (SOR) as a light source.	1	130	19	24	21	35	68	28	2	1
			2	107	19	23	20	38	77	21	2	0
			X	32					97	3	0	0
		58. Development of powerful positron sources, and widespread use of positron microscopes.	1	96	12	19	18	52	30	45	21	3
			2	77	11	19	15	55	34	43	19	3
			X	18					72	22	6	0
		59. Creation of new elements with atomic numbers of 120 or higher.	1	74	12	8	17	62	15	36	28	16
			2	61	12	7	18	63	13	38	36	11
			X	20					20	50	15	15
		60. Development of sub-lightspeed ion beam propulsion rockets.	1	72	5	11	20	63	25	56	13	4
			2	61	5	12	20	64	23	59	13	5
			X	8					13	63	13	13
		61. Development of technologies for producing and storing antimatters and energy sources which utilize them.	1	72	11	13	13	64	26	28	29	13
			2	61	10	14	13	63	23	31	31	13
			X	16					6	50	25	19
		62. Development of ultra fine particle beam technologies for gene engineering.	1	73	5	13	19	63	40	45	11	1
			2	60	5	14	17	64	48	40	8	2
			X	8					75	25	0	0
		63. Determination of feasibility of muon nuclear fusion reactors.	1	93	11	17	19	53	33	39	24	2
			2	78	10	18	20	53	26	49	23	1
			X	16					50	38	13	0
		64. Development of quenching processing and nuclear transmutation technology for radioactive waste by high-energy elementary particles.	1	107	16	24	14	45	61	30	3	6
			2	87	17	19	16	48	67	26	2	
			X	29					76	14	3	3
		65. Development of portable particle accelerators that can be mounted on aircraft and the like for repairing ozone holes.	1	77	8	10	22	60	30	38	18	13
			2	66	7	11	22	60	33	35	17	14
			X	11					55	27	0	18
		66. Widespread medical use of free electron lasers with variable wavelengths.	1	108	14	17	23	45	47	35	15	2
			2	87	13	15	24	48	52	36	11	0
			X	22					77	18	5	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	24	43	27	10	31	26	26					75	2	0	31	25	8	8	2
	18	50	30	15	33	28	22	43	42	2	7	84	0	0	36	25	8	6	2
	41	53	6	13	44	22	22	50	47	0	0	91	0	0	34	22	16	6	0
	19	25	47	17	33	21	20					69	2	1	23	27	8	6	3
	14	36	47	18	43	19	18	5	58	14	16	87	1	1	13	45	9	4	3
	28	50	22	22	44	11	22	11	67	22	0	89	6	0	22	17	22	11	0
	12	27	34	28	20	18	9					55	0	3	4	26	16	7	4
	11	26	44	34	26	18	5	0	25	39	18	61	0	0	5	36	7	8	5
	25	40	20	30	45	10	0	0	25	55	0	60	0	0	5	40	10	5	5
	13	22	49	40	24	10	10					74	0	0	8	39	11	6	3
	11	23	57	57	23	10	3	2	26	34	31	89	0	0	7	56	3	5	3
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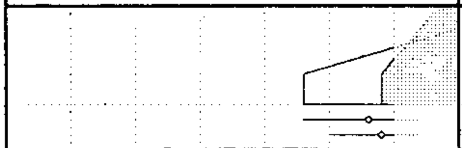	15	21	39	47	11	8	7					64	0	0	18	18	4	10	4
	13	25	49	57	11	7	8	2	25	33	23	80	0	0	18	26	2	11	5
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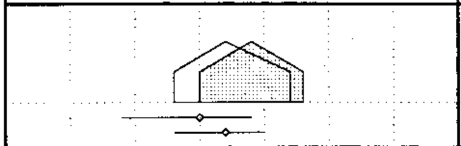	5	48	36	22	37	21	12					73	3	7	8	29	12	14	1
	3	57	38	28	37	27	5	10	47	15	22	82	3	3	7	37	10	18	0
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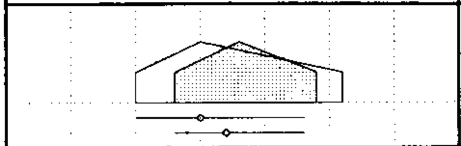	14	32	40	49	27	12	2					74	2	1	15	24	6	9	4
	9	38	49	55	24	12	4	6	59	9	15	83	4	0	17	37	5	9	5
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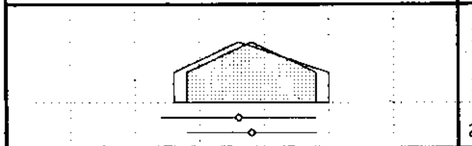
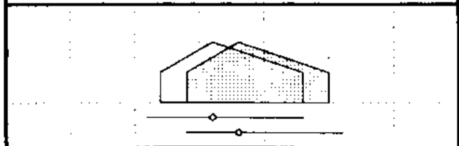
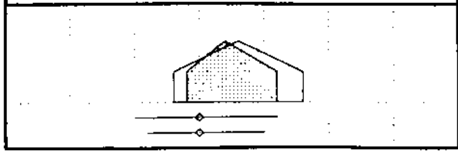
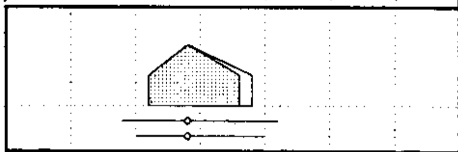
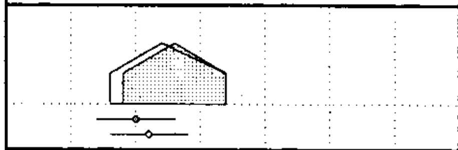
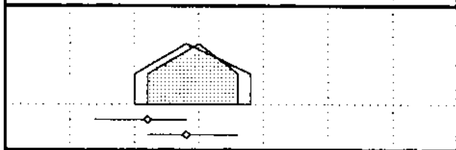
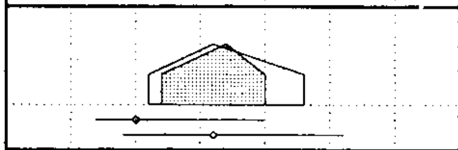
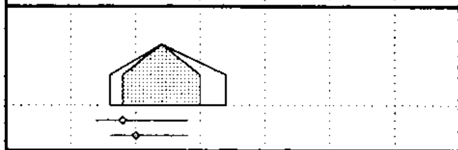
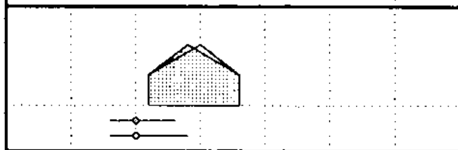
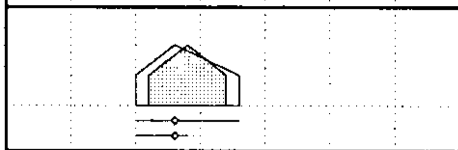
	11	48	30	50	26	9	4					73	4	7	24	30	4	10	3
	10	56	30	56	25	10	5	8	53	18	15	84	2	7	25	36	2	11	3
	24	62	14	41	31	14	14	17	66	10	3	79	3	3	38	48	3	14	3
	10	34	36	53	16	6	6					60	1	3	17	35	9	9	3
	6	35	47	55	18	8	5	3	39	23	14	71	0	0	17	41	5	9	3
	27	45	18	55	18	0	18	9	27	45	0	91	0	0	18	27	9	9	9
	14	38	40	17	38	23	13					64	2	0	31	22	12	11	4
	8	44	45	22	40	24	9	2	54	26	9	80	3	0	41	20	6	9	1
	27	41	32	27	41	23	9	0	45	50	5	73	9	0	36	18	14	18	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Particles	Accelerator	67. Widespread use of subminiature proton and heavy ion accelerators for medical treatment and diagnosis of deep-body cancers.	1	112	17	23	17	43	65	24	6	3
			2	95	16	21	18	44	67	25	5	1
			X	28					79	18	4	0
	Measurement and detection technologies	68. Practical use of analog-digital converting devices with an accuracy of 10 b or more and a sampling frequency of 10 GHz or more.	1	81	7	14	21	58	58	30	9	0
			2	69	4	14	23	58	62	29	7	0
			X	7					100	0	0	0
		69. Practical use of semiconductor optical detecting devices with more than one million pixels capable of detecting one photon in a visible light area.	1	94	10	13	25	52	63	24	7	2
			2	79	9	17	21	53	72	22	4	1
			X	15					100	0	0	0
		70. Development of semiconductors that do not deteriorate in performance at 100 Mrad radiation.	1	84	9	16	18	57	46	43	7	1
			2	66	8	15	17	60	56	38	5	0
			X	13					62	31	8	0
		71. Development of charged-particle detectors with a time resolution of 10 ps.	1	85	20	13	11	57	46	44	9	0
			2	68	21	13	7	59	57	38	3	0
			X	34					76	24	0	0
		72. Practical use of computers with a throughput exceeding 10 TFlops.	1	84	4	16	23	57	87	13	0	0
			2	68	4	16	21	59	93	7	0	0
			X	6					100	0	0	0
		73. Practical use of large-capacity recording equipment with a writing speed of 1 GB or more per second.	1	90	7	16	23	54	80	19	1	0
			2	72	5	17	21	57	86	13	0	0
			X	9					100	0	0	0
		74. Practical use of electro-magnets for high energy physics experiments using high-temperature superconducting wires.	1	121	17	20	23	40	47	36	17	0
			2	100	16	21	21	41	55	27	17	0
			X	28					68	14	18	0
		75. Practical use of online detectors for measuring the traces of charged particles with an accuracy of 1 μm within a range of 1 m.	1	75	16	13	9	62	47	31	19	0
			2	57	18	11	6	65	53	30	14	0
			X	29					69	24	7	0
		76. Practical use of analysing equipment with a precision ceiling on the order of parts per trillion.	1	66	6	11	18	66	61	30	8	0
			2	59	5	11	20	64	73	24	2	0
			X	8					88	13	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	19	51	22	15	29	31	17					49	4	2	35	37	13	7	2
	14	59	23	22	35	27	11	8	62	13	9	60	5	3	40	41	13	6	1
	25	64	11	18	39	32	7	14	57	21	4	57	11	4	39	46	21	7	0
	10	41	37	12	25	22	31					70	0	0	30	16	7	7	1
	7	54	33	12	32	25	25	33	43	0	14	84	0	0	32	13	6	7	1
	29	43	29	43	14	29	14	29	43	0	14	86	0	0	14	29	29	0	0
	16	36	35	7	26	29	31					77	0	0	26	19	7	9	1
	8	49	38	9	28	33	25	43	35	4	10	87	0	0	32	22	5	8	1
	20	67	13	27	27	20	27	20	53	13	7	80	0	0	33	27	7	7	0
	15	27	40	13	29	20	25					77	0	1	17	19	6	8	4
	12	29	53	20	32	18	23	17	47	12	15	86	0	0	23	18	3	11	3
	38	38	15	31	0	31	31	15	38	15	15	77	0	0	8	31	8	15	0
	22	54	20	24	28	24	19					81	0	0	13	25	14	5	4
	21	62	15	25	34	18	19	9	71	7	10	88	0	0	13	29	10	7	1
	38	56	6	29	44	15	12	9	76	6	6	94	0	0	18	18	6	9	0
	18	43	32	12	27	24	30					80	0	0	26	21	8	6	2
	13	60	25	15	35	24	25	41	43	9	3	93	1	0	24	21	4	10	1
	33	67	0	17	67	17	0	17	50	17	0	100	0	0	33	17	0	17	0
	17	47	30	11	24	30	28					76	0	0	22	19	8	7	2
	14	58	28	13	32	29	25	50	42	1	3	94	0	1	29	17	4	8	1
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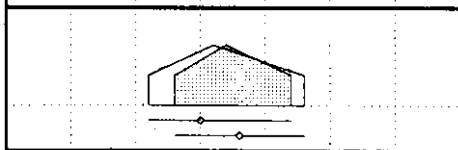
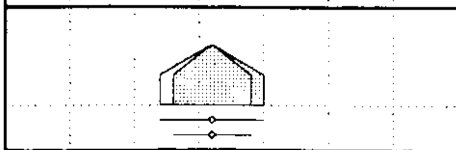
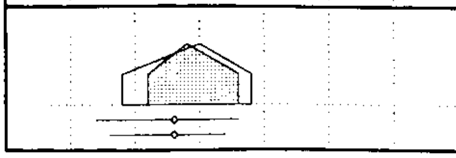
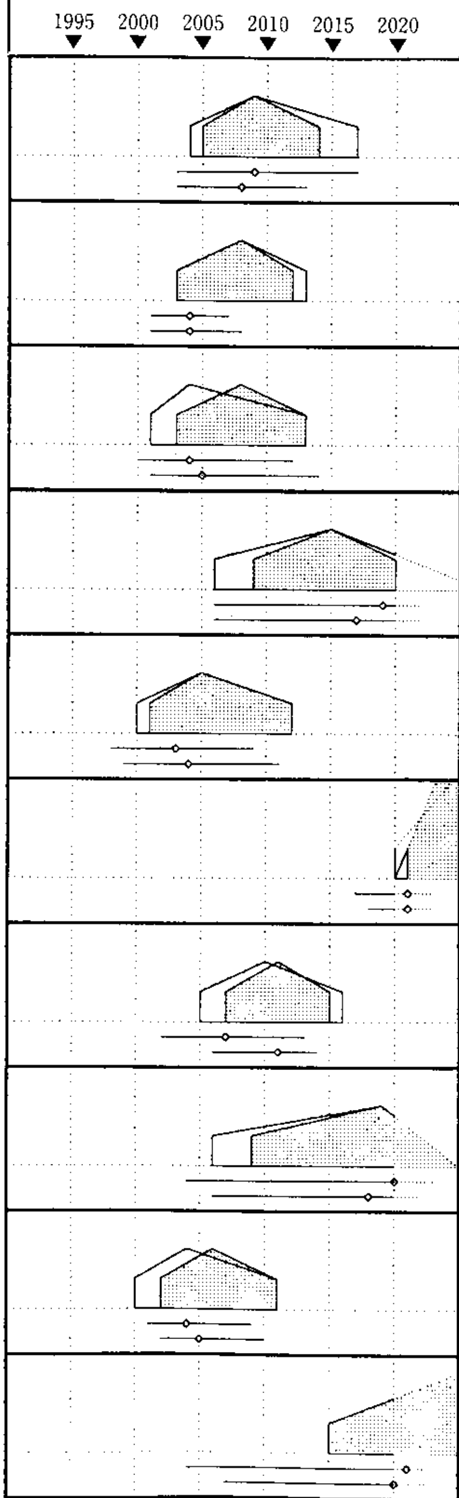
	8	47	37	21	37	22	13					85	0	0	20	25	6	6	2
	7	57	34	25	48	16	9	30	57	2	5	93	0	0	22	32	2	5	2
	11	79	11	43	32	14	11	36	64	0	0	96	0	0	29	25	4	0	4
	9	53	29	39	25	16	11					79	0	0	8	31	9	8	1
	7	65	26	39	33	21	5	9	74	12	2	89	0	0	18	33	7	7	2
	14	76	10	34	41	17	7	7	72	17	0	90	0	0	28	24	7	3	0
	6	55	29	20	30	23	15					73	0	0	26	21	11	5	3
	7	56	32	20	37	22	14	8	68	5	10	88	0	0	24	24	7	8	0
	25	63	13	38	25	13	25	25	63	13	0	100	0	0	13	38	0	13	0

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Particles	Measurement and detection technologies	77. Widespread use of X-ray microscopes as same as that of current electron microscopes.	1	90	7	18	21	54	43	38	14	1
			2	72	7	16	20	57	46	44	7	1
			X	12					75	25	0	0
		78. Practical use of hard X-ray holography.	1	77	6	14	19	61	31	52	14	0
			2	66	7	12	21	60	33	58	6	0
			X	11					64	36	0	0
		79. Detection of gravitational waves with laser interferometers or the like.	1	85	7	14	23	56	48	34	15	1
			2	72	7	15	22	56	46	40	10	1
			X	11					82	18	0	0
		80. Detection of 1.9 K cosmic background neutrino.	1	73	12	11	15	63	53	19	25	0
			2	63	11	12	15	62	57	21	19	0
			X	18					94	6	0	0
		81. Determination of the presence of neutrino mass.	1	85	19	12	13	57	64	27	9	0
			2	73	19	12	14	56	71	23	5	0
			X	31					90	10	0	0
		82. Construction of proton decay detectors of the million-ton class on the lunar surface.	1	78	12	12	15	60	17	31	32	19
			2	61	11	13	13	63	16	25	39	18
			X	18					22	39	17	22
		83. Start of the use of high-resolution spectroscopes with spectrum resolution $\Delta E/E$ of 10^{-5} or less.	1	74	9	14	15	62	41	41	16	1
			2	60	9	13	15	64	43	37	17	2
			X	15					73	20	7	0
		84. Development of method for surveying earth's interior by the use of some type of powerful particle beam (e.g., neutrino).	1	78	11	14	15	60	36	40	21	4
			2	63	10	13	15	62	33	52	10	3
			X	17					47	41	6	6
		85. Practical use of equipment capable of realtime X-ray structure analysis for large bio-macromolecular crystals, including the collection and analysis of diffraction data.	1	74	5	14	18	62	62	28	5	1
			2	67	5	13	23	60	64	28	4	1
			X	8					100	0	0	0
		86. Development of new telecommunication systems utilizing (or using) media other than electromagnetic waves (e.g., neutrino, etc.).	1	71	9	10	17	63	28	30	28	13
			2	57	9	9	17	65	30	33	23	11
			X	14					29	50	14	7

Forecasted realization time (Year)



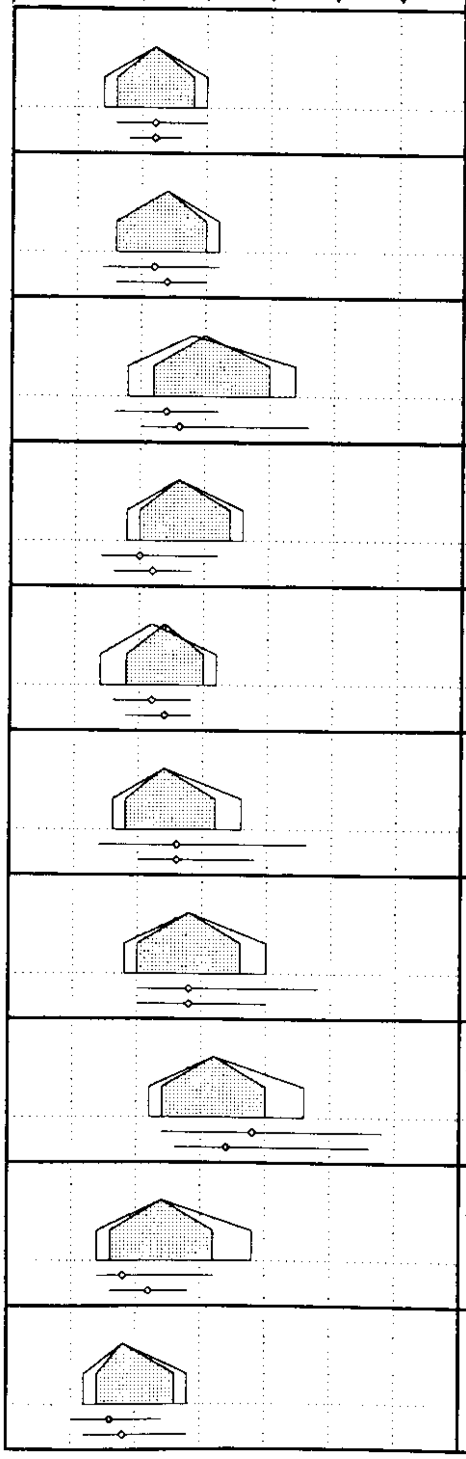
Degree of certainty (%): High	Degree of certainty (%): Medium	Degree of certainty (%): Low	Necessity of international joint development (%): High	Necessity of international joint development (%): Medium	Necessity of international joint development (%): Low	Necessity of international joint development (%): None	Comparison of current R&D level between Japan and other countries (%): Japan is more advanced	Comparison of current R&D level between Japan and other countries (%): Equivalent	Comparison of current R&D level between Japan and other countries (%): Other countries are more advanced	Comparison of current R&D level between Japan and other countries (%): Don't know	Constraints on realization (%): Technical	Constraints on realization (%): Institutional	Constraints on realization (%): Cultural	Constraints on realization (%): Cost	Constraints on realization (%): Funding	Constraints on realization (%): Fostering/securing human resources	Constraints on realization (%): R&D system	Constraints on realization (%): Others
10	40	40	16	26	30	19					70	0	1	20	23	11	8	2
8	40	46	17	38	29	14	15	56	18	7	83	0	1	24	26	10	13	1
42	50	8	25	33	25	17	17	42	33	8	83	0	0	25	25	25	25	0
9	38	44	14	38	26	13					75	0	0	9	31	12	5	1
8	42	44	20	36	29	11	15	55	11	12	88	0	0	6	32	11	9	0
36	64	0	18	27	36	18	36	45	0	18	100	0	0	0	36	18	18	0
11	34	46	46	28	11	8					71	0	0	6	40	15	6	2
3	44	47	51	32	6	7	1	53	29	10	83	0	0	4	47	13	6	1
18	55	27	73	18	0	9	0	82	18	0	91	0	0	18	45	9	18	0
12	26	47	53	25	5	3					67	0	0	4	33	15	8	1
10	29	57	62	29	5	2	11	57	10	17	87	0	0	8	38	10	10	2
22	39	39	78	17	0	6	11	67	6	11	100	0	0	11	28	6	6	0
15	35	42	55	21	13	7					73	1	0	9	36	19	9	6
15	44	40	58	26	10	5	7	71	16	4	84	1	0	4	44	19	11	5
29	52	19	42	39	6	10	10	81	6	0	84	3	0	6	35	19	16	10
9	18	46	64	5	0	1					51	1	3	14	54	4	3	1
10	20	56	74	7	3	2	5	28	28	21	62	2	0	13	66	3	5	2
22	28	28	67	11	0	0	6	39	22	11	61	6	0	17	56	0	6	0
8	24	55	45	34	7	3					62	0	0	11	45	8	8	1
5	32	57	50	35	8	2	3	50	27	13	80	0	0	7	57	5	8	2
13	60	27	33	47	13	7	7	73	7	13	87	0	0	13	67	7	7	0
9	27	51	71	13	3	3					72	0	0	15	45	8	8	1
6	27	62	78	16	0	2	3	48	22	21	86	0	0	13	56	6	5	2
24	47	24	59	29	0	6	6	53	18	18	82	0	0	18	53	6	6	0
12	49	27	31	41	11	8					66	0	0	16	32	12	15	1
7	58	30	27	45	16	7	12	64	12	6	78	0	0	13	43	7	12	1
38	50	13	25	63	13	0	13	75	0	0	88	0	0	13	38	13	25	0
13	15	52	45	15	17	1					73	0	0	11	27	8	8	1
11	23	54	54	16	11	5	2	42	16	25	82	0	0	12	35	7	9	2
14	36	36	50	29	0	0	0	50	14	21	86	0	0	21	36	14	7	0

4.6 Marine science and earth science

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Marine science	Observation and forecast	1. Practical use of tsunami forecasting systems based on tide and tsunami observation through satellites and on other data including shelf topography.	1	188	11	30	39	21	46	48	6	0
			2	170	7	29	40	24	45	49	4	1
			X	16					50	44	6	0
		2. Practical use of global system for detecting sea surface variability which combine space technologies (VLBI, GPS, and satellite remote sensing) with tidal observation technologies.	1	168	7	27	37	29	40	48	11	1
			2	156	7	25	40	29	35	56	8	0
			X	15					47	47	7	0
		3. Practical use of satellites remote sensing technology capable of yielding highly precise information on sea temperature, currents, and chlorophyl concentration down to 200 m depth.	1	172	12	29	32	27	49	40	9	1
			2	153	10	25	34	30	48	45	5	1
			X	23					78	17	4	0
		4. Practical use of automatic observation systems which are fixed at open sea and are capable of long-term (a few years) monitoring of marine phenomena and conditions from the vicinity of the sea surface down to 6,000 m depth.	1	177	13	30	33	24	38	42	16	2
			2	159	11	27	34	27	36	50	11	1
			X	25					76	24	0	0
		5. Widespread use of ultrasonic, underwater holographic technology capable of application for probing underwater objects.	1	127	3	21	31	45	20	58	20	1
			2	110	4	19	27	49	14	68	17	0
			X	9					33	56	11	0
		6. Practical use of technologies for predicting and forecasting changes in the ocean currents in the seas adjoining Japan.	1	176	15	25	35	25	52	39	7	0
			2	160	12	25	35	27	54	40	4	0
			X	26					73	23	4	0
		7. Development of technologies based on large-scale numerical models for forecasting changes in the global oceans.	1	164	10	24	36	29	59	35	6	0
			2	150	9	21	38	32	67	30	3	0
			X	20					95	5	0	0
		8. Development of forecasting technology for the fluctuation of marine resources based on elucidation of the mechanism of change in ocean currents and temperature.	1	160	11	24	34	31	59	35	4	0
			2	140	11	19	34	36	64	31	4	0
			X	23					83	17	0	0
		9. Practical use of image analysis systems capable of identifying minute oceanic life (microorganisms, planktons, etc.).	1	135	11	19	28	42	21	58	21	0
			2	117	8	18	27	46	19	61	20	0
			X	18					39	50	11	0
		10. Practical use of marine observation system using amphibious aircraft by which specimens are gathered, instruments are installed and retrieved.	1	154	10	21	34	34	24	41	28	6
			2	138	10	20	34	37	19	46	28	4
			X	21					43	29	14	10

Forecasted realization time (Year)

1995 2000 2005 2010 2015 2020



Degree of certainty (%): High	Medium	Low	Necessity of international joint development (%): High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%): Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%): Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
26	52	19	54	36	9	2					36	13	2	23	43	16	32	4
22	59	16	63	32	2	2	28	38	21	13	40	10	2	22	55	12	38	2
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14	63	20	88	10	1	0	9	36	42	12	38	6	2	14	65	10	38	1
47	53	0	100	0	0	0	7	33	60	0	13	13	7	13	73	20	40	0
16	47	29	53	31	9	2					61	7	3	17	44	16	22	1
13	52	32	65	27	5	1	5	41	39	14	71	6	1	10	58	11	22	0
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24	42	29	38	41	12	3					48	7	2	32	55	5	17	2
18	50	27	43	43	10	1	7	49	25	17	50	6	1	26	68	6	18	0
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11	58	30	15	40	33	11	6	46	30	16	56	5	2	41	49	11	9	0
44	44	11	33	22	33	11	22	56	22	0	44	11	11	33	33	11	33	0
19	48	26	25	34	28	8					43	9	3	19	47	15	27	2
11	56	28	25	41	26	4	42	37	8	11	53	4	3	14	63	14	28	1
27	54	15	23	54	19	0	38	35	15	4	65	0	0	15	62	19	19	0
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40	50	10	90	10	0	0	0	50	45	0	45	5	0	20	60	30	35	5
14	46	36	38	40	15	4					54	6	1	18	38	25	28	2
9	50	39	41	48	6	3	22	46	12	15	64	4	2	11	47	26	29	1
26	48	22	39	48	9	0	30	43	22	0	61	0	0	4	39	35	48	4
18	46	32	19	24	36	16					52	5	4	22	38	24	19	1
14	56	28	21	30	34	12	19	44	18	15	62	4	2	22	45	24	18	1
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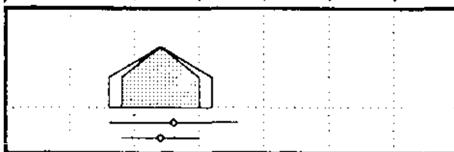
29	38	24	15	26	28	24					21	21	2	36	49	9	15	3
26	38	30	14	30	32	20	9	37	30	17	20	17	2	45	59	5	14	4
48	29	14	19	24	24	24	19	38	24	14	14	29	5	48	48	5	10	5

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Marine science	Observation and forecast	11. Extensive use of high-technology survey vessels specializing exclusively for geological, geophysical, physical or biological research, in addition to multi-functioned survey vessels currently in vogue.	1	200	26	32	27	15	38	41	17	5
			2	181	23	31	27	19	33	50	14	3
			X	51					55	33	10	0
		12. Development of remote sensing technology using sea bottom stations that monitor temperature, current direction and speed, salinity, oxygen concentration, and other parameters at all depths.	1	176	14	29	33	24	30	49	18	2
			2	159	12	29	32	27	28	57	14	1
			X	26					58	31	12	0
		13. Practical use of ocean observation systems employing continuous acoustic tomography.	1	142	8	24	29	39	33	51	14	1
			2	123	7	22	28	44	26	60	12	1
			X	15					47	47	7	0
		14. Development of technologies involving artificial intelligence capable of detecting and monitoring sudden environmental changes on ocean floors on a long-term, selective basis, requiring no maintenance.	1	133	8	20	30	42	26	43	25	4
			2	116	6	19	28	47	28	52	17	3
			X	12					67	25	8	0
		15. Practical use of methods for gathering abyssal specimens by using unmanned untethed submersibles.	1	185	15	30	33	22	31	52	16	1
			2	171	13	33	31	24	29	61	10	0
			X	28					61	39	0	0
		16. Widespread use of continuous observation by using automatic floating observation boxes which move with the deep currents from the Antarctic Ocean to the northern hemisphere.	1	124	8	20	25	47	19	45	27	6
			2	112	6	20	25	49	16	51	29	4
			X	13					38	38	15	8
		17. Practical use of systems capable of continuously monitoring environmental changes, interaction between sea ice and seawater for an extended period of time (a few to several months) under sea ice in the polar regions.	1	123	6	23	24	47	22	47	28	2
			2	108	4	20	26	51	15	56	29	1
			X	9					44	44	11	0
	Preservation and creation of environments	18. Construction of artificial islands for processing waste for offshore dumping in waters to about 100 m depth. (Refuse is completely disassembled and decomposed for the purpose of dumping harmless portions and recycling useful portions of the refuse.)	1	159	18	25	26	31	52	30	9	8
			2	143	17	22	26	35	57	29	9	4
			X	37					70	27	3	0
		19. Practical use of highly reliable automatic observation systems (chemical oceanography) located on the open sea, capable of monitoring marine pollution on a long-term basis (at least one year, without maintenance).	1	162	11	31	29	29	47	46	6	1
			2	147	9	29	29	33	48	50	3	0
			X	20					65	30	5	0
		20. Development of systems capable of monitoring changes in biological resources on shallow ocean floors over an extended period of time.	1	135	10	25	23	41	42	41	15	1
			2	118	9	21	24	46	39	48	10	3
			X	19					53	37	5	5

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	26	45	21	32	28	23	11					13	18	3	37	58	14	26	1
	19	57	18	34	32	22	8	10	47	29	10	7	13	2	43	69	11	30	2
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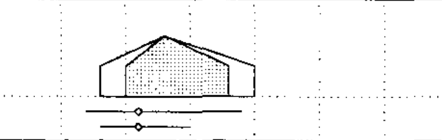	19	49	25	24	36	24	9					45	5	2	30	57	7	15	1
	13	60	23	25	48	20	4	6	42	31	18	51	5	1	31	67	6	12	1
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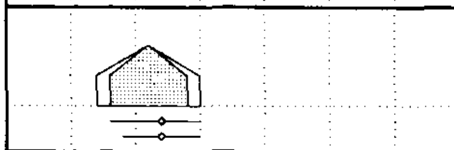	25	46	23	37	27	23	8					45	6	1	20	54	12	16	1
	15	56	23	41	33	19	4	8	37	40	11	54	3	2	19	68	11	10	0
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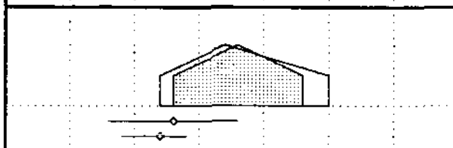	11	34	44	37	33	17	5					57	6	2	16	56	9	16	0
	9	35	49	41	41	9	4	12	41	16	27	64	5	1	17	69	7	10	1
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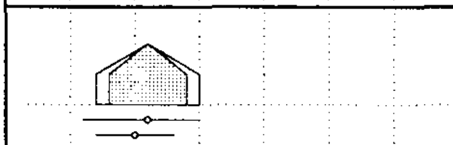	31	45	21	26	31	25	14					49	3	3	34	57	4	14	1
	25	55	19	25	37	27	10	13	48	28	9	56	1	1	38	66	5	11	0
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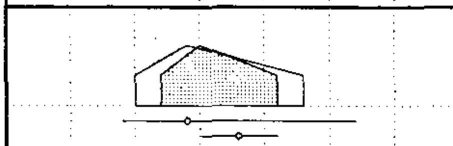	10	38	38	56	28	2	2					45	6	2	20	49	9	18	2
	7	43	42	64	24	2	4	3	38	33	20	50	4	0	28	66	7	15	1
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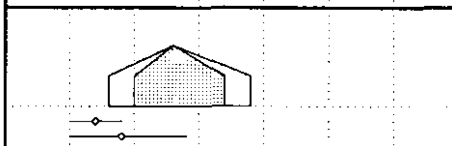	15	46	33	58	28	5	2					41	11	2	17	62	9	24	1
	9	54	31	61	27	3	3	2	35	43	16	44	4	1	20	77	6	22	0
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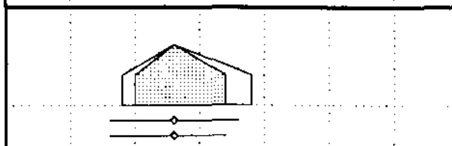	25	35	30	13	13	29	37					27	38	21	33	28	4	8	4
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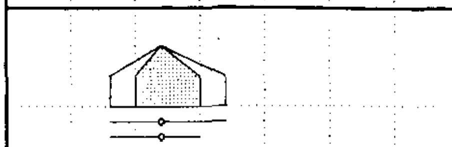	20	44	31	34	28	19	15					54	7	1	28	56	6	14	1
	14	56	28	34	38	17	8	7	52	22	16	59	6	3	22	73	7	11	1
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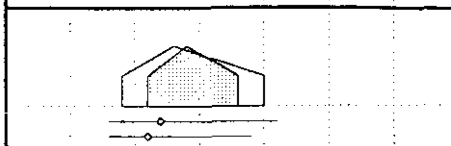
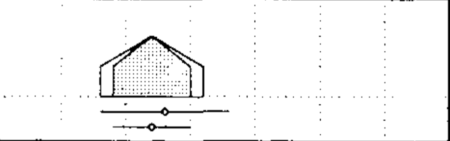
	16	45	35	21	31	29	14					53	10	3	23	50	14	21	1
	9	53	34	18	41	29	8	12	51	13	20	60	10	0	24	59	12	18	0
	21	53	16	32	26	26	0	11	68	0	11	58	0	0	21	53	11	21	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	26	45	21	32	28	23	11					13	18	3	37	58	14	26	1
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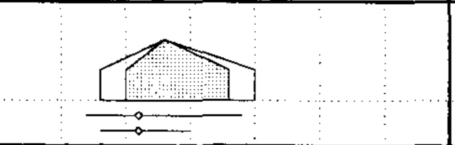	19	49	25	24	36	24	9					45	5	2	30	57	7	15	1
	13	60	23	25	48	20	4	6	42	31	18	51	5	1	31	67	6	12	1
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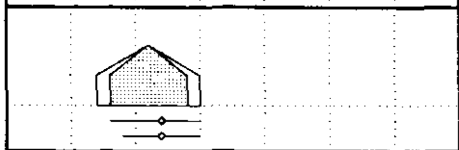	25	46	23	37	27	23	8					45	6	1	20	54	12	16	1
	15	56	23	41	33	19	4	8	37	40	11	54	3	2	19	68	11	10	0
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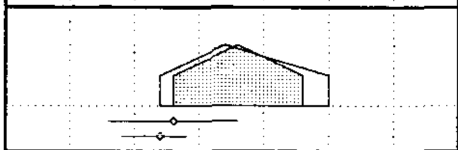	11	34	44	37	33	17	5					57	6	2	16	56	9	16	0
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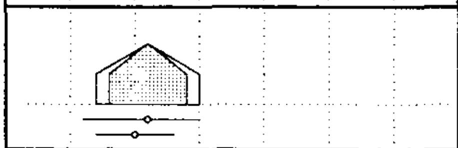	31	45	21	26	31	25	14					49	3	3	34	57	4	14	1
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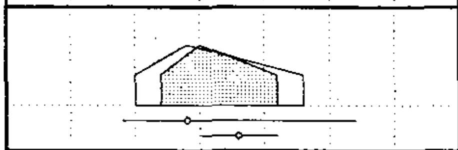	10	38	38	56	28	2	2					45	6	2	20	49	9	18	2
	7	43	42	64	24	2	4	3	38	33	20	50	4	0	28	66	7	15	1
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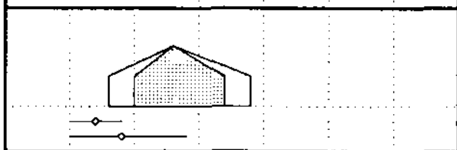	15	46	33	58	28	5	2					41	11	2	17	62	9	24	1
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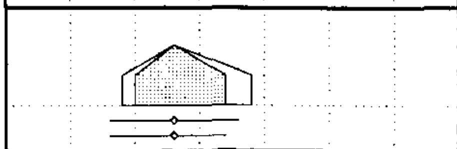	25	35	30	13	13	29	37					27	38	21	33	28	4	8	4
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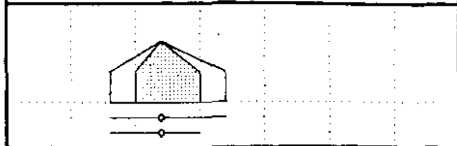	20	44	31	34	28	19	15					54	7	1	28	56	6	14	1
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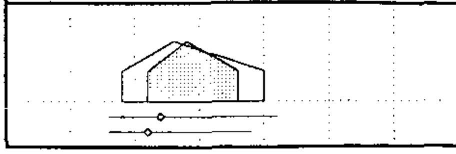	16	45	35	21	31	29	14					53	10	3	23	50	14	21	1
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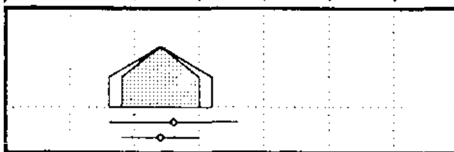
	21	53	16	32	26	26	0	11	68	0	11	58	0	0	21	53	11	21	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	26	45	21	32	28	23	11					13	18	3	37	58	14	26	1
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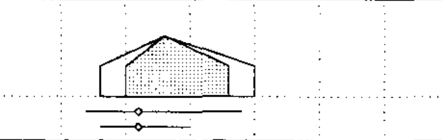	19	49	25	24	36	24	9					45	5	2	30	57	7	15	1
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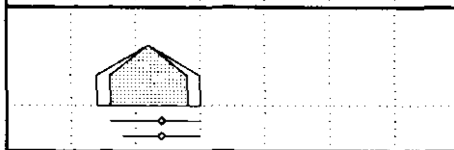	25	46	23	37	27	23	8					45	6	1	20	54	12	16	1
	15	56	23	41	33	19	4	8	37	40	11	54	3	2	19	68	11	10	0
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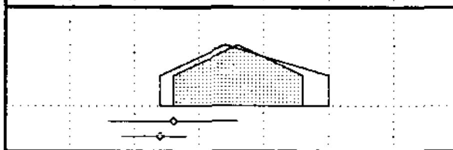	11	34	44	37	33	17	5					57	6	2	16	56	9	16	0
	9	35	49	41	41	9	4	12	41	16	27	64	5	1	17	69	7	10	1
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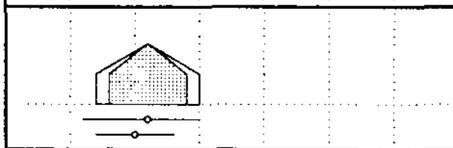	31	45	21	26	31	25	14					49	3	3	34	57	4	14	1
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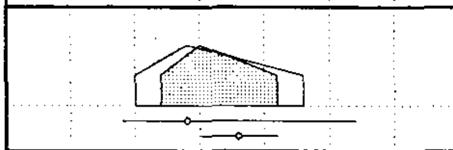
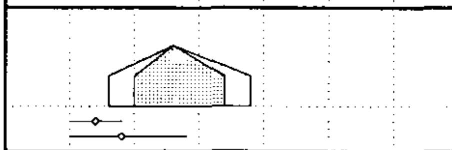
	10	38	38	56	28	2	2					45	6	2	20	49	9	18	2
	7	43	42	64	24	2	4	3	38	33	20	50	4	0	28	66	7	15	1
	23	31	38	69	23	0	0	8	23	46	8	62	0	0	46	62	8	8	0
	15	46	33	58	28	5	2					41	11	2	17	62	9	24	1
	9	54	31	61	27	3	3	2	35	43	16	44	4	1	20	77	6	22	0
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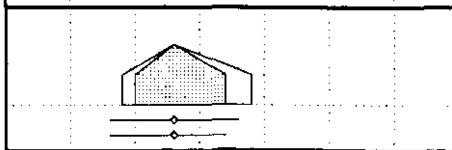
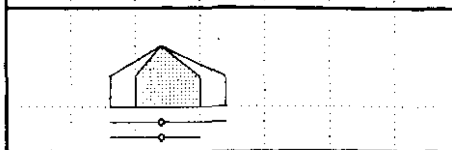
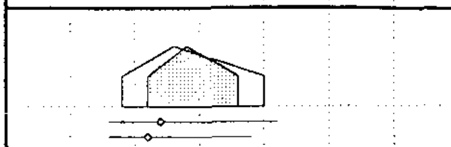
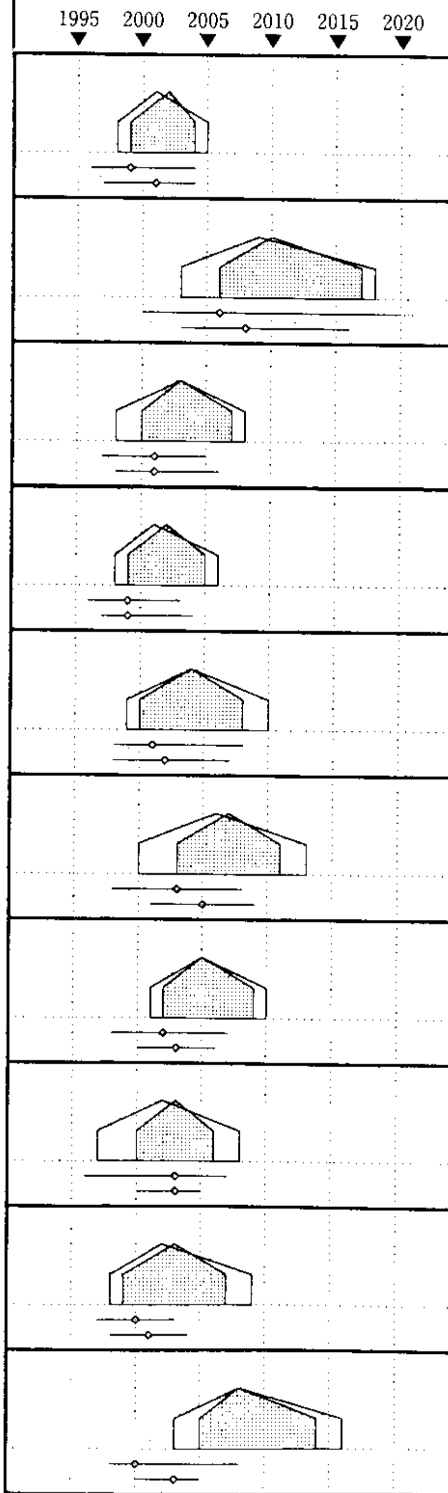
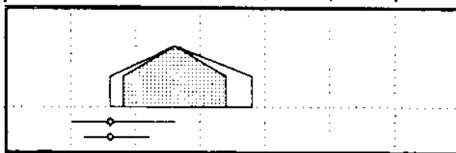
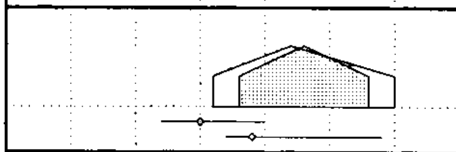
	25	35	30	13	13	29	37					27	38	21	33	28	4	8	4
	21	47	27	13	14	34	34	43	30	6	16	25	42	21	45	29	3	7	3
	38	51	8	11	19	32	38	51	30	11	8	30	46	19	46	41	0	3	5
	20	44	31	34	28	19	15					54	7	1	28	56	6	14	1
	14	56	28	34	38	17	8	7	52	22	16	59	6	3	22	73	7	11	1
	35	55	10	20	55	20	5	15	70	10	5	70	5	5	15	75	15	15	0
	16	45	35	21	31	29	14					53	10	3	23	50	14	21	1
	9	53	34	18	41	29	8	12	51	13	20	60	10	0	24	59	12	18	0
	21	53	16	32	26	26	0	11	68	0	11	58	0	0	21	53	11	21	0

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Marine science	Preservation and creation of environments	21. Inauguration of long-term integrated observation for the investigation mechanisms of coral reef as growth useful for carbon dioxide fixation by installing large-scale artificial reefs.	1	157	12	22	33	33	31	39	23	5
			2	144	8	24	33	35	30	46	19	6
			X	18					56	28	17	0
		22. Establishment of a comprehensive marine ecosystem theory, enabling elucidation of impacts on the ecosystem arising from marine development.	1	138	13	24	23	40	70	25	4	1
			2	121	11	22	23	44	69	25	5	1
			X	23					91	9	0	0
		23. Advancement in the development of sea water decontaminating systems such as decontaminating concrete blocks and bio-filters, and widespread use of hydrophilic space creating technologies.	1	127	9	19	27	45	43	44	11	1
			2	113	7	17	28	49	45	49	6	0
			X	15					60	40	0	0
		24. Development of safe, economically feasible technology for removal/detoxification of sea-bottom sludges, enabling widespread use of decontamination/recovery of fishery grounds (already employed at specific locations experimentally).	1	143	9	23	29	39	56	34	8	0
			2	124	8	20	28	44	62	35	2	0
			X	18					72	28	0	0
	Use of resources, energy and space	25. Widespread use of technologies for the optimum use and conservation of the entire bay with large sea areas and high utilization densities like Tokyo Bay.	1	162	14	26	30	30	60	31	7	1
			2	147	13	24	29	34	70	27	3	0
			X	29					93	7	0	0
		26. Practical use of marine cities (bases for transportation, communication, research, production and recreational activities) which mainly consist of structures with legs or of floating structures.	1	158	21	20	27	31	26	44	25	4
			2	138	20	20	23	37	25	49	23	3
			X	44					45	41	14	0
		27. Practical use of marine farming with optimal environmental management through incorporation of biological system technology and a wide range of engineering technology.	1	153	13	21	32	34	33	43	20	1
			2	136	11	19	32	38	33	45	20	1
			X	25					52	40	8	0
		28. Practical use of culture technology for engineering application of microbes extracted from sea water or sea bottom.	1	116	7	13	31	49	38	46	14	0
			2	103	5	12	31	53	32	57	11	0
			X	10					60	40	0	0
		29. Elucidation of migration and living conditions of fish and mammals over a wide area by using biotelemetry.	1	117	6	16	28	50	23	56	19	0
			2	97	3	15	27	55	16	65	19	0
			X	6					50	33	17	0
		30. Practical use of sea-water (hydrogen) engines to power underwater craft.	1	97	3	9	30	58	32	45	18	2
			2	80	2	11	23	63	24	60	14	1
			X	5					20	60	0	20



Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	11	41	36	30	33	18	8					31	3	4	23	50	15	31	1
	11	47	38	33	42	15	3	8	45	18	24	42	4	3	19	60	11	33	1
	22	50	22	33	28	17	11	11	56	28	6	22	0	6	22	61	22	39	0
	20	38	33	57	26	11	1					51	7	1	7	36	31	29	2
	14	49	34	68	21	7	1	7	38	36	17	54	4	5	5	44	31	35	2
	30	57	9	91	4	0	0	13	35	52	0	52	13	0	0	61	26	30	4
	20	46	29	15	30	30	21					41	10	2	47	50	5	12	1
	12	60	26	15	34	29	19	35	40	10	15	50	10	2	43	62	4	9	0
	33	60	0	7	33	27	27	47	27	7	13	53	7	7	33	67	7	13	0
	20	52	24	10	21	40	25					39	13	4	52	43	6	8	0
	17	57	24	10	23	44	20	60	27	2	10	40	10	4	60	53	5	8	1
	50	44	6	0	28	44	28	78	22	0	0	33	6	6	61	78	11	0	0
	14	52	30	4	17	38	39					25	49	17	20	33	9	17	4
	12	56	29	2	17	38	41	52	31	4	13	22	64	16	22	42	4	12	3
	34	45	17	3	14	34	48	45	34	10	10	14	72	21	14	41	3	17	10
	22	37	32	9	13	41	31					21	34	16	46	41	3	5	1
	18	44	33	8	16	41	30	41	33	9	14	14	38	12	56	49	1	4	1
	34	55	11	9	11	41	39	50	36	11	2	9	52	11	48	57	0	9	5
	13	45	34	10	25	35	24					42	15	3	41	37	12	14	1
	10	44	39	10	25	41	18	51	24	4	16	47	13	4	51	43	9	11	1
	32	52	12	16	20	36	24	68	20	0	4	44	24	4	48	52	8	8	0
	17	41	32	30	36	19	8					56	3	3	26	36	22	18	0
	11	47	38	23	48	17	6	22	44	17	14	68	3	3	23	40	23	17	0
	30	40	20	40	30	20	0	50	20	20	0	60	10	0	50	30	10	10	0
	15	42	35	45	31	12	7					41	1	1	19	47	23	21	0
	7	45	44	47	37	8	3	11	55	23	8	52	2	3	13	63	23	25	0
	50	33	0	50	17	0	17	17	67	0	0	17	0	17	17	67	17	33	0
	10	38	39	27	26	21	18					66	1	1	35	37	5	10	0
	8	45	39	25	38	19	13	5	40	25	24	74	0	1	41	50	4	6	0
	0	40	60	20	20	20	40	0	80	0	20	80	0	0	60	40	0	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Marine science	Use of resources, energy and space	31. Practical use of three-dimensional underwater navigation systems for underwater craft.	1	117	9	20	23	48	29	52	18	0
			2	98	6	19	19	55	22	69	8	0
			X	14					57	43	0	0
		32. Development of landmark underwater transport systems that would dramatically improve locomotion performance, e.g., the use of active skin-like hull shell surface that would allow hull shape alteration.	1	83	5	12	20	62	12	43	36	6
			2	69	4	12	16	68	7	46	39	6
			X	8					0	38	38	25
		33. Practical use of technology for undersea communications in a horizontal plane for a distance of several km to facilitate underwater operations.	1	114	5	20	27	48	35	49	15	0
			2	101	4	17	26	53	30	61	9	0
			X	9					78	22	0	0
		34. Advances in studies of deep-sea-bottom mineral resources (e.g., manganese, hydrothermal ore, and cobalt-rich crust), resulting in the practical use of technology enabling economically feasible extraction of one such mineral.	1	193	18	31	35	15	40	50	8	2
			2	179	15	32	33	20	40	53	7	1
			X	33					64	24	12	0
		35. Widespread use of technologies for utilizing deep-layer water by generating upwelling currents over artificial submarine ranges, by direct pumping, by thermal energy conversion, etc.	1	174	16	29	31	23	22	47	25	3
			2	154	13	28	29	30	18	58	21	3
			X	29					48	41	10	0
		36. Widespread use of technologies for building underwater leisure facilities in response to demand for underwater sightseeing and recreation, with increased use of submarines including tourist submarines.	1	153	14	23	32	32	7	43	45	5
			2	135	12	21	29	38	5	41	51	2
			X	26					19	46	31	4
		37. Widespread use of various undersea robots for use in observation, inspection, and other work operations at a depth of 300 m.	1	164	10	29	34	27	43	46	11	0
			2	147	9	30	28	33	38	57	5	0
			X	19					63	37	0	0
		38. Practical use of robots for undersea probes at a depth of 10,000 m.	1	158	10	27	32	30	27	53	19	0
			2	141	7	29	29	36	24	62	13	0
			X	15					47	47	7	0
		39. Practical use of fuel cells that last for a long period of time (at least one year) in abyssal depths.	1	95	2	10	30	57	45	38	15	0
			2	87	1	12	27	60	49	39	10	0
			X	2					50	50	0	0
Earth science	Observation and forecast	40. Elucidation of the mechanisms of the formation, change and extinction of the ozone layer surrounding the earth.	1	121	5	15	38	42	70	26	2	0
			2	111	3	12	41	43	81	17	1	0
			X	6					100	0	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	23	38	34	20	34	32	12					59	6	1	38	47	3	13	0
	19	44	36	18	40	30	10	8	50	30	11	68	4	0	37	56	3	14	0
	64	36	0	14	21	21	43	7	50	36	0	43	0	0	57	64	7	21	0
	11	29	45	20	30	22	17					77	0	0	24	34	7	5	1
	7	30	52	14	42	20	14	6	35	9	43	81	0	0	28	39	4	3	1
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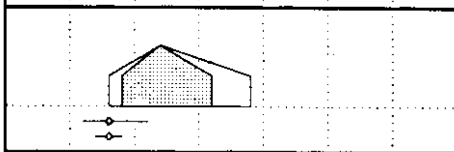
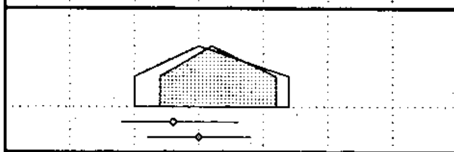
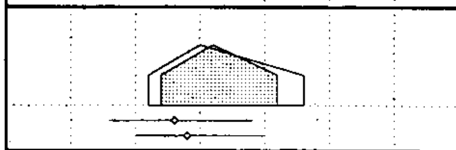
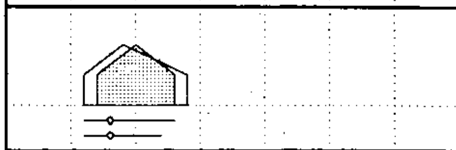
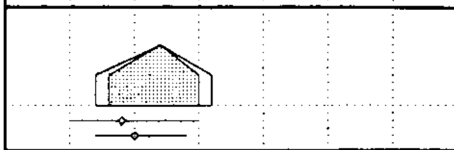
	15	54	29	18	32	28	17					73	2	3	29	35	7	14	0
	9	57	33	14	45	29	10	9	46	29	15	79	1	1	29	44	8	8	0
	33	67	0	22	56	11	11	0	67	33	0	89	0	0	22	56	0	11	0
	23	41	30	47	31	12	7					44	13	3	52	42	5	11	3
	21	49	27	51	30	9	6	9	43	34	11	52	11	2	63	39	7	9	3
	39	42	15	58	12	15	15	21	36	36	6	39	9	6	58	48	9	9	6
	14	39	34	26	26	26	13					44	6	4	52	40	5	11	1
	11	42	39	29	31	27	8	12	44	21	18	53	3	2	65	38	3	10	0
	45	41	14	34	34	24	7	24	59	14	3	55	7	0	52	55	3	7	0
	27	48	18	3	18	32	39					13	25	9	66	27	4	4	1
	21	54	22	3	19	36	39	16	47	20	11	15	22	7	72	36	2	4	3
	35	54	8	4	15	35	42	15	50	23	8	19	38	4	65	23	4	8	8
	23	54	20	11	36	27	23					44	1	4	60	33	7	9	1
	18	61	21	12	37	29	20	18	50	24	4	50	1	3	65	37	4	7	2
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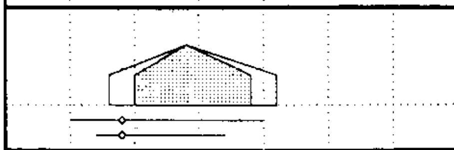
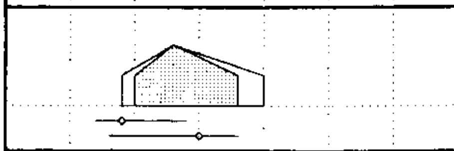
	18	41	35	21	37	21	17					58	3	3	33	53	4	7	3
	17	45	35	21	42	23	11	22	41	23	10	68	1	2	34	62	3	4	1
	53	27	20	27	27	20	27	33	33	33	0	47	7	7	47	67	0	0	7
	15	38	41	19	31	35	11					72	1	0	37	35	6	8	2
	9	46	43	16	39	33	9	17	47	17	17	84	0	0	45	45	2	6	0
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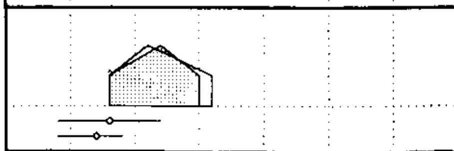
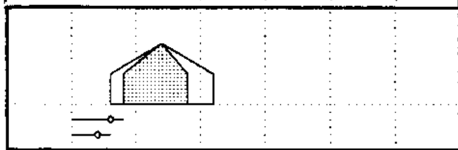
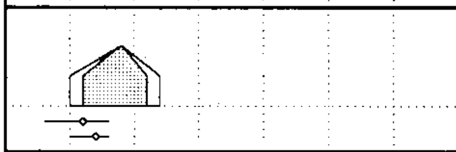
	24	41	28	83	9	2	2					48	5	4	9	37	28	40	0
	13	52	29	86	7	2	0	5	34	45	11	61	1	1	7	50	16	46	1
	50	33	0	67	0	17	0	17	33	33	0	33	0	0	0	17	67	83	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Earth science	Observation and forecast	41. Practical use of international monitoring systems for changes in the atmospheric composition of the stratosphere.	1	107	2	15	34	49	55	37	6	0
			2	96	2	12	35	52	56	42	2	0
			X	4					75	25	0	0
		42. Inauguration of commercial use of remote sensing technologies based on satellites for long- and short-term meteorological forecast.	1	138	6	22	36	36	58	35	6	0
			2	128	4	20	39	36	64	32	4	0
			X	9					89	11	0	0
		43. Establishment of techniques for long-term meteorological forecast (1 to 6 months ahead).	1	118	6	12	37	44	53	36	10	0
			2	113	5	10	42	44	58	33	9	0
			X	10					80	10	10	0
		44. Significant improvement in the accuracy of medium-term meteorological forecast (7 to 10 days ahead) by numerical computation using 10 km lattices.	1	108	4	12	35	48	54	38	8	0
			2	99	3	13	34	50	59	37	4	0
			X	6					83	17	0	0
		45. Widespread use of meteorological information service systems capable of providing detailed meteorological information including images up to 1 day ahead in small areas in response to individual requests.	1	116	5	13	37	44	30	45	22	2
			2	109	3	14	38	45	22	57	21	0
			X	5					20	80	0	0
		46. Widespread use of accurate, short-time forecasting of very intense rainfall, snowfall, and other sharply localized phenomena based on improvement of the radar observation network and the development of data processing technololgy.	1	120	7	12	38	43	72	23	5	0
			2	111	4	14	38	45	77	20	3	0
			X	8					100	0	0	0
		47. Practical use of floating observation stations (unmanned airships) for meteorological observation and collecting of specimens.	1	92	2	11	31	56	16	57	23	4
			2	79	2	10	28	60	19	56	24	1
			X	4					25	75	0	0
		48. Possibility of direct or extremely closeup observation of clouds, thus revealing the details of the physical properties and processes of generation, development and extinction of clouds.	1	76	3	12	22	63	29	49	21	0
			2	72	3	11	23	64	28	53	18	0
			X	6					67	17	0	0
		49. Practical use of survey based on the inertial system (using a gyro and accelerograph).	1	71	5	13	17	65	25	51	20	3
			2	65	3	13	17	67	22	57	15	- 5
			X	6					67	33	0	0
		50. Use of GPS (global positioning system using many radio satellites) which improves the accuracy of height measurement, for geodetic survey.	1	120	11	23	23	43	56	37	7	0
			2	111	7	23	24	45	60	35	5	0
			X	15					87	13	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	19	43	31	89	5	0	2					36	15	5	19	45	13	33	1
	16	45	38	94	2	0	1	1	39	49	8	50	6	1	15	59	10	40	1
	50	50	0	100	0	0	0	25	25	25	0	50	0	0	0	0	50	100	0
	32	47	14	59	28	5	4					38	9	2	25	39	18	22	2
	30	55	14	71	22	2	2	7	52	33	6	56	3	0	27	55	13	16	1
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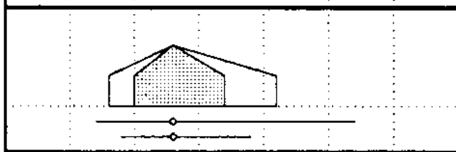	22	42	31	57	30	8	3					63	7	1	14	30	21	26	3
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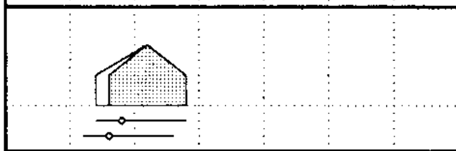	21	45	30	35	35	18	10					57	7	0	25	38	13	19	3
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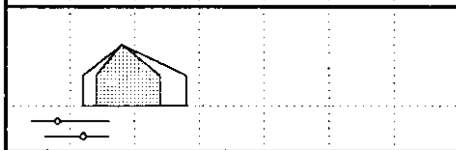	27	42	27	9	23	37	28					36	13	3	52	24	14	14	3
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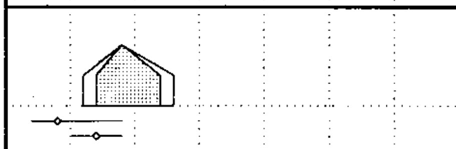	29	49	18	11	24	40	23					47	3	1	40	41	15	18	2
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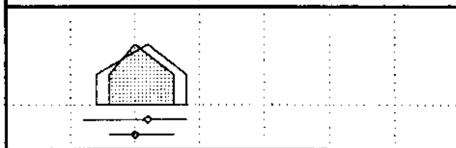	15	42	37	18	35	27	15					29	9	2	45	48	11	13	3
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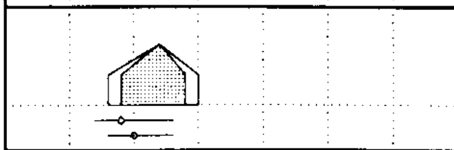	12	47	34	37	36	20	3					49	7	1	21	47	17	21	0
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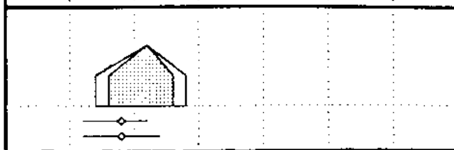
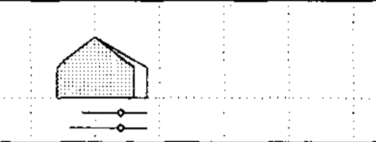
	23	42	25	14	35	24	17					48	4	1	30	27	8	18	3
	18	52	23	14	46	23	11	9	43	23	18	75	0	0	43	26	3	14	2
	83	0	0	33	17	50	0	33	17	50	0	67	0	0	50	0	17	33	0
	45	36	18	59	26	9	4					48	13	1	31	33	12	14	8
	49	40	12	72	23	3	1	13	32	47	6	62	14	1	36	40	5	14	4
	80	20	0	67	27	0	0	0	73	27	0	67	27	0	20	33	13	13	7

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Earth science	Observation and forecast	51. Widespread use of portable type absolute gravimeters for geodetic survey, which will be made smaller and more reliable.	1	103	8	16	26	50	21	60	17	1
			2	91	6	14	27	54	19	71	10	0
			X	12					42	58	0	0
		52. Realization of relative accuracy down to 10^{-8} or less in measurement of movements in the earth's crust based on very long baseline interferometers (VLBI), GPS satellite lasers, and inverse laser ranging, improving the precision of earthquake forecasting.	1	101	10	18	21	51	47	43	9	1
			2	96	8	17	24	51	54	43	3	0
			X	16					75	25	0	0
		53. Widespread use of superconductive gravimeters which are utilized for ultra-precision observation of crustal alterations.	1	79	7	14	17	62	33	49	16	0
			2	69	5	13	18	64	32	59	9	0
			X	10					60	30	10	0
		54. Nationwide installation of bore-hole observation equipment integrating various types of gauges (e.g., seismometers, tiltmeters, and strain-gauges) for use in earthquake forecasting.	1	127	11	24	26	39	58	36	4	0
			2	119	9	23	28	40	66	30	3	0
			X	18					72	28	0	0
		55. Widespread use of powerful noninvasive (nondestructive) inspection equipment for geological materials, which allows the three-dimensional structures of strata, rocks and fossils to be identified from meter-size CT images.	1	125	14	22	23	40	18	50	26	2
			2	110	13	20	23	44	16	60	23	0
			X	26					38	42	19	0
		56. Widespread measurement of stresses in ocean floor crusts performed by deep sea bottom excavating vessels.	1	129	13	19	30	38	23	50	23	2
			2	116	12	18	29	41	19	62	18	0
			X	23					52	35	9	0
		57. Development of method for measuring expansion/contraction and vertical fluctuation of sea-bottom tracts.	1	119	12	22	24	42	35	50	11	0
			2	108	10	20	26	45	36	55	9	0
			X	19					84	11	5	0
		58. Widespread use of cable-form sea-bottom seismometers which are used to identify anisotropy and heterogeneity in the distribution of materials in the earth's interior.	1	116	10	20	26	43	32	45	20	2
			2	111	11	18	28	43	29	56	15	0
			X	21					52	43	5	0
		59. Practical use of continuous measurement techniques for various crustal fluctuations on the ocean floor, with application for short-term earthquake forecasting.	1	131	12	24	28	36	53	40	5	0
			2	125	11	21	32	37	57	38	4	0
			X	21					81	19	0	0
		60. Practical use of boring technology capable of reaching the depth of 15 km.	1	157	18	28	27	26	39	43	17	0
			2	144	16	25	30	28	30	56	13	0
			X	33					55	36	9	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	18	54	22	20	40	23	12					50	2	2	27	36	14	17	2
	16	60	21	21	45	20	11	19	45	21	14	65	1	0	37	35	11	22	2
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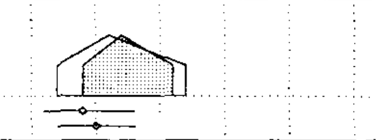	22	45	26	57	32	4	4					53	5	2	23	42	17	18	4
	17	51	28	68	23	3	3	8	41	41	8	69	4	1	24	58	9	18	1
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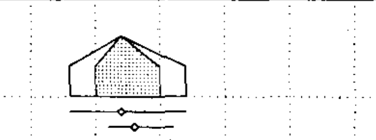	20	38	32	29	37	16	10					57	1	1	25	41	14	15	5
	12	54	29	30	46	10	9	12	33	42	9	68	1	0	28	51	10	12	0
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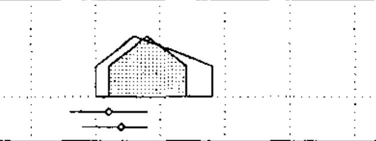	24	44	24	12	31	37	17					34	6	2	33	61	10	21	1
	24	50	24	12	37	39	9	47	38	4	7	39	8	3	39	71	6	18	0
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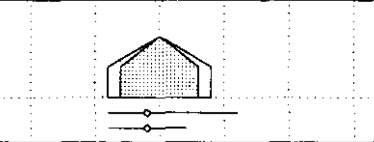	10	46	31	18	37	23	13					54	2	3	22	37	10	14	2
	7	57	31	12	48	24	12	11	42	24	20	68	0	1	30	47	7	14	2
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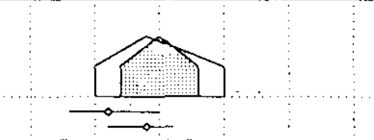	12	46	33	50	28	10	5					49	2	2	26	50	12	21	0
	6	57	34	52	34	8	3	4	31	52	11	68	0	1	29	67	3	12	0
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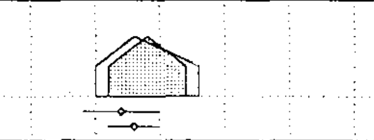	12	48	31	38	34	14	6					60	2	2	22	50	9	18	0
	11	53	33	43	43	7	5	15	47	25	12	73	1	2	21	64	6	14	0
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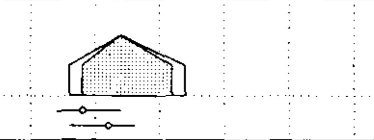	22	44	25	50	24	10	6					40	7	2	31	56	11	17	1
	14	53	31	56	28	9	4	21	49	15	13	52	2	1	31	72	5	18	2
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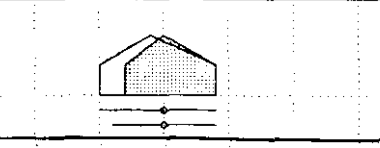	18	44	31	37	37	15	8					54	5	2	22	57	11	18	1
	11	54	32	32	50	10	4	21	50	9	16	75	1	1	21	67	5	15	1
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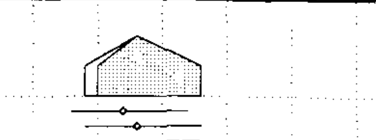
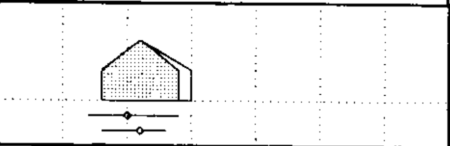
	21	46	25	54	25	13	4					57	4	1	27	65	7	10	1
	18	51	28	60	26	8	3	4	22	64	8	69	3	1	26	76	2	8	1
	55	36	9	70	12	6	12	3	24	67	3	55	6	0	27	79	6	6	3

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Earth science	Measures for natural disasters	71. Practical use of technology for predicting and forecasting landslides or rockslides due to intense rainfall.	1	151	12	31	28	29	70	25	5	0
			2	138	11	26	31	32	78	19	4	0
			X	22					91	9	0	0
		72. Development of technology for monitoring the chronological trend in location and amount of snowfall, enabling forecasting of the scale and degree of risk surface avalanches.	1	102	3	17	29	51	33	55	12	0
			2	91	3	12	32	54	34	54	11	0
			X	6					83	17	0	0
		73. Development of technology capable of forecasting the occurrence of major earthquakes (magnitude 7 or above) a few days in advance.	1	137	15	23	27	35	87	9	4	0
			2	131	13	22	30	35	88	9	2	0
			X	27					100	0	0	0
		74. Elucidation of animal behavior before earthquakes relating to various geophysical and geochemical phenomena.	1	120	10	17	30	43	23	39	30	7
			2	111	9	15	32	44	20	45	31	5
			X	18					39	28	33	0
		75. Realization of observation of the existing form of magma inside volcanoes in time series.	1	135	15	29	20	36	55	38	7	0
			2	129	13	28	24	36	57	37	5	0
			X	26					85	15	0	0
		76. Realization of forecasting volcanic eruptions with certainly 2 to 3 days in advance.	1	139	16	27	23	34	74	22	3	0
			2	131	15	26	25	34	80	16	3	0
			X	29					93	7	0	0
		77. Realization of forecasting outbreak and scale of pyroclastic flows (nuee ardente, etc.) accompanying volcanic eruption.	1	139	15	30	22	34	67	26	6	0
			2	130	14	26	26	34	80	16	3	0
			X	28					89	11	0	0
		78. Development of observation technologies that help elucidate the generating and emitting mechanisms of volcanic gases, mainly carbon dioxide.	1	114	10	22	23	45	33	46	18	1
			2	103	8	19	26	47	27	61	11	1
			X	15					53	47	0	0
		79. Inauguration of experiments in which the extrusion of magma from underground is induced or suppressed in volcanic areas.	1	119	13	23	21	43	29	39	21	9
			2	114	11	21	25	42	27	42	22	9
			X	22					45	41	0	14
	Common and others	80. Development of technologies for maintaining good balance between the use of fossil fuels and the conservation of the global environment, based on elucidation of the whole aspect of the movement and storage of carbon dioxide extending over the air oceans and sea bottoms.	1	174	13	28	40	20	79	17	3	1
			2	164	9	27	45	19	80	17	3	0
			X	18					89	11	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	21	52	23	9	24	38	28					53	5	1	21	46	15	28	3
	14	64	22	8	22	40	25	47	36	3	12	64	4	1	20	59	12	25	2
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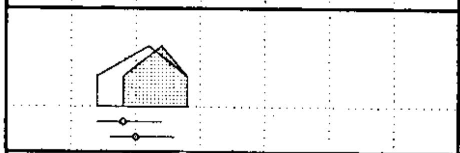	15	58	25	5	31	37	25					57	0	2	21	38	20	26	1
	10	68	20	8	31	38	19	27	55	4	11	73	1	1	18	46	19	24	1
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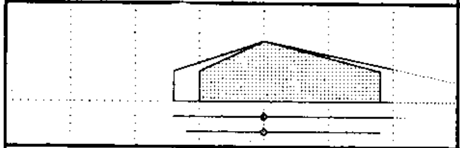	20	34	39	45	32	13	7					74	4	2	9	38	20	31	1
	16	40	43	42	37	11	6	38	48	5	8	81	1	3	8	47	18	30	1
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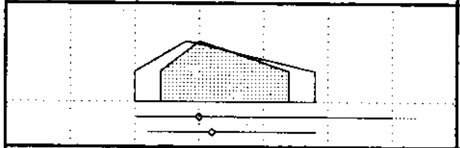	14	32	33	26	25	25	12					48	4	8	6	19	22	22	10
	14	37	44	20	35	29	9	17	44	15	19	68	4	10	5	18	26	35	5
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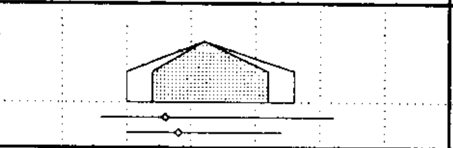	16	44	34	37	36	19	6					61	2	0	13	53	25	19	1
	10	53	35	34	43	16	3	25	57	8	9	75	0	1	11	60	19	19	0
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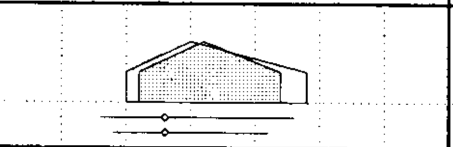	23	40	28	36	32	22	7				.	60	1	3	9	53	27	23	1
	18	51	31	37	36	19	5	34	53	5	8	74	0	1	7	60	23	26	0
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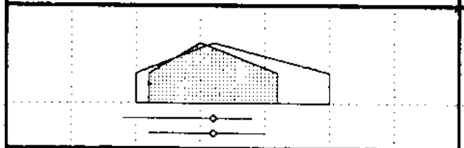	17	42	31	30	35	25	5					60	3	2	12	43	29	19	4
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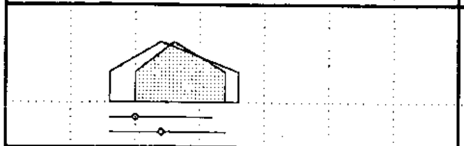	11	44	36	36	36	20	4					61	0	1	13	39	25	19	1
	7	52	36	27	50	12	3	14	68	5	9	73	0	1	10	51	21	15	0
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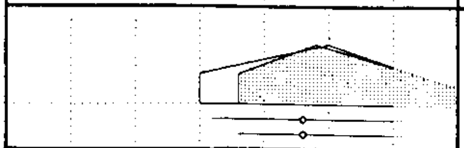
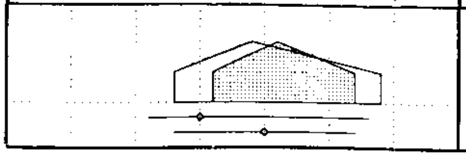
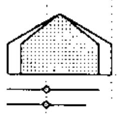
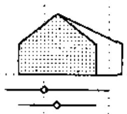
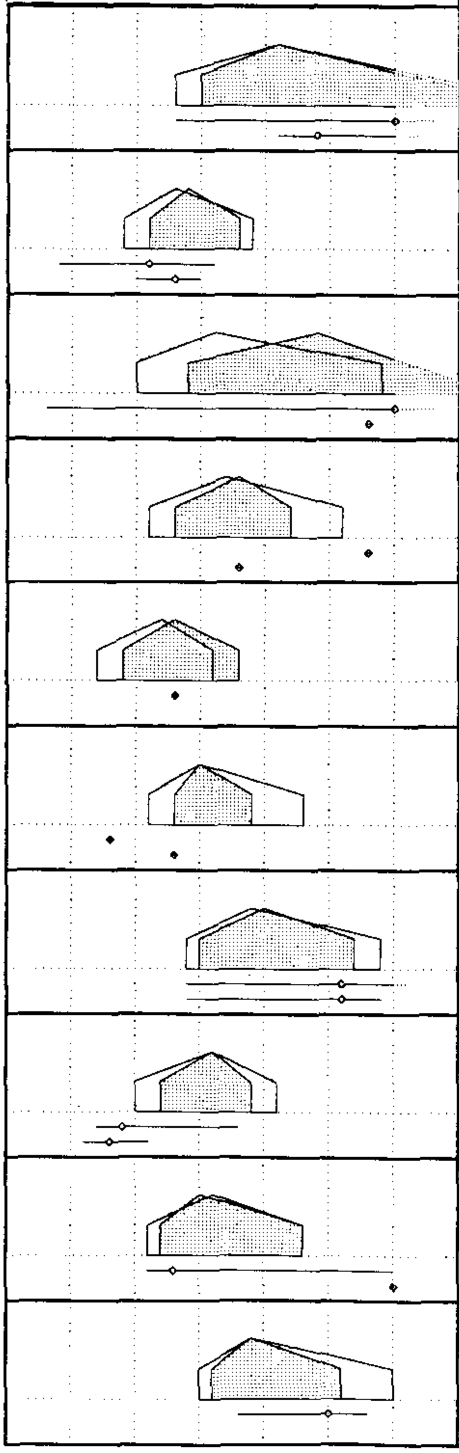
	9	29	45	40	27	12	7					66	6	6	13	39	10	14	2
	7	30	54	44	33	8	4	8	43	16	24	76	4	4	10	52	7	12	1
	14	41	41	36	41	9	0	9	68	5	14	73	9	5	14	41	23	14	0
	13	43	36	76	14	4	2					58	5	6	13	39	19	32	1
	7	48	43	83	10	2	1	4	43	34	15	70	2	4	12	49	17	34	1
	22	44	33	72	6	0	6	0	44	39	0	44	0	0	33	50	11	50	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Earth science	Common and others	81. Inauguration of global science and technology education organizations in the broad sense for fostering international scientists and technologists contributing to conservation of global environment, development and maintenance of global resources, etc.	1	179	22	29	32	18	69	25	4	1
			2	172	18	30	34	17	77	19	3	1
			X	38					95	3	3	0
		82. Inauguration of international research centers for comparative planetology as well as the science of the earth, based on development of planetology centering around specimens obtained from meteorites and planets.	1	127	13	21	26	40	31	43	22	1
			2	116	10	20	27	42	30	48	20	1
			X	20					70	15	15	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	28	39	25	78	9	6	3					4	45	13	3	31	37	31	3
	22	53	22	90	4	3	2	3	45	32	16	3	59	10	5	31	44	30	3
	29	53	16	89	3	3	3	5	39	42	8	0	58	11	5	39	42	29	3
	17	40	31	82	8	2	0					9	27	11	8	39	33	35	4
	13	47	34	91	3	3	0	8	40	35	10	6	35	7	4	45	35	45	2
	40	40	20	100	0	0	0	20	35	40	0	5	15	10	15	40	45	50	0

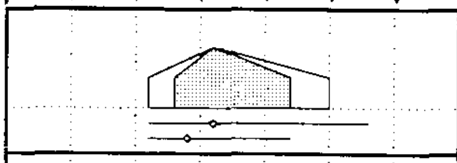
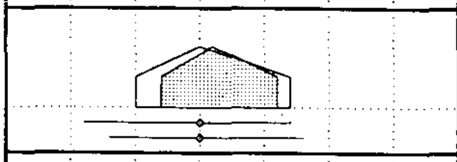
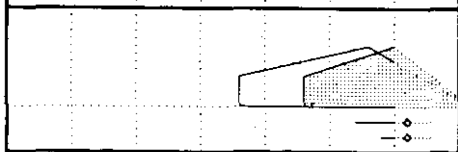
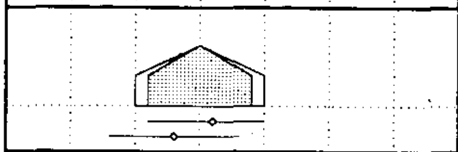
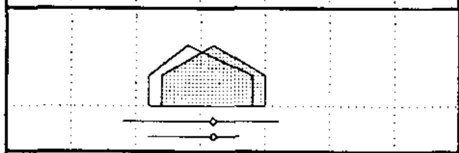
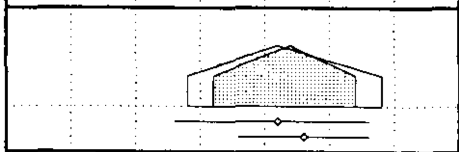
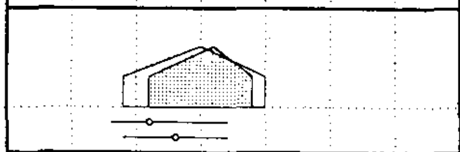
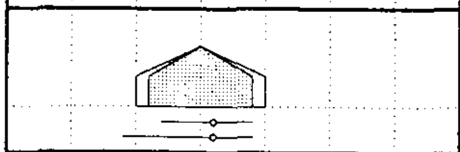
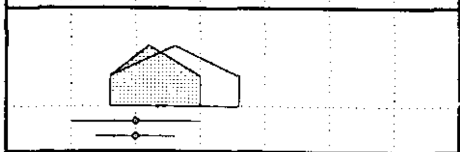
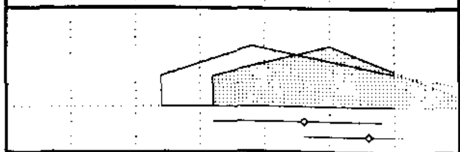
4.7 Mineral and water resources

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Mineral resources	Metals	1. Practical use of the solution mining of copper and other metals deep in the earth based on the in-situ leaching technology.	1	62	8	39	26	27	19	52	24	5
			2	52	7	42	22	29	17	58	21	4
			X	5					20	60	20	0
		2. Extensive application of biotechnology for extraction and separation of metallic elements.	1	60	9	32	29	29	33	45	18	0
			2	50	7	34	27	32	36	48	16	0
			X	5					60	40	0	0
		3. Practical use of reduction method in aluminum smelting instead of using electrolysis.	1	32	2	9	26	62	38	53	6	3
			2	24	1	10	22	67	29	58	13	0
			X	1					100	0	0	0
		4. Practical use of processes that apply magnetic force, as non-ferrous metal casting methods.	1	18	1	6	14	79	17	22	61	0
			2	14	1	8	10	81	14	29	57	0
			X	1					100	0	0	0
		5. Substantial shift in photography from silver chloride film and photographic paper to electronic cameras, resulting in drastic reduction of demand for silver in this field.	1	40	1	11	35	53	15	50	25	8
			2	33	0	13	33	54	12	58	24	6
			X	0					0	0	0	0
	Nonmetals	6. Development of high-polymer and other electrically conductive organic materials, which replace copper and aluminum in certain applications.	1	35	1	5	35	59	37	40	14	6
			2	29	1	4	34	60	38	48	10	3
			X	1					0	100	0	0
	Scarce resources	7. Practical use of technology for mining manganese nodules from the deep sea bottom.	1	76	20	43	25	13	29	57	13	0
			2	65	17	43	25	14	29	55	14	0
			X	13					54	38	8	0
		8. Development of standard refining methods enabling the extraction of valuable components from manganese nodules.	1	64	12	34	29	26	30	53	16	2
			2	54	9	34	30	27	28	57	15	0
			X	7					29	57	14	0
		9. Development of systems that apply laser separating methods, as new refining methods for rare metals.	1	29	2	8	24	66	21	55	21	0
			2	23	1	7	23	68	22	65	13	0
			X	1					0	0	100	0
		10. Practical use of technology for recovering helium from air, spurred by rising demand for helium and depletion of other helium resources.	1	33	2	7	29	61	21	42	33	3
			2	25	0	8	26	66	20	44	32	4
			X	0					0	0	0	0

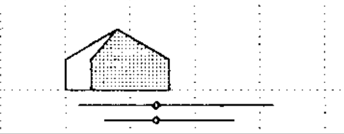
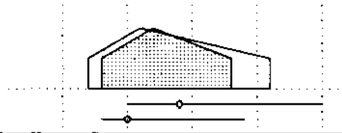


Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	10	32	48	32	32	21	10					61	6	5	61	15	6	10	10
	8	37	50	31	40	17	4	0	23	38	33	71	6	0	67	10	4	15	8
	20	20	60	60	0	40	0	0	40	20	40	60	20	0	80	0	0	20	20
	15	42	38	12	55	20	12					58	0	0	43	10	25	18	2
	8	60	28	16	58	18	4	6	36	34	22	76	2	2	60	8	22	12	4
	0	60	20	0	60	20	20	20	40	40	0	60	0	0	80	0	40	0	20
	6	31	56	16	38	22	22					53	3	0	69	16	16	9	3
	4	29	67	13	50	25	13	8	29	13	50	71	0	0	71	13	17	8	8
	0	100	0	0	100	0	0	0	0	0	100	100	0	0	0	0	100	0	0
	6	28	67	11	33	33	22					56	0	0	67	0	22	6	6
	0	36	64	14	29	36	21	0	36	14	50	71	0	0	57	0	29	14	7
	0	100	0	100	0	0	0	0	0	0	100	100	0	0	0	0	100	0	0
	18	30	40	0	18	28	50					30	5	10	53	5	5	8	10
	9	30	55	0	9	30	58	45	12	0	33	39	3	9	58	0	3	9	3
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	31	54	20	34	26	11					57	0	0	57	9	11	9	0
	0	34	62	17	34	45	0	17	48	0	28	69	0	0	69	0	10	10	0
	0	100	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	100	0
	18	34	43	45	34	14	4					36	17	4	75	24	4	11	8
	14	40	45	54	35	8	2	14	45	26	11	48	18	2	91	18	2	6	6
	23	62	15	85	15	0	0	23	46	31	0	38	15	0	100	23	0	8	0
	13	45	39	27	39	25	8					41	6	2	61	28	9	16	3
	11	54	33	26	43	26	6	11	54	19	15	50	6	2	78	22	2	11	6
	29	43	14	57	0	14	29	29	57	14	0	43	0	0	71	29	0	0	0
	0	24	66	21	31	34	7					62	0	0	59	10	14	14	0
	4	22	70	22	43	30	4	4	43	22	26	87	0	0	65	13	13	13	0
	0	0	0	0	0	0	100	0	0	0	100	100	0	0	0	0	100	0	0
	6	30	55	33	33	21	9					36	9	0	73	12	12	12	6
	0	28	68	40	40	12	4	0	24	20	48	60	4	0	76	8	8	8	8
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Mineral resources	Common	11. Development of semiquantitative prospecting technology for mineral resources using the artificial satellite.	1	70	24	29	29	18	41	47	9	1
			2	62	23	31	29	17	40	53	6	0
			X	17					71	24	6	0
		12. The development of new mineral deposits discovered by the exploration based on new geological theories such as plate tectonics.	1	69	37	21	22	20	41	36	20	3
			2	60	38	23	20	19	43	28	25	2
			X	28					54	32	11	4
		13. Development of exploration technology capable of estimating the economic feasibility of mineral deposits with virtually no drilling.	1	65	35	21	20	24	32	35	18	11
			2	59	36	24	19	20	29	47	15	8
			X	27					37	33	19	11
		14. Practical use of technologies that enable to identify the underground structures three-dimensionally due to advancement in geophysical survey method such as geotomography.	1	62	18	25	28	29	53	37	6	2
			2	52	21	26	21	32	65	35	0	0
			X	16					69	31	0	0
		15. Practical use of ultra-deep drilling and excavating technologies designed to be applied under the condition of up to 400 °C and a depth of 15 km.	1	63	13	26	35	27	37	44	17	0
			2	55	12	31	31	27	36	49	13	2
			X	9					67	33	0	0
		16. Practical use of techniques for exploiting new sea-bottom mineral resources (e.g., mud containing heavy metals, deep-sea hydrothermal deposit, and cobalt-rich crust).	1	65	21	30	24	24	29	48	20	0
			2	58	20	33	24	24	31	59	9	0
			X	15					40	60	0	0
		17. Practical use of technologies for loosening rock mass by systematic, large-scale cracking for the solution mining and the development of geothermal energy.	1	60	13	31	26	30	32	47	15	2
			2	52	12	36	21	31	29	58	8	2
			X	9					78	22	0	0
		18. Practical use of fully-automated (i.e., unmanned mining methods combined with robot technologies).	1	65	14	27	35	24	58	34	6	0
			2	58	15	30	34	22	64	33	3	0
			X	11					91	9	0	0
		19. Practical use of economical methods of segregating valuable substances in city garbage for their retrieval.	1	66	14	20	43	23	79	17	3	0
			2	57	15	19	43	23	88	11	2	0
			X	11					91	0	9	0
Water resources	Technologies for developing water resources	20. Practical use of inducing artificial precipitation in event of drought.	1	43	8	22	29	40	33	42	23	2
			2	37	7	16	30	46	27	43	27	0
			X	5					60	0	40	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	16	40	34	57	29	3	6					61	4	0	14	27	27	19	3
	15	47	34	60	29	5	5	3	34	52	8	81	5	0	8	35	26	11	3
	29	53	18	65	29	0	6	6	41	53	0	94	12	0	0	18	35	12	0
	14	33	43	52	25	12	4					42	4	6	13	32	39	19	0
	13	35	47	52	30	10	3	5	38	35	15	58	3	3	3	30	45	20	3
	25	46	25	54	29	7	7	4	46	36	11	50	7	4	0	21	50	29	4
	14	17	51	34	26	14	9					63	3	3	14	20	17	17	3
	15	17	59	46	27	10	8	0	15	41	34	76	2	3	12	25	20	20	3
	26	19	44	63	7	11	7	0	7	48	33	74	4	4	15	15	19	26	4
	18	40	31	29	32	27	3					60	2	2	13	29	21	13	2
	13	58	25	29	42	23	2	8	42	29	19	79	2	2	10	31	29	13	2
	25	63	13	19	38	44	0	0	50	38	13	88	0	6	13	13	13	13	6
	6	51	35	44	41	6	3					70	3	0	24	49	6	13	0
	5	51	40	51	40	7	0	7	11	71	9	87	2	0	22	60	5	4	0
	11	89	0	67	22	11	0	0	0	89	11	100	0	0	11	67	0	11	0
	11	43	45	49	35	9	5					49	11	2	68	31	8	6	0
	7	43	50	52	43	3	2	9	47	26	17	59	7	0	72	40	3	3	3
	13	33	53	73	20	7	0	0	60	27	13	67	0	0	87	20	0	13	0
	15	40	35	35	28	17	8					55	8	2	37	30	15	8	2
	12	44	38	38	40	10	8	8	33	42	12	63	2	2	48	27	13	10	6
	44	44	11	56	22	22	0	11	44	44	0	67	11	0	44	33	11	22	0
	17	49	31	20	35	22	20					63	5	0	45	31	12	12	0
	12	62	26	19	47	17	17	40	38	17	3	74	0	0	50	26	7	12	2
	18	73	9	36	45	9	9	18	45	36	0	73	0	0	45	27	9	18	9
	29	44	23	14	18	38	27					32	24	11	61	27	8	11	2
	23	60	18	7	19	47	25	37	40	5	16	42	30	14	74	18	2	5	2
	18	82	0	0	18	55	27	55	36	0	9	45	36	18	55	36	0	9	0
	12	49	33	42	44	7	5					60	9	9	26	26	7	23	9
	5	57	38	38	49	3	8	0	35	35	22	76	5	8	27	22	8	22	8
	20	60	20	40	40	0	20	0	60	20	0	60	0	20	40	60	0	20	0

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Water resources	Technologies for developing water resources	21. Establishment of technologies for forecasting rainfall with good accuracy, and the effective use of precipitation.	1	44	21	14	26	39	68	27	5	0
			2	38	14	13	27	46	76	18	5	0
			X	10					100	0	0	0
		22. Acquirement of knowledge about the occurrence of the phenomena of abnormal precipitation, e.g., heavy rain and drought, caused by global warming, and implementation of measures for coping with changes in railfall characteristic.	1	44	17	18	26	39	64	27	9	0
			2	37	16	12	26	46	68	27	5	0
			X	11					100	0	0	0
		23. Refinement of technology for artificial groundwater recharge, resulting in the conservation of aquifer and rational use of groundwater.	1	51	22	28	21	29	45	41	12	2
			2	43	18	25	21	37	53	30	14	2
			X	12					58	25	8	8
		24. Development of technologies for flowing appropriate volume of sediment to downstream without allowing it to accumulate in dam reservoirs and for efficiently removing accumulated sand, thus extending the service lives of, and rejuvenating, dams.	1	47	22	19	24	35	43	55	2	0
			2	39	16	18	24	43	38	56	5	0
			X	11					73	27	0	0
		25. Widespread recycling of waste water such as sewage by means of sophisticated treatment so that it can be used for miscellaneous purposes (e.g., flush toilets) in areas suffering from shortage of water.	1	50	15	23	30	32	40	50	8	2
			2	42	14	19	27	40	33	64	0	2
			X	10					50	50	0	0
		26. Widespread use of recycling systems for sewage and waste water even in small-scale plants, based on advances in treatment technology.	1	51	14	21	36	30	51	41	8	0
			2	44	10	17	36	37	48	52	0	0
			X	7					86	14	0	0
		27. Effective use of water resources with very few cases of leakage of waterworks.	1	42	14	17	28	42	40	43	14	2
			2	34	10	18	22	50	29	56	12	3
			X	7					57	14	14	14
	Technologies for preventing water disasters	28. Significant reduction in the loss of human lives by virtue of improved technologies for forecasting landslides and landslips.	1	54	19	36	19	26	59	39	2	0
			2	47	16	31	20	33	68	32	0	0
			X	11					100	0	0	0
		29. Establishment of technologies enabling accurate forecast of rainfall and therefore effective dam operation in the case of floods.	1	42	26	17	15	42	55	45	0	0
			2	37	19	15	21	46	62	38	0	0
			X	13					92	8	0	0
		30. Widespread use of levees designed not to break even if overtopping happens with the design of super levees and new materials to be developed.	1	40	19	18	18	44	55	35	8	0
			2	32	15	16	16	53	63	34	3	0
			X	10					100	0	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Degree of certainty (%) Medium	Degree of certainty (%) Low	Necessity of international joint development (%) High	Necessity of international joint development (%) Medium	Necessity of international joint development (%) Low	Necessity of international joint development (%) None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Comparison of current R&D level between Japan and other countries (%) Equivalent	Comparison of current R&D level between Japan and other countries (%) Other countries are more advanced	Comparison of current R&D level between Japan and other countries (%) Don't know	Constraints on realization (%) Technical	Constraints on realization (%) Institutional	Constraints on realization (%) Cultural	Constraints on realization (%) Cost	Constraints on realization (%) Funding	Constraints on realization (%) Fostering/securing human resources	Constraints on realization (%) R&D system	Constraints on realization (%) Others
	36	39	23	41	30	18	11					64	20	0	11	32	18	27	2
	26	50	21	45	37	13	3	18	55	8	13	87	11	0	16	26	18	21	3
	40	50	10	50	30	20	0	20	50	20	0	80	20	0	0	30	20	20	0
	11	50	36	73	14	7	7					61	20	2	7	30	14	32	5
	8	59	32	78	16	3	3	3	51	19	24	76	8	3	11	32	11	32	3
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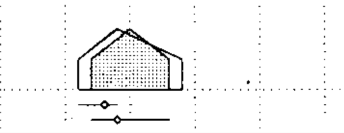	10	61	27	20	25	35	18					57	43	0	22	14	10	14	4
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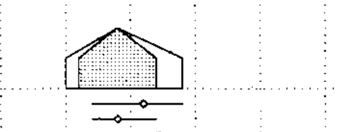	32	49	19	4	17	34	45					51	21	0	47	32	9	9	2
	33	49	18	0	15	36	49	41	46	0	10	67	15	0	64	26	5	5	3
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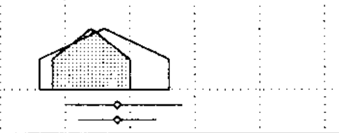	22	52	24	10	12	34	42					18	24	28	68	28	2	4	2
	29	60	12	2	14	45	36	40	40	14	0	12	29	26	83	12	2	2	5
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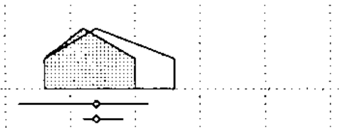	29	53	12	8	16	33	41					24	20	10	80	22	4	4	4
	25	66	9	2	18	50	30	41	39	7	11	43	20	2	91	11	2	0	5
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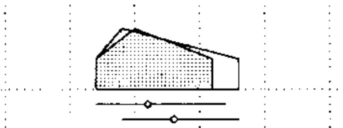	21	40	29	7	7	12	69					40	2	0	60	36	7	7	7
	18	53	26	0	6	24	71	35	35	6	21	59	3	0	71	32	3	0	9
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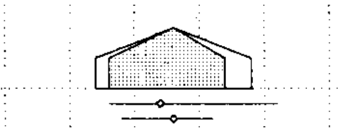	20	39	37	9	20	35	35					70	13	2	28	24	15	22	2
	15	47	38	4	19	32	43	51	34	4	6	72	9	2	30	36	6	26	2
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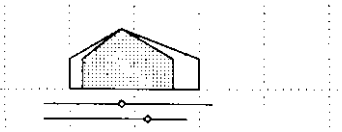	43	31	24	21	24	24	31					62	21	5	10	12	17	21	5
	27	49	24	19	22	27	30	35	35	8	14	68	24	3	16	22	8	14	5
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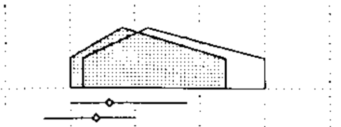
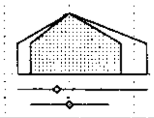
	40	33	25	8	15	25	48					25	33	10	53	43	3	3	10
	50	28	22	0	16	34	50	44	34	3	6	28	41	6	59	34	3	6	9
	90	10	0	0	0	10	90	90	0	0	0	20	50	0	50	30	0	0	30

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Water resources	Technologies for improving water quality	31. Practical use of water purification technology for rivers, lakes, and marshes, spurring environmental improvement and more effective water use.	1	56	19	22	36	22	73	21	4	2
			2	48	12	21	38	29	75	23	0	2
			X	8					100	0	0	0
		32. Widespread use of technologies for removing wider range of pollutants than such ordinary pollutants as BOD substances in the treatment of waste water.	1	51	11	22	38	29	63	29	8	0
			2	44	6	21	38	35	70	27	2	0
			X	4					100	0	0	0
		33. Significant improvement in water purifying technologies due to new materials and biotechnologies, thus providing safe, good-tasting water to drink.	1	55	10	22	44	25	42	49	7	2
			2	50	7	19	46	29	42	52	4	2
			X	5					80	20	0	0
		34. Improvement in the water quality of closed water bodies such as Tokyo Bay, enabling people to enjoy swimming.	1	53	11	17	46	26	30	49	19	2
			2	44	9	12	44	35	27	52	18	0
			X	6					67	33	0	0
	Common technologies	35. Widespread use of comprehensive systems of management for both water use and flood control based on application of snowmelt control technology and long-term flood forecasting technology.	1	44	21	15	25	40	41	41	16	2
			2	37	15	13	26	46	41	43	14	3
			X	10					70	30	0	0
		36. Practical use of international water transfer systems to enable stable supply of water.	1	39	16	18	19	47	18	26	28	28
			2	32	13	13	21	53	22	22	34	22
			X	9					44	0	11	44
		37. Widespread use of inland water such as river water, effluent and ground water for snow thawing or heating and cooling based on heat pump technology.	1	53	19	22	32	27	25	43	28	4
			2	45	14	17	33	35	13	62	20	2
			X	10					20	50	20	0
		38. Quantitative determination of the influences of acid rain on the water system, allowing corrective measures to be formulated.	1	54	11	24	38	27	50	37	11	2
			2	47	10	20	38	32	60	32	9	0
			X	7					71	29	0	0
		39. Development of technologies enabling accurate forecast of environmental impacts caused by very small amounts of pollutant.	1	46	11	22	31	36	43	50	7	0
			2	43	9	20	33	38	53	37	9	0
			X	6					67	33	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	21	46	27	18	34	25	18					41	18	5	55	27	5	21	2
	13	60	25	21	29	31	13	27	56	4	8	52	19	6	60	21	2	17	0
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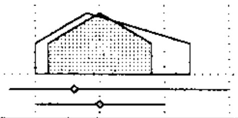	14	57	25	20	27	29	20					39	10	2	69	20	6	10	2
	7	68	25	20	27	34	14	27	57	2	11	55	9	2	80	20	2	7	0
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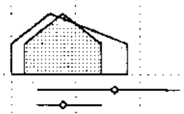	16	44	33	9	31	27	25					36	7	4	71	13	7	9	5
	8	62	28	12	26	40	18	30	48	8	12	54	8	2	84	14	2	8	0
	20	80	0	40	20	40	0	0	60	20	0	40	0	0	80	40	0	40	0
	11	34	43	8	17	19	49					28	38	11	40	34	8	11	4
	11	34	52	2	11	20	57	32	39	2	18	32	39	11	50	36	2	7	0
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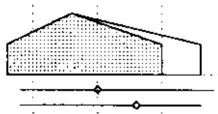	23	36	36	5	36	23	32					57	20	2	11	25	14	20	2
	19	43	38	3	38	19	35	38	35	5	16	78	8	0	27	22	5	27	0
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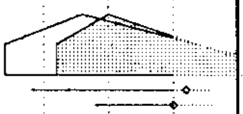	18	23	31	59	8	5	10					8	56	21	18	13	5	15	5
	16	13	59	56	13	9	9	0	22	38	28	3	69	25	22	16	9	13	0
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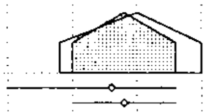	19	40	34	2	21	36	30					36	26	8	47	13	6	6	4
	16	44	38	0	13	42	40	36	38	4	13	47	22	9	62	9	4	11	0
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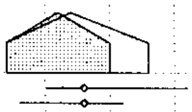
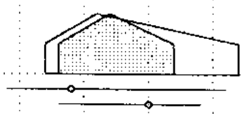
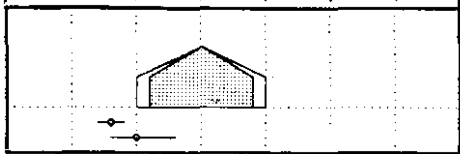
	13	50	30	63	19	7	6					46	22	6	15	19	13	33	11
	11	60	28	74	13	2	4	6	40	38	9	66	19	2	4	21	9	43	6
	29	71	0	71	0	0	0	0	29	57	0	86	29	14	14	0	0	43	0
	7	46	39	26	48	11	9					52	15	2	24	28	15	24	0
	0	58	40	28	58	2	7	9	56	21	7	67	14	0	21	37	12	23	0
	0	100	0	50	33	0	0	0	50	33	0	67	0	0	50	17	17	33	0

4.8 Energy

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Primary energies	Coal, petroleum, and natural gas	1. Possibility of a considerable level of simulation of the forming processes of sedimentary basins and the generation, movement and accumulation of hydrocarbon inside the sedimentary basins.	1	59	3	7	29	61	22	54	24	0
			2	51	1	7	29	63	18	61	22	0
			X	2					100	0	0	0
		2. Development of economical recovery of off-shore oil at a depth of 1,000 m or more.	1	89	3	8	46	42	38	46	11	2
			2	76	3	7	45	45	38	54	5	3
			X	4					100	0	0	0
		3. Widespread use of technology for the extraction of oil from oil sand (tar sand).	1	98	4	16	44	36	31	47	19	2
			2	89	3	14	47	36	31	52	15	2
			X	4					75	25	0	0
		4. Practical use of technology for the *in-situ* recovery of oil from oil shale (i.e., recovery in form of oil or gas without mining the shale itself, directly from the oil shale stratum).	1	85	4	14	38	44	28	44	22	4
			2	77	3	13	40	45	22	57	17	4
			X	4					50	25	25	0
		5. Practical use of technology for direct liquefaction of coal.	1	119	6	21	51	22	42	36	20	1
			2	107	4	19	53	24	44	41	14	0
			X	6					50	0	50	0
		6. Practical use of alloyed or ceramic materials for high-temperature gas furnaces, capable of withstanding the outlet gas temperature of 1,000 °C.	1	116	9	29	38	24	46	45	9	1
			2	104	10	28	39	24	48	47	4	1
			X	13					62	31	8	0
		7. Development of super-decomposing processes that turn all vacuum distillation residues, etc. into petrochemical materials, gasoline and gas oil in a single process by catalysts, reactors, etc. to be developed.	1	57	3	10	25	62	32	49	19	0
			2	48	2	10	23	64	33	52	15	0
			X	3					67	0	33	0
		8. Practical use of technologies for producing methane or methanol from carbon dioxide collected from the exhaust gas of large boilers at thermal power plants and the like by using hydrogen.	1	105	7	21	42	30	39	31	21	8
			2	93	6	20	43	31	52	33	11	4
			X	8					38	50	0	13
	Sun, wind power, and ocean biotechnology	9. Development of space solar power generating systems.	1	125	8	26	48	18	31	30	30	8
			2	116	7	25	51	16	26	37	32	5
			X	10					50	30	20	0
		10. Practical use of marine temperature difference power generation.	1	131	8	26	51	15	10	41	43	5
			2	120	9	25	53	14	10	43	42	5
			X	12					17	58	25	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	3	44	49	41	44	12	2					56	2	2	12	34	29	29	2
	0	47	53	45	47	6	0	0	25	55	18	59	4	0	18	31	37	37	2
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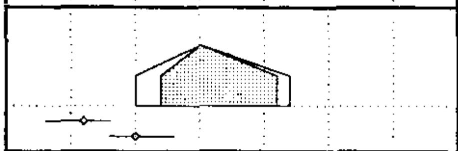	12	37	45	61	27	3	3					58	4	2	60	27	6	10	4
	11	43	42	72	20	3	0	5	12	64	14	68	0	0	68	29	8	12	1
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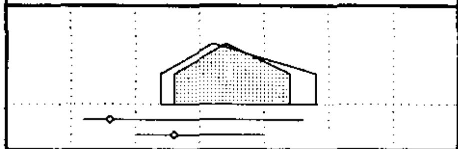
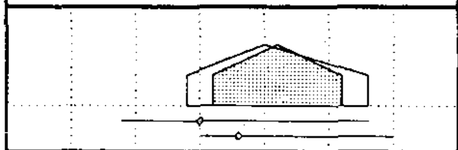
	17	41	35	53	31	11	1					36	2	2	80	22	4	7	6
	13	49	33	56	30	9	1	1	16	67	13	43	1	2	90	17	8	7	6
	50	25	25	100	0	0	0	0	25	75	0	50	0	0	100	0	25	0	0
	9	33	46	53	29	7	2					54	2	1	72	21	4	8	6
	5	32	56	61	23	6	1	1	14	65	14	64	0	3	78	14	5	5	4
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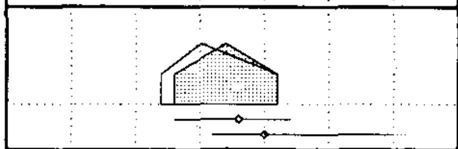
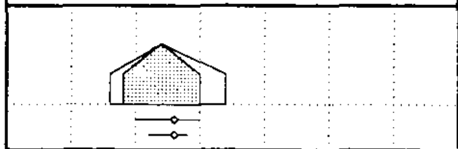
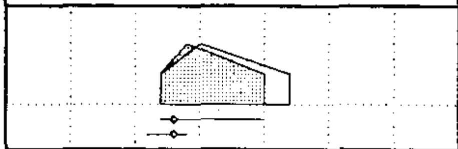
	12	48	37	21	48	19	9					45	2	3	86	20	4	9	4
	7	58	34	21	57	14	6	8	53	24	12	49	1	2	90	21	6	7	2
	67	17	17	0	67	17	17	17	83	0	0	50	0	0	100	50	0	0	0
	21	59	18	10	30	39	20					76	3	0	45	21	5	10	2
	17	65	16	11	32	41	14	35	44	10	7	84	2	0	52	17	4	13	1
	38	54	8	23	15	31	31	38	54	8	0	92	0	0	38	15	8	23	8
	9	40	46	11	25	42	19					74	4	0	39	28	7	11	2
	10	42	46	8	29	44	15	17	40	27	15	79	4	0	60	21	4	8	0
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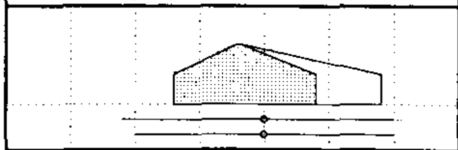	14	35	41	21	26	28	17					55	4	0	65	20	6	5	6
	6	46	42	16	37	31	11	14	56	10	13	63	3	0	81	10	3	5	2
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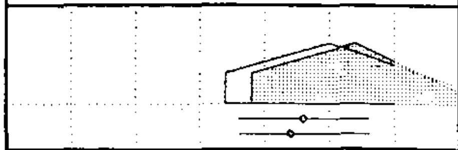	10	34	49	66	18	6	2					67	3	2	42	42	2	10	3
	9	32	55	73	15	6	1	8	25	45	15	72	4	1	53	41	2	8	3
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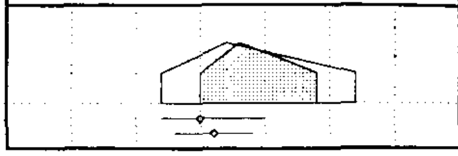
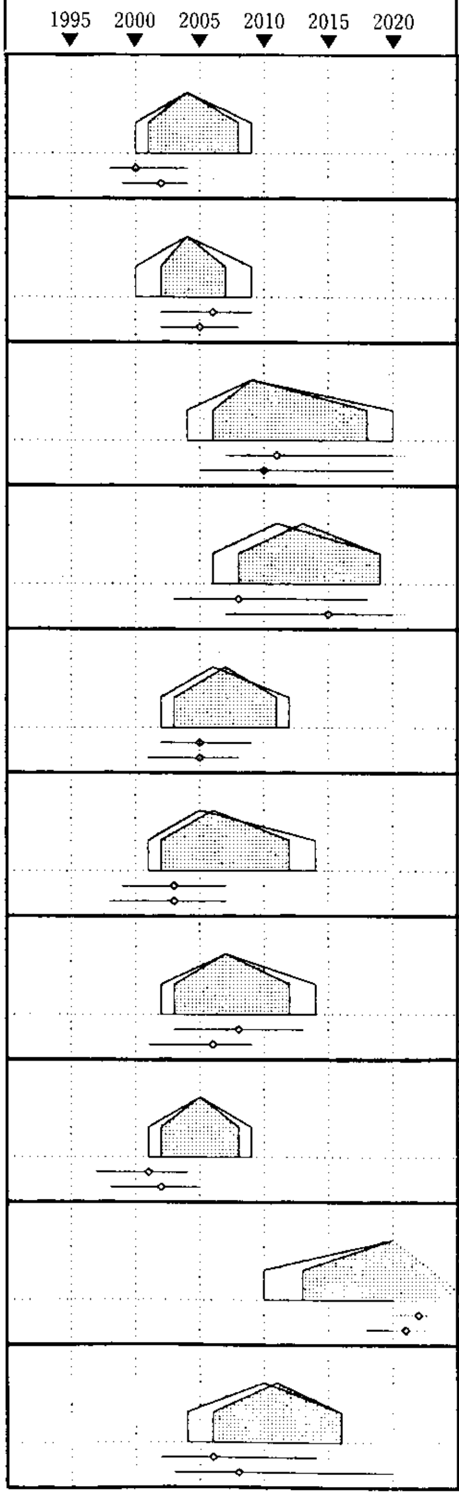
	14	44	38	20	34	25	19					39	7	2	79	31	2	5	2
	11	48	39	17	42	24	13	13	48	14	19	46	5	0	83	30	2	4	3
	42	42	17	17	58	17	8	17	58	17	8	42	8	0	100	33	0	8	0

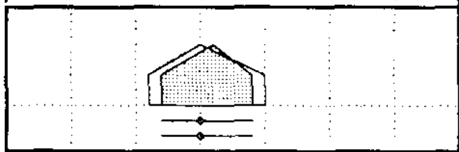
Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Primary energies	Sun, wind power, ocean, and biotechnology	11. Practical use of a wind power generation system of a megawatt scale.	1	132	5	37	45	14	10	36	48	6
			2	121	7	35	46	12	8	38	45	7
			X	9					22	33	44	0
		12. Practical use of large-area thin-film solar cells with a cell conversion factor of at least 20%.	1	130	10	35	41	15	62	33	5	0
			2	118	12	32	41	14	68	29	3	0
			X	17					82	18	0	0
		13. Widespread world-wide production of energy using biomass as the raw materials.	1	104	5	18	45	32	34	45	20	0
			2	91	6	16	44	34	31	46	20	1
			X	8					50	25	25	0
		14. Practical use of energy supply systems that convert clean energy in other countries into energy carriers such as hydrogen to transport them.	1	109	7	26	39	28	25	50	21	3
			2	99	7	26	39	27	28	49	18	1
			X	10					70	20	10	0
		15. Widespread use of solar cells for residential power supply.	1	140	16	32	44	9	50	38	11	1
			2	127	17	31	43	9	51	35	10	2
			X	24					67	29	0	0
		16. Practical use of innovative passive solar houses which effectively use natural energy.	1	123	9	31	41	19	26	50	20	2
			2	113	8	32	42	18	23	54	19	2
			X	11					64	27	0	9
		17. Widespread use of technologies that make it possible to treat and recycle wastes and the like at low cost by using bio-technologies and to collect energies such as methane.	1	114	5	21	49	25	32	47	19	0
			2	100	4	23	47	27	28	55	15	0
			X	5					60	20	20	0
		18. Widespread use of technology to process urine/excrement and various other livestock wastes for use as feed or fuel (e.g., through methanization).	1	103	6	16	46	32	24	43	29	2
			2	90	6	18	42	34	23	43	30	2
			X	8					50	25	25	0
	Terrestrial heat	19. Development of technology for the conversion of the heat of magma pockets to electrical power.	1	104	7	18	44	32	22	38	36	5
			2	93	5	20	43	32	18	38	39	5
			X	7					57	29	14	0
		20. Practical use of high-temperature rock power-generating technologies.	1	100	9	19	38	34	22	48	26	4
			2	91	9	18	39	34	19	47	31	3
			X	12					58	25	17	0

Forecasted realization time (Year)



Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
19	40	31	14	25	27	27					36	11	6	73	20	2	5	9
12	49	31	12	24	28	26	8	38	40	3	32	10	5	82	14	2	2	12
67	33	0	11	22	33	33	11	56	33	0	22	11	11	100	0	11	0	22
15	58	26	11	31	27	32					75	6	1	70	12	2	6	2
14	61	25	12	31	29	26	43	44	7	4	80	3	1	77	8	2	4	3
35	65	0	6	12	47	35	47	47	6	0	88	0	0	82	6	0	6	0
11	42	42	31	33	19	16					40	11	10	63	29	7	13	1
9	52	37	31	38	14	12	10	47	24	16	52	7	7	74	23	4	11	0
63	25	13	25	50	13	13	13	50	38	0	63	0	13	75	38	0	0	0
12	39	41	56	24	10	5					48	14	5	69	29	3	6	1
8	41	47	60	20	10	4	5	53	17	21	54	9	4	76	21	3	8	2
30	40	30	80	0	10	10	0	80	20	0	60	10	0	60	30	0	20	10
19	50	30	4	19	31	46					36	27	4	86	11	2	4	1
17	54	27	2	19	34	41	41	45	4	6	41	27	2	91	4	2	3	4
46	42	8	4	4	25	63	42	42	8	0	17	46	4	88	4	4	0	4
20	41	34	7	15	28	45					37	15	8	76	20	1	5	2
12	53	33	4	12	36	43	14	52	9	19	44	14	8	87	11	2	4	2
73	18	9	27	0	18	55	18	45	27	9	45	18	9	82	18	9	9	0
10	47	41	9	29	32	28					49	17	5	61	24	7	10	1
6	55	38	4	28	37	28	13	52	5	25	58	12	6	72	15	3	8	2
20	60	20	20	40	40	0	0	60	20	0	100	0	0	60	20	0	20	0
11	50	35	9	21	26	39					28	17	12	63	25	10	9	1
11	52	33	4	23	31	36	16	47	3	29	34	11	14	73	14	8	8	2
50	38	13	0	25	50	25	38	63	0	0	63	25	13	75	25	0	0	0
13	31	47	23	38	25	11					78	2	3	44	29	3	13	2
12	29	56	16	49	22	8	9	44	16	24	87	2	3	57	20	2	8	2
71	14	14	14	57	14	0	29	57	0	14	86	0	0	57	14	0	29	0
14	47	32	23	36	25	12					67	7	2	57	26	4	7	3
11	54	31	13	53	21	7	14	43	21	15	80	4	1	59	21	2	7	4
42	58	0	25	50	8	0	8	67	25	0	75	25	0	42	25	0	25	8

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Primary energies	Nuclear power	21. Practical use of new uranium enrichment technology (e.g., based on application of lasers).	1	109	16	31	25	29	36	57	7	0
			2	100	16	30	26	28	35	61	4	0
			X	22					45	55	0	0
		22. Practical use of fast breeder reactor systems with an operation including the nuclear fuel cycle.	1	117	27	28	22	24	63	33	3	0
			2	106	29	26	22	24	70	26	3	0
			X	40					83	18	0	0
		23. Development of fusion reactors.	1	123	25	29	25	20	76	18	5	0
			2	112	26	33	21	20	78	17	2	1
			X	36					86	11	3	0
		24. Practical use of plants that utilize nuclear reactor heat for producing secondary energy substances such as hydrogen.	1	103	18	24	25	33	37	42	20	0
			2	93	19	25	23	33	32	51	16	0
			X	26					54	38	8	0
		25. Realization of nuclear power facilities (reactors, nuclear fuel cycle facilities) with a high degree of full automation through application of remote monitoring and robot systems.	1	112	21	23	29	27	46	43	9	2
			2	101	20	25	28	27	45	46	9	0
			X	27					52	41	7	0
		26. Practical use of sophisticated reprocessing technologies capable of group separation. * The separation of nuclides from high-level radioactive wastes according to half-life or the like (e.g., the separation of TRU elements, ^{137}Cs, ^{40}Sr, and elements of the platinum group).	1	88	16	23	19	42	58	36	6	0
			2	80	15	24	19	42	66	33	1	0
			X	21					57	43	0	0
		27. Practical use of reusing technology of low-level radioactive wastes.	1	99	16	18	31	35	34	45	14	4
			2	91	16	19	31	34	37	49	10	2
			X	22					41	36	18	0
		28. Practical use of technology for the safe disposal of highly radioactives solid waste.	1	102	16	25	25	33	76	23	1	0
			2	93	17	22	28	33	84	16	0	0
			X	24					83	17	0	0
		29. Development of quenching processing technology for radioactive waste based on high-energy elementary particles.	1	91	12	23	23	41	43	40	12	4
			2	84	14	24	23	39	44	42	10	5
			X	19					47	32	11	11
Secondary energy	Processing energy	30. Practical use of manufacturing processes for energy-source hydrogen employing a method of thermochemical decomposition.	1	94	5	27	31	37	35	50	14	1
			2	82	7	25	28	40	34	54	11	1
			X	10					50	30	20	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	65	18	20	32	24	23					73	6	6	52	31	5	6	1
	13	67	19	17	36	22	23	7	31	50	8	82	5	4	55	26	5	5	0
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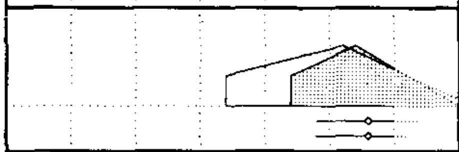
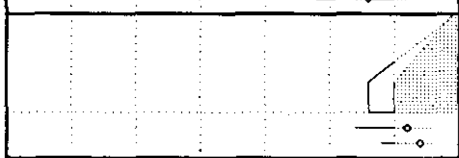
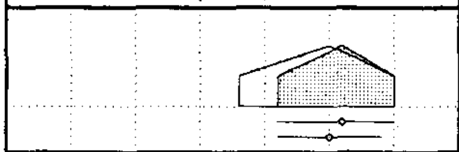
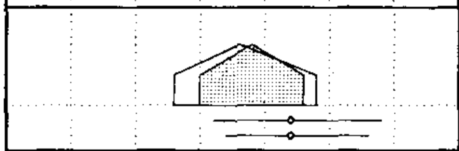
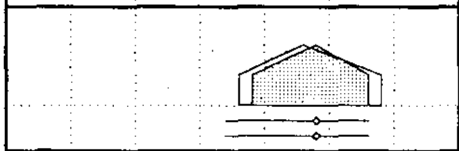
	32	45	21	44	38	10	5					61	5	23	54	28	1	6	6
	26	50	21	48	42	5	3	7	42	44	2	61	5	22	64	22	0	6	5
	45	45	10	50	45	3	3	13	50	33	3	50	8	28	73	23	0	8	3
	38	24	34	79	13	3	2					89	2	5	25	43	2	14	0
	43	21	34	88	8	1	2	3	62	29	4	92	0	4	21	45	4	13	1
	64	22	14	89	11	0	0	6	67	22	0	94	0	0	22	53	3	14	0
	14	49	33	28	40	17	13					55	8	14	54	35	4	7	3
	18	41	39	24	58	8	9	5	59	17	15	71	5	10	66	26	1	5	4
	35	42	23	31	58	0	12	8	77	12	0	73	4	12	69	19	0	12	8
	20	52	21	20	36	23	16					64	18	18	27	23	9	6	4
	17	59	22	18	43	27	11	40	49	3	4	78	16	17	39	23	8	4	1
	26	59	15	15	59	19	7	26	67	0	0	56	22	30	52	15	7	4	0
	11	40	44	43	39	9	3					80	7	3	40	31	6	13	0
	13	39	45	46	48	3	0	10	50	21	9	88	3	1	49	25	4	11	1
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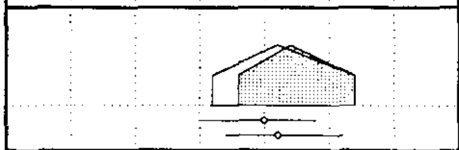	13	40	35	24	35	18	13					49	29	26	35	17	6	4	4
	14	41	41	31	44	14	7	2	55	18	19	56	27	29	44	13	4	4	3
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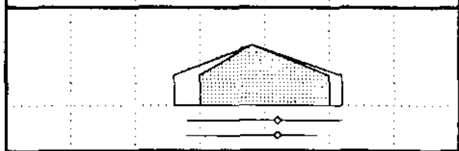
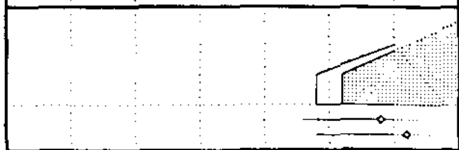
	21	50	26	42	41	9	7					53	26	40	23	16	7	9	9
	17	52	29	42	52	4	1	1	56	32	8	57	24	51	23	14	3	6	5
	33	50	17	33	67	0	0	0	71	25	0	46	38	58	17	13	8	13	4
	14	30	48	51	33	7	4					77	5	7	35	36	3	7	2
	18	30	48	55	36	2	2	5	46	32	12	86	1	6	39	36	4	7	2
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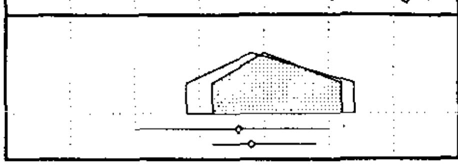
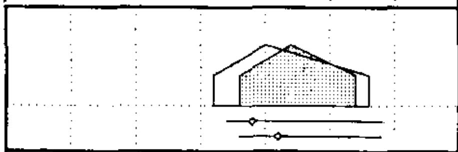
	7	48	43	24	35	26	15					79	2	0	66	27	4	3	2
	7	51	41	20	46	23	11	7	68	12	10	83	0	0	77	20	1	4	1
	30	50	20	30	30	20	20	10	80	0	0	80	0	0	60	40	0	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Secondary energy	Processing energy (hydrogen, methanol, etc.)	31. Practical use of the manufacturing technologies of methane and methanol fuels from coal and biomass by using hydrogen produced from nuclear reactor heat and solar heat.	1	101	6	23	38	33	23	57	19	1
			2	88	7	22	36	36	18	67	14	1
			X	9					33	44	11	11
		32. Widespread use of methanol and other fuel cells as highly efficient, environmentally safe, portable power sources, e.g., for electric automobiles.	1	116	13	26	38	24	31	53	16	1
			2	107	10	27	40	23	31	58	11	0
			X	14					50	21	29	0
		33. Widespread use of hydrogen motorcars.	1	126	5	25	52	18	31	37	25	6
			2	113	5	24	52	19	26	44	26	4
			X	7					29	14	57	0
	Electricity	34. Widespread use of efficient power generating technologies (e.g., Karina's cycle and Rankine's cycle) in low-temperature areas such as exhaust heat, etc.	1	96	13	19	31	37	29	53	17	1
			2	86	12	22	28	38	22	63	14	1
			X	17					24	71	6	0
		35. Practical use of molten salt fuel-cell power generation plants in the 200,000 to 300,000 KW class, applying coal gas.	1	107	12	32	27	30	36	50	12	1
			2	97	10	32	28	30	29	60	11	0
			X	14					36	64	0	0
		36. Widespread use of 100,000 KW-class solid-state electrolytic fuel cells for local cogeneration and distributed electric utility.	1	115	12	34	30	24	41	51	8	0
			2	107	10	36	31	22	35	59	7	0
			X	14					36	64	0	0
		37. Practical use of coal-gasifying, combined-cycle power generation plants.	1	114	14	25	36	25	36	58	4	1
			2	101	14	25	35	27	36	60	3	0
			X	19					63	37	0	0
		38. Practical use of large-scale combined-cycle power generation based on highly efficient gas turbines (inlet temperature of at least 1,500 °C).	1	114	13	28	34	25	52	43	5	0
			2	105	12	28	36	24	57	39	3	0
			X	17					71	29	0	0
		39. Practical use of the closed MHD (magnetohydrodynamic) compound power generation.	1	98	10	23	32	35	15	48	32	3
			2	90	9	25	31	34	11	56	30	2
			X	13					23	23	46	8
		40. Practical use of secondary batteries (e.g., Ni/MH batteries and Li batteries) with a high energy density (200 Wh/kg: about 5 times that of lead batteries).	1	95	6	21	36	38	44	46	8	0
			2	89	5	23	36	36	42	53	4	0
			X	7					100	0	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	10	44	41	21	40	24	12					66	3	2	65	26	3	9	3
	2	57	40	20	52	19	5	6	53	13	24	75	0	1	74	20	1	9	1
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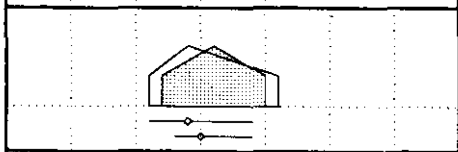	16	49	29	8	27	37	26					59	12	3	81	10	4	2	1
	12	56	30	12	28	36	22	12	58	11	15	66	10	2	91	5	3	4	1
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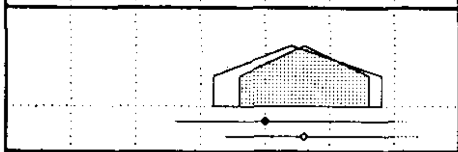	12	38	40	11	28	27	26					58	15	2	75	10	3	2	2
	8	45	42	10	33	31	21	10	61	4	19	67	10	4	84	5	2	2	1
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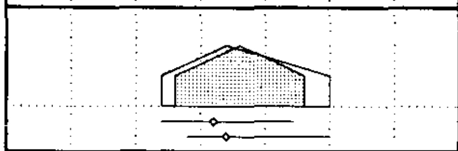	11	45	40	10	26	33	28					65	5	1	77	16	1	6	2
	3	55	38	8	28	37	23	13	50	9	26	70	5	2	85	14	1	6	1
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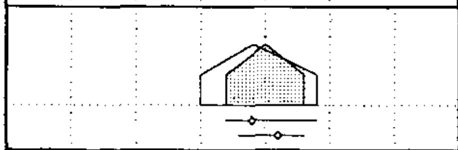	14	51	33	17	37	30	16					79	3	1	73	26	2	3	0
	6	57	35	15	43	30	10	18	57	14	9	84	1	0	81	19	2	3	1
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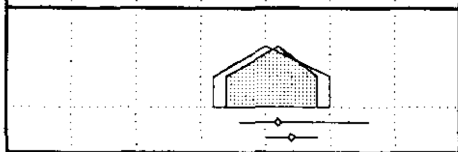	19	50	30	17	39	27	17					77	8	0	70	23	3	1	0
	8	60	28	13	46	28	10	11	53	23	10	87	5	0	78	14	1	2	0
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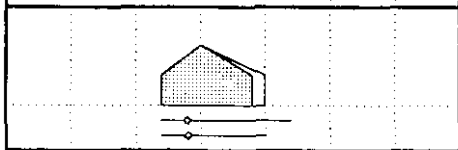	22	49	24	6	34	37	18					56	3	3	68	28	1	9	0
	19	55	24	5	35	41	16	11	59	17	9	65	1	1	80	21	1	7	0
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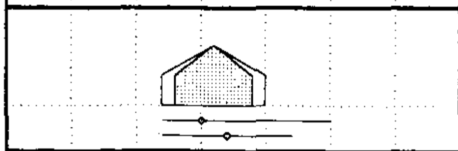
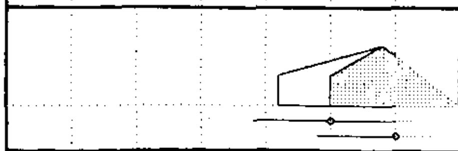
	23	52	22	12	34	32	19					82	3	1	46	24	2	4	1
	15	59	25	8	39	35	16	19	56	12	10	86	1	0	56	23	1	3	0
	47	47	6	18	29	47	6	24	59	18	0	76	0	0	53	24	0	6	0
	12	35	43	24	48	13	9					89	0	0	44	30	3	4	0
	11	39	47	20	60	9	7	8	48	26	14	91	0	1	48	26	2	4	0
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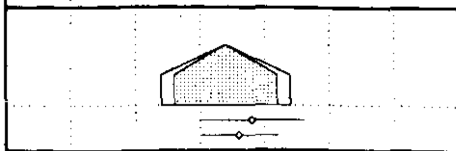
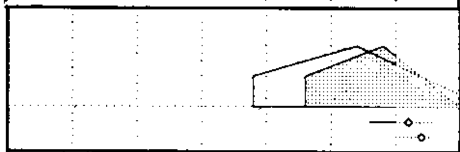
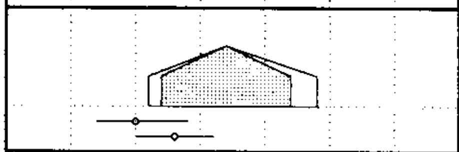
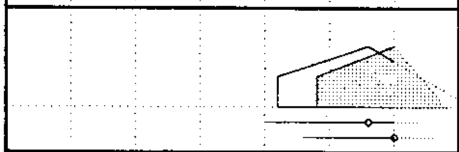
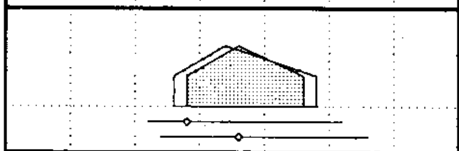
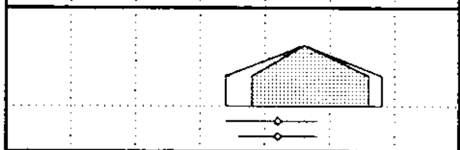
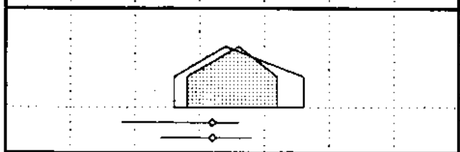
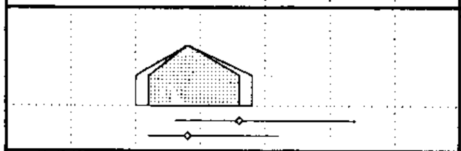
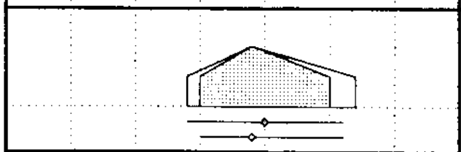
	11	51	33	12	36	26	23					87	1	0	67	9	3	4	1
	7	58	33	6	40	35	16	10	56	8	19	91	0	0	79	4	1	2	1
	43	57	0	14	0	57	29	29	57	14	0	100	0	0	86	14	0	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Secondary energy	Electricity	41. Practical use of superconductive energy storage systems with a capacity(1 million KWh) as large as that of pumped storage hydroelectric plants.	1	118	9	26	43	22	44	46	8	1
			2	108	9	27	43	21	41	52	6	1
			X	12					42	50	8	0
		42. Practical use of electric power storage equipment using secondary batteries for smoothing electric power load.	1	105	10	21	39	30	35	51	12	0
			2	102	11	20	44	26	34	57	8	0
			X	15					53	47	0	0
		43. Practical use of superconductive power transmission using high-temperature superconductive materials.	1	115	9	20	47	24	48	41	9	2
			2	106	10	19	49	22	47	42	8	2
			X	13					62	23	15	0
		44. Practical use of DC power transmission in the 1,000 KV class.	1	81	5	17	32	46	30	49	17	2
			2	73	5	18	31	46	27	59	12	0
			X	7					57	14	29	0
		45. Widespread use in industries of a power generator and other electrical equipment applying superconduction.	1	111	9	21	44	26	39	45	14	1
			2	100	10	19	45	26	37	51	10	1
			X	13					46	46	8	0
		46. Widespread use of electric cars with driving performance equal to that of gasoline motorcars.	1	134	6	25	56	13	52	36	11	1
			2	119	5	23	58	14	57	34	8	1
			X	7					71	14	14	0
	Heat and power	47. Widespread use of catalytic combustion technologies for industrial processes.	1	74	6	17	26	51	28	58	14	0
			2	66	5	15	29	51	29	58	14	0
			X	7					29	43	29	0
		48. Widespread use of fuel cells in the home for on-site cogeneration (thermal energy and electrical power).	1	114	15	27	34	25	29	48	21	2
			2	99	14	26	32	28	26	53	19	2
			X	19					32	63	5	0
		49. Widespread use of high-efficiency heat pumps with a coefficient of performance at least twice that of existing heat pumps.	1	96	15	20	28	36	35	55	9	0
			2	84	15	20	26	39	33	58	8	0
			X	21					57	38	5	0
Energy systems (energy saving, compounding, etc.)		50. Establishment of the concept of a thermal industrial complex aimed at total, efficient use of energy.	1	107	15	22	34	29	51	42	6	1
			2	99	15	20	36	28	52	45	3	0
			X	21					76	19	5	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	10	34	48	29	37	20	10					85	1	0	44	36	5	6	2
	10	34	53	28	46	18	6	11	54	15	16	89	1	0	50	32	3	5	2
	42	33	25	25	50	17	8	8	75	17	0	75	8	0	33	58	0	8	8
	13	47	34	10	27	33	27					68	6	0	74	20	1	6	2
	13	55	28	6	32	38	22	12	62	3	19	71	5	1	84	14	2	4	1
	40	53	7	7	13	60	20	13	73	7	0	67	13	7	80	27	0	7	0
	9	27	52	28	39	15	12					81	2	1	50	26	3	5	1
	8	28	60	25	46	18	8	9	62	8	17	88	1	0	61	22	2	4	1
	23	46	31	23	46	31	0	23	69	0	0	69	8	0	46	46	0	15	0
	11	44	40	11	32	27	25					58	10	7	49	35	2	2	4
	11	49	36	5	33	36	22	15	51	16	12	67	7	4	56	30	3	0	5
	43	43	14	0	14	43	43	14	57	29	0	14	14	0	71	43	0	0	14
	5	46	43	20	32	28	16					78	1	0	66	22	2	2	1
	4	41	54	14	39	32	14	11	66	4	16	82	1	0	70	15	2	2	0
	15	69	15	15	31	38	15	23	77	0	0	69	8	0	69	23	0	8	0
	16	50	32	9	33	25	31					71	7	6	78	7	1	4	1
	13	60	28	3	41	27	28	27	59	7	6	77	8	3	88	3	1	3	2
	57	29	14	0	43	29	29	14	86	0	0	86	0	0	86	29	0	0	0
	19	51	23	8	38	30	22					80	0	1	61	9	5	7	3
	12	59	26	6	42	26	23	18	61	3	17	88	0	2	68	6	2	3	2
	43	43	14	0	29	57	14	43	57	0	0	86	0	14	86	0	0	0	14
	18	51	28	9	25	30	32					46	28	7	85	7	3	0	0
	12	58	28	5	25	33	34	25	55	6	12	45	32	7	91	2	2	1	0
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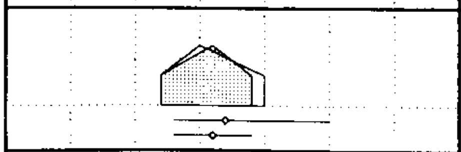
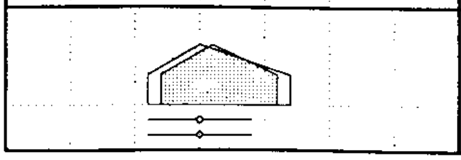
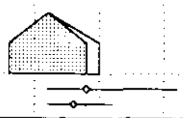
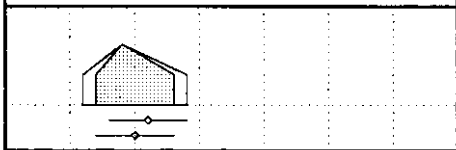
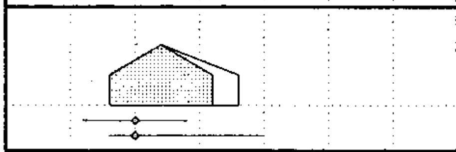
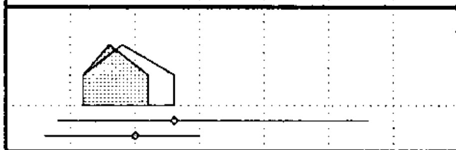
	18	50	30	8	24	35	30					78	1	2	67	8	4	3	1
	14	54	30	6	26	33	32	37	48	2	11	87	0	2	80	5	4	2	0
	33	52	14	19	24	19	38	57	29	5	10	76	0	0	71	14	5	10	0
	21	44	28	8	33	35	21					29	45	15	46	26	3	9	1
	15	45	37	6	30	44	17	19	46	10	21	32	52	11	60	18	1	7	0
	43	48	5	10	19	48	19	33	52	5	5	24	33	10	76	19	0	10	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Energy systems (energy saving, compounding, etc.)	51. Domination of non-Freon type air-conditioning systems.	1	112	12	20	43	25	63	30	6	1
		2	102	10	21	44	25	75	23	3	0
		X	14					79	21	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	32	49	17	29	27	25	18					68	12	1	73	11	1	9	1
	28	56	15	25	29	29	14	21	60	7	10	72	11	1	85	5	1	6	1
	36	43	14	36	29	29	0	14	71	7	0	64	29	7	57	7	0	7	7

4.9 Environment

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Global-scale environment	Destruction of ozone layer	1. Completion of high-accuracy, high-density observation systems capable of determining global trends in the change of stratosphere ozone for each altitude.	1	118	11	29	40	21	45	42	13	1
			2	98	8	25	50	18	41	50	9	0
			X	9					89	11	0	0
		2. Elucidation of quantitative impacts caused by fluorocarbon and the like on changes in the ozone layer.	1	122	15	26	41	18	58	29	12	1
			2	101	9	26	50	15	59	31	10	0
			X	11					100	0	0	0
		3. Elucidation of influences exerted by an increase in ultraviolet rays because of damage to the ozone layer on man, animals and plants for each wavelength of ultraviolet rays.	1	112	9	23	44	25	45	39	15	1
			2	91	7	20	50	24	45	41	13	0
			X	8					88	13	0	0
		4. Practical use of materials that replace fluorocarbon and halon, that do not damage the ozone layer and cause no global warming problem.	1	126	8	36	41	15	76	21	3	0
			2	100	7	31	47	15	81	16	1	0
			X	8					88	13	0	0
	Warming of the earth	5. Possibility of determining, with high accuracy, the inventory of greenhouse gases other than carbon dioxide for each generating source and each area.	1	137	21	33	38	8	47	40	12	1
			2	110	16	35	42	7	50	46	3	0
			X	19					84	16	0	0
		6. Elucidation of precise mechanisms of the emission and extinction of carbon dioxide in the atmosphere.	1	134	19	38	34	10	68	27	4	1
			2	105	15	39	35	11	79	19	2	0
			X	18					100	0	0	0
		7. Possibility of an accurate forecast of the magnitude of climate changes due to the global warming at about 50 km mesh level all over the earth.	1	133	13	36	40	11	47	41	11	2
			2	107	12	33	46	9	49	48	3	1
			X	14					71	29	0	0
		8. Elucidation of global and quantitative impacts of the global warming on forests.	1	127	12	30	44	15	55	39	5	0
			2	101	8	31	47	14	55	42	2	0
			X	9					89	11	0	0
		9. Possibility of accurate forecast of the sea level rise caused by global warming.	1	132	13	30	46	11	62	32	5	0
			2	105	9	28	52	11	72	25	3	0
			X	11					82	18	0	0
		10. Possibility of approximate forecast of the scale of areas affected and damage caused by epidemics due to global warming.	1	86	5	19	34	42	37	47	12	2
			2	65	2	21	32	45	40	49	11	0
			X	2					50	50	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	26	50	20	81	16	3	0					40	8	1	25	55	26	28	3
	16	59	23	87	11	2	0	3	34	40	17	44	5	1	20	67	24	24	0
	56	44	0	100	0	0	0	0	33	56	0	22	22	0	44	78	33	0	0
	27	53	17	66	25	7	1					50	5	0	11	37	39	31	2
	18	65	16	74	21	4	0	6	36	40	13	57	2	1	10	47	39	27	0
	55	45	0	82	18	0	0	0	55	36	0	91	0	0	18	45	36	9	0
	17	50	30	47	30	17	4					37	6	0	11	41	42	29	3
	11	60	27	58	32	8	2	3	29	42	19	40	2	2	9	49	51	34	0
	38	50	13	75	13	13	0	0	75	25	0	25	0	13	13	38	63	38	0
	34	48	16	36	33	21	10					56	10	4	65	17	6	14	2
	35	53	10	34	40	17	8	24	44	20	3	67	2	3	70	18	5	15	1
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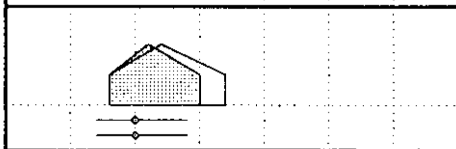	20	54	24	82	13	3	1					36	12	10	15	40	22	38	4
	18	63	18	88	10	1	0	11	44	24	13	37	7	6	12	55	21	42	1
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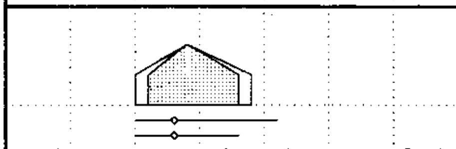	16	54	26	72	22	4	0					51	4	4	11	46	25	33	2
	14	58	28	85	12	3	0	4	52	29	8	56	1	2	9	53	27	39	1
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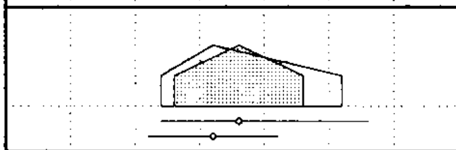	11	51	36	79	15	3	1					53	3	3	16	47	25	32	1
	7	56	36	87	11	1	0	7	38	37	9	64	1	1	18	61	22	26	1
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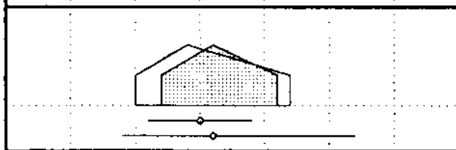
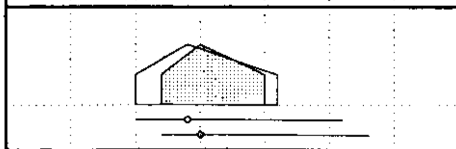
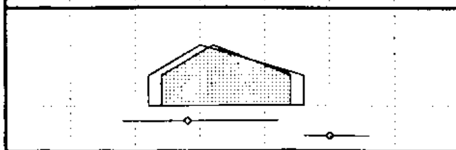
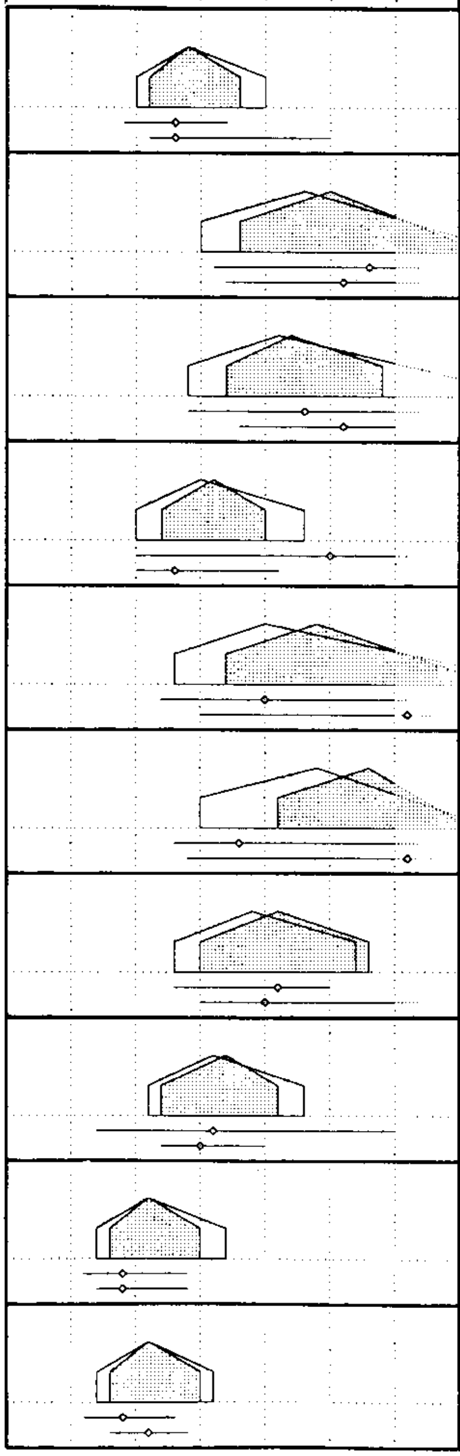
	13	49	34	75	22	2	0					39	5	9	10	46	31	33	2
	10	47	42	86	12	1	0	3	36	43	12	48	1	7	8	61	34	32	1
	33	56	11	100	0	0	0	0	56	44	0	33	0	0	0	67	56	33	0
	16	51	31	79	17	3	0					48	4	1	11	42	29	33	2
	13	56	30	89	10	1	0	3	35	41	12	64	0	0	11	54	27	32	2
	36	55	9	100	0	0	0	9	27	55	0	45	0	0	27	55	36	27	0
	9	42	44	76	12	8	0					38	13	12	7	27	37	31	3
	14	43	43	88	12	0	0	0	26	35	25	48	5	8	3	40	45	38	2
	0	50	50	100	0	0	0	0	0	50	0	50	0	0	0	50	50	0	0

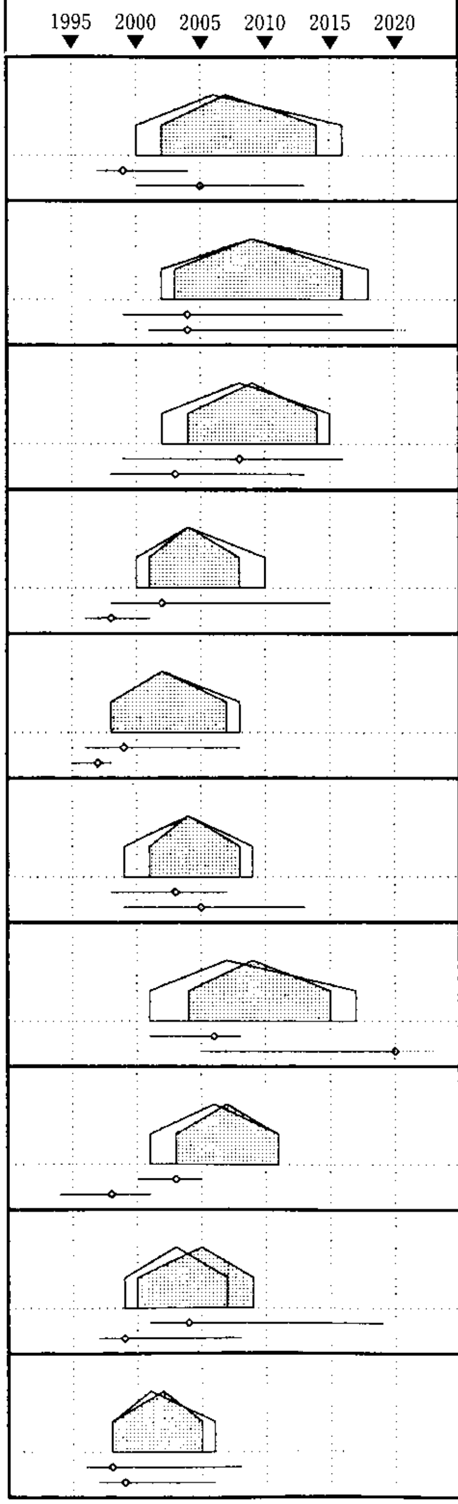
Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Global-scale environment	Warming of the earth	11. Determination of impacts of global warming on the whole world's agricultural production.	1	115	12	23	45	21	67	29	3	0
			2	93	11	19	48	21	83	17	0	0
			X	13					77	23	0	0
		12. Worldwide reduction of the emission of carbon dioxide (per year) by 20% of the current level.	1	133	20	34	36	10	69	22	7	0
			2	109	18	33	42	8	83	12	4	0
			X	21					86	5	5	0
		13. Possibility of controlling an increase in the concentration of the greenhouse effect gases (other than carbon dioxide) in the atmosphere.	1	134	20	34	37	9	58	34	6	1
			2	108	18	29	45	8	69	29	2	0
			X	21					95	0	5	0
		14. Development of high efficient carbon dioxide separating films (separating coefficient of 100 or more)	1	93	10	22	31	37	33	44	17	4
			2	71	7	22	32	39	31	51	14	4
			X	8					25	50	13	13
		15. Practical use of technologies for collecting carbon dioxide from large boilers at thermal power plants and the like, and for dumping it without causing serious environmental impact to the ocean deep (3,000 m or deeper), gas fields and the like.	1	112	18	26	32	24	40	32	20	8
			2	91	15	25	38	22	41	36	18	5
			X	17					47	18	18	18
		16. Creation of coral reefs capable of fixing carbon dioxide at the rate of 5 kg/m^2 per year or more.	1	86	7	19	33	41	16	43	33	7
			2	70	5	17	38	40	17	50	27	6
			X	6					33	17	33	17
		17. Developing of a technique for fixing carbon dioxide in flue gases (concentration: 10 to 15%; temperature of 55 °C or more) by using algae having a photosynthesis efficiency that is twice or more that of the conventional type.	1	102	11	26	33	31	28	47	17	7
			2	80	8	24	37	32	25	53	16	6
			X	9					22	33	11	33
		18. Development of a technique for decomposing methane with a concentration of 1% or less turning it into resources. (Combustion if impossible at concentrations of 5% or less.)	1	74	9	16	26	49	12	53	27	7
			2	70	7	17	37	39	21	57	19	3
			X	8					75	13	0	13
	Acid rain	19. Elucidation, on the global scale, of the long-distance transportation mechanisms of substances such as SOx and NOx that are responsible for acid rain.	1	133	28	30	33	10	51	43	5	1
			2	101	19	36	31	14	59	39	2	0
			X	23					61	35	4	0
		20. Elucidation of the mechanisms of the impact caused by acid rain to animals and plants.	1	123	18	31	35	16	55	36	7	1
			2	94	14	26	40	20	64	35	1	0
			X	16					75	25	0	0



Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	14	45	34	75	19	0	1					40	6	7	10	34	32	34	2
	11	51	38	90	8	0	0	6	38	34	12	52	2	3	8	38	41	42	0
	31	31	38	85	8	0	0	23	38	23	8	38	0	0	0	46	69	31	0
	22	38	32	79	11	2	2					44	24	35	48	12	7	5	5
	17	49	34	95	3	1	1	36	32	17	6	50	28	31	61	10	5	5	3
	38	57	5	90	5	0	5	14	48	24	0	48	33	38	57	0	0	10	5
	16	42	35	71	17	5	1					55	10	15	40	26	9	14	4
	15	53	30	85	9	2	1	11	47	19	13	69	13	11	53	24	5	10	3
	48	43	5	81	5	5	5	14	48	19	5	86	5	5	62	24	0	10	0
	11	44	39	20	39	19	13					66	5	0	56	17	6	8	1
	10	58	27	27	42	18	8	27	34	11	15	76	1	0	76	10	3	14	1
	63	38	0	38	25	13	25	38	13	13	13	75	0	0	63	0	13	0	13
	15	42	35	33	33	16	11					59	7	5	60	17	2	13	4
	18	44	36	40	41	8	10	27	38	12	11	68	3	3	74	16	2	10	8
	65	24	12	35	18	6	35	29	35	6	6	41	0	12	65	24	0	12	6
	7	28	53	35	36	13	8					57	5	3	38	31	6	16	6
	11	40	46	40	40	9	9	3	31	20	33	74	0	1	56	27	4	14	6
	67	17	17	50	17	0	33	0	67	0	17	17	0	17	83	17	0	17	17
	10	39	43	16	46	21	9					66	2	2	51	27	8	9	2
	11	41	45	26	44	18	10	11	39	10	26	71	0	3	65	16	10	11	4
	44	33	22	11	22	22	33	22	33	0	11	44	0	22	67	0	0	11	11
	11	41	38	20	39	24	5					69	3	0	47	16	11	14	1
	13	47	37	29	44	17	4	10	49	9	23	71	0	0	59	23	16	13	0
	75	25	0	25	50	0	13	0	75	13	0	50	0	0	25	38	38	13	0
	23	56	18	74	15	5	1					39	9	5	14	43	29	32	4
	20	64	16	86	13	0	1	10	49	28	8	52	5	3	6	62	24	38	0
	52	48	0	74	22	0	4	0	48	43	4	43	9	0	13	61	30	35	0
	22	50	24	45	38	11	1					42	7	1	7	39	35	33	2
	16	62	21	57	37	2	1	2	48	32	11	51	4	0	11	52	30	34	1
	50	44	6	63	38	0	0	0	69	31	0	44	6	0	25	44	50	19	6

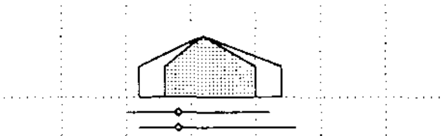
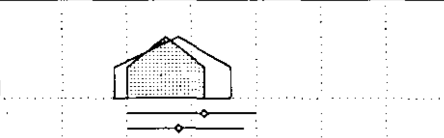
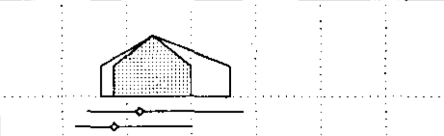
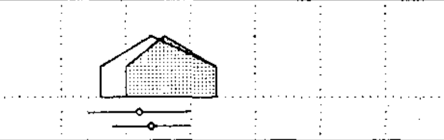
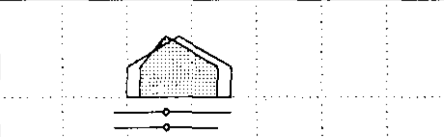
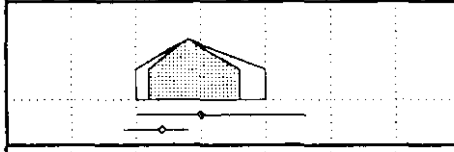
Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Global-scale environment	Acid rain	21. Development of technologies for recovering the acidified lakes and the damaged forests in Europe and North America.	1	115	12	27	39	21	56	36	7	1
			2	90	8	25	44	23	66	30	2	1
			X	9					67	22	0	11
	Contamination of oceans	22. Completion of global automatic and remote monitoring networks for controlling marine pollution and marine ecosystem.	1	104	5	25	41	29	41	47	10	1
			2	81	6	21	42	31	46	51	2	0
			X	7					86	14	0	0
		23. Elucidation of impacts exerted by marine pollutants upon the marine ecosystem.	1	97	8	18	40	34	51	44	4	0
			2	76	7	15	44	35	51	46	1	0
			X	8					38	63	0	0
		24. Practical use of effective technologies for restoring ocean areas contaminated by tanker accidents (e.g., oil pollution control technologies utilizing marine microorganisms).	1	95	8	21	35	35	47	45	5	1
			2	79	6	18	43	33	47	49	3	0
			X	7					43	57	0	0
	Reduced tropical forests	25. Practical use of techniques enabling measurement of the existing quantity of tropical forest biomass.	1	90	7	27	28	39	34	53	11	0
			2	71	3	23	34	39	25	69	4	0
			X	4					25	75	0	0
		26. Elucidation of impacts exerted by destroying tropical forests upon climate and weather.	1	113	11	24	42	23	55	36	5	3
			2	92	5	24	49	22	60	35	1	1
			X	6					83	17	0	0
		27. Elucidation of impacts exerted by destroying tropical forests upon the ecosysem such as the genes of wild organisms.	1	82	5	18	32	44	38	48	11	2
			2	63	3	15	35	47	41	56	2	0
			X	4					50	50	0	0
		28. Development of effective recovering technologies for reproducing damaged tropical forest ecosystem.	1	98	7	20	39	33	67	27	4	1
			2	79	3	20	44	33	70	27	1	0
			X	3					33	67	0	0
	Desertification	29. Elucidation of impacts exerted by desertification upon climate and weather.	1	93	4	36	30	30	53	34	5	0
			2	87	5	19	49	26	60	34	5	0
			X	6					83	17	0	0
		30. Development of biodegradable water-holding materials, for recovering desertification.	1	93	5	21	38	36	35	47	12	4
			2	75	3	18	43	36	35	52	9	3
			X	3					33	67	0	0

Forecasted realization time (Year)



Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
16	40	35	53	26	11	3					43	8	4	35	39	16	11	3
14	49	31	73	18	4	0	2	18	59	11	59	4	1	32	58	13	11	1
33	44	11	78	11	0	0	0	11	78	0	56	11	11	22	33	33	11	0
12	47	36	76	14	2	0					39	7	2	17	56	18	29	3
10	60	30	91	7	0	0	0	46	37	10	58	2	0	16	74	15	25	0
29	71	0	100	0	0	0	0	71	14	14	71	0	0	29	71	14	0	0
8	47	38	72	19	4	0					43	4	2	9	52	35	26	2
4	55	41	87	11	0	1	3	41	36	13	49	1	0	11	64	46	22	0
13	75	13	88	13	0	0	13	75	13	0	63	0	0	25	38	63	13	0
14	58	26	44	43	8	2					61	3	3	44	34	14	15	2
11	63	25	49	42	6	1	3	47	35	8	73	1	4	37	48	11	10	1
57	43	0	57	29	14	0	0	57	43	0	57	0	0	43	29	14	43	0
23	48	28	68	24	7	0					46	2	4	20	43	28	20	1
20	54	27	75	21	3	0	6	46	28	11	48	1	3	15	68	34	17	0
75	25	0	25	50	25	0	50	50	0	0	25	25	0	0	100	50	0	0
14	49	32	77	14	4	0					44	2	4	8	46	35	27	1
5	59	35	90	8	0	0	0	39	40	13	51	1	2	7	58	38	24	1
33	67	0	83	17	0	0	0	83	0	17	17	0	17	33	17	33	67	0
7	43	40	66	20	6	0					35	5	9	9	43	38	28	0
3	57	40	84	11	3	0	0	32	44	16	44	0	5	6	57	52	22	0
25	50	25	50	25	25	0	0	50	25	25	0	0	25	0	0	50	50	0
13	49	30	72	19	4	0					40	10	11	29	45	21	18	0
10	56	32	89	9	0	0	8	44	24	15	47	3	6	19	63	33	15	0
33	33	33	0	100	0	0	67	33	0	0	33	0	0	67	33	67	0	0
11	51	29	70	17	4	0					45	4	4	5	40	31	29	1
8	61	31	92	7	0	0	2	37	43	9	49	0	1	3	66	46	21	0
50	50	0	83	17	0	0	0	83	17	0	17	0	0	0	33	83	50	0
17	47	28	31	35	20	5					47	0	4	52	26	13	13	2
16	56	27	31	44	16	5	29	32	16	9	60	0	3	59	31	15	8	3
67	33	0	67	33	0	0	33	33	0	0	67	0	0	0	67	33	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Global-scale environment	Common	31. Completion of internationally unified and standardized for environmental informations which is based on worldwide monitoring of pollutants (air, water, etc.) and satellite communications.	1	128	16	33	37	14	52	40	6	0
			2	100	14	32	39	15	55	41	3	0
			X	16					94	6	0	0
Regional environment	Atmosphere	32. Widespread use of fuel control technologies in virtually all types of automobiles, capable of meeting the emission control standard for nitric oxide on the order of 0.1 to 0.2 g/km. (The current level for heavy diesel motorcars is on the order of 4 to 5 g/km, and the standard control value for gasoline passenger cars in 1978 is 0.25 g/km.)	1	104	20	26	24	30	71	28	0	0
			2	84	15	30	26	29	80	19	0	0
			X	18					89	11	0	0
	Water quality	33. Quantitative elucidation (with considerable precision) of the effects of heavy metals and other substances on mechanisms of enrichment in ecosystems and biological eutrophication, for estimating and fore-casting the effects of progressing water equality deterioration in closed water areas (e.g., lakes, marshes, or inlets) on water ecosystems.	1	101	18	28	22	32	44	51	4	0
			2	80	18	26	24	32	45	53	1	0
			X	21					62	38	0	0
		34. Widespread use of techniques for the preservation of water quality and environmental planning applying natural purifying mechanisms of rice paddies, irrigation ponds, waterways, etc.	1	101	19	26	24	31	28	55	12	4
			2	80	19	25	25	32	29	56	13	3
			X	22					36	45	9	9
		35. Development of a compact, waste water treatment system applying biotechnology, enabling highly efficient treatment of hardly decomposable and harmful substances.	1	103	16	26	27	30	45	46	6	4
			2	82	17	19	33	31	41	49	6	4
			X	20					50	25	15	10
		36. Development of bio-reactor systems utilizing bacteria capable of decomposing algae that cause water bloom or red tide, and microorganisms which eat and decompose them.	1	96	13	24	28	35	30	54	10	4
			2	76	13	20	31	36	22	63	11	4
			X	15					33	47	7	13
	Noise and vibration	37. Development of low-noise engines and tires, and sound-absorbing construction materials reducing automobile noise within the environmental standard for the area specified to be for resident.	1	92	8	27	27	38	34	50	14	1
			2	78	7	27	32	34	26	65	9	0
			X	8					25	63	13	0
	Wastes	38. Widespread use of product design techniques easy to recover and separate materials of disposed durable consumer goods for recycling purposes.	1	117	14	29	36	21	74	24	3	0
			2	99	12	26	46	16	75	23	1	0
			X	14					71	29	0	0
		39. Practical use of biodegradable plastics for containers and packages of shorter-term use which can be completely decomposed by anaero microorganisms.	1	111	9	25	41	24	50	35	13	2
			2	94	8	19	52	20	50	36	12	2
			X	10					50	40	10	0
		40. Development of technologies for turning harmful wastes into harmless without causing any secondary pollutions.	1	106	16	23	33	28	67	30	3	0
			2	89	14	21	41	25	75	21	3	0
			X	16					81	19	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	16	55	24	88	9	1	0					39	21	7	22	52	19	20	1
	13	62	24	95	3	0	0	10	45	27	8	48	19	4	17	66	17	17	1
	38	56	6	100	0	0	0	13	44	31	0	56	6	0	19	63	19	6	6
	24	54	21	21	28	35	15					65	19	2	69	15	3	5	6
	21	57	20	24	26	30	17	76	6	0	7	75	15	1	82	8	2	2	0
	33	61	6	39	22	28	11	83	11	0	0	72	11	0	94	17	6	0	0
	21	55	19	26	42	22	8					50	5	2	11	52	31	29	1
	16	65	16	23	45	25	4	26	44	5	11	60	3	0	5	64	25	29	0
	48	43	5	29	33	29	5	29	38	10	0	43	0	0	0	48	48	33	0
	19	48	24	8	30	36	18					32	30	15	32	23	16	14	2
	10	64	23	6	34	38	19	33	38	3	16	33	41	15	29	30	18	13	0
	18	64	9	9	36	27	18	45	36	5	0	18	41	14	23	36	27	9	0
	27	44	25	16	41	27	14					64	11	3	48	23	13	12	0
	17	62	17	11	46	30	7	29	41	6	11	74	5	2	66	16	10	10	0
	40	35	15	0	40	30	20	50	30	0	0	65	10	0	75	15	5	5	0
	19	44	29	11	44	26	11					63	7	0	34	31	13	14	0
	13	54	29	7	53	30	5	29	45	3	11	78	3	1	46	32	9	12	0
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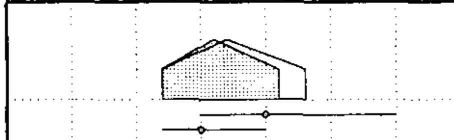
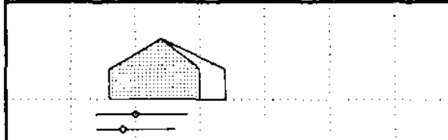
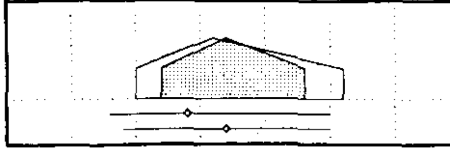
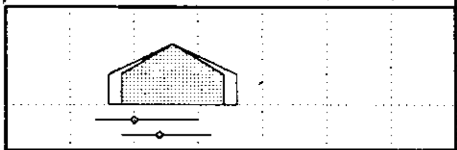
	17	50	26	10	27	40	18					63	20	4	60	13	3	5	2
	8	67	23	9	28	41	19	50	27	1	13	69	21	4	73	9	4	4	1
	38	38	25	0	25	25	50	50	25	0	13	75	25	0	75	13	0	0	13
	26	48	24	11	39	31	18					42	31	14	67	9	4	9	1
	19	66	15	10	44	33	11	30	40	14	7	62	30	5	75	5	3	5	1
	43	43	14	21	36	36	7	43	36	14	0	57	21	7	79	14	0	0	0
	23	50	20	11	41	29	13					62	18	4	63	10	4	6	0
	20	65	13	7	48	31	11	26	48	6	10	73	16	2	74	7	5	2	1
	50	50	0	0	80	10	10	20	70	0	0	60	20	0	70	10	10	0	0
	19	43	31	23	41	24	8					69	14	2	58	17	7	10	0
	11	57	30	19	54	18	8	19	46	12	11	87	7	0	72	12	7	7	0
	31	44	25	25	56	13	6	25	44	13	0	88	0	0	50	13	6	13	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Regional environment	Wastes	41. Achievement of heat efficiency for waste fuel power generation plant that exceeds twice the current value. (Present level: 12%)	1	106	16	24	31	28	25	62	11	1
			2	88	18	22	35	25	32	59	9	0
			X	21					43	48	10	0
	Noise and vibration	42. Establishment of assessing socio-economic damage/loss because of the destruction of natural environment due to soil contamination and land subsidence (e.g., loss of natural beaches, forests, or fields) and incorporation of its countermeasures in regulatory system.	1	108	20	24	29	27	56	36	6	0
			2	88	17	23	35	25	61	34	3	0
			X	20					75	25	0	0
	Crosswise	43. Elucidation how a long-term exposure effects human beings to trace quantities of most of the harmful chemical substances in ordinary environment.	1	102	12	24	33	31	53	40	5	1
			2	83	9	19	42	30	61	34	2	0
			X	11					91	9	0	0
		44. Determination of presence or absence of trans-generation effects of environmental contamination on human beings.	1	77	7	20	26	48	65	30	3	1
			2	62	5	14	33	47	73	26	0	0
			X	6					100	0	0	0
		45. Accumulation of knowledge concerning the fate of hard degradable chemical substances after release into the environment in advance to their production.	1	93	13	22	29	37	60	37	1	1
			2	76	11	19	35	35	63	34	1	0
			X	13					85	15	0	0
		46. Establishment of techniques, models, and data bases for biological testing and measurement of the harmfulness of chemical substances resulting in the construction of screening systems for harmful chemical substances.	1	98	14	23	30	33	63	33	2	1
			2	81	10	21	38	31	69	23	2	1
			X	12					67	25	0	8
		47. Development and application of "index" animals and plants to be used in measurement of severity of contamination in natural environments (air, land, water) as part of environmental monitoring and warning systems.	1	103	11	29	31	30	27	55	15	2
			2	88	9	26	39	25	23	60	13	1
			X	11					27	73	0	0
		48. Establishment of an evaluation system for man-made micro-organisms which are created by biotechnologies including gene manipulation in open systems, and utilization of organisms useful for purifying the environment.	1	82	8	21	28	43	33	49	11	5
			2	66	8	16	32	44	20	59	14	6
			X	9					44	44	0	11
		49. Widespread use (e.g., globally more than 10%) of automobiles as urban transportation system (e.g., electric automobiles) which do not cause conventional atmospheric or noise pollution.	1	122	17	27	39	18	53	41	2	3
			2	100	16	24	45	15	62	35	1	1
			X	19					84	11	0	5
		50. Practical use of techniques for on-site detoxification of soil contaminated with heavy metals or chemical substances (e.g., residue of agricultural chemicals).	1	99	12	24	30	33	31	57	8	2
			2	82	12	26	31	31	32	63	4	0
			X	14					50	43	7	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	23	52	22	6	34	35	22					65	23	7	57	15	4	7	0
	19	61	17	1	38	43	16	41	34	5	10	68	22	5	74	10	2	6	0
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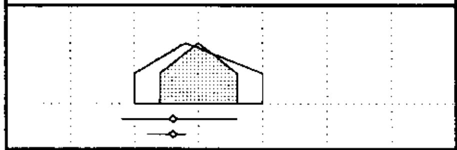	15	49	27	22	40	19	14					31	51	25	14	10	18	19	1
	11	65	22	14	58	17	10	8	36	25	20	36	65	25	15	10	13	19	2
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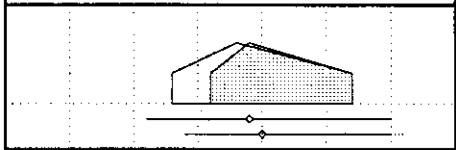	12	47	34	45	37	7	7					59	9	6	9	39	23	27	2
	12	49	37	57	33	6	4	4	41	31	14	71	4	4	8	52	24	23	0
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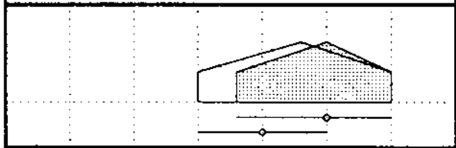	13	42	35	56	32	6	1					61	9	12	6	29	29	27	3
	8	47	40	61	29	6	2	3	35	27	21	74	5	11	3	39	34	21	0
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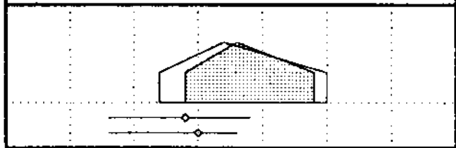	15	52	28	45	39	8	3					58	12	2	11	30	29	31	2
	12	58	29	57	33	8	1	4	45	22	17	72	3	1	12	42	24	28	0
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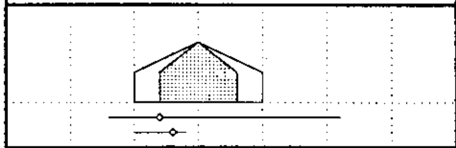	14	57	22	52	34	8	2					50	20	1	14	31	26	33	3
	11	59	25	60	31	5	0	4	42	31	11	64	14	1	15	37	19	32	0
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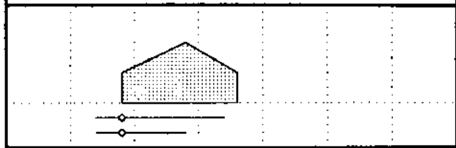	16	48	32	33	44	12	6					47	13	5	14	26	31	26	1
	11	60	24	30	48	15	3	6	48	11	22	55	7	1	8	38	33	30	0
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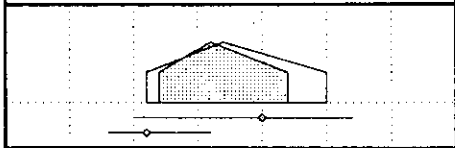	13	48	29	43	29	16	2					51	26	17	18	12	17	22	1
	11	59	24	41	41	9	2	6	41	24	14	64	27	14	17	14	14	20	2
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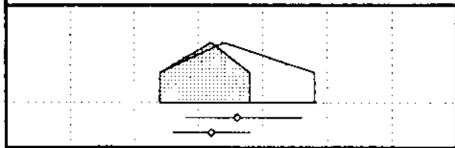	16	52	26	34	31	20	6					49	27	4	75	9	3	3	2
	15	61	22	36	41	16	3	39	40	8	4	59	24	1	85	7	3	3	1
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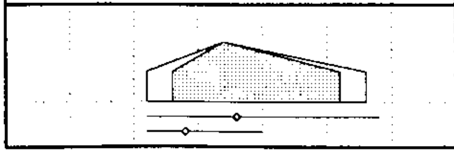
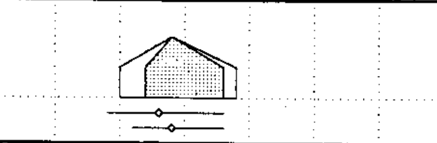
	18	43	29	19	41	19	10					66	14	3	48	19	8	11	0
	15	55	29	18	54	15	11	10	44	23	11	77	7	1	62	21	7	9	1
	21	71	7	29	50	7	7	7	64	14	0	64	29	0	57	21	0	7	0

4.10 Agriculture, forestry, and fisheries

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Agriculture	Cultivation of crops, sericulture, etc.	1. Elucidation of the base sequences of the DNAs of crops (e.g. rice plants) to isolate useful genes.	1	144	16	19	31	34	67	27	6	0
			2	121	17	17	32	34	70	25	4	0
			X	31					81	13	3	0
		2. Practical use of improved crop varieties (higher yield and more disease- and cold-resistance) created by plant gene manipulation.	1	151	18	19	32	30	80	19	1	0
			2	128	17	19	33	30	85	15	0	0
			X	32					84	16	0	0
		3. Development of salt-resistant crops, enabling cultivation in areas having severe salt injuries.	1	133	13	19	30	38	40	46	14	0
			2	111	13	18	30	39	44	46	10	0
			X	24					67	29	4	0
		4. Practical use of crop breeding techniques using cell fusion.	1	152	15	21	34	30	49	41	9	0
			2	126	16	18	34	32	51	44	5	0
			X	30					43	43	13	0
		5. Development of C_3 crops, which introduce the photosynthetic function of C_4 plants through physiological and biochemical control of photosynthesis or gene manipulation.	1	127	10	22	28	40	35	46	17	0
			2	105	9	20	29	42	38	48	14	0
			X	16					56	25	19	0
		6. Widespread use of hybrid rice plants for at least 50% of the total planting in Japan.	1	120	16	15	25	44	20	43	32	6
			2	98	17	14	23	46	18	46	32	4
			X	30					20	27	50	3
		7. Development of new crops with an adaptability to paddy fields that is as high as that of rice plants.	1	115	11	20	23	45	24	28	39	9
			2	95	12	19	22	47	28	27	38	5
			X	21					29	24	48	0
		8. Development of new varieties of domesticated silkworms capable of producing wild silkworm fibroin thanks to the introduction of the wild silkworm fibroin gene into domesticated varieties by DNA recombination.	1	74	2	11	22	65	18	42	38	3
			2	57	3	10	19	68	18	44	37	2
			X	5					20	40	40	0
		9. Practical use of rice plant cultivation by developing and utilizing symbiotic algae and fungi with a high nitrogen fixing function.	1	109	9	19	24	48	33	46	17	5
			2	93	9	17	25	49	31	56	11	2
			X	16					56	44	0	0
		10. Practical use of technologies for effectively utilizing the phosphorus fixed in soil for cultivating crops.	1	99	8	15	25	53	44	49	6	0
			2	82	7	14	24	54	54	43	4	0
			X	13					69	31	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	19	42	37	37	44	10	8					33	3	1	16	52	44	27	1
	15	51	31	34	52	4	6	30	46	13	7	29	0	0	9	61	54	31	0
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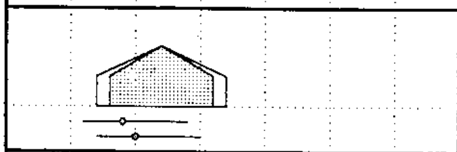
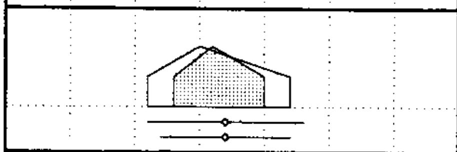
	28	42	26	23	40	26	8					42	17	18	14	32	32	19	2
	23	54	21	24	52	17	4	6	46	38	6	49	13	14	5	40	44	23	1
	56	38	6	25	53	16	6	9	44	47	0	31	25	28	0	41	31	34	3
	7	40	49	60	28	8	0					57	2	4	15	37	32	19	3
	5	49	43	66	31	1	0	3	23	54	17	62	2	2	8	43	36	24	3
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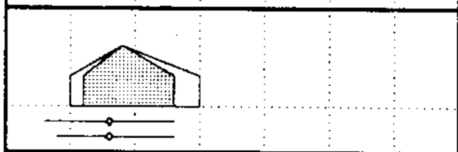	32	41	23	19	36	28	13					52	4	5	17	30	36	15	3
	33	45	20	17	43	26	10	13	57	21	7	64	0	2	11	37	44	14	1
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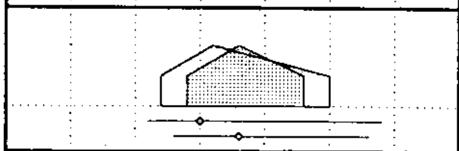	9	32	54	39	39	15	4					73	2	2	10	30	33	12	2
	5	35	57	43	46	7	1	4	30	40	21	79	0	0	6	37	36	16	1
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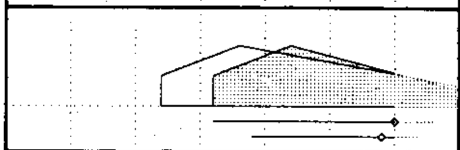
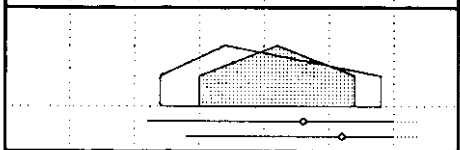
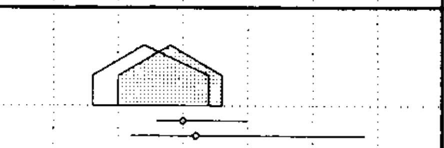
	19	36	38	10	25	32	28					34	23	20	37	15	9	11	10
	19	38	38	7	27	35	22	27	30	32	6	40	14	15	48	16	9	20	10
	43	33	20	13	27	20	33	17	20	57	3	40	17	23	57	7	10	17	10
	11	26	48	14	23	31	19					40	17	20	31	17	15	10	3
	6	31	53	16	28	29	16	21	32	9	29	48	11	16	43	17	15	18	1
	24	38	38	14	43	14	24	33	33	5	29	62	10	10	33	29	19	24	0
	4	43	46	3	22	39	30					57	3	1	20	30	34	16	1
	7	42	47	5	18	33	37	70	12	4	9	60	4	0	14	39	39	21	0
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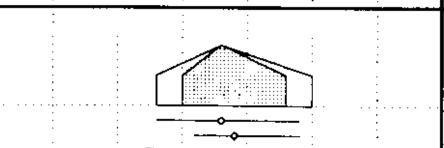	6	42	44	31	38	19	7					65	6	0	20	28	26	19	5
	6	35	55	29	45	14	6	18	38	17	19	74	1	0	19	29	32	20	3
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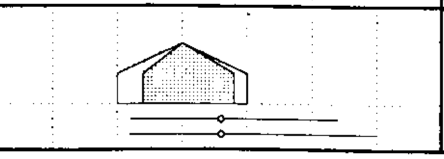
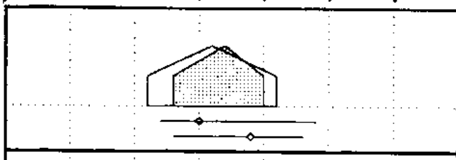
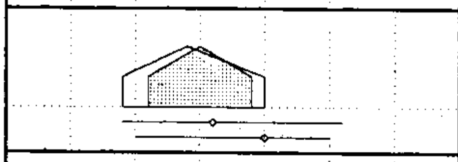
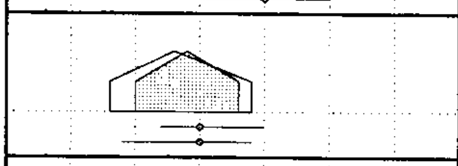
	7	47	39	37	42	14	3					58	3	2	22	29	27	18	3
	7	49	39	35	48	9	2	11	44	15	26	62	1	1	18	35	33	21	2
	31	46	23	62	23	0	15	23	46	23	8	46	0	0	23	31	46	31	8

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Agriculture	Cultivation of crops, sericulture, etc.	11. Practical use of technologies enabling the repeated cultivation of the same crops on the same land by treating the soil with microorganisms or allelopathic substances.	1	111	8	18	27	47	37	51	11	1
			2	93	7	18	27	48	39	54	8	0
			X	13					46	46	8	0
		12. Practical use of weed control technologies utilizing the characteristics of physiologically active substances or other organisms.	1	127	6	21	34	40	41	50	9	0
			2	105	4	22	31	42	44	53	3	0
			X	8					63	38	0	0
		13. Widespread use of biological insecticides and insect repellents (natural microbial enemies, pheromones, etc.) as the principal method of pest control.	1	141	4	19	43	33	60	36	4	0
			2	114	6	16	41	37	64	33	2	0
			X	10					90	10	0	0
		14. Development of technologies for artificially preparing attenuated fruit-tree viruses, enabling higher quality and higher yield.	1	98	4	17	26	53	35	56	9	0
			2	79	4	16	24	56	38	58	4	0
			X	8					75	25	0	0
		15. Development of cold damage prevention systems based on highly accurate medium and long term weather forecasts.	1	97	3	12	30	54	48	42	8	1
			2	74	2	12	27	59	53	42	5	0
			X	4					75	25	0	0
		16. Widespread use of vegetable plants designed to perform cultivation of farm products such as tomatoes, cucumbers, and eggplants in aseptic houses, automatic control of their growth and ripeness, and automatic harvesting and packing of the products.	1	113	7	13	34	47	16	27	50	8
			2	92	7	11	33	49	11	30	54	4
			X	13					31	38	23	8
		17. Practical use of robots that can simultaneously harvest vegetables and fruits and sort them according to quality.	1	98	3	13	30	54	22	62	15	0
			2	79	3	12	29	56	23	61	15	1
			X	5					60	40	0	0
		18. Practical use of biomimetic farming aid machines such as small weeding robots which mimic the actions of helmet shrimps, a crossbreed of wild and domestic ducks, or pollinating robots which mimic bees.	1	79	2	8	27	63	16	51	25	8
			2	65	2	6	29	63	11	58	26	5
			X	3					33	67	0	0
		19. Development of remote-controlled, multi-purpose agricultural robots equipped with artificial intelligence, enabling even aged people to easily cultivate farms and harvest crops.	1	96	3	8	33	55	35	51	10	3
			2	80	2	8	34	56	29	61	9	1
			X	4					50	50	0	0
		20. Widespread use of wide-frame tractors in Japan which are designed with an emphasis on the agricultural ecosystem and to minimize pressure applied to soil.	1	76	2	5	29	64	17	50	29	4
			2	60	1	6	27	66	17	53	27	3
			X	2					0	100	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%): High	Medium	Low	Necessity of international joint development (%): High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%): Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%): Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	5	48	41	19	50	20	7					72	3	0	20	27	32	18	0
	6	49	43	15	62	15	5	13	44	25	16	77	1	0	16	29	39	19	0
	23	46	31	15	54	23	8	46	31	23	0	62	0	0	15	31	62	23	0
	8	46	41	20	47	24	3					54	2	4	32	29	28	15	2
	8	50	39	17	62	16	2	4	44	27	22	68	0	1	34	32	35	16	0
	50	50	0	13	38	38	13	0	63	38	0	50	0	0	0	63	50	38	0
	17	45	33	33	40	17	7					51	6	8	33	29	18	17	2
	13	48	36	30	49	12	5	12	51	17	18	59	5	4	41	28	20	14	2
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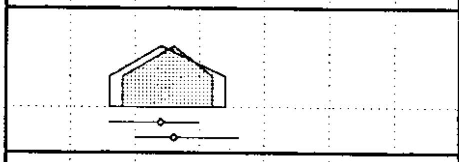	18	50	30	16	45	29	7					58	2	1	19	35	30	22	1
	15	57	28	15	58	20	4	16	51	16	15	63	1	1	16	43	34	19	0
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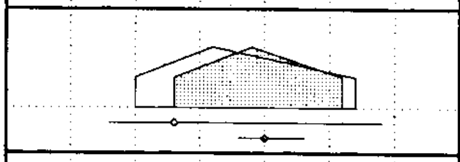	15	32	44	33	25	22	14					64	5	0	16	26	18	25	2
	18	28	50	39	28	18	9	28	35	9	22	80	4	0	14	34	14	23	1
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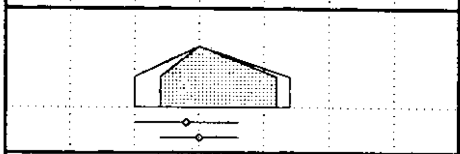	13	42	34	5	18	27	41					28	4	9	66	26	4	8	4
	9	41	43	2	14	36	41	60	18	5	11	28	3	9	72	34	4	8	3
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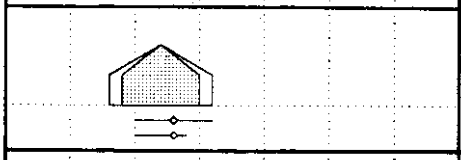
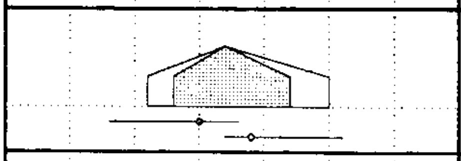
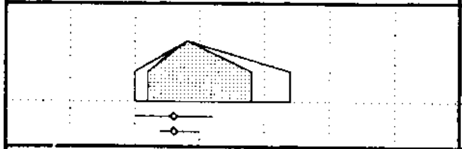
	14	54	28	1	26	37	33					39	3	0	64	35	8	9	1
	9	58	29	1	19	46	29	61	23	5	6	43	1	1	75	43	6	9	1
	20	80	0	20	40	20	20	40	60	0	0	40	0	0	40	20	40	20	20
	8	34	48	5	18	43	24					43	3	1	59	29	10	11	0
	6	40	49	3	17	57	18	45	25	2	23	51	0	2	71	29	8	6	0
	0	100	0	33	33	33	0	33	33	33	0	67	0	0	67	33	33	0	0
	11	45	38	7	27	34	25					42	3	1	58	33	4	19	1
	8	54	36	5	25	43	25	54	26	1	15	51	1	3	68	34	5	15	3
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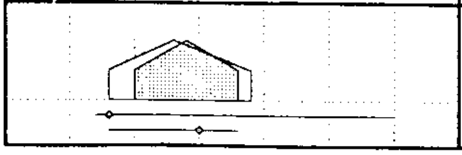
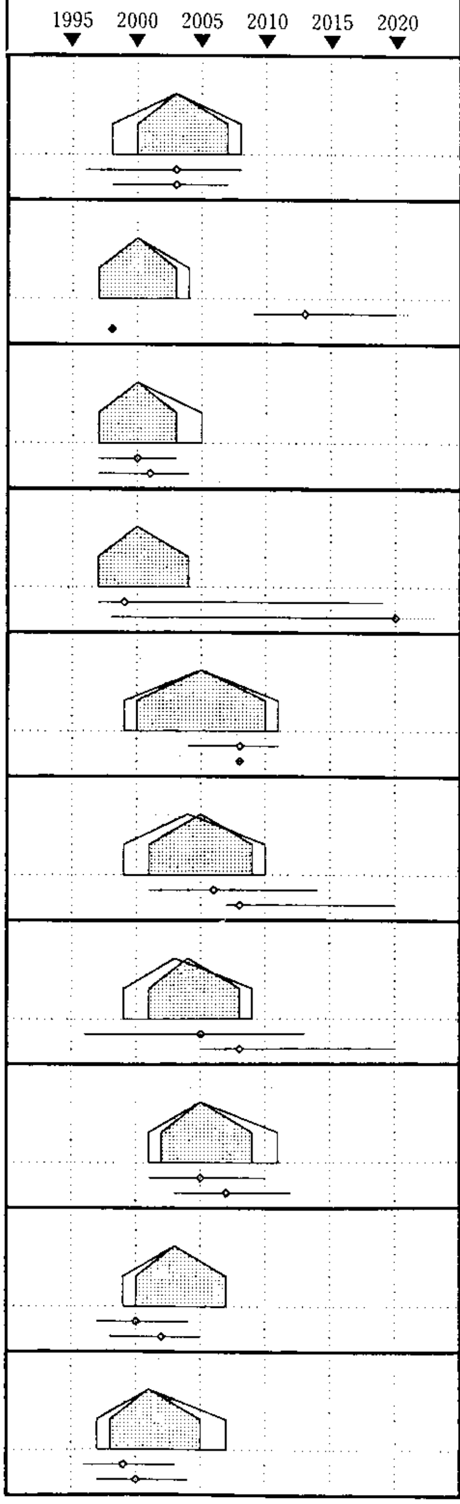
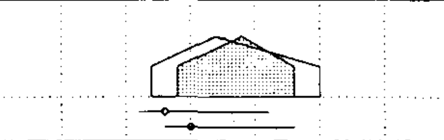
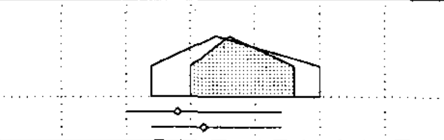
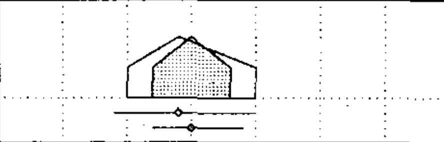
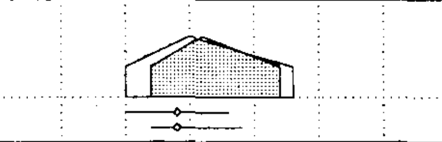
	11	41	46	11	24	38	24					34	7	5	63	30	5	11	3
	7	43	48	13	20	45	20	27	18	28	23	40	2	2	77	38	8	10	3
	0	100	0	0	100	0	0	50	0	50	0	50	0	0	50	50	50	0	0

Division		Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Agriculture	Cultivation of crops, sericulture, etc.	21. Elucidation of the dormant mechanism of and control method for cereals, and development of technologies for preventing deterioration of quality caused by ear budding-out.	1	106	9	18	23	50	26	52	19	2
			2	89	7	19	23	50	29	54	12	2
			X	13					54	46	0	0
		22. Possibility of complete sterilization of food at a relatively low-level of high pressure (approx. 3,000 bar) by combining physical and chemical methods to replace the conventional super high-pressure sterilization, and practical use of the new sterilizing method which permits continuous processing as a general sterilizing technology.	1	67	1	9	21	68	30	52	15	3
			2	52	1	9	20	71	31	56	10	0
			X	1					0	100	0	0
		23. Practical use of systems capable of performing online measurement of the physiological conditions including respiration volume and ethylene production volume of fruits and vegetables such as melons and tomatoes.	1	106	4	14	32	50	24	58	17	1
			2	85	4	13	30	53	21	66	11	0
			X	7					43	43	0	0
		24. Development of technologies for preventing senescene of starchy foods containing much moisture for an extended period of time, enabling us to enjoy good pouch-packed foods and sterilized packed foods at any time without the need of reheating.	1	62	2	10	17	70	16	63	19	2
			2	44	1	9	15	75	11	68	16	2
			X	2					0	50	50	0
		25. Development of technologies for directly converting cellulose into starch by using enzymes or the like, enabling effective use of biomass resources for foods.	1	90	2	16	24	57	36	47	14	3
			2	71	1	14	26	60	34	52	11	1
			X	1					0	100	0	0
		26. Widespread use of food manufacturing factories which are equipped with various advanced sensors and artificial intelligence (AI) capable of efficiently controlling the whole food manufacturing process.	1	65	2	9	20	69	22	54	25	0
			2	50	2	7	19	72	24	48	26	0
			X	4					0	75	0	0
		27. Practical use of technologies for freely cutting out particular parts of proteins by using enzymes or the like to isolate and utilize them.	1	90	3	13	26	57	39	54	7	0
			2	74	2	11	28	58	43	51	4	0
			X	4					50	25	25	0
	Stock raising	28. Practical use of techniques for genetic improvement of domestic animals whose disease resistance and fecundity are enhanced by introduction of genes with desirable traits into the fertilized ovum or embryo of mammals.	1	144	11	25	29	34	56	37	7	0
			2	116	10	24	29	37	63	35	2	0
			X	19					84	16	0	0
		29. Practical use of production of copies of outstanding individual cattle (clones) by nuclear transplantation.	1	143	11	26	29	34	48	45	8	0
			2	113	10	23	28	38	55	42	4	0
			X	19					68	21	11	0
		30. Practical use of technologies for selecting the sex of livestock eggs through DNA analysis.	1	138	11	26	26	37	42	45	12	1
			2	110	10	24	26	40	46	50	4	0
			X	19					58	42	0	0



Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	14	46	32	15	36	29	12					55	4	0	15	27	24	17	0
	10	51	34	11	40	34	7	13	48	17	15	66	1	0	8	33	35	18	0
	23	54	23	23	77	0	0	15	31	54	0	69	0	0	8	46	54	23	0
	21	48	25	7	22	43	21					51	6	7	52	30	4	12	3
	19	50	27	6	13	56	17	29	48	2	15	54	0	4	65	33	2	6	4
	0	100	0	0	100	0	0	0	100	0	0	0	0	0	0	100	100	0	0
	16	54	25	5	28	33	29					33	2	2	55	32	9	11	3
	14	60	25	1	25	45	25	38	40	2	15	35	0	1	68	39	8	12	5
	29	43	29	0	43	29	29	57	29	0	14	14	0	0	43	43	14	29	14
	8	55	31	5	29	39	21					50	5	11	42	18	6	18	3
	7	50	34	2	25	43	16	41	30	5	11	61	0	5	55	20	7	18	2
	0	50	50	0	50	50	0	50	50	0	0	50	0	50	0	50	50	0	0
	4	47	46	22	36	26	11					52	1	8	38	33	11	10	4
	4	54	41	21	34	32	8	23	46	8	18	59	1	4	51	32	8	13	3
	0	100	0	0	100	0	0	0	100	0	0	0	0	0	0	100	100	0	0
	15	55	26	6	35	32	25					49	3	3	58	29	8	15	2
	12	62	26	4	26	40	24	44	34	6	12	68	0	4	64	18	8	16	0
	25	50	25	0	25	50	25	75	0	0	25	25	0	0	25	50	25	25	0
	11	48	40	30	41	21	6					61	3	2	23	31	26	12	2
	5	49	45	32	41	19	3	9	45	27	16	70	5	4	12	38	24	14	1
	0	75	25	25	50	0	25	0	50	0	50	25	0	0	0	100	25	50	0
	15	51	32	31	36	22	8					59	9	15	18	33	21	22	1
	14	57	29	28	49	12	8	3	35	46	13	66	5	9	16	41	22	22	1
	32	53	16	42	37	16	5	0	26	68	5	37	5	11	11	63	42	32	0
	18	50	29	21	41	24	11					61	5	10	19	33	20	23	2
	18	56	25	23	53	15	4	6	42	35	11	69	3	8	17	42	21	23	1
	47	42	11	37	32	21	11	5	37	53	0	58	5	5	21	58	26	26	0
	19	48	28	23	40	25	8					54	4	8	20	35	24	20	3
	21	55	24	24	47	21	5	5	39	41	11	65	3	5	15	47	26	20	1
	53	37	11	32	42	16	11	5	37	53	0	63	5	5	16	58	42	11	0

Division		Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
					High	Medium	Low	None	High	Medium	Low	Unnecessary
Agriculture	Stock raising	31. Development of technologies for achieving the production of consistent high-quality milk or beef with high productivity by modifying the mechanism of hormonal regulation of metabolic function in cattle using gene manipulation.	1	111	11	18	23	49	28	54	16	1
			2	90	10	16	23	51	26	60	13	1
			X	19					42	47	11	0
		32. Development of technologies for controlling the quality of cattle products (milk and meat) by modifying the functions of the microorganisms of rumen (fore-stomach of cattle) through cellular manipulation or the like.	1	112	15	17	20	48	27	48	22	2
			2	89	15	11	23	51	26	54	19	1
			X	27					48	33	19	0
		33. Practical use of synthetic vaccines by molecular designs utilizing gene engineering and protein engineering for preventing diseases in farm animals.	1	107	11	13	25	50	50	40	9	0
			2	85	11	11	24	54	59	38	4	0
			X	20					75	25	0	0
		34. Development of management methods to save agricultural chemicals and labor for vegetation and farm animals, which utilize functions of organisms in the grassland ecosystem, enabling graze-breeding by which resources can be stably utilized for a long period of time.	1	131	15	17	29	39	34	51	11	2
			2	107	14	17	28	41	36	55	6	3
			X	25					52	44	0	4
		35. Development of technologies for manufacturing foods, which do not invoke allergy, by elucidating and modifying the antigenic structures of livestock products (milk, eggs, etc.).	1	108	7	17	26	50	35	44	20	1
			2	84	6	15	25	54	39	42	19	0
			X	11					55	36	9	0
		36. Development of technologies for controlling the methane production in ruminant livestock without the need of additional cost.	1	94	11	11	23	56	23	45	28	4
			2	76	12	11	19	58	26	43	28	3
			X	22					45	27	18	9
Forestry		37. Development of useful tree varieties with desirable characteristics using gene manipulation, cell fusion and other similar technologies in forest tree breeding.	1	107	7	15	29	48	40	40	19	0
			2	96	7	14	32	46	41	48	11	0
			X	13					62	31	8	0
		38. Practical use of forestry robots combining mechanical and electronic features (mechatronics) capable of climbing slopes.	1	76	2	10	25	63	38	42	17	0
			2	60	2	8	24	66	42	50	8	0
			X	4					75	25	0	0
		39. Realization of systems enabling forest biomass to be used in a balanced manner in terms of energy and economic considerations through the practical use of technologies for efficiently raising and collecting broad-leaved trees, bamboo grass, slash and other yet-unused resources that are presently of relatively little economic importance.	1	98	6	17	25	53	33	47	18	1
			2	85	6	17	25	52	33	56	11	0
			X	11					36	55	9	0
		40. Practical use of technologies for chemical conversion and utilization of wood resources in order to replace petro-chemical products such as plastics.	1	83	5	10	25	60	39	49	11	1
			2	70	4	10	25	61	40	47	11	1
			X	8					50	38	13	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	9	43	42	30	38	22	7					67	6	13	14	32	25	14	2
	7	44	47	30	48	16	7	2	29	52	13	76	6	8	14	42	30	12	0
	11	58	26	53	26	5	16	5	26	58	5	58	0	0	21	42	58	5	0
	9	43	44	32	37	23	4					69	4	3	12	29	31	21	2
	9	43	46	30	47	18	3	4	35	44	12	79	2	3	11	30	35	16	0
	22	56	22	48	30	22	0	4	26	59	7	67	4	0	11	44	44	7	0
	17	42	35	40	40	12	5					64	7	2	19	37	20	20	3
	13	47	35	42	42	11	2	5	46	34	13	69	2	1	18	46	16	22	0
	35	35	25	50	25	15	10	15	45	35	5	45	0	0	20	65	35	25	0
	15	42	35	18	41	24	9					48	6	2	28	31	27	21	3
	10	48	36	18	49	22	7	8	36	35	14	61	2	2	23	36	25	24	1
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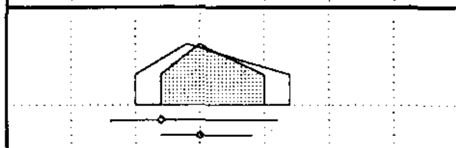	12	40	37	29	44	17	5					64	3	4	22	25	20	22	3
	7	51	37	31	48	14	2	4	51	21	19	70	1	1	20	32	23	25	1
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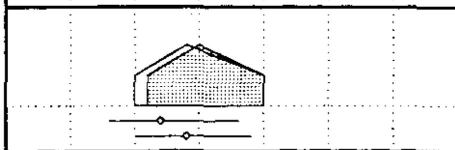	11	46	37	31	39	15	7					61	2	0	23	28	26	14	2
	7	50	38	34	46	9	8	4	42	30	18	74	1	1	18	33	26	17	4
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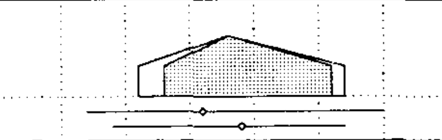
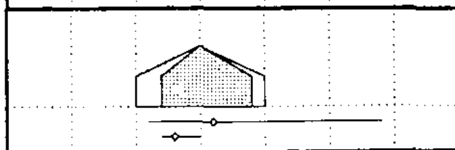
	8	41	46	19	42	29	7					64	3	0	16	35	32	18	2
	7	49	43	17	52	27	3	11	43	23	19	70	1	1	11	39	42	21	1
	31	54	15	0	62	31	8	15	54	23	8	54	8	0	23	38	46	8	0
	5	53	37	7	32	37	20					41	3	0	62	43	8	14	0
	3	65	32	7	35	45	13	30	30	13	23	42	2	0	73	48	3	15	0
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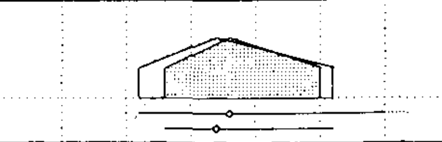	14	40	42	11	46	28	12					38	13	2	54	33	9	23	2
	12	46	42	11	52	29	8	32	44	8	13	46	7	0	67	34	6	21	0
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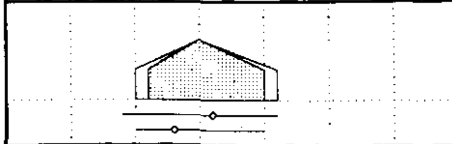
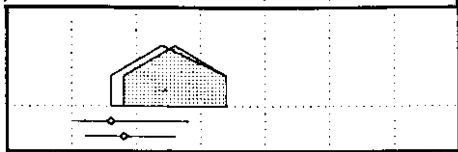
	16	41	37	25	40	24	6					47	4	2	58	37	10	10	1
	13	53	31	27	46	21	3	17	50	10	16	54	1	3	66	36	10	13	0
	38	63	0	25	38	38	0	38	63	0	0	13	13	0	50	50	13	50	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Forestry	41. Advancement in technologies for compounding wood with non-wood materials, leading to the development of manufacturing technologies for wood-based composite materials with high strength and multiple functions which permit easy forming because they retain the physical properties of wood.	1	60	4	7	18	71	32	52	17	0
		2	49	4	6	18	72	37	51	12	0
		X	7					43	43	14	0
	42. Practical use of technologies for manufacturing paper and pulp by utilizing the enzyme system of wood deteriorating germs.	1	62	3	6	20	70	29	48	19	3
		2	50	2	7	19	72	32	56	10	2
		X	3					33	33	33	0
	43. Development of technologies using satellite data and computers to enable accurate forecasts of avalanches and destruction of mountainous and other steep land areas.	1	75	5	10	21	64	43	49	7	0
		2	60	5	9	20	66	42	53	5	0
		X	9					67	22	11	0
	44. Establishment of techniques for quantitatively evaluating the ability of forests to preserve soil and water in their natural state, and widespread use of forest management technologies that exploit this natural ability of forests.	1	81	5	11	23	61	51	42	7	0
		2	68	7	8	23	61	57	37	6	0
		X	13					54	46	0	0
	45. Development of comprehensive control systems based on the elucidation of the mechanisms of control of pathogenic bacteria and harmful insects in natural forest ecosystems and on the establishment of techniques to prevent the appearance of major pests.	1	90	5	11	28	57	41	54	4	0
		2	79	6	8	31	55	47	49	4	0
		X	10					70	30	0	0
Fisheries	46. Possibility of creating marine species that are highly resistant to water temperature changes and diseases by cell fusion, gene manipulation and other similar technologies so that they are advantageous for breeding.	1	92	4	13	27	57	34	54	10	1
		2	77	2	13	28	57	34	58	5	1
		X	4					50	50	0	0
	47. Widespread use of technologies for utilizing physiologically active substances such as hormones and pheromones to achieve efficient culture such as breedings of parent tuna and abalone in short terms.	1	81	5	10	23	62	20	57	20	4
		2	63	4	7	24	65	19	57	19	5
		X	7					29	57	14	0
	48. Domination of cultivated resources in fishery production through including the liberation of seedlings and construction of nursery grounds for medium- and high-grade fish and shellfish such as red sea bream and flatfish.	1	84	7	10	22	61	32	49	14	4
		2	66	6	8	23	64	30	59	8	3
		X	10					30	60	10	0
	49. Practical use of environmental control technologies for preventing eggs or floating larvae of fish and shellfish from reducing or scattering away from spawning places and guiding them to water areas suited for growth. Widespread use of management systems for reproducing coastal fishery resources.	1	69	5	10	17	68	35	45	19	1
		2	52	4	8	17	71	35	48	15	2
		X	7					43	29	29	0
	50. Practical use of technologies for constructing seaweed "pastures" in undeveloped areas such as sandy beaches and estuaries to exploit the potential productivity of marine organisms.	1	70	5	12	16	67	31	56	11	1
		2	52	4	8	17	71	37	56	8	0
		X	7					57	29	14	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	13	48	37	7	33	35	22					50	2	2	60	25	13	13	0
	8	61	29	10	43	29	16	33	45	2	16	43	2	2	69	29	12	12	0
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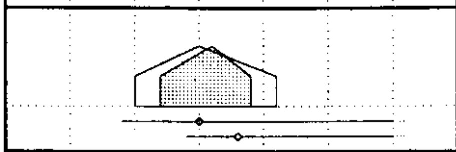	11	35	48	15	42	27	13					63	2	2	63	21	10	15	0
	6	46	44	12	52	28	6	14	46	12	22	74	2	2	60	18	6	20	0
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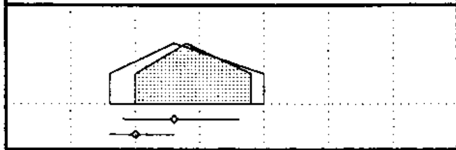	15	37	44	31	37	21	9					53	8	0	20	39	25	29	0
	12	43	42	28	52	15	5	20	38	17	18	68	2	0	20	47	23	25	0
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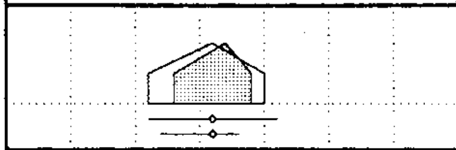	9	49	37	23	35	32	7					49	12	2	22	32	23	25	1
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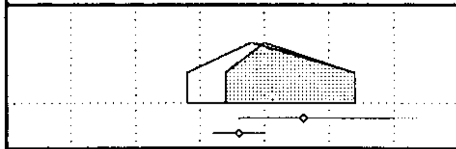	4	39	51	26	44	23	3					62	7	2	19	29	27	23	0
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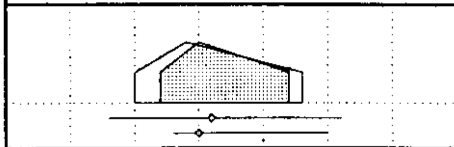	8	51	38	17	36	33	11					57	5	9	10	33	33	21	1
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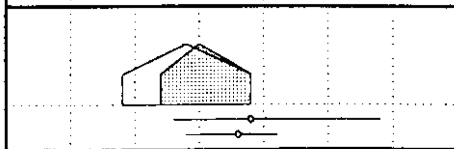	11	46	37	10	28	40	16					43	6	22	25	26	26	15	2
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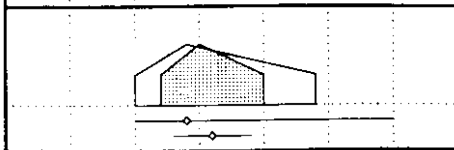	19	40	33	5	23	38	26					39	14	4	36	37	14	17	4
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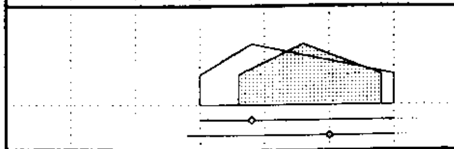	13	32	48	4	43	32	16					59	19	0	33	32	14	20	4
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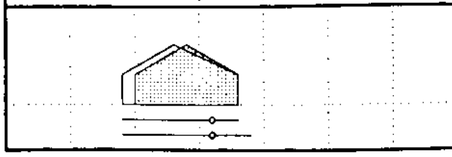
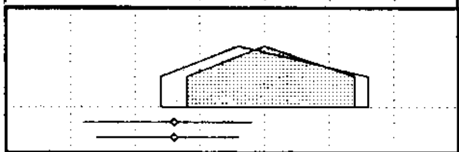
	13	46	37	7	29	39	24					39	19	6	36	39	19	20	4
	21	48	29	6	19	52	23	63	27	0	6	46	19	4	38	40	13	21	2
	57	43	0	29	14	57	0	71	14	0	0	29	0	0	43	57	29	14	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Fisheries	51. Restoration of organism production conditions in deeply contaminated inner bay areas and deteriorated culture ground through practical use of environmental improvement technologies relying on seawater replacement and wave energy.	1	65	6	9	16	69	51	40	8	0
		2	49	4	8	15	73	65	29	4	0
		X	7					71	29	0	0
	52. Practical use of technologies for using a large volume of deep water for new fishing grounds in the open sea.	1	56	5	8	13	74	23	43	27	7
		2	41	4	7	12	77	22	44	22	10
		X	8					63	25	0	13
	53. Development of technologies for utilizing physiologically active substances of algae such as allelopathy to prevent unwanted seaweed or herbivores from growing and allow useful seaweed to dominate and flourish in rocky beaches.	1	63	3	8	19	70	19	46	32	2
		2	46	2	8	15	74	24	46	30	0
		X	4					25	75	0	0
	54. Completion of fishing grounds information service systems through practical use of satellites and automated observation buoys spatio-temporally continuous and wide-area simultaneous data collection, processing, analysis, and transmission methods.	1	60	6	8	14	72	43	47	8	0
		2	45	4	7	14	75	44	49	4	0
		X	8					75	25	0	0
	55. Possibility of accurately distinguishing species and quantifying volume of a fish school estimating community size through development of direct stock assessment technologies by ultra-sonic estimation fish sonar and remote sensing.	1	66	6	9	16	69	42	44	11	2
		2	51	4	8	16	71	43	49	6	0
		X	8					63	25	0	0
	56. Practical use of selective fishing methods for catching desired size and species of fish and of inductive fishing for catching in desirable water area through the development of technologies that are able to control the behavior of a shoal of fish.	1	59	5	8	15	72	32	44	15	7
		2	44	4	6	14	75	30	50	16	2
		X	8					50	13	13	13
	57. Widespread use of super labor-saving fishing boats designed to automate a series of operations from searching for shoals of fish, dragging and lifting nets, to sorting fish by size and storing them consequently allowing the crew to devote only to monitoring.	1	59	5	7	16	72	27	47	20	2
		2	43	4	4	15	76	26	47	23	0
		X	8					38	13	25	0
	58. Possibility of prevention of eutrophication and other types of environmental control in lakes and marshes, inner bays, shallow seas, and other major water regions through the development of technologies for the concentration or absorption and removal of nitrogen, phosphorus, potassium and other substances by biological or biochemical methods.	1	83	7	8	25	61	59	31	7	0
		2	66	6	8	23	63	73	21	3	0
		X	11					82	9	0	0
	59. Possibility of managing large scale migratory living marine resources such as tuna and salmon through the development of technologies for forecasting the relationship between oceanic environmental changes and its biological production.	1	69	8	7	18	67	45	38	13	1
		2	52	5	6	18	71	48	38	8	2
		X	9					56	22	0	0
	60. Possibility of estimating appropriate fish production volume for each water area through the development of technologies for simulating low- to high-level biological production in coastal and offshore areas.	1	66	7	9	15	69	45	47	5	2
		2	49	4	8	15	73	51	43	4	0
		X	8					63	38	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	38	40	14	35	31	17					45	14	2	42	48	9	22	2
	8	43	45	18	37	31	10	39	41	8	10	59	10	2	41	51	4	22	0
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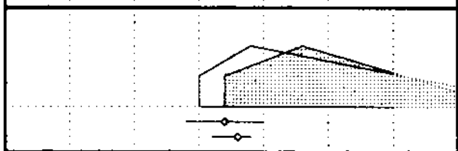	9	34	45	20	45	16	11					39	9	0	54	39	9	18	2
	2	39	51	17	54	17	7	37	32	10	17	51	2	0	61	41	7	15	2
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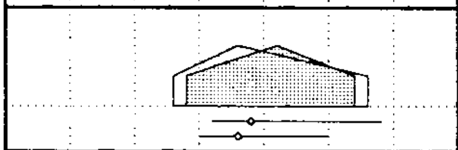	6	35	44	6	38	32	13					59	6	5	21	21	22	27	2
	2	43	46	11	46	30	7	22	59	2	13	72	2	4	13	28	30	30	2
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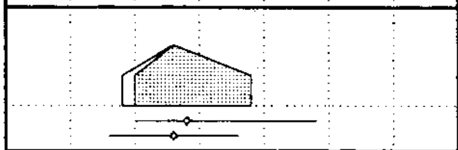	28	42	27	40	40	10	5					40	8	0	33	50	13	33	0
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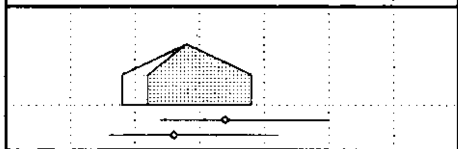	18	55	24	29	44	17	8					59	3	2	20	39	20	29	2
	10	63	25	29	45	18	6	45	33	16	4	76	0	0	14	51	14	33	0
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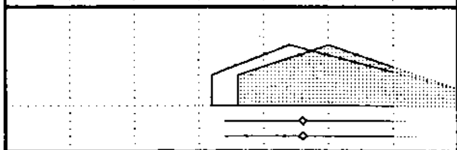	12	29	51	10	36	29	20					68	10	2	27	32	14	19	2
	7	36	52	11	45	25	16	39	34	2	23	82	7	2	23	41	9	20	0
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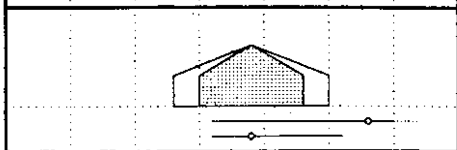	10	37	46	5	19	37	34					51	3	3	46	36	12	14	5
	7	40	51	2	21	40	35	67	14	5	12	60	5	0	58	28	7	19	0
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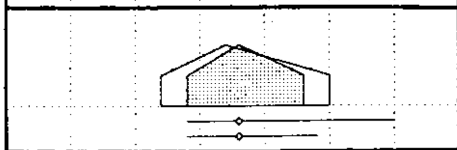	10	43	40	22	41	25	8					54	4	1	31	37	16	27	0
	2	62	30	26	48	20	5	9	65	9	15	64	3	2	35	39	17	26	2
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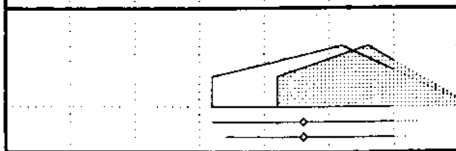	12	39	38	61	22	9	3					59	12	1	6	43	14	36	4
	4	40	48	73	17	6	0	23	58	6	10	73	8	0	4	46	13	40	6
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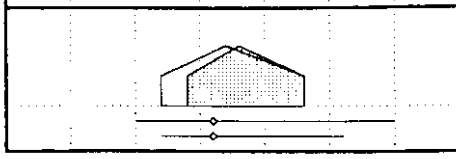
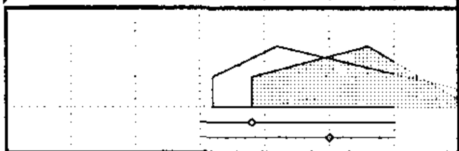
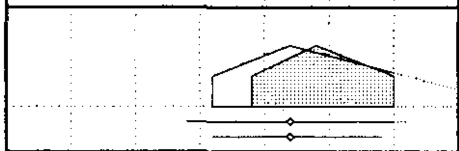
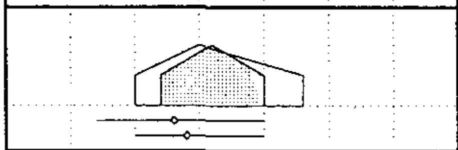
	12	45	38	24	39	23	9					55	8	2	9	41	26	30	2
	6	61	31	22	53	16	4	31	47	12	8	80	2	0	8	47	12	37	0
	13	75	0	38	38	0	0	25	50	0	13	38	0	0	13	50	25	25	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Fisheries	61. Development of production regulation systems as a step toward management of resources and fisheries once it becomes possible to predict the long term (10 to 20 years) changes major fishery resources.	1	69	7	8	18	67	52	39	7	0
		2	49	4	7	16	73	63	31	4	0
		X	8					88	13	0	0
Common (total systems, etc.)	62. Elucidation of the mechanisms of totipotency of plant cells.	1	127	14	20	25	41	65	29	5	1
		2	106	14	16	28	43	75	23	3	0
		X	26					88	8	4	0
	63. Widespread use of technologies enabling the storage and use at the DNA and cellular level of the genetic resources.	1	163	21	22	32	26	65	30	4	0
		2	140	21	21	32	26	74	24	2	0
		X	39					82	18	0	0
	64. Widespread use of technologies for identifying the species of animals and plants by DNA fingerprint analysis.	1	141	18	21	27	34	44	48	9	0
		2	122	20	20	26	35	47	48	6	0
		X	37					54	43	3	0
	65. Development of new plants that are usable for tree-planting in areas with very little rainfall.	1	124	9	19	30	42	58	31	6	3
		2	107	9	16	33	42	61	31	7	1
		X	16					81	19	0	0
	66. Practical use of automated assessment and prediction of growth through the development of biological data sensors, etc.	1	104	6	18	24	51	28	58	13	1
		2	88	6	17	24	52	26	63	10	0
		X	11					45	55	0	0
	67. Practical use of technologies to maintain freshness of perishable foods for a long period of time through advanced freezing and defrosting technologies.	1	103	5	13	31	52	48	40	11	1
		2	89	6	11	31	52	55	38	7	0
		X	11					73	27	0	0
	68. Practical use of general-purpose taste measuring equipment provided with a taste sensor capable of sensing taste ingredients and a texture sensor capable of sensing.	1	86	4	14	23	60	20	49	27	5
		2	73	3	11	26	60	18	53	27	1
		X	5					60	40	0	0
	69. Widespread and general use of biodegradable packing materials that can be decomposed naturally to harmless substances by microorganisms, enzymes or the like.	1	117	4	9	41	45	74	23	3	0
		2	104	3	10	44	44	80	17	2	0
		X	5					60	40	0	0
	70. Realization of systems capable of monitoring around-the-clock changes in global agricultural and forestry resources and agricultural and forestry environments through advancement of next-generation remote sensing technologies with high resolutions.	1	126	7	13	39	41	67	29	4	0
		2	110	5	13	41	41	77	20	3	0
		X	9					78	22	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	16	38	43	43	36	13	6					61	9	3	6	36	20	42	1
	10	37	51	53	35	12	0	27	59	6	6	78	6	0	2	41	12	49	0
	25	38	25	50	38	13	0	25	50	13	0	38	0	0	13	38	25	63	0
	13	39	43	63	25	6	2					72	5	1	2	28	36	25	2
	8	43	42	77	15	5	0	5	44	36	12	78	2	0	2	32	42	25	0
	23	50	19	88	8	0	0	4	50	42	4	69	4	0	0	35	62	15	0
	20	42	32	63	21	9	4					53	7	2	17	37	28	25	1
	18	47	34	71	19	6	3	4	54	29	11	64	4	1	14	41	32	26	1
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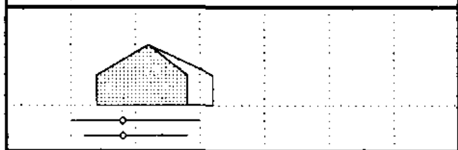	23	49	24	46	30	11	9					48	6	1	17	40	35	22	1
	23	55	20	52	30	11	4	3	54	30	11	57	4	1	15	49	40	20	0
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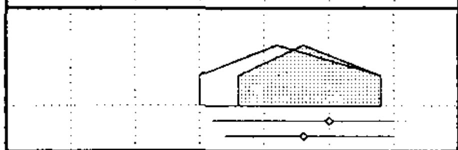	8	36	43	64	21	2	2					68	6	2	8	35	19	20	1
	5	45	46	80	14	2	0	2	15	56	21	79	3	3	6	44	18	27	1
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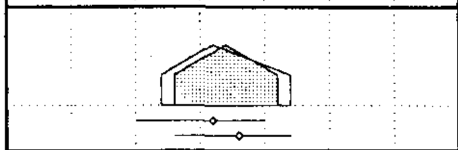	14	43	38	26	38	22	12					62	2	1	26	37	20	19	0
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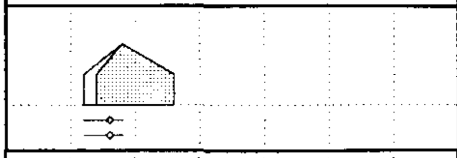	24	53	19	11	22	40	23					47	4	3	56	29	11	14	0
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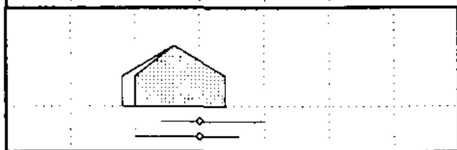	12	52	30	5	28	42	22					58	2	9	26	31	17	15	1
	4	59	33	4	29	47	16	44	32	7	15	75	0	5	25	40	12	18	0
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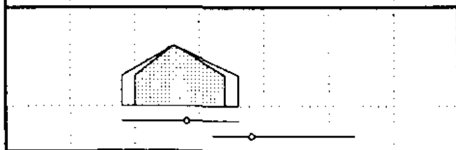
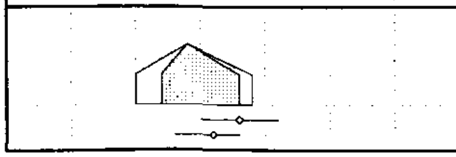
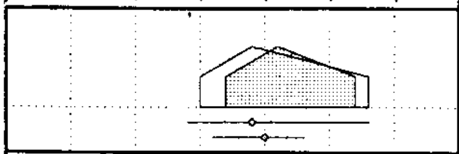
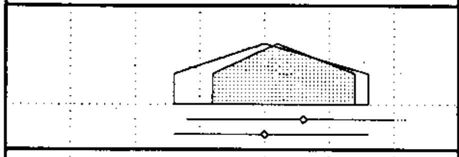
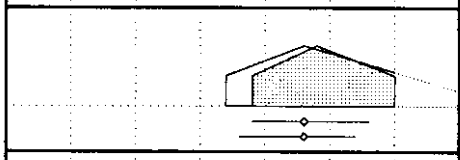
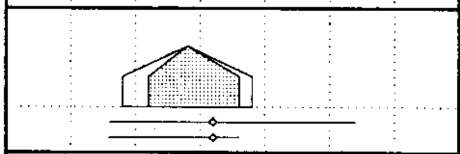
	17	50	29	32	36	17	11					56	4	6	55	22	6	15	0
	12	55	31	31	50	13	3	13	54	12	19	67	2	3	63	19	9	18	0
	20	60	20	20	60	20	0	0	60	20	20	40	0	0	20	60	20	40	0
	21	41	35	83	12	5	0					48	11	1	27	51	11	27	1
	10	52	35	86	9	3	0	5	41	42	8	60	5	0	25	56	8	31	1
	22	56	22	78	0	11	0	11	78	0	11	56	22	0	11	56	33	11	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Common (total systems, etc.)	71. Practical use of resource management systems using artificial intelligence and computer simulation technologies to conserve forest, water, soil, and other natural environments and harmonize the agricultural-forestry ecosystem.	1	109	9	15	29	47	60	34	6	1
		2	98	9	12	32	47	65	32	2	1
		X	16					88	13	0	0
	72. Practical use of local environment management technologies including the preservation of wildlife.	1	134	4	22	38	36	59	39	2	0
		2	121	3	20	42	35	64	35	1	1
		X	6					83	17	0	0
	73. Practical use of technologies for efficient management and use of tropical forest and the organisms living there through elucidation of the mechanisms of structure and functions of forest ecosystems in tropical regions.	1	124	4	17	39	40	66	31	2	1
		2	111	5	15	41	39	69	27	1	2
		X	9					67	33	0	0
	74. Development of a low-introduction continuous dry field farming technology for reducing the nitric acid ion contamination of underground water.	1	88	5	10	28	57	53	42	5	0
		2	79	5	10	27	57	66	32	3	0
		X	10					70	30	0	0

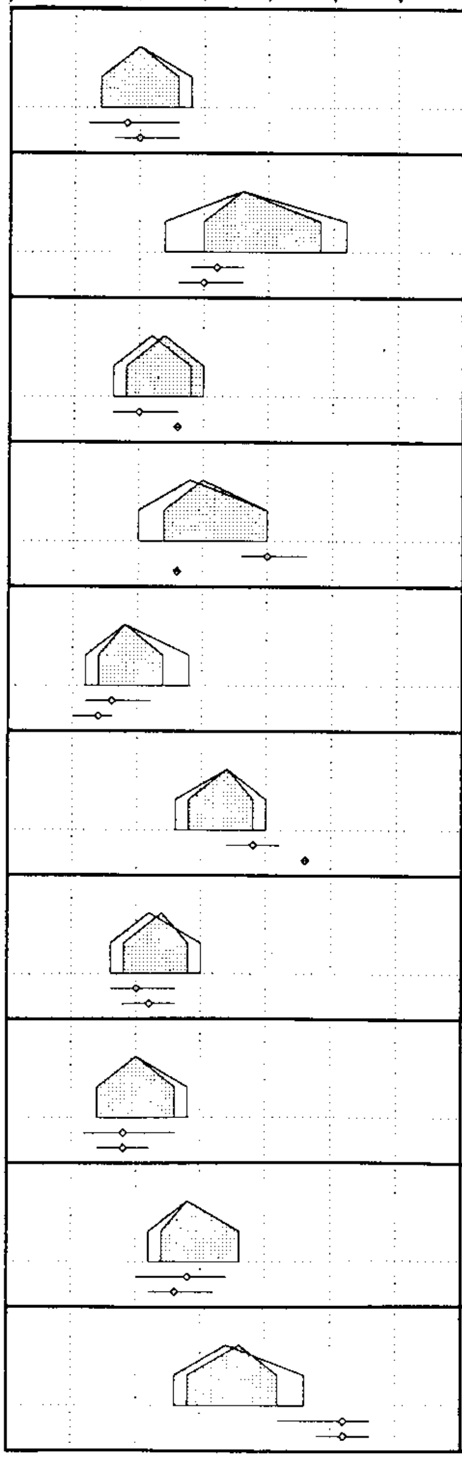
Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	12	39	45	48	39	8	2					56	11	1	18	42	21	28	1
	4	41	52	54	36	7	1	6	50	28	9	68	12	0	11	52	13	28	0
	6	69	25	56	31	13	0	19	50	25	6	81	6	0	25	38	25	19	0
	11	40	43	62	25	7	2					37	28	16	14	39	22	22	1
	6	45	44	68	21	7	0	4	21	60	9	47	23	13	11	45	22	22	1
	17	33	33	67	17	0	0	0	50	17	17	33	33	17	33	0	33	17	0
	10	33	51	84	10	1	1					41	19	19	8	36	27	26	4
	7	32	52	87	6	2	0	4	25	55	9	53	14	15	8	41	25	26	4
	22	44	33	89	11	0	0	0	78	22	0	56	22	11	22	11	44	22	11
	13	50	36	31	39	24	5					53	13	2	32	38	13	25	2
	10	52	38	34	46	19	1	10	52	22	13	63	11	3	24	52	15	24	1
	20	70	10	30	30	30	10	10	70	10	10	40	30	0	50	40	20	0	10

4.11 Production

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Use of new materials and new processes, use of new environment and state-of-the-art environment	1. Widespread use of "intelligent" materials with properties capable of adapting to external stimuli (e.g., shape-memory alloys), contributing to improved performance of machines.	1	100	6	23	50	21	12	67	20	1
		2	92	6	25	55	14	10	77	13	0
		X	6					33	67	0	0
	2. Prevailing use of cold superconductive materials for industrial products.	1	90	3	12	56	29	77	21	2	0
		2	82	3	12	62	23	80	18	1	0
		X	3					100	0	0	0
	3. Widespread use of liquid crystal polymers as materials providing memorizing, recording and switching function in the electronics and information fields to replace silicon.	1	43	3	2	29	66	21	53	23	2
		2	42	1	4	35	60	19	57	21	2
		X	1					100	0	0	0
	4. Practical use of polymer gel as a functional material for artificial muscles, bioreactors, information processing devices, etc.	1	38	2	4	25	69	18	61	21	0
		2	35	1	2	30	67	6	74	20	0
		X	1					100	0	0	0
	5. Development of technologies for forming diamond thin films of complex configurations, enabling practical use of hard films for sliding surfaces as in bearings or other similar parts or for special tools.	1	69	8	13	35	44	23	51	26	0
		2	65	7	17	38	39	18	68	14	0
		X	7					29	57	14	0
	6. Establishment of high-speed precision control technologies for crystal and molecular structures, enabling widespread use of high-performance and ultimate materials.	1	50	2	13	25	59	50	44	6	0
		2	44	1	10	31	58	55	43	2	0
		X	1					100	0	0	0
	7. Application of miniaturized SORs in many industrial fields.	1	41	3	12	18	67	24	56	20	0
		2	36	3	10	21	66	17	69	14	0
		X	3					0	67	33	0
	8. Widespread use of methods for processing materials that have been produced by ultra-precision casting or forging, by grindstones to replace the cutting methods of processing.	1	82	15	26	25	34	11	61	23	2
		2	72	19	26	22	33	8	68	22	0
		X	20					10	60	30	0
	9. Practical use, in minute-scale areas, of micro-machines for various operations which were regarded impossible in many fields including biotechnology, fine machining/assembly, and the manufacture of semiconductors.	1	101	10	30	41	19	52	36	12	0
		2	90	9	31	44	17	56	37	7	0
		X	10					50	30	20	0
	10. Realization of new material plants utilizing the high-vacuum, weightless condition in space.	1	90	4	18	51	27	34	44	20	1
		2	82	3	21	53	23	30	52	17	0
		X	3					0	100	0	0

Forecasted realization time (Year)

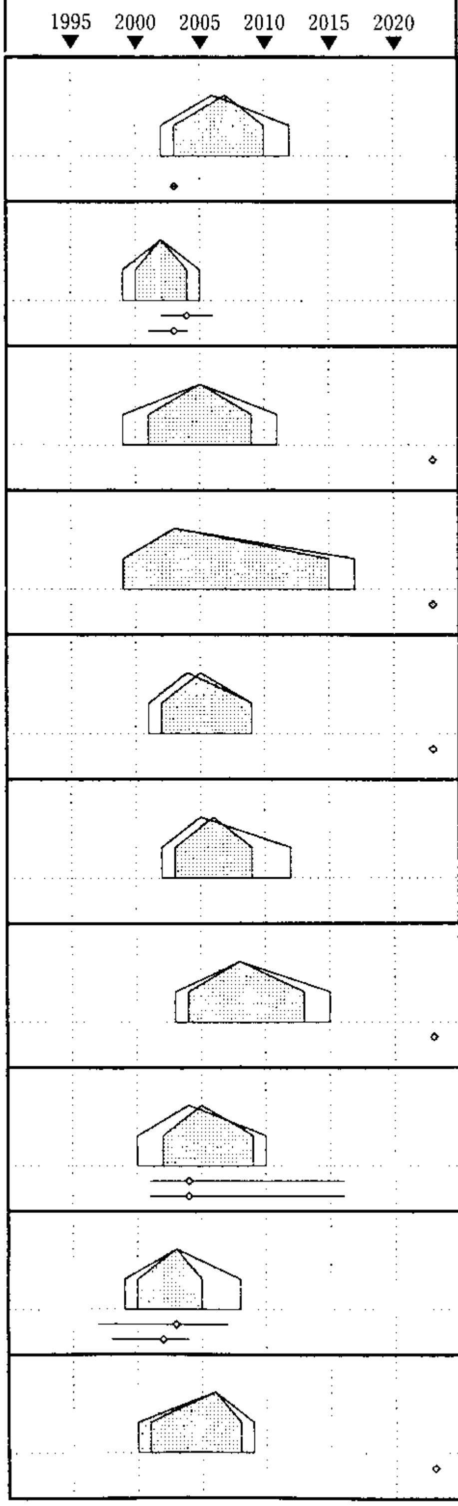
1995 2000 2005 2010 2015 2020



Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
20	49	29	9	20	45	24					66	2	1	37	20	7	11	4
14	61	23	7	23	53	16	23	36	8	30	75	1	1	54	20	5	7	1
33	67	0	17	17	50	17	33	67	0	0	83	17	0	33	17	0	0	0
13	32	47	41	39	11	4					81	1	0	42	16	9	16	0
4	44	50	43	48	10	0	16	56	10	15	91	1	1	52	7	11	10	0
0	67	33	100	0	0	0	33	67	0	0	100	0	0	67	0	0	33	0
14	35	40	5	23	49	19					81	0	0	49	12	9	7	0
14	43	38	2	24	60	12	24	33	7	31	88	0	0	67	7	5	7	0
0	100	0	0	0	100	0	0	100	0	0	100	0	0	0	0	0	100	0
3	55	32	16	37	32	13					79	5	0	32	8	18	11	0
0	63	31	17	34	40	9	9	29	14	40	100	0	0	43	3	14	6	0
0	100	0	100	0	0	0	100	0	0	0	100	0	0	0	0	0	0	0
25	36	33	1	19	41	30					67	0	0	52	16	7	13	0
23	49	28	2	18	52	28	25	43	3	25	75	0	0	71	14	5	6	0
86	14	0	0	0	71	29	57	29	14	0	86	0	0	86	29	0	0	0
8	42	48	26	38	28	4					68	2	2	28	24	6	14	0
2	48	50	18	48	34	0	11	52	11	20	86	0	0	36	20	2	11	0
0	100	0	100	0	0	0	0	100	0	0	100	0	0	0	0	0	100	0
20	54	27	10	32	44	15					66	2	0	51	37	7	12	0
11	67	22	3	31	56	8	31	44	11	8	67	0	0	72	31	6	8	0
0	100	0	0	0	100	0	33	0	67	0	100	0	0	33	0	0	0	0
21	49	21	1	13	39	38					55	1	0	41	12	15	10	2
24	58	15	1	7	46	43	40	43	3	11	71	0	0	54	13	17	11	3
70	30	0	5	0	35	55	50	50	0	0	65	0	0	60	20	15	15	10
11	59	27	25	31	30	12					81	3	5	22	18	17	15	4
9	70	21	21	46	26	8	21	42	17	16	90	3	1	28	17	17	14	2
20	80	0	10	60	20	10	10	60	30	0	80	0	0	10	20	20	30	20
9	38	46	83	12	1	0					56	8	1	42	48	2	18	0
1	46	51	91	7	0	0	2	4	84	6	66	2	0	50	48	1	17	0
0	33	67	100	0	0	0	0	0	100	0	100	0	0	0	100	0	0	0

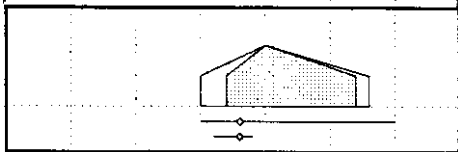
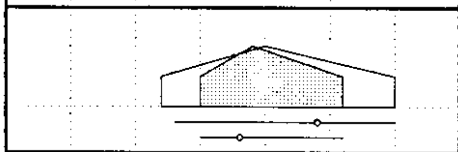
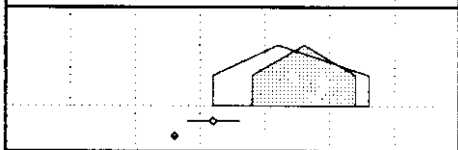
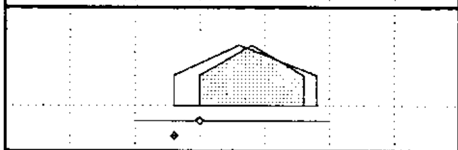
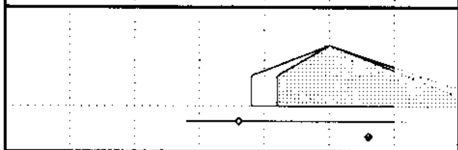
Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Use of new materials and new processes, use of new environment and state-of-the-art environment	11. Progress in projects for developing and utilizing great underground depths, realizing underground factories.	1	75	0	17	44	40	17	35	40	7
		2	68	1	17	44	38	9	41	43	7
		X	1					0	0	100	0
	12. Practical use of manufacturing technology for low-cost mass production of ultra fine metal particles ranging in size from 10 to 100Å.	1	50	2	11	27	60	22	64	14	0
		2	47	2	14	28	56	9	79	11	0
		X	2					0	100	0	0
	13. Development of artificial high-performance catalysts enabling synthesis of various substances under conditions approaching ordinary temperature and pressure, enabling practical use for manufacture of basic chemicals.	1	25	1	6	14	80	44	48	8	0
		2	23	0	7	15	78	43	57	0	0
		X	0					0	0	0	0
Use of organisms, use of biomimetics	14. Development of technologies for producing proteins from carbon dioxide and ammonia by bioreactors.	1	22	1	4	13	82	45	45	5	5
		2	23	0	6	16	79	48	48	4	0
		X	0					0	0	0	0
	15. Practical use of technologies for producing glucide by artificial photosynthesis systems applying the mechanism of photosynthesis.	1	25	1	4	15	80	28	52	16	4
		2	26	0	7	18	76	27	54	19	0
		X	0					0	0	0	0
	16. Practical use of technologies for mass-producing hydrogen by decomposing organic substances through application of solar energy and biological systems.	1	29	0	4	20	76	48	38	14	0
		2	26	0	3	21	76	50	46	4	0
		X	0					0	0	0	0
	17. Elucidation of the homestasis of living bodies, leading to development of automatic control devices applying this mechanism.	1	40	1	10	22	67	38	43	18	3
		2	36	0	12	21	66	36	50	14	0
		X	0					0	0	0	0
	18. Development of actuators resembling human muscles, which can be applied to small, lightweight robots.	1	93	9	19	46	26	43	44	11	1
		2	83	6	23	45	25	40	52	8	0
		X	7					43	57	0	0
	19. Development of programs for automatically enhancing functions by learning based on the imitation of biological functions.	1	80	9	23	33	35	41	39	19	1
		2	73	8	24	35	33	38	48	12	1
		X	9					78	22	0	0
	20. Practical use of manufacturing process for basic chemicals, which utilize the efficiency of special environment microorganisms.	1	28	1	5	17	77	25	64	11	0
		2	25	0	6	18	77	24	64	12	0
		X	0					0	0	0	0

Forecasted realization time (Year)



Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
3	32	55	7	13	31	40					37	23	15	43	41	0	3	3
3	35	54	0	18	31	44	29	24	12	22	35	22	13	57	41	1	3	1
0	0	100	0	0	0	100	0	100	0	0	0	0	0	100	0	0	0	100
8	46	38	6	22	40	28					74	2	2	42	20	4	14	0
4	55	36	0	23	55	21	21	51	6	19	87	2	0	60	6	2	13	0
0	100	0	0	0	50	50	50	50	0	0	100	0	0	0	0	0	100	0
24	20	40	24	32	28	12					76	0	0	16	16	16	16	4
17	35	35	17	48	30	4	9	43	26	17	87	4	0	30	13	13	17	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	32	41	36	9	36	9					45	0	5	32	23	18	27	0
4	43	35	43	13	30	4	9	30	13	35	61	4	0	22	17	22	22	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	32	40	20	24	28	16					52	4	0	28	16	28	20	0
4	38	42	31	27	27	12	8	42	4	38	81	4	0	23	12	27	15	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	21	55	38	28	24	3					69	3	3	38	21	14	14	0
8	27	54	50	23	27	0	8	38	8	38	88	8	0	42	12	15	12	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	33	50	48	23	20	3					70	3	0	18	20	30	18	5
3	42	53	58	22	17	0	0	42	28	22	89	3	0	17	19	22	19	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	41	42	27	24	29	15					81	0	1	31	22	9	17	1
10	45	45	24	30	35	10	27	39	11	18	88	0	0	39	17	7	17	0
14	71	14	14	43	29	14	14	14	57	14	100	0	0	0	29	14	43	0
16	45	35	34	29	21	13					73	1	8	11	21	18	16	4
8	60	30	34	27	27	10	11	30	38	15	88	0	5	10	26	23	16	0
33	67	0	33	11	33	22	22	22	56	0	78	0	0	11	33	22	22	0
11	36	46	25	29	25	21					68	4	0	29	21	18	25	4
8	36	48	32	20	32	16	8	36	16	28	80	0	0	24	16	20	32	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Use of organisms, use of biomimetics	21. Development of machines which apply the biological energy converting mechanism to provide high energy converting efficiency.	1	45	3	7	26	64	60	27	13	0
		2	43	2	10	28	60	56	37	7	0
		X	2					100	0	0	0
	22. Development of production and office automation systems applying computers equipped with functions similar to those of biological brains.	1	87	12	21	37	30	51	39	6	5
		2	83	10	24	42	25	52	40	5	4
		X	11					64	36	0	0
Energy saving, resource saving and resource recycling, and environmental preservation	23. Commercialization of electric power tankers capable of storing and transporting electricity in its original state.	1	58	2	9	35	54	34	33	26	7
		2	49	1	6	38	55	33	41	22	4
		X	1					100	0	0	0
	24. Widespread use of industrial heat recovery systems, as a result of the development of thermoelectric conversion devices.	1	57	3	6	36	54	40	37	21	2
		2	52	1	7	40	51	44	42	13	0
		X	1					100	0	0	0
	25. Realization of small-size nuclear reactors, leading to application in industry (e.g., for steel plants).	1	58	2	2	43	53	28	31	26	16
		2	48	1	3	41	55	21	35	29	15
		X	1					0	0	0	100
	26. Practical use of non-electric methods of refining for use in a aluminum manufacture, through the direct deduction of bauxite.	1	36	3	3	23	71	28	39	28	6
		2	32	3	4	24	70	22	56	22	0
		X	3					33	67	0	0
	27. Reduction of rare-metal production costs at least half of their current levels, based on perfection of technologies for integrating rare-metal production processes.	1	29	1	4	19	76	10	69	21	0
		2	26	1	4	20	75	12	73	15	0
		X	1					0	100	0	0
	28. Widespread use of designing, producing, collecting and recycling systems which make it possible to recycle most used materials through legally establishing manufacturers' responsibilities for collection and disposal of disused products.	1	100	6	21	54	20	74	24	2	0
		2	91	5	21	57	17	84	16	0	0
		X	5					100	0	0	0
	29. Widespread use of automobiles and power engines that use hydrogen as their fuel instead of petroleum or alcohol.	1	83	5	12	50	34	58	31	8	2
		2	77	4	12	55	29	60	34	5	1
		X	4					75	25	0	0
	30. Progress in the development of technologies including those for absorbing carbon dioxide, artificial photosynthesis, turning wastes into harmless substances and preventing desertification, leading to world-wide implementation of global environmental preservation measures.	1	77	2	13	46	38	91	8	1	0
		2	69	2	13	49	36	91	9	0	0
		X	2					100	0	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	9	40	47	51	31	11	2					73	2	0	20	20	20	16	2
	5	40	51	58	26	12	2	5	37	21	30	88	2	0	26	12	23	16	0
	0	100	0	100	0	0	0	0	0	0	50	100	0	0	50	0	50	0	0
	15	44	36	48	25	11	9					76	2	7	15	16	18	20	3
	5	52	40	52	27	13	6	13	36	35	10	89	2	6	14	13	30	19	1
	0	100	0	64	9	18	9	27	0	73	0	91	9	9	9	9	27	45	0
	5	26	57	34	33	19	7					72	2	0	52	29	0	9	2
	0	27	65	35	35	24	4	4	49	6	37	82	2	0	73	16	0	6	2
	0	100	0	0	100	0	0	0	100	0	0	100	0	0	0	0	0	100	0
	4	30	61	14	46	28	9					70	5	4	53	16	2	9	2
	2	31	63	13	52	25	8	13	38	8	35	81	6	2	62	13	2	6	0
	0	100	0	0	0	0	100	0	100	0	0	100	0	0	100	0	0	0	0
	7	22	59	34	22	16	16					45	34	31	19	10	2	7	9
	2	25	67	38	31	15	10	2	35	38	19	54	33	40	21	6	4	6	4
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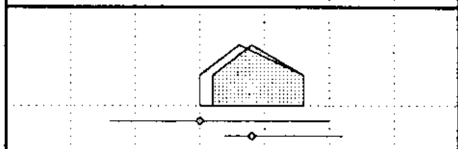	8	31	42	19	25	31	14					61	3	3	53	25	3	0	0
	6	25	59	25	22	41	9	9	25	22	41	69	3	3	72	13	3	3	0
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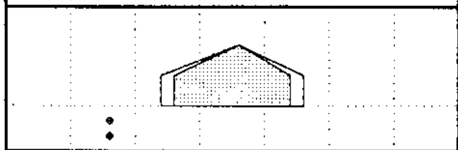	7	45	34	14	41	34	7					76	0	0	34	41	3	7	0
	8	54	31	15	46	35	4	8	31	27	31	77	4	0	54	27	0	8	0
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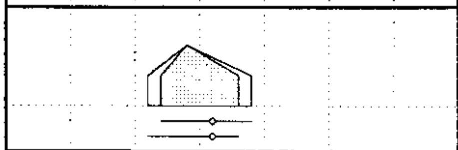	16	48	33	36	27	19	15					32	42	12	67	11	2	4	1
	14	57	26	49	29	10	11	18	30	31	18	37	43	10	77	9	0	7	0
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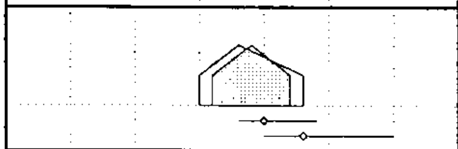	8	45	41	25	36	23	8					52	17	2	75	11	4	2	1
	8	51	40	34	34	25	4	19	48	12	14	65	10	0	87	8	1	8	1
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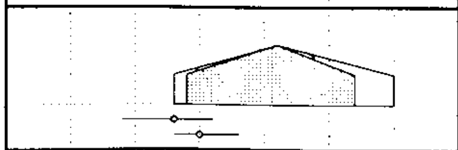
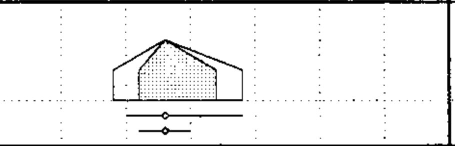
	14	43	43	92	4	1	1					52	19	14	40	30	5	9	6
	9	46	43	94	4	0	0	14	41	20	19	71	14	9	48	30	1	7	3
	0	100	0	100	0	0	0	50	50	0	0	50	50	0	50	50	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Improvement of productivity, automation and unmanned operation, and integration	31. Development of devices and machines equipped with functions for self repairing of (or self recovery from) simple failures.	1	97	14	31	32	23	37	47	14	1
		2	89	15	30	34	21	31	55	12	1
		X	17					65	29	6	0
	32. Practical use of aseptic packing of chemicals, foods, etc. by the use of component type capsule machines which enable efficient sterilizing.	1	39	1	7	23	69	10	56	28	5
		2	38	1	6	27	66	8	63	26	3
		X	1					100	0	0	0
	33. Practical use of systems capable of producing ground plans of sites from photographs horizontally taken by radar type cameras.	1	56	2	14	29	55	5	36	45	14
		2	50	1	14	31	55	8	30	46	16
		X	1					0	0	0	100
	34. Widespread use of operation manuals supplied in the form of software which is built into industrial equipment and facilities in order to enable anyone to operate sophisticated and complex functions easily.	1	110	21	28	37	13	33	49	17	1
		2	101	21	30	38	11	31	57	12	0
		X	24					46	38	17	0
	35. Widespread use of remote control systems from outside the factories which permit operation and maintenance of equipment and facilities having sophisticated and complex functions.	1	106	23	28	32	17	32	42	22	4
		2	96	23	27	34	16	31	47	20	2
		X	26					54	35	12	0
	36. Advent of robots having two hands and walking on two feet, leading to the development of anthropomorphic robots which are as large as humans and, without needing any modification, can take over factory jobs that have hitherto been done by humans.	1	107	23	30	31	16	29	25	33	13
		2	94	22	29	32	18	21	31	31	17
		X	25					32	24	32	12
	37. Development of intelligent robots for unmanned machining plants, capable of patrolling, detecting abnormalities, and troubleshooting.	1	108	29	29	27	15	37	37	19	7
		2	97	26	32	26	15	39	41	14	5
		X	30					70	23	3	3
	38. Micro robots capable of performing inspection, control and repair troughout machines and facilities.	1	106	21	31	31	17	29	54	11	6
		2	95	22	29	32	17	28	52	17	3
		X	25					44	40	12	4
	39. Widespread use of a pattern recognition technology capable of reading handwritten Japanese in the service industry.	1	106	17	27	40	17	26	51	21	2
		2	95	17	25	41	17	23	59	18	0
		X	19					42	47	11	0
	40. Construction of infrostructure and distribution systems enabl-ing high-speed, unmanned transportation between factories, companies, factories and markets, etc. through dedicated lines.	1	81	12	17	36	36	35	35	23	6
		2	74	12	19	35	35	28	43	22	7
		X	13					62	15	15	8

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	19	53	27	8	29	38	22					79	1	3	45	15	8	12	0
	17	60	22	9	26	45	18	25	46	12	12	83	0	1	62	12	4	9	0
	53	47	0	12	18	35	35	41	41	12	6	88	0	0	41	18	6	12	0
	8	49	41	3	26	36	33					46	10	5	69	10	5	8	0
	8	50	39	3	24	45	26	18	45	8	24	55	0	5	79	8	8	5	0
	100	0	0	100	0	0	0	0	0	0	0	100	0	0	0	0	100	0	0
	9	39	41	4	20	36	30					63	0	2	36	23	7	11	4
	4	44	46	2	16	42	32	14	34	18	24	76	2	2	40	18	6	6	2
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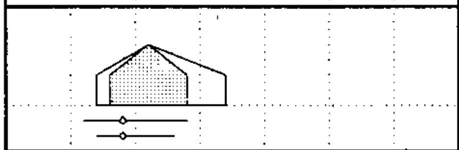
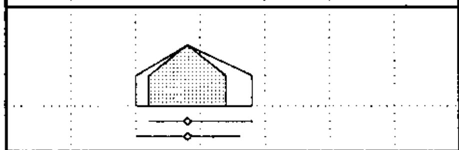
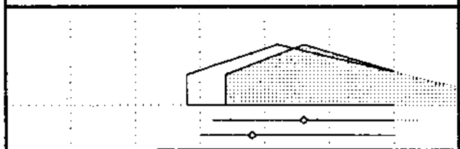
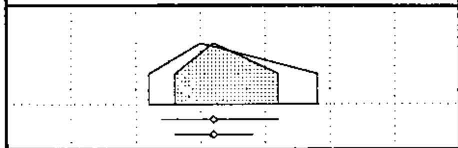
	32	46	19	9	25	25	36					37	10	13	61	10	15	7	3
	32	53	14	8	23	28	38	24	43	18	7	49	9	13	72	10	12	3	1
	67	33	0	17	17	17	50	21	42	33	0	29	17	17	71	13	17	8	0
	23	43	27	11	30	27	24					53	14	7	51	18	4	9	5
	21	57	19	9	32	33	21	29	42	9	13	65	11	8	67	9	7	2	3
	42	46	12	15	38	23	23	42	35	15	4	69	15	8	73	12	8	0	0
	20	26	40	15	27	21	22					63	2	13	36	18	3	7	5
	17	28	40	14	29	20	21	36	27	7	12	72	2	13	41	13	6	4	5
	32	40	16	16	28	20	24	44	20	16	4	80	0	16	52	20	8	0	0
	24	40	28	11	27	28	25					69	6	6	36	19	5	5	2
	23	48	26	8	33	28	27	46	34	3	8	81	6	1	58	16	3	4	4
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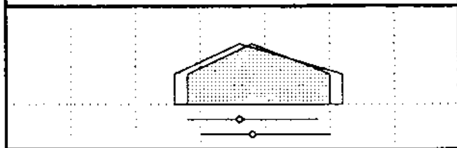	12	44	34	18	29	27	17					75	5	0	42	21	5	3	3
	13	52	31	12	37	26	20	27	44	7	13	84	3	0	54	17	6	4	2
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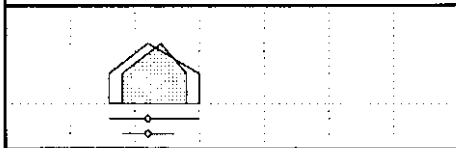	16	61	18	5	17	24	49					56	5	6	58	11	6	3	3
	13	69	17	5	17	24	52	63	22	0	9	71	3	4	75	8	5	4	1
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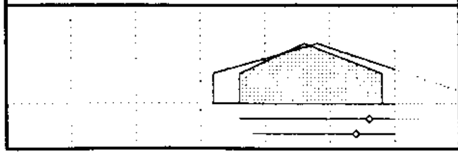
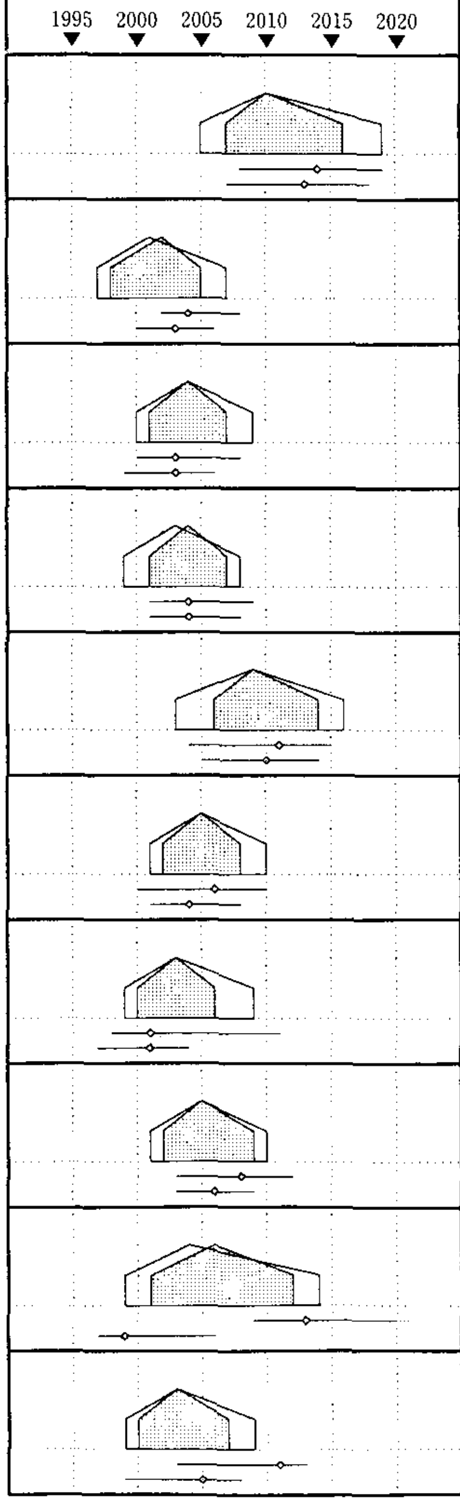
	11	36	42	6	27	30	28					22	40	12	42	31	2	4	1
	8	32	54	4	24	31	34	22	23	9	35	23	42	7	61	31	3	1	1
	23	46	23	8	8	31	46	23	23	15	31	8	62	0	62	46	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Improvement of productivity, automation and unmanned operation, and integration	41. Widespread use of robots capable of serving many and unspecified people in offices, factories and homes.	1	101	17	22	41	20	21	39	34	7
		2	91	16	24	40	20	18	44	32	7
		X	18					28	39	28	6
Information and intelligence	42. Widespread use of high definition video displays as computer three-dimensional video displays for multimedia applications as more multimedia are used for designing, training and other purposes.	1	90	8	27	37	28	22	53	23	1
		2	80	8	27	37	27	15	60	24	1
		X	9					33	56	11	0
	43. Advancement in digitalizing the sensing of sounds, colors, touch, etc., leads to practical use of design and inspection based on such digitalized sensing.	1	93	10	26	38	26	16	55	28	1
		2	84	9	24	42	24	12	68	19	1
		X	10					30	60	10	0
	44. Automation of most machining process designing jobs, leading to the widespread use of technologies for directly machining from design data.	1	109	31	33	23	13	36	56	7	1
		2	98	29	35	24	13	38	56	6	0
		X	32					53	47	0	0
	45. Practically complete establishment of engineering data bases categorizing all processing technologies in terms of shape and properties of workpieces and processing energy and conversion.	1	94	24	26	26	24	23	57	18	1
		2	85	24	25	28	23	26	56	16	1
		X	26					38	54	8	0
	46. Development of apparatuses and machines which enable operators to experience the advanced technologies of expert systems or high level skills, so that the operators will be able to learn expert capabilities.	1	100	23	26	32	19	26	49	20	4
		2	90	22	31	29	19	27	52	19	2
		X	24					58	29	8	4
	47. Widespread use of sophisticated training systems in career development planning directed to acquisition of new knowledge and technical skills by corporate personnel in the middle and upper age groups.	1	88	10	23	37	30	32	45	20	2
		2	79	10	21	39	29	34	48	16	1
		X	11					45	45	9	0
	48. Widespread use of technologies for providing artificial virtual realities in such fields as machines, construction, and electrical machinery and appliances.	1	90	15	17	40	27	16	52	30	2
		2	84	14	16	46	24	15	55	26	2
		X	15					20	67	13	0
	49. Development of apparatuses for estimating latent needs according to customers' psychological reactions at antenna shops (pilot shops) or other similar places.	1	55	2	12	30	55	7	29	53	11
		2	50	3	12	31	54	4	26	68	2
		X	3					33	33	33	0
	50. Application of moderately priced hologram technology, leading to wide application as a means of relaying three-dimensional images of products.	1	73	6	13	40	41	8	30	56	5
		2	65	6	14	40	40	5	29	62	5
		X	6					33	67	0	0

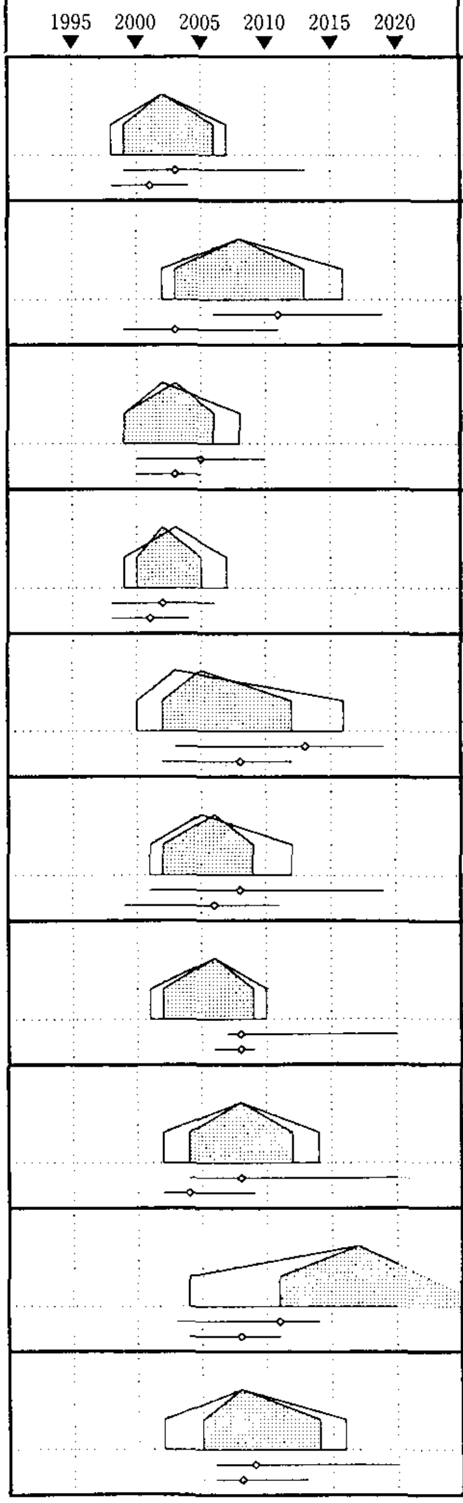
Forecasted realization time (Year)



Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
12	37	42	15	25	33	18					58	7	18	46	16	2	4	1
8	37	52	8	31	38	20	29	42	7	15	68	7	23	64	7	4	2	0
17	44	39	11	44	17	28	44	28	17	6	72	0	39	67	6	0	6	0
18	51	30	14	39	23	20					44	13	2	61	16	7	8	2
13	63	23	9	46	25	16	44	31	9	9	55	15	3	70	11	6	6	0
22	67	11	11	56	11	22	22	56	22	0	44	22	0	78	33	0	11	0
11	44	42	14	38	29	15					70	4	12	30	16	14	9	2
7	51	39	13	45	24	15	14	40	12	29	87	4	10	44	8	10	4	1
20	80	0	30	30	20	20	10	50	30	10	90	0	30	50	0	10	0	0
27	47	25	17	33	26	20					72	3	4	40	17	13	6	1
20	56	23	10	39	35	15	35	45	10	7	87	2	3	55	9	12	5	0
47	47	6	16	31	25	25	47	41	6	6	94	0	3	53	16	6	0	0
10	49	35	31	33	20	9					48	9	4	24	28	17	17	2
9	55	34	24	42	24	7	16	47	14	18	64	6	2	28	35	15	9	2
27	54	19	19	54	12	8	19	46	27	4	58	0	0	19	50	27	4	0
14	47	31	18	30	27	17					68	3	3	32	20	20	10	2
10	58	30	12	39	31	12	20	41	22	11	84	4	3	38	12	17	9	4
13	58	25	21	38	29	8	17	42	33	4	88	0	0	33	21	21	4	4
8	52	35	10	18	40	27					27	30	19	25	18	25	10	3
6	54	38	6	16	53	22	28	39	4	25	30	29	15	24	18	29	9	5
9	91	0	0	36	27	36	18	55	0	27	27	18	0	45	27	27	9	27
8	54	34	11	43	23	21					71	2	0	46	22	11	7	2
5	60	35	6	48	29	14	13	35	31	15	81	2	2	61	14	12	0	1
13	60	27	7	53	13	27	7	27	60	7	80	7	0	67	27	13	0	0
4	29	55	7	13	38	29					64	7	15	24	7	4	5	4
2	22	76	6	14	32	42	14	32	12	40	82	2	18	44	8	4	4	2
33	33	33	0	33	33	33	0	67	0	33	100	0	0	33	0	0	33	0
7	38	47	3	22	32	36					40	1	11	55	15	3	7	3
2	51	42	2	22	37	32	18	45	15	14	63	0	8	69	5	5	5	0
17	83	0	0	83	17	0	17	50	33	0	100	0	0	50	33	17	0	0

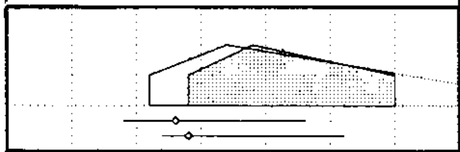
Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Information and intelligence	51. Practical use of product planning, ordering & production, and product marketing by using mock products through three-dimensional video monitor for virtual realities.	1	82	8	19	38	35	11	38	46	5
		2	72	7	18	39	36	6	42	49	4
		X	8					25	50	25	0
	52. Practical use of pocket-type voice actuated interpreting machines that enable people to communicate even if they do not speak each other's language.	1	96	4	20	52	24	53	36	10	0
		2	88	3	19	57	21	56	38	7	0
		X	3					100	0	0	0
	53. Widespread use of automatic translation machines capable of rendering foreign-language documents into Japanese (or vice-versa) in offices.	1	101	3	24	53	20	42	47	12	0
		2	91	4	22	55	19	45	48	7	0
		X	4					75	25	0	0
	54. Widespread use of office systems to electronify all office activities (i.e., editing, preparation, storage, retrieval, and interoffice communication of documents and statistics as well as electronic conferences).	1	100	8	26	45	21	30	47	18	4
		2	89	6	28	46	21	27	61	10	2
		X	7					71	29	0	0
	55. Development of interactive AI systems which give their users triggers or contexts that help them to come up with ideas.	1	65	8	15	30	47	20	40	29	9
		2	60	7	15	33	45	20	42	32	7
		X	8					75	13	0	13
	56. Widespread use of at-home performance of work in general office divisions (excluding interviews and negotiations) based on advances in video teolephones, on-line computer systems, and facsimile equipment.	1	98	7	21	49	22	21	44	28	6
		2	89	6	21	53	21	15	54	28	3
		X	7					43	57	0	0
	57. Widespread use of operatorless systems enabling at-home health examination and diagnosis.	1	84	4	13	50	33	29	40	24	6
		2	80	4	15	53	28	20	51	25	4
		X	4					50	25	0	25
	58. Practical use of optical computers, switching equipment, and information processing, resulting in the emergence of super information-intensive society based on optical application.	1	87	6	22	42	30	48	39	8	3
		2	79	5	23	45	28	46	44	8	3
		X	5					60	40	0	0
	59. Advancement in the research into image communication, leading to significant revolution in communication systems that have changed little since the invention of characters and languages.	1	54	4	11	28	56	20	26	35	19
		2	48	3	10	32	55	19	31	35	15
		X	3					67	0	33	0
	60. Practical use of production systems which enable individual and consumers to make low cost products designed to their own tastes in function, shape and color.	1	81	18	17	31	34	22	36	30	11
		2	75	19	13	37	31	20	39	33	8
		X	21					43	43	10	5

Forecasted realization time (Year)



Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
10	46	38	5	18	38	33					45	7	20	54	17	7	1	4
7	50	39	1	13	46	36	25	24	19	24	63	6	14	69	8	6	3	1
25	50	25	0	25	38	38	0	50	38	13	50	25	13	75	0	0	13	0
7	44	46	54	33	7	3					69	2	18	43	14	9	13	1
6	44	49	56	34	9	0	28	45	5	17	81	0	11	56	10	7	7	0
67	0	33	33	67	0	0	0	67	33	0	33	0	33	0	0	0	33	0
18	44	36	37	30	22	9					64	2	11	62	12	4	4	1
12	52	35	40	35	19	4	43	34	1	18	75	1	5	76	4	5	3	0
50	25	25	50	50	0	0	0	75	0	25	50	0	0	50	0	0	25	0
18	45	31	7	26	29	32					22	22	24	57	15	4	6	1
11	55	30	4	22	40	28	19	42	18	16	27	25	18	76	11	4	4	0
43	57	0	14	29	29	29	0	43	43	14	14	14	14	71	0	14	14	0
11	34	45	11	25	28	23					63	3	8	18	12	9	11	2
3	37	57	8	35	27	27	3	33	35	23	82	2	13	18	12	12	15	2
13	50	25	25	38	13	13	0	50	38	0	75	0	13	13	0	25	38	0
15	42	35	5	13	39	36					10	43	53	26	11	3	3	2
7	53	35	3	10	45	37	16	39	21	17	8	51	65	28	6	3	3	2
14	86	0	14	14	14	57	14	43	29	14	0	43	86	0	0	0	14	14
8	39	38	17	15	24	32					33	44	24	35	10	0	11	2
3	48	48	9	20	35	34	15	41	14	25	38	65	23	43	5	3	4	1
0	0	100	0	25	75	0	25	50	0	25	75	75	25	25	0	0	0	0
10	43	39	33	33	21	5					60	5	3	39	24	8	11	3
6	47	43	30	44	19	3	23	38	20	13	68	9	4	57	22	4	5	0
20	80	0	40	60	0	0	0	80	20	0	80	0	0	40	40	0	20	0
7	22	52	35	26	13	9					44	7	31	17	19	2	4	4
4	19	69	42	29	13	8	6	31	19	31	56	8	44	17	15	4	2	2
33	67	0	0	100	0	0	0	67	33	0	33	0	67	0	33	33	0	0
10	42	35	5	17	31	37					47	5	12	59	11	5	2	2
4	47	41	5	15	36	36	28	29	7	24	64	3	15	72	3	4	4	0
14	71	10	5	19	29	43	48	29	5	14	52	5	10	76	0	10	10	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Information and Intelligence	61. Possibility of predicting risks in economic, international relationships or other relationships by fully utilizing simulation technologies based primarily on electronics.	1	74	8	11	41	40	38	42	16	3
		2	68	7	11	44	38	35	53	10	1
		X	8					50	50	0	0
Humanity, human science, and working environment	62. Widespread use of factory entertainment where operators and visitors can both enjoy. (Systems designed for publicity and entertainment of people as a part of enhanced expression of identities of companies and research organizations.)	1	77	14	14	35	38	13	38	38	12
		2	73	15	13	40	32	14	32	41	12
		X	16					25	25	44	0
	63. Widespread use of medical systems capable of measuring the degree of physical and mental fatigue of individual workers in a short time and of indicating the proper amount of rest required.	1	69	4	16	35	45	28	51	19	3
		2	66	5	13	43	40	30	58	9	3
		X	5					80	20	0	0
	64. Dramatic improvement in noise level in production environments through dissemination of quiet production machinery.	1	99	19	37	23	21	38	46	11	2
		2	92	19	35	29	17	37	55	8	0
		X	21					52	48	0	0
	65. Establishment of bioholonics, enabling advance estimation of optimization actions for production plants or other communities.	1	44	10	10	16	64	20	52	23	2
		2	38	8	8	19	64	11	66	21	3
		X	9					22	56	22	0
	66. Enhancement of individualization in work, leading to possibility of building individual habits, personalities, etc. into software through the use of identity cards (sheets). (e.g., possibility of expressing individual habits and characteristics in word processor characters)	1	66	8	12	33	47	8	32	44	17
		2	58	6	13	34	47	7	33	48	12
		X	7					43	43	14	0
	67. Widespread use of functions for sensing the degree of fatigue through sensors and correcting it in chairs or the like for vehicles, factory work, offices, etc., where people sit for long hours.	1	67	6	11	38	46	10	34	49	6
		2	60	6	9	40	45	3	35	58	3
		X	6					17	50	33	0
	68. Widespread use of function-supporting robots for increasing the work opportunities for handicapped persons.	1	96	8	23	47	23	47	40	14	0
		2	86	5	24	49	22	45	48	7	0
		X	6					50	50	0	0
	69. Widespread use of a production system with comprehensive support for faculties of aged workers mentally and physically.	1	91	16	23	35	27	43	42	11	3
		2	79	14	24	35	28	49	43	6	1
		X	15					87	13	0	0
	70. Practical use of "behavior alarm" systems based on elucidation of physical and psychological mechanisms causing human to mistake.	1	72	8	17	33	42	40	43	15	1
		2	67	7	17	38	39	42	46	12	0
		X	8					100	0	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	36	42	42	31	12	8					47	19	12	14	22	14	18	7
	10	32	56	47	35	12	4	4	25	44	21	66	15	15	10	29	12	16	7
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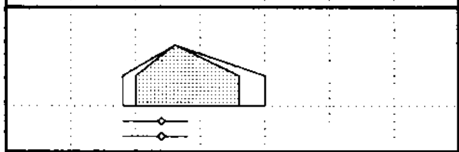
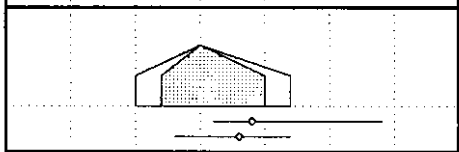
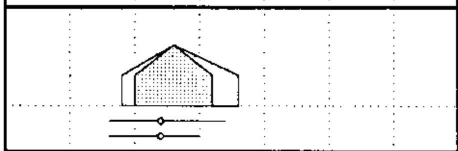
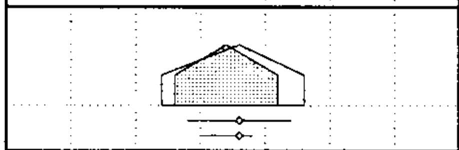
	17	35	38	4	13	30	43					16	18	32	39	25	3	3	3
	14	38	40	3	12	30	47	16	30	12	30	12	14	45	56	25	1	3	0
	31	50	19	0	19	44	38	31	50	0	19	13	13	50	56	31	0	6	0
	6	33	55	13	25	35	19					46	30	16	29	13	6	14	3
	3	41	55	9	30	41	18	6	41	12	36	65	33	17	35	11	6	9	3
	0	80	20	20	20	40	20	0	60	20	20	80	20	0	80	0	0	20	0
	16	49	28	11	27	32	23					62	9	3	61	13	4	5	2
	11	61	27	8	25	42	25	39	39	9	10	78	4	1	76	10	3	2	0
	14	67	19	19	19	38	24	57	24	19	0	71	0	0	86	14	5	0	0
	9	34	52	11	36	32	16					75	9	2	25	18	11	14	2
	5	39	53	8	39	37	13	16	45	16	16	95	8	8	26	16	13	5	3
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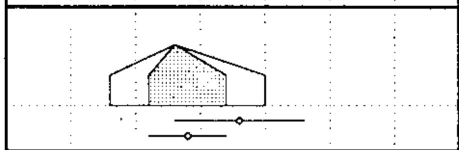
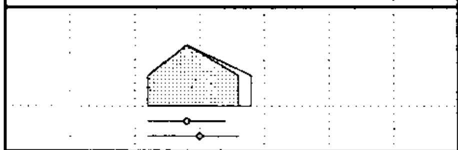
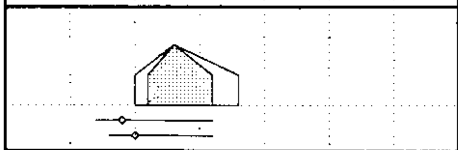
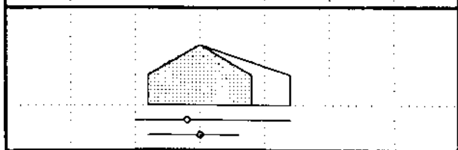
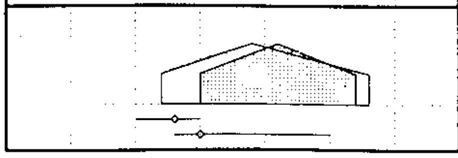
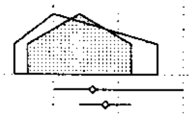
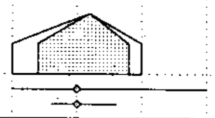
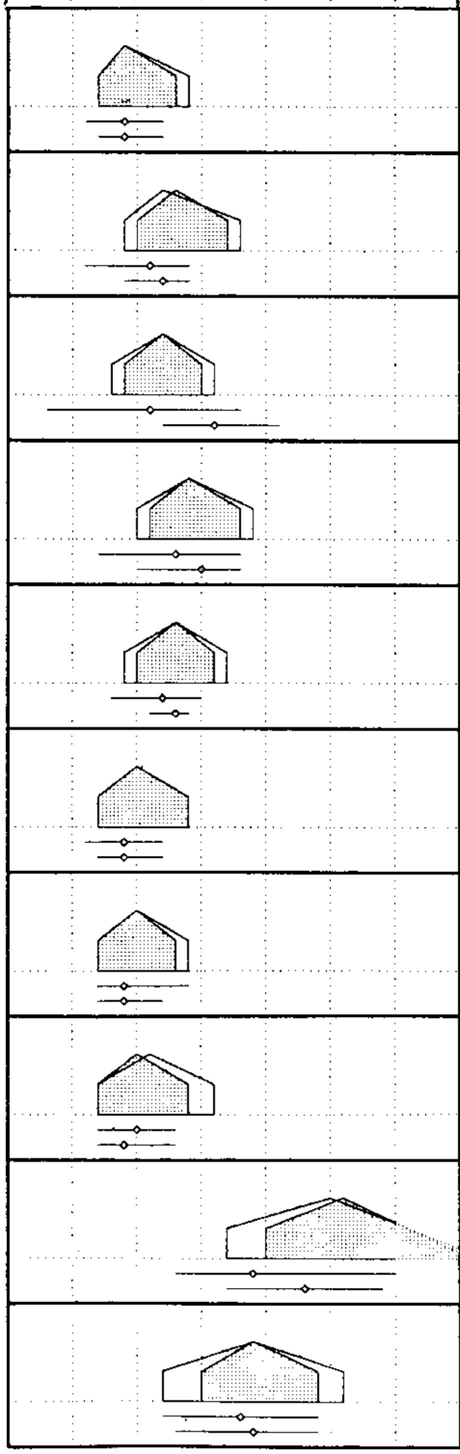
	5	42	38	3	18	33	29					35	9	24	45	3	5	5	5
	2	47	45	3	17	43	29	16	47	14	16	53	9	19	72	0	2	3	2
	14	86	0	0	57	43	0	14	57	29	0	71	0	29	86	0	0	14	0
	6	31	57	6	15	36	36					55	4	4	60	6	4	3	4
	5	28	62	7	8	45	35	10	43	5	35	78	3	5	70	2	2	3	3
	17	33	50	0	17	67	17	0	83	17	0	83	0	0	83	0	0	17	0
	13	47	38	25	28	29	15					49	22	9	54	25	7	6	1
	9	58	30	22	30	33	14	15	34	29	17	60	15	3	76	17	2	7	1
	33	67	0	33	0	33	33	33	33	33	0	33	17	0	100	17	0	0	0
	12	47	35	22	20	33	19					52	10	10	58	25	5	9	1
	9	57	33	15	22	39	23	18	34	16	29	65	9	6	72	16	5	8	0
	27	67	7	27	13	33	27	27	33	33	7	60	13	0	73	40	0	0	0
	10	38	46	32	22	31	8					71	8	11	21	19	7	10	0
	6	40	49	30	27	34	4	6	30	30	28	90	4	12	31	19	4	7	0
	25	38	38	38	0	63	0	25	50	25	0	88	0	13	50	38	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Humanity, human science, and working environment	71. Practical use of a technology to assess potential risk and estimate extent of hypothetical disasters, resulting in spread of safety measures for industrial complexes, aircraft, tankers, and large-scale storage tank facilities, based on techniques to determine the proper balance of scale performance and safety.	1	58	3	10	34	53	71	28	2	0
		2	57	3	10	40	47	75	25	0	0
		X	3					100	0	0	0
	72. Diffusion of systems to prevent damage at such facilities as oil complexes or nuclear power generation plants due to earthquakes or other disasters, e.g., incorporating safety equipment triggered by first slight tremors.	1	67	3	10	42	45	70	27	3	0
		2	62	2	10	45	43	84	15	2	0
		X	2					50	50	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	7	45	45	33	43	17	3					52	19	12	29	28	3	16	3
	5	47	47	32	60	7	2	2	51	14	30	82	12	9	42	19	0	11	4
	0	67	33	33	33	33	0	0	33	33	33	67	33	0	67	0	0	0	33
	10	45	43	39	36	15	6					55	16	1	40	34	3	13	3
	3	56	40	44	42	8	5	19	48	8	21	79	10	2	58	21	0	6	2
	0	100	0	0	50	50	0	0	50	0	50	50	50	0	100	0	0	0	0

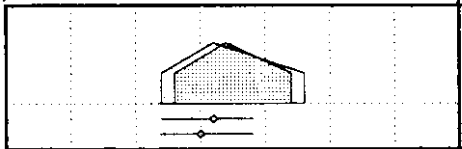
4.12 Urbanization and construction

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Management & effective use of resources and advanced use of cities	1. Construction of three-dimensional cities space; e.g., by combining artificial grounds by effective use of available railway tracks above.	1	123	28	34	28	10	39	48	11	2
		2	110	31	34	26	9	37	52	9	1
		X	37					62	27	8	3
	2. Integration of information on the possession, utilization, transaction of land, enabling use of such information for land policy and city planning.	1	100	7	21	45	26	47	47	3	3
		2	94	7	19	51	22	45	48	4	1
		X	9					67	33	0	0
	3. Establishment of comprehensive, wide-area water control and management technology for rivers, dams, and other water resources in the vicinity of major cities, enabling a more effective use of water resources.	1	95	8	24	38	30	54	44	2	0
		2	85	6	25	39	30	61	38	1	0
		X	7					86	14	0	0
	4. Widespread use of new joint-use duct systems in cities, housing cable for wire broadcasting, vacuum garbage collection pipelines, distribution pipelines, and regional heating and cooling pipes.	1	125	17	32	43	8	50	41	9	0
		2	114	16	32	46	7	61	33	4	0
		X	19					100	0	0	0
	5. Promotion of distribution of job functions by dramatic progress in information communication and transportation systems.	1	104	7	24	45	24	44	43	12	1
		2	94	5	21	51	23	45	46	9	1
		X	6					67	33	0	0
	6. Widespread use of technologies for preserving historical environments including historical neighborhoods because of growing interests in preserving and restoring historical structures.	1	123	12	35	43	10	26	54	19	1
		2	113	12	34	47	7	27	65	8	0
		X	15					53	40	7	0
	7. Practical use of technologies for surveying existing buried objects and ground properties lying deeper than 5 meters from the surface in response to increased use of underground space.	1	110	24	28	29	19	40	49	11	0
		2	95	20	29	30	21	37	58	5	0
		X	24					50	46	4	0
	8. Development of technologies for producing concrete and steel durable for more than 100 years, resulting in dramatically improved durability of buildings and structures.	1	122	29	42	19	10	43	40	14	2
		2	109	27	42	20	11	42	46	10	1
		X	33					58	33	3	3
Effective use of new frontier space	9. Realization of deep underground cities where people can reside.	1	126	26	30	36	8	10	37	29	25
		2	110	22	34	34	10	6	37	34	23
		X	27					15	37	15	33
	10. Realization of marine cities by progress in offshore engineering.	1	121	20	31	37	12	21	55	21	4
		2	105	20	32	34	15	18	56	22	4
		X	24					38	46	13	4



Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	37	47	14	2	7	33	55					7	81	17	24	22	2	7	7
	34	55	11	2	7	32	57	43	26	12	15	5	81	15	31	29	0	5	5
	57	38	3	0	3	38	54	43	22	19	8	5	92	8	27	35	0	3	3
	16	40	37	1	12	16	68					4	87	33	10	14	3	6	10
	7	51	36	1	5	16	72	12	26	19	35	2	93	38	10	11	2	5	7
	33	67	0	0	0	44	56	22	44	11	11	0	100	33	0	11	11	11	11
	25	46	26	5	13	28	53					22	64	11	17	24	5	13	5
	19	54	24	1	18	31	48	24	42	9	20	20	81	6	14	31	2	12	6
	57	43	0	14	0	29	57	14	43	29	0	29	86	0	0	29	14	29	14
	20	52	28	5	14	30	51					18	62	4	42	42	1	8	3
	14	68	18	4	12	32	52	17	36	32	12	11	73	4	44	44	0	5	3
	21	79	0	16	11	21	53	16	32	42	5	5	84	5	32	53	0	11	0
	14	48	33	10	21	31	36					12	44	44	16	22	11	5	5
	11	59	28	6	18	37	35	18	41	21	11	3	64	52	14	26	3	4	4
	0	67	33	17	0	67	17	0	50	50	0	0	83	50	0	33	0	0	17
	22	50	22	13	27	28	28					8	38	39	34	34	9	7	2
	19	59	19	11	27	32	27	7	20	60	7	7	47	52	33	34	8	4	1
	27	67	7	13	40	20	27	7	40	47	0	20	40	60	27	33	13	7	0
	34	51	15	14	33	25	29					75	5	2	35	14	7	16	2
	26	56	15	12	39	23	23	16	51	15	15	79	5	2	46	8	4	18	2
	46	54	0	13	42	13	33	25	42	21	4	83	0	0	42	25	0	25	4
	26	48	20	21	31	23	20					61	10	7	56	6	3	14	2
	27	54	16	19	39	19	17	28	54	8	8	70	9	6	70	6	0	13	1
	52	39	6	21	36	21	21	27	64	6	0	64	12	6	67	3	0	9	0
	7	31	39	13	21	25	19					37	29	36	29	10	1	3	3
	8	29	45	12	24	27	19	12	33	20	19	43	28	40	29	7	0	5	8
	15	37	26	26	22	22	7	4	41	22	7	26	37	30	22	15	0	0	11
	16	42	36	18	37	27	12					51	25	13	49	30	0	8	1
	9	50	36	15	47	23	10	19	42	20	11	57	21	10	59	28	0	6	0
	21	50	25	25	33	29	4	13	54	21	4	54	17	17	46	38	0	4	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Effective use of new frontier space	11. Utilization of deep underground spaces to store most of radioactive wastes, crude oil, underground water, etc. because of advancement of storing and shielding technologies.	1	117	16	31	39	13	60	33	5	2
		2	106	16	28	41	14	67	27	4	2
		X	20					75	25	0	0
	12. Construction of super-high-rise buildings with comfortable living spaces which are at least 1,000 meters high.	1	126	27	26	40	7	11	37	36	17
		2	113	25	28	39	7	8	41	34	18
		X	31					13	48	19	19
	13. Realization of facilities by which ordinary citizens can stay in space for an extended period of time (about 1 year or more).	1	90	4	13	49	34	8	32	49	11
		2	77	2	11	49	37	3	30	58	9
		X	3					0	67	33	0
	14. Construction of manned laboratories on Mars.	1	67	3	7	40	50	6	30	54	10
		2	60	1	7	42	50	2	23	67	8
		X	1					0	100	0	0
	15. Development of technology systems for building new cities in deserts or polar regions.	1	104	7	26	44	24	26	45	26	3
		2	95	6	26	46	22	22	56	20	2
		X	7					71	14	14	0
Improvement productivity	16. Development of highly durable, high-performance bonding agents for steel, enabling substantial rationalization of steel frame assembly.	1	98	13	27	33	27	37	40	19	3
		2	85	13	27	31	29	31	51	16	2
		X	16					56	31	6	6
	17. Development of new matrials to replace reinforced concrete, leading to easier field work.	1	108	22	33	24	20	46	45	8	0
		2	95	21	34	24	21	46	47	5	1
		X	25					52	40	4	4
	18. Advancement of soil stabilization technology with development of new soil stabilization materials facilitates the construction of buildings on soft ground.	1	119	29	30	29	12	54	41	5	0
		2	104	27	31	28	14	60	38	2	0
		X	33					73	27	0	0
	19. Incorporation of intelligent robots anywhere on the construction sites, enabling safe and short-time construction.	1	122	21	33	36	10	56	39	5	1
		2	107	20	32	36	12	61	35	4	1
		X	24					88	8	4	0
	20. Widespread use of techniques for large buildings and structures with little demolishing effect on surrounding area.	1	119	16	30	41	12	53	43	4	0
		2	107	14	33	41	12	61	37	2	0
		X	17					76	24	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Degree of certainty (%) Medium	Degree of certainty (%) Low	Necessity of international joint development (%) High	Necessity of international joint development (%) Medium	Necessity of international joint development (%) Low	Necessity of international joint development (%) None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Comparison of current R&D level between Japan and other countries (%) Equivalent	Comparison of current R&D level between Japan and other countries (%) Other countries are more advanced	Comparison of current R&D level between Japan and other countries (%) Don't know	Constraints on realization (%) Technical	Constraints on realization (%) Institutional	Constraints on realization (%) Cultural	Constraints on realization (%) Cost	Constraints on realization (%) Funding	Constraints on realization (%) Fostering/securing human resources	Constraints on realization (%) R&D system	Constraints on realization (%) Others
	11	49	32	36	38	16	6					60	28	16	32	24	3	12	4
	8	53	35	47	34	10	6	7	33	46	9	74	28	13	40	12	3	6	2
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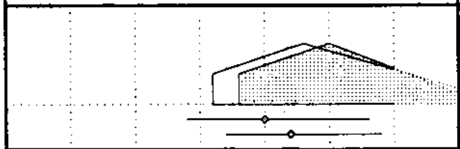	10	34	43	13	20	30	25					44	28	32	37	15	2	3	1
	9	36	47	11	23	30	27	34	35	10	9	52	27	35	44	11	0	2	1
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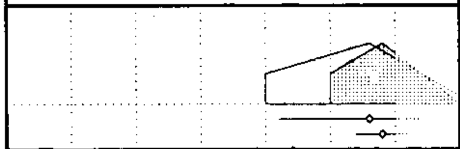	8	36	48	82	8	3	0					70	1	11	26	49	6	7	3
	8	35	55	92	4	1	0	3	4	84	3	84	4	6	17	61	6	5	0
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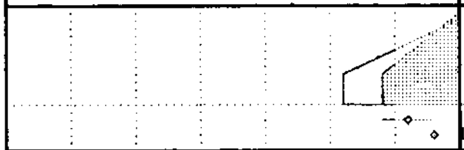	10	25	54	91	3	3	0					81	0	1	27	61	1	13	6
	8	28	60	97	0	2	0	2	3	83	7	87	2	2	15	70	0	8	0
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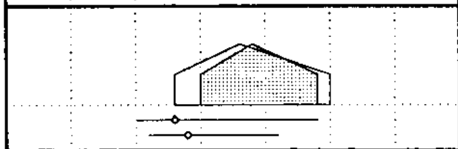	9	47	38	70	22	3	0					43	12	16	31	45	10	13	4
	5	55	37	84	9	2	1	6	27	45	16	60	9	13	29	56	3	6	3
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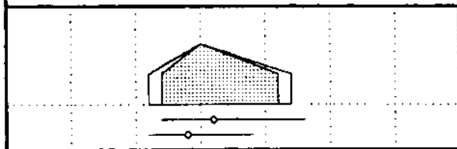
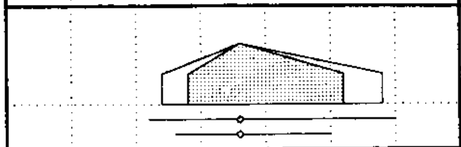
	12	50	32	24	33	22	15					81	18	0	29	8	8	16	3
	11	56	31	24	45	16	13	8	54	7	26	86	12	1	44	4	5	18	1
	13	63	19	13	56	13	13	13	50	6	25	88	6	0	63	0	6	6	0
	18	42	36	26	38	19	13					80	4	0	55	6	9	16	5
	16	48	34	25	46	18	8	20	46	12	17	86	2	1	61	2	5	16	1
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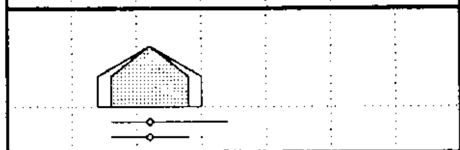	30	50	17	11	34	29	24					68	4	2	61	11	8	12	1
	31	55	14	11	32	36	21	42	41	3	12	74	1	0	73	9	3	11	2
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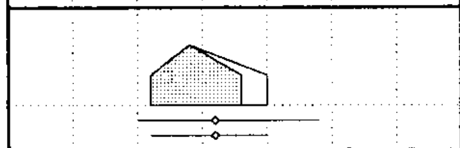	27	52	20	13	28	33	24					66	6	6	52	16	9	15	3
	24	56	18	13	27	39	18	63	21	5	6	76	4	5	73	5	2	12	0
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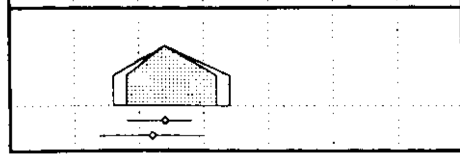
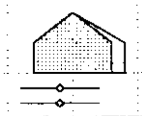
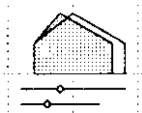
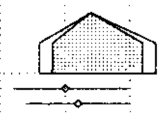
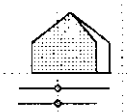
	25	57	17	28	36	24	10					73	21	5	36	12	11	8	3
	17	67	16	29	42	21	7	14	31	47	6	78	21	5	50	7	7	7	2
	29	65	6	35	24	24	18	24	59	12	0	82	29	0	53	6	0	0	6

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Improvement productivity	21. Simplification and sophistication of architectural designs by improvement of man-machine interfaces by introducing artificial intelligence and virtual reality technologies.	1	111	14	32	37	17	28	57	15	0
		2	95	14	28	37	21	28	57	15	0
		X	17					53	35	12	0
	22. Widespread use of house manufacturing systems directly connected with design support systems.	1	110	15	26	41	18	23	58	19	0
		2	98	13	28	40	18	18	69	12	0
		X	16					38	50	13	0
	23. Development of new structural materials using high-polymer fiber and ceramics, with application for bridges, dikes and other structures.	1	114	19	25	41	15	25	61	14	0
		2	97	16	22	43	19	24	64	12	0
		X	19					32	68	0	0
	24. Drastic progress in efficiency and safety of construction work, by introducing intelligent robots and large-scale construction machinery for tunneling, underwater work, and operations at elevated area on the construction site.	1	111	20	25	37	17	59	39	3	0
		2	102	17	26	40	16	64	35	1	0
		X	21					90	10	0	0
	25. Creation of standard data base for soil, and geological characteristics, meteorological conditions, which are easily accessible in planning and designing.	1	108	22	27	32	19	51	38	11	0
		2	99	20	26	36	18	51	42	7	0
		X	24					75	25	0	0
	26. Development of construction technologies utilizing micro machines.	1	80	7	20	33	39	20	61	18	1
		2	68	3	20	34	43	13	72	15	0
		X	3					33	67	0	0
	27. Development of construction technologies which incorporate, in advance, maintenance and demolishing functions.	1	109	14	29	40	18	39	52	7	1
		2	96	10	29	41	20	36	59	4	0
		X	12					42	58	0	0
Pursuit of richer and more comfortable lifestyle	28. Incorporation of countermeasures for harmful effects of noise, vibration, and lack of sunshine, etc., based on the establishment of methods of assessing the related social and economic loss as well as better understanding of their physical and psychological effects.	1	104	16	30	32	23	44	50	6	0
		2	95	14	31	33	21	38	57	4	0
		X	17					71	29	0	0
	29. Construction of cities that present diverse landscapes including roads and bridges thanks to advancement of landscape design technologies.	1	113	23	25	36	16	37	46	15	2
		2	102	20	24	39	16	33	53	12	1
		X	25					56	40	0	4
	30. Development of energy-saving airconditioning systems that can be used for outdoor spaces, thereby enhancing the comfort of outdoor spaces such as plazas and bus stops where people gather.	1	85	10	18	36	37	14	33	41	11
		2	79	10	19	37	34	10	32	49	9
		X	12					25	33	25	17

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	40	45	15	21	38	27	14					59	6	9	31	10	23	18	4
	38	52	11	16	47	25	12	25	41	26	6	74	3	8	47	4	24	20	1
	82	18	0	24	24	35	18	6	59	35	0	53	18	18	59	6	41	6	0
	39	50	11	6	25	35	32					38	15	18	33	9	18	11	3
	39	57	4	4	27	37	31	40	41	7	10	53	14	20	51	2	16	10	3
	75	25	0	0	38	31	31	19	81	0	0	44	25	19	50	6	19	13	0
	26	46	24	18	38	31	11					61	11	2	68	6	3	12	2
	21	53	24	16	45	32	6	18	54	9	19	71	6	1	86	2	1	10	0
	53	42	5	21	42	26	11	26	68	0	0	68	16	0	84	5	0	16	0
	35	55	8	5	41	32	20					61	9	1	56	17	7	15	0
	30	60	8	5	47	31	16	56	30	2	9	75	7	1	71	10	3	12	0
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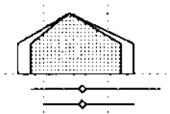	30	43	24	18	27	25	27					17	45	5	14	32	18	26	6
	19	56	25	19	31	22	25	18	47	15	17	19	59	3	19	31	13	28	2
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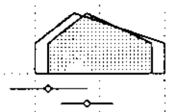	14	48	35	24	36	25	14					68	1	0	38	19	18	15	1
	6	59	34	25	49	18	9	34	40	6	19	85	1	0	60	9	16	10	0
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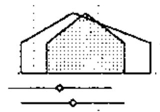	23	46	27	19	38	21	19					54	22	7	43	13	6	12	0
	14	56	28	21	46	22	11	18	42	18	22	70	24	5	57	11	1	7	0
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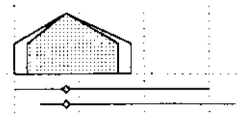	18	50	30	23	30	26	20					38	31	32	19	13	19	18	3
	12	59	28	21	39	21	18	23	36	20	17	47	37	35	18	7	16	20	1
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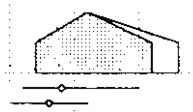	31	41	22	19	35	25	17					11	33	42	23	19	18	13	4
	30	46	23	20	44	25	11	6	26	55	8	10	51	60	27	10	15	9	0
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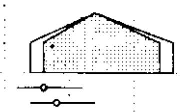
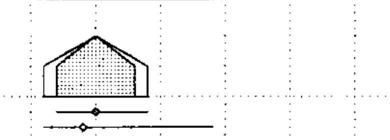
	13	41	34	6	21	29	32					31	6	9	62	24	1	8	4
	9	47	35	5	20	37	29	32	32	10	16	43	5	6	81	16	3	5	1
	33	42	8	0	25	25	33	42	25	8	0	25	8	0	67	0	0	8	8

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Pursuit of richer and more comfortable lifestyle	31. Possibility of acquirement of required maps of aerial photos immediately at offices or home through communication networks.	1	95	7	22	41	29	19	40	35	6
		2	86	4	24	43	29	19	45	30	6
		X	5					0	60	40	0
	32. Widespread use of living rooms or gardens whose sceneries can be set as desired by using virtual reality technology.	1	88	10	16	40	34	7	27	53	13
		2	80	7	16	45	33	1	33	56	10
		X	8					0	63	25	13
	33. Development of interior materials which possess sensing functions for temperature, humidity, etc. and adjust indoor environment.	1	94	10	19	42	30	16	52	29	3
		2	83	9	20	40	30	13	60	23	4
		X	11					45	27	18	9
	34. Construction of marine resort facilities in coastal areas.	1	114	18	22	46	15	11	39	42	8
		2	104	18	20	48	14	5	45	44	6
		X	22					14	59	23	5
Response to diversification and individualization	35. Widespread use of housing in which rooms and furnishing can be easily altered or converted in step with alternation of generations or shift in life stages.	1	107	16	25	39	21	31	48	21	1
		2	99	13	28	40	18	30	53	16	1
		X	16					50	31	13	6
	36. Widespread use of personalized indoor environments where airconditioning, light, sound and other environments are individually created in addition to private rooms.	1	99	18	16	40	27	15	45	37	2
		2	92	16	15	45	24	12	54	34	0
		X	19					37	53	11	0
Promotion of welfare and preparedness for aged society	37. Equipping of public-use facilities in cities with technological systems enabling them to be used by senior citizens and disabled as easily as by other citizens, due to sophisticated man-machine interface.	1	97	10	20	42	28	54	42	4	0
		2	86	9	19	43	29	56	41	3	0
		X	11					82	18	0	0
	38. Widespread use of comprehensive home security systems that check for overheating, short circuits, gas leakages, etc. and, if necessary, automatically activate safety devices to enable inhabitants including the elderly to feel secure, even during their absence.	1	106	6	27	46	21	45	47	8	0
		2	99	7	26	50	18	47	48	4	0
		X	8					88	13	0	0
	39. Widespread use of houses equipped with robots or apparatuses which enable the aged or handicapped to eat, have a bath, excrete, play and do other activities without help.	1	95	6	19	46	29	52	40	6	1
		2	86	3	20	48	28	62	33	5	1
		X	4					75	25	0	0
Coexistence with nature and environmental preservation	40. Monitoring of various types of urban environmental information (level of pollution, ratio of green coverage, etc.) gathered through the use of remote sensing and other technology, for urban environmental control.	1	102	12	24	40	24	52	42	6	0
		2	94	12	26	40	22	59	35	6	0
		X	14					79	14	7	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	35	40	20	19	26	20	29					24	20	5	49	24	3	17	3
	29	50	17	21	28	21	27	10	45	27	13	33	26	5	66	19	1	10	2
	80	20	0	20	40	20	20	0	80	20	0	0	0	0	80	40	20	0	20
	24	38	31	8	23	32	30					32	3	26	50	10	8	10	5
	14	50	33	8	21	35	33	18	29	25	23	46	0	33	66	6	3	9	3
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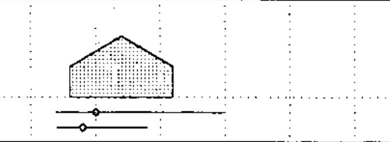	23	51	22	12	24	36	26					52	5	4	70	12	1	13	2
	22	53	22	10	20	45	23	29	39	5	24	67	4	2	83	7	1	8	2
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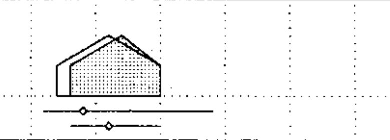	25	46	22	10	27	30	27					22	36	18	39	31	2	3	4
	18	59	17	6	32	37	21	10	38	32	14	29	46	12	48	27	2	2	4
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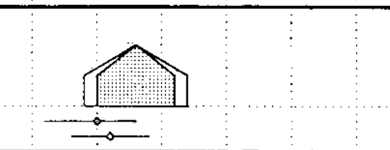	21	58	20	7	12	36	44					29	20	21	67	7	4	7	1
	23	57	18	3	11	44	40	25	35	12	25	39	20	24	77	4	3	7	1
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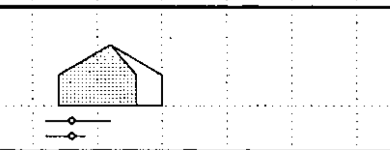	24	49	23	5	16	38	37					23	1	20	81	13	1	2	3
	23	58	18	3	13	48	36	23	50	12	13	32	1	22	88	13	2	2	3
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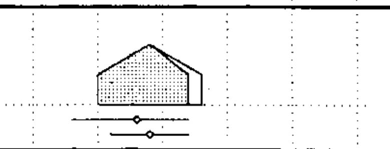
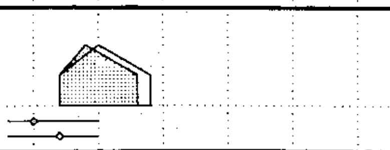
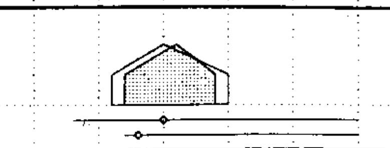
	15	57	27	27	39	22	12					35	15	15	47	25	11	13	3
	12	63	26	20	49	21	9	2	30	57	9	49	15	10	67	20	6	12	0
	27	55	18	9	45	27	18	0	27	73	0	36	27	18	64	27	0	9	0
	37	53	8	8	17	35	39					25	11	11	70	13	4	8	1
	30	60	8	6	21	37	35	26	40	14	16	38	14	7	90	9	2	5	0
	88	13	0	13	0	38	50	13	50	25	0	13	25	0	100	25	0	0	0
	17	45	33	18	23	35	20					42	5	15	62	21	4	8	2
	15	48	35	13	35	29	20	23	28	30	15	59	5	16	81	14	3	6	1
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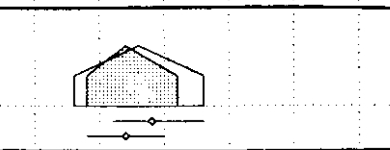
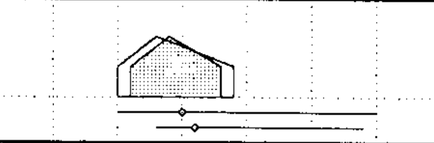
	23	53	24	39	42	10	6					43	23	2	30	40	9	17	4
	22	59	19	45	41	10	3	11	46	35	6	53	23	3	43	43	4	12	2
	50	50	0	50	43	7	0	7	43	43	0	43	21	0	57	43	7	14	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Coexistence with nature and environmental preservation	41. Better understanding of environmental preservation function of trees, grass, and shrubs (in preventing urban "heat stress" and noise), resulting in the practical use of "urban tree and shrubs" which are highly durable and can be easily maintained.	1	81	4	20	37	40	32	52	14	1
		2	73	4	18	38	39	36	56	7	1
		X	5					100	0	0	0
	42. Widespread use of techniques of urban planning, silviculture, and landscaping through scientific elucidation of the relationship between contact with forests and other plant life in natural settings and physiology and psychology.	1	86	4	17	43	36	36	44	19	0
		2	76	4	15	44	37	38	49	13	0
		X	5					80	20	0	0
	43. Development of planning and construction technology enabling new urban development or urban redevelopment in harmony with the natural environment.	1	108	16	24	40	20	60	34	6	0
		2	100	14	20	48	18	71	25	4	0
		X	17					88	12	0	0
	44. Development of compact waste water treatment systems applying biotechnology, enabling highly efficient processing of substances not readily decomposed and harmful substances.	1	89	7	15	44	34	63	36	1	0
		2	82	5	18	46	32	72	27	1	0
		X	6					67	33	0	0
	45. Improvement of water quality by building various water treatment facilities, seawater exchanging facilities, etc. in estuaries and bays near metropolitan areas suffering severe pollution and contamination.	1	92	9	19	40	31	73	25	1	1
		2	82	8	16	43	33	79	20	0	1
		X	10					90	10	0	0
	46. Widespread use of levees at rivers, which have easy access to shore as well as excellent disaster preventing features, at general rivers.	1	108	15	24	41	20	36	52	12	0
		2	97	15	20	44	21	34	58	8	0
		X	18					61	39	0	0
Resource saving, energy saving, and recycling	47. Widespread use of self-supporting systems for recycling energy, waste, and other resources on the neighborhood level enabled by advances in technology for harmonization with natural ecosystem (e.g., improved energy/resource accumulation, circulation, recycling, and durability).	1	107	8	25	46	20	63	28	8	0
		2	96	7	29	43	21	73	21	6	0
		X	8					100	0	0	0
	48. Widespread use of community-level systems of non-pottable water supply for miscellaneous use (e.g., flush toilets) based on sophisticated processing of waste water in big cities.	1	112	10	24	49	16	54	40	5	1
		2	99	11	22	48	19	62	34	4	0
		X	14					79	21	0	0
	49. Practical use of recycling technologies (a cycle consisting of natural cultivation, pumping, reprocessing, and artificial cultivation) for enabling effective use of ground water.	1	93	5	23	42	30	44	49	5	0
		2	87	5	20	46	29	49	46	3	1
		X	6					83	0	0	17
	50. Widespread use of technological systems for automatic separation of combustible materials, metal, glass, and other substances in city garbage and other general waste by hardness, specific gravity, moisture, and color, etc.	1	92	4	21	43	31	63	34	2	1
		2	83	2	19	47	31	72	24	2	1
		X	3					100	0	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	10	57	27	20	31	37	6					64	0	6	25	31	10	21	1
	5	59	33	21	34	38	5	8	52	12	22	73	3	3	29	36	7	25	1
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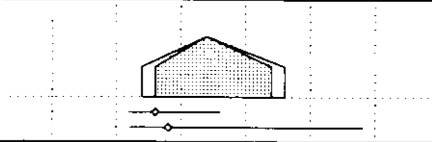	8	51	34	27	41	26	3					51	6	16	19	26	22	23	0
	4	55	38	21	49	28	3	7	42	29	18	70	4	4	18	38	18	24	1
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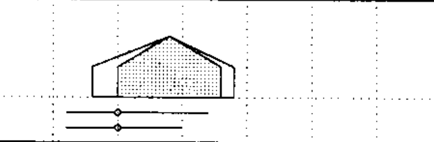
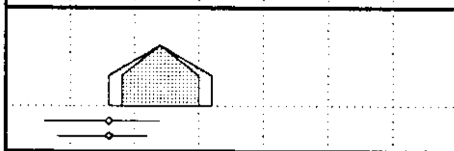
	23	47	26	21	42	24	11					31	31	23	24	23	18	14	0
	21	53	25	21	51	17	11	7	32	46	11	38	36	33	25	22	14	8	0
	65	29	6	35	41	12	12	6	59	29	0	29	35	35	29	18	18	6	0
	25	48	25	27	34	27	11					69	6	2	42	27	8	21	2
	17	55	27	24	41	26	9	16	50	15	17	83	4	0	62	20	4	15	1
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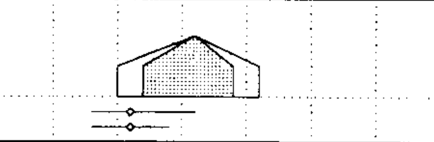	20	46	29	37	40	12	9					51	13	3	39	50	5	13	0
	16	57	23	38	45	10	6	15	44	20	18	66	6	4	35	62	6	7	0
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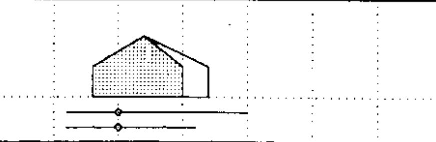
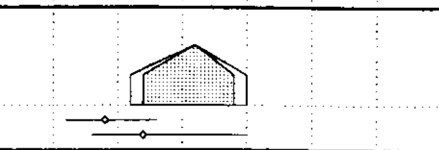
	27	48	19	5	20	43	31					18	48	9	32	42	6	9	2
	21	58	20	5	22	46	27	21	31	28	18	12	64	7	29	49	3	9	2
	56	28	17	17	28	44	11	28	33	33	0	11	61	17	33	56	0	11	0
	21	40	38	18	34	25	21					44	42	11	43	25	3	10	0
	15	50	34	21	33	31	14	10	41	28	18	49	50	10	51	20	1	5	0
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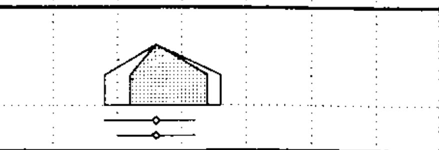
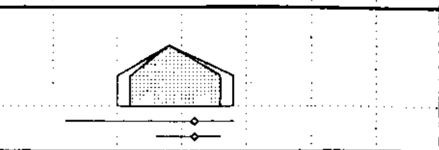
	22	46	29	12	20	38	29					30	36	10	54	37	3	5	0
	15	58	27	8	20	47	24	21	49	12	15	29	42	3	64	36	2	4	0
	36	64	0	14	29	21	36	50	43	0	0	21	64	7	79	21	0	0	0
	13	51	33	14	30	26	27					51	16	8	48	31	4	14	2
	9	52	37	13	32	31	22	17	43	11	22	60	14	2	59	28	0	14	1
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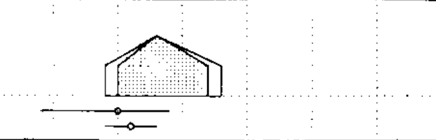
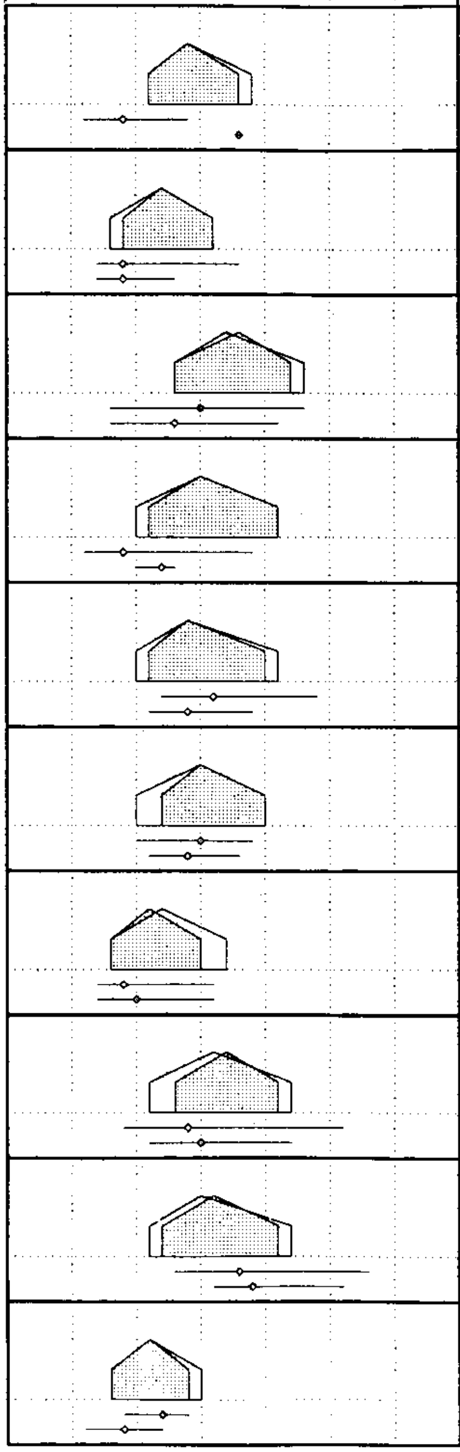
	21	55	21	15	34	29	20					54	15	8	50	32	4	10	0
	8	66	24	18	37	33	11	16	49	13	17	71	10	2	63	30	2	6	0
	33	33	33	0	33	33	33	0	67	0	0	67	0	0	33	33	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Resource saving, energy saving, and recycling	51. Development of waste recycling technology, enabling the amount of city waste (i.e., that must be disposed of) to be reduced to half its current level.	1	107	4	21	54	21	82	18	0	0
		2	94	1	23	54	22	83	17	0	0
		X	1					100	0	0	0
	52. Practical use of a heating and cooling system through a combination of solar heat and super heat pumps.	1	94	7	19	45	30	43	51	5	0
		2	91	6	19	50	25	38	55	5	0
		X	7					86	14	0	0
	53. Advancement in technologies for effectively using energies such as extended heat storage of natural energies, leading to dissemination of energy-independent buildings and houses.	1	107	7	21	51	21	44	48	7	1
		2	99	6	21	55	18	40	52	6	1
		X	7					57	43	0	0
	54. Practical use of distributed type house cogeneration, utilizing fuel cells.	1	91	5	23	41	31	27	55	13	3
		2	82	3	24	40	32	26	61	10	2
		X	4					50	50	0	0
Security safety	55. Substantial reduction of damage on river banks and roads (casualties or loss accompanying concentrated rain or floods) due to the establishment of warning systems forecasting, evacuation, and restrictions for disasters based on general use of localized meteorological forecasting through improvement of meteorological satellites and ground observation networks.	1	93	10	20	40	31	58	35	6	0
		2	80	8	16	41	34	71	23	6	0
		X	10					100	0	0	0
	56. Development of disaster forecasting and information transmission systems incorporating studies in social and behavioral psychology, in order to prevent panic in big cities in event of major earthquakes or fires.	1	94	13	22	36	30	60	33	7	0
		2	83	9	22	37	32	65	30	5	0
		X	11					100	0	0	0
	57. Practical use of a disaster prevention system based on the development of sensors to detect signs of impending outbreak of a landslide.	1	91	13	21	34	32	51	45	4	0
		2	76	11	18	34	37	54	43	3	0
		X	13					85	15	0	0
	58. Establishment of nationwide networks for detecting earthquakes, enabling dissemination of disaster preventing systems which transmit information on earthquakes at distances of about 50 km or more in advance.	1	94	22	18	31	30	63	32	4	1
		2	82	20	18	30	32	76	21	2	1
		X	24					96	4	0	0
	59. Practical use of online data base on natural disasters all over Japan necessary for risk management.	1	84	11	20	32	37	46	48	6	0
		2	75	9	20	32	39	52	45	3	0
		X	11					82	18	0	0
	60. Development of fire fighting and rescuing technologies for high-rise building fires.	1	103	9	20	49	23	50	46	4	0
		2	92	9	20	46	25	59	39	2	0
		X	11					82	0	18	0

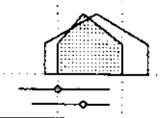
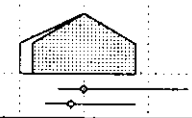
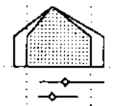
Forecasted realization time (Year)

1995 2000 2005 2010 2015 2020



Degree of certainty (%): High	Medium	Low	Necessity of international joint development (%): High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%): Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%): Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
13	49	35	22	31	28	16					53	19	6	58	26	4	12	2
11	53	35	18	46	23	12	17	49	14	19	63	13	5	70	20	1	10	1
0	0	100	0	0	0	100	0	0	100	0	100	100	0	0	0	0	0	0
17	50	28	28	27	29	13					71	2	0	69	17	3	11	0
12	55	31	30	27	27	13	16	49	15	16	79	3	0	78	12	1	11	0
43	43	14	14	29	29	29	57	29	14	0	86	0	0	86	29	0	0	0
18	37	37	26	28	30	11					57	5	4	69	19	4	8	2
12	39	42	25	32	33	8	9	58	16	15	73	3	4	80	11	2	9	2
57	29	14	14	57	14	14	14	71	14	0	43	0	14	86	29	0	0	14
18	46	29	19	31	29	15					46	18	5	70	15	1	10	2
13	50	33	21	37	27	13	17	49	13	18	61	18	1	82	9	0	10	1
50	25	25	0	50	0	50	50	50	0	0	75	0	0	75	50	0	0	0
22	48	25	39	28	18	11					59	22	3	18	32	6	25	2
15	55	28	43	33	16	6	19	46	20	13	68	20	1	19	43	1	23	1
50	40	10	30	20	40	10	30	50	10	0	70	10	0	30	60	0	10	10
17	51	29	23	35	26	13					50	24	17	5	27	15	26	1
11	54	35	24	47	22	7	19	45	19	14	67	29	14	8	20	10	25	1
27	55	18	9	55	36	0	45	36	9	0	36	27	18	9	36	18	27	0
26	42	31	19	32	29	20					66	11	1	34	31	5	19	1
25	47	28	14	41	28	17	36	42	5	16	83	5	1	39	36	0	12	1
62	23	15	8	46	38	8	31	54	8	0	85	8	0	23	46	0	8	0
20	41	35	30	22	28	18					64	16	3	17	45	4	23	1
17	43	39	38	21	24	16	54	34	4	5	78	9	0	16	59	2	21	1
38	42	21	33	29	13	25	63	29	0	4	71	21	0	21	63	4	21	0
19	43	33	13	31	30	25					36	24	2	18	54	13	25	1
12	51	37	20	31	28	19	29	37	16	16	51	23	3	12	61	11	23	1
45	27	27	27	55	9	9	27	45	9	9	45	36	9	27	45	0	27	0
23	48	25	19	39	24	15					54	20	0	38	25	13	16	2
18	61	20	22	49	17	12	10	45	37	7	71	15	0	48	22	9	18	0
45	55	0	9	73	0	18	9	73	18	0	82	18	0	73	9	0	9	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Security safety	61. Widespread use of snow removal systems to eliminate damage to roads and buildings in areas with heavy snowfall (e.g., continuous removal systems applying drift channels and special conveyors).	1	93	7	21	41	31	20	60	19	0
		2	82	7	18	42	33	22	65	13	0
		X	9					56	44	0	0
	62. Practical use of technology for thaw control and long-term flood forecasting, resulting in widespread use of total water management system (i.e., integrating water use and flood control).	1	73	4	16	34	46	29	59	12	0
		2	63	4	13	35	48	30	60	10	0
		X	5					60	40	0	0
	63. Widespread use of remote monitoring and controlling systems for enhancing safety of "life-line" infrastructural elements (e.g., water, electricity, gas) in event of disasters.	1	96	7	30	34	28	59	35	5	0
		2	85	6	30	35	29	67	29	4	0
		X	7					86	14	0	0
	64. Widespread use of technology enabling localized absorption and control of seismic energy in structures.	1	117	33	29	25	13	49	44	7	0
		2	107	31	30	26	12	50	47	4	0
		X	38					79	18	3	0
	65. Establishment of safe and efficient demolition technologies for decommissioned commercial nuclear power plants.	1	85	14	20	31	36	75	24	1	0
		2	77	12	19	33	36	83	16	1	0
		X	14					93	7	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	17	52	29	3	25	31	39					30	10	3	65	42	6	9	1
	15	59	27	1	21	38	40	35	32	5	26	34	7	4	73	46	2	11	0
	56	44	0	0	22	33	44	56	33	0	11	11	11	0	67	78	11	0	0
	8	55	33	8	26	36	26					52	14	3	33	34	12	16	4
	3	65	32	5	29	43	24	27	46	5	21	63	11	2	38	41	3	16	2
	20	60	20	0	60	40	0	20	80	0	0	100	40	0	20	0	0	40	0
	22	54	19	5	25	41	25					41	16	0	49	36	7	10	2
	18	62	19	9	28	44	18	26	49	11	13	55	9	0	62	41	4	9	1
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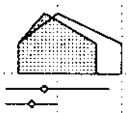
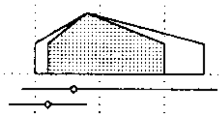
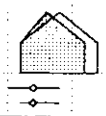
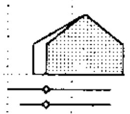
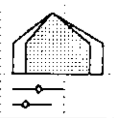
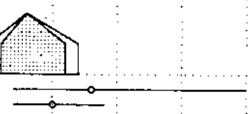
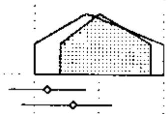
	50	40	9	23	29	23	24					55	16	1	69	12	3	6	1
	51	42	7	23	29	22	25	64	26	5	3	66	14	1	84	7	1	7	1
	79	21	0	37	18	24	21	58	32	8	0	61	18	0	92	3	0	5	0
	31	45	20	51	29	13	6					72	15	14	33	26	5	13	4
	22	52	23	68	21	6	5	21	34	39	5	77	13	8	53	18	4	8	1
	50	50	0	71	0	14	14	29	50	14	7	64	14	0	64	29	0	0	7

4.13 Communications

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Transmission technology	1. Practical use of spread spectrum methods for consumer communication networks (private communication networks), personal communication networks and other similar networks.	1	107	14	33	35	19	28	53	16	3
		2	94	11	34	37	18	22	63	15	0
		X	13					54	38	8	0
	2. Widespread use of optical radio communication utilizing indoor indirect light and scattered light.	1	99	11	25	40	24	12	39	43	5
		2	89	10	27	41	22	6	44	47	3
		X	11					27	36	27	9
	3. Practical use of large-capacity optical fiber communications based on optical heterodyne modes and other types of coherent optical transmission technology.	1	121	19	37	36	8	79	20	1	0
		2	106	21	36	38	5	79	19	2	0
		X	23					87	13	0	0
	4. Practical use of modes of transmission ever extremely long distance without repeaters based on realization of optical fiber with low rate of transmission loss (less than 0.01 dB/km), enabling installation of Japan-Hawaii repeater optical circuit.	1	114	19	27	41	13	65	30	5	0
		2	98	21	24	43	13	70	27	3	0
		X	23					78	22	0	0
	5. Development of non-linear optical fiber transmission methods applying solitons, induced Raman effect, and other non-linear effects.	1	75	8	16	34	41	24	45	29	0
		2	63	9	15	32	43	13	54	32	0
		X	10					30	70	0	0
	6. Development of optical fiber communications modes applying the photon quantum state.	1	60	6	14	26	53	27	38	33	0
		2	53	6	14	27	52	15	43	40	0
		X	7					43	14	43	0
	7. Practical use of radio relay systems which use flying objects that fly in the stratosphere, powered by electricity supplied through radio waves.	1	100	11	15	49	25	15	45	35	5
		2	88	10	16	52	23	9	51	38	2
		X	11					27	45	27	0
	8. Development of ultra-fine, multi-functional optical and millimeter-wave IC devices, leading to practical use of extra-broadband space transmission of three-dimensional images, etc.	1	86	8	16	43	33	33	48	19	0
		2	74	8	14	44	34	24	59	16	0
		X	9					56	44	0	0
	9. Practical use of undersea image communications systems enabling motion picture communications with undersea facilities.	1	85	2	21	43	35	6	42	51	0
		2	74	4	18	45	34	1	49	50	0
		X	4					25	75	0	0
	10. Development of underground communication technologies through electromagnetic waves, etc.	1	64	2	15	32	51	9	23	58	8
		2	57	2	14	35	50	9	19	65	7
		X	2					50	0	50	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	20	50	25	9	27	34	25					42	42	4	57	6	2	6	7
	18	54	26	7	29	40	21	2	48	40	9	55	43	0	67	3	1	3	2
	54	46	0	8	0	54	38	0	31	69	0	54	54	0	69	0	0	8	0
	11	43	39	0	12	36	46					61	9	4	57	2	0	2	10
	10	48	38	1	7	36	53	16	42	8	29	73	8	1	63	2	1	2	7
	18	45	27	0	9	45	36	9	64	0	18	82	0	0	73	0	0	0	0
	36	48	16	8	33	35	23					77	2	0	46	7	6	4	3
	29	58	12	4	38	43	15	47	42	4	8	83	1	3	54	6	3	4	1
	70	26	4	4	35	35	26	65	35	0	0	83	0	0	65	9	0	0	4
	21	39	38	19	36	27	17					81	2	2	32	17	8	4	1
	13	49	37	13	39	37	11	40	43	4	13	88	0	0	40	14	8	1	1
	26	35	39	30	35	26	9	30	61	9	0	91	0	0	30	22	9	0	0
	5	39	55	19	32	36	13					93	0	0	24	12	9	11	1
	2	32	65	11	33	46	10	10	46	13	32	97	0	0	30	10	6	8	0
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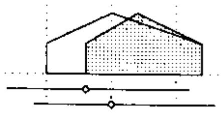
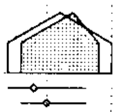
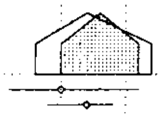
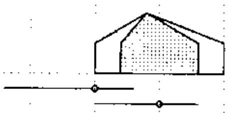
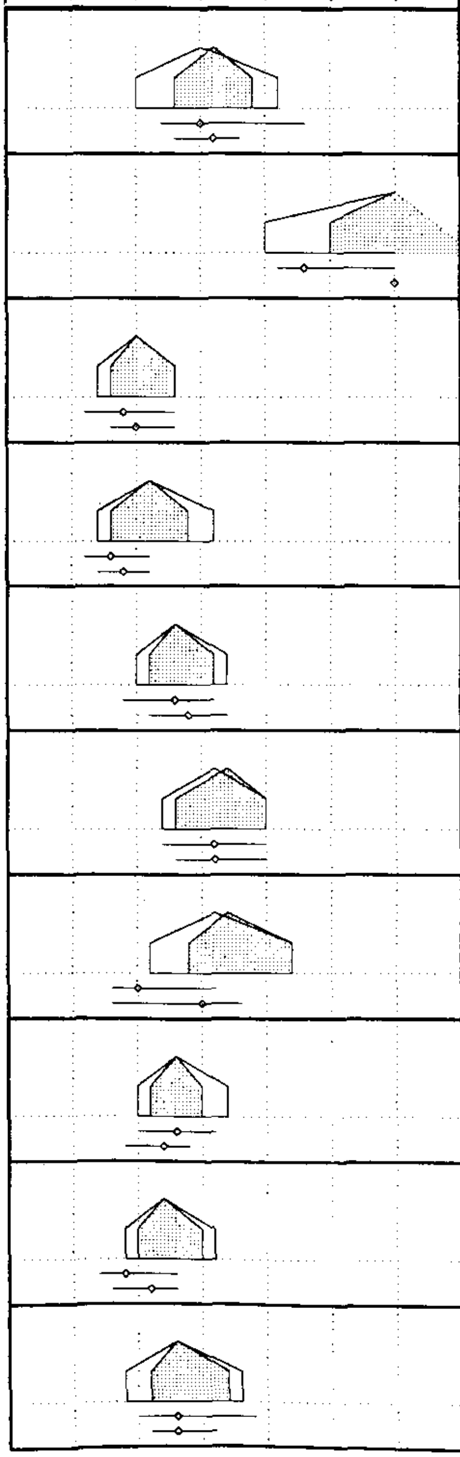
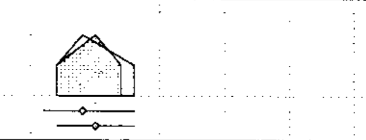
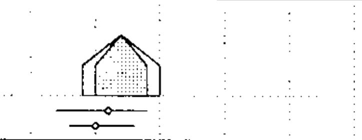
	2	22	75	27	35	30	8					95	0	0	18	10	15	7	2
	2	19	77	17	45	28	9	8	47	13	28	94	0	0	17	6	15	4	0
	14	57	29	29	43	14	14	0	71	29	0	100	0	0	0	14	14	0	0
	3	39	51	20	41	20	14					71	15	7	39	21	4	9	2
	2	32	66	20	47	24	9	6	28	34	30	80	13	1	50	22	2	2	6
	18	55	27	9	73	0	18	9	27	45	9	73	0	0	55	45	9	0	0
	6	38	50	14	31	37	14					74	7	7	41	17	6	3	2
	7	27	65	5	39	42	12	30	45	5	19	82	3	7	50	14	4	1	4
	33	44	22	11	56	22	11	56	22	11	11	78	0	0	67	33	0	0	0
	2	47	45	5	29	39	21					60	4	5	38	16	1	4	8
	3	46	47	0	31	45	23	4	34	20	38	78	1	4	49	9	5	1	7
	0	100	0	0	25	75	0	0	75	25	0	75	0	0	75	0	0	0	0
	2	22	64	14	23	36	16					81	3	2	14	20	6	2	3
	0	18	74	9	26	42	16	2	26	12	49	91	4	0	16	26	7	4	2
	0	50	50	50	0	50	0	0	0	50	50	100	0	0	0	0	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Transmission technology	11. Development of communications systems based on electromagnetic waves outside the visible to infrared light spectrum and radio wave (e.g., applying far infrared light or ultraviolet light).	1	85	7	16	42	35	15	46	31	8
		2	75	6	19	42	34	9	57	28	5
		X	7					29	43	29	0
	12. Development of communications systems applying media other than electromagnetic waves (e.g., neutrinos).	1	40	2	4	26	69	13	33	45	10
		2	34	1	5	24	70	9	29	50	12
		X	1					0	0	100	0
	13. Practical use of coding methods (e.g., PARCOR-partial auto correlation system) enabling audio transmission at a speed of 2.4 Kbps and at a quality on a par with or better than analog telephony.	1	115	15	40	33	12	42	38	18	2
		2	103	12	44	34	10	46	39	14	2
		X	14					64	29	7	0
Exchange technology	14. Practical use of tracking connection exchange by which one can perform communication freely anywhere and at any time using a personal ID code.	1	125	27	35	32	6	66	30	5	0
		2	110	27	36	33	4	70	25	5	0
		X	31					74	26	0	0
	15. Formation of B-ISDN and widespread use of ATM-base switches.	1	115	34	32	21	12	73	25	2	0
		2	101	33	35	21	11	71	26	2	0
		X	37					81	19	0	0
	16. Practical use of optical switching equipment that switches light signals without converting into electrical signals.	1	113	23	30	34	14	58	35	8	0
		2	98	22	34	31	13	63	33	4	0
		X	25					56	40	4	0
	17. Development of A/D converters and high-speed switching devices using high-temperature superconductors.	1	78	5	13	41	40	24	55	19	1
		2	70	4	13	46	38	17	64	17	1
		X	5					20	80	0	0
	18. Practical use of satellite systems capable of switching multiplexed signals transmitted from numerous ground stations.	1	114	14	25	48	13	38	47	14	1
		2	100	12	27	50	12	33	53	13	0
		X	13					46	46	8	0
	19. Practical use of automatic protocol conversion technology, enabling easy interconnection of various communications networks.	1	105	19	24	37	20	55	36	9	0
		2	95	18	25	42	16	59	38	3	0
		X	20					80	20	0	0
	20. Practical use of speech dialing methods based on incorporation of speech recognition technology in switching equipment.	1	117	21	28	40	11	17	56	26	1
		2	104	18	32	40	9	13	59	28	0
		X	21					19	52	29	0



Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	5	28	56	14	29	32	16					78	4	1	19	13	5	9	4
	1	29	65	7	36	37	16	3	33	21	40	92	3	1	17	19	3	11	8
	0	43	57	29	57	14	0	0	57	43	0	100	0	0	14	29	14	0	0
	3	13	70	40	18	23	5					83	3	0	10	23	3	8	0
	0	15	76	44	21	18	9	0	18	29	44	88	3	0	9	26	9	6	3
	0	0	100	100	0	0	0	0	0	100	0	100	0	0	0	0	0	0	0
	18	59	20	10	35	30	21					72	9	2	49	4	3	4	3
	13	66	19	6	43	35	15	18	53	12	11	82	4	1	61	5	1	2	3
	36	64	0	7	64	14	14	21	71	7	0	86	0	0	64	7	7	0	7
	26	57	17	22	38	26	14					43	47	20	44	10	1	5	3
	23	65	12	22	45	24	9	9	71	10	6	45	56	15	50	4	1	1	1
	52	48	0	23	35	26	16	13	81	6	0	23	81	16	48	0	0	3	0
	38	52	10	28	46	18	8					43	17	9	71	23	2	2	3
	34	55	10	23	53	16	7	38	54	2	1	50	12	6	80	18	1	1	2
	54	41	5	30	43	16	11	46	54	0	0	46	8	11	84	22	0	3	0
	17	48	32	23	35	30	7					86	2	1	51	9	4	5	2
	13	55	32	12	42	37	8	12	61	14	9	95	1	0	65	5	1	2	1
	28	56	16	8	32	44	16	12	64	24	0	88	0	0	84	4	0	0	0
	5	22	67	23	22	36	14					82	0	0	23	13	8	14	1
	1	29	70	14	27	49	10	9	47	11	30	96	0	0	40	4	4	7	3
	20	60	20	20	40	40	0	0	80	0	0	80	0	0	60	0	0	0	0
	11	47	39	34	41	12	9					61	12	1	51	20	1	10	3
	12	50	38	27	57	10	6	6	50	28	12	73	7	1	63	20	0	5	1
	31	69	0	15	69	15	0	15	62	8	8	77	0	0	77	15	0	0	0
	19	57	23	47	34	14	4					62	30	9	36	7	7	8	8
	14	62	22	58	34	7	1	1	54	29	12	80	29	5	47	6	3	1	4
	30	55	15	65	20	10	5	0	75	15	5	70	35	10	60	0	0	0	0
	16	49	32	13	24	35	26					74	4	20	50	6	3	3	1
	11	57	32	8	29	40	23	19	53	8	16	86	5	19	58	4	1	1	1
	29	48	19	0	33	29	38	14	67	10	5	86	0	24	67	5	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Exchange technology	21. Practical use of large-scale adaptive digital filters, eliminating howling caused by interference between microphones and speakers and deterioration in sound quality.	1	90	14	20	34	32	17	58	24	1
		2	84	15	19	39	27	13	62	25	0
		X	17					35	65	0	0
Satellite and mobile communications technologies	22. Practical use of ghost cancelers capable of quickly adapting themselves to characters that change quickly, making it possible to receive television images free from ghosts or flutter while riding in moving automobiles or trains.	1	99	11	23	42	24	29	56	13	2
		2	88	10	22	46	23	25	64	11	0
		X	11					55	45	0	0
	23. Practical use of small, long-lasting, and easy-to-charge portable telephones (capacity: 50cc; service hours: 3 hrs).	1	117	18	31	41	11	65	33	1	1
		2	101	15	32	42	11	68	32	0	0
		X	17					88	12	0	0
	24. Realization of personal telephone numbers, leading to practical use of personal mobile communication that enables communication with desired parties from anywhere in the world.	1	125	25	32	38	5	59	33	7	0
		2	112	21	35	42	3	70	28	3	0
		X	24					75	25	0	0
	25. Practical use of subminiature variable directional planar antennas for mobile objects.	1	95	12	22	39	27	38	51	11	1
		2	84	5	25	43	26	31	61	8	0
		X	6					67	17	17	0
	26. Practical use of videophone and other two-way video communications with access provided to parties in various types of mobile vehicles.	1	115	15	36	38	12	19	57	23	0
		2	103	13	39	38	10	11	67	22	0
		X	15					20	60	20	0
	27. Practical use of low-orbit satellite communications systems, with application in wireless, mobile communication systems for automobiles, shipping, and aircraft.	1	99	12	24	40	24	33	60	7	0
		2	88	11	25	41	23	30	66	5	0
		X	12					58	42	0	0
	28. Realization of high-temperature superconductive Josephson devices, leading to the development of ultra-high sensitivity receiving technologies of terahertz-band electromagnetic waves which use higher-harmonic mixing mechanisms.	1	53	5	7	30	59	23	55	21	2
		2	42	4	5	27	63	17	69	14	0
		X	5					60	40	0	0
	29. Widespread use of systems for gathering information of all kinds, (e.g., meteorological, environment monitoring, road traffic control) from a dense nationwide networks of telemeters by means of intersatellite communications integrating geomobile and geostationary satellite.	1	85	8	15	42	35	32	42	24	2
		2	77	4	17	46	32	22	56	21	1
		X	5					40	40	20	0
	30. Widespread use of two-way paging devices capable of calling for help in event of emergencies and of receiving replies to such calls and detecting their locations.	1	108	9	24	49	18	34	47	19	0
		2	97	6	30	48	16	32	54	14	0
		X	7					57	14	29	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	19	52	24	0	20	44	32					66	0	2	69	2	1	3	0
	15	61	24	0	11	56	33	13	61	10	17	75	1	1	82	1	0	1	0
	47	53	0	0	18	47	35	18	65	12	6	88	0	0	88	0	0	0	0
	9	48	37	2	24	39	29					77	3	0	59	7	2	3	1
	9	51	39	2	20	44	33	23	56	6	15	88	1	0	70	1	2	1	1
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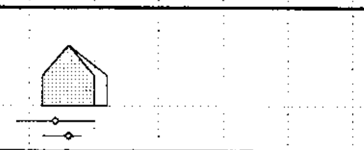
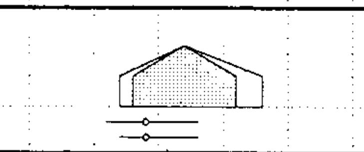
	30	53	17	2	29	36	32					76	6	2	59	8	2	4	1
	32	53	15	0	24	44	33	38	52	5	3	82	1	0	72	3	1	1	0
	59	29	12	0	29	41	29	47	35	18	0	76	0	0	76	0	0	0	0
	14	49	37	68	27	2	2					46	53	18	38	14	1	5	2
	12	55	33	78	16	4	1	10	63	19	6	51	66	10	44	2	0	4	3
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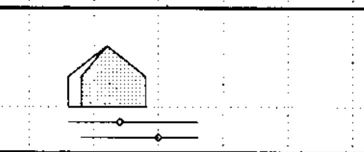	14	53	33	2	26	37	34					85	2	0	49	7	1	3	1
	7	65	27	4	19	43	35	30	51	6	12	92	0	0	63	4	0	0	1
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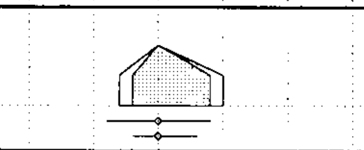
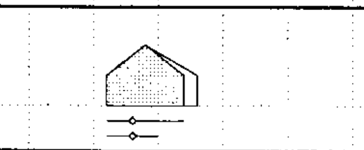
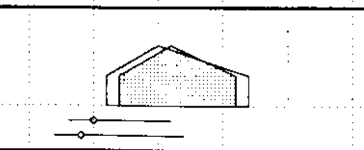
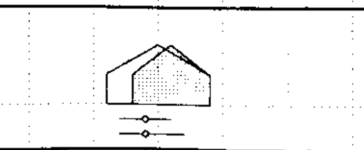
	9	50	40	13	36	34	16					71	21	8	57	15	0	1	3
	3	54	43	7	48	36	10	14	64	6	15	84	16	4	67	4	0	1	2
	13	73	13	7	67	20	7	20	73	0	7	87	20	7	73	7	0	0	0
	14	46	35	60	30	4	2					58	28	3	44	31	1	6	2
	7	59	34	70	28	0	1	5	17	70	6	72	28	1	52	27	0	1	0
	33	67	0	92	8	0	0	0	17	83	0	50	42	0	75	25	0	0	0
	6	32	55	21	32	30	11					83	0	0	19	15	4	13	0
	2	36	60	17	29	40	12	10	40	17	29	95	0	0	26	7	2	7	0
	20	60	20	40	20	40	0	20	40	0	20	80	0	0	20	0	20	0	0
	9	49	36	26	39	25	7					44	25	2	48	38	2	8	2
	1	52	44	23	42	27	5	1	36	40	19	55	23	0	60	43	0	1	1
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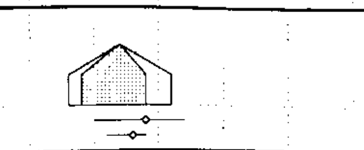
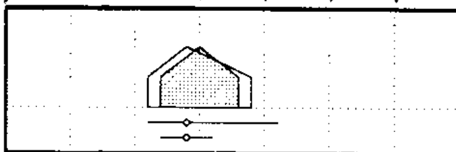
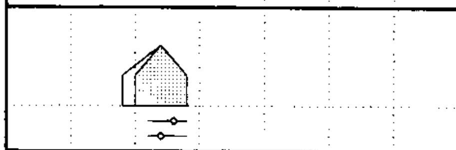
	13	56	29	10	31	33	24					46	33	6	56	18	0	5	0
	11	63	26	8	29	41	20	11	64	10	12	56	32	1	70	11	0	1	0
	43	57	0	57	43	0	0	14	71	14	0	43	43	0	29	57	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Video communications technology	31. Widespread use of communication systems for retrieval of still or motion video information from electronic libraries (containing character data, books, still videos, movies, TV, documentary films, etc.) through broad-band lines.	1	120	20	29	43	8	31	54	15	0
		2	105	19	29	44	8	27	60	13	0
		X	22					55	41	5	0
	32. Development of high-definition displays with a 10-fold definition (2,048 x 2,048 pixels) and 10-fold response ability (1/500 sec.).	1	77	8	16	35	41	43	48	6	3
		2	66	5	18	35	42	33	59	6	2
		X	7					57	29	0	14
	33. Widespread use of personal teleconference systems in offices through desk-top terminals (capable of providing audio, motion video, drawings, documents, graphics, and other data in integrated form or separately).	1	117	16	31	43	11	31	59	10	0
		2	102	15	30	45	11	25	67	9	0
		X	17					53	47	0	0
	34. Practical use of methods which make it possible to perform playback and transmission, and receiving and re-recording of videotaped animation signals at a 10-fold speed through optical-fiber, broadband ISDN communication.	1	110	17	32	35	15	20	51	26	3
		2	96	18	33	33	16	14	61	23	1
		X	20					30	45	20	5
	35. Practical use of flat displays capable of displaying A3-size information in near-actual size at high quality, leading to dramatically improved office automation working.	1	95	6	22	45	27	33	56	9	2
		2	83	4	21	48	27	31	63	5	0
		X	5					20	80	0	0
	36. Practical use of communications systems designed to enhance links between headquarters and satellite (branch) offices by using entire wall surface as display to afford an "on-the-spot" feeling.	1	103	11	21	47	21	19	40	38	3
		2	90	8	23	48	21	14	42	42	1
		X	9					33	67	0	0
	37. Development of three-dimensional video equipment providing a high level of realism, leading to dissemination of three-dimensional video conferences.	1	100	9	23	43	24	17	43	36	4
		2	87	8	21	47	24	8	51	38	3
		X	9					11	44	33	11
Networking technology	38. Completion of international integrated services digital networks (ISDN) covering virtually all countries, with automatic access from domestic ISDN.	1	122	32	32	30	6	69	28	3	0
		2	106	31	35	29	5	78	18	4	0
		X	35					86	11	3	0
	39. Practical use of large-scale traffic information communications systems, consisting of numerous transceivers on the ground to manage traffic on freeways and control traffic volume on city streets, as well as small transceivers or reflectors mounted on automobiles for identification of individual vehicles.	1	105	10	21	48	21	31	53	15	0
		2	91	7	21	51	21	30	58	12	0
		X	8					50	50	0	0
	40. Widespread use of transmission of images and knowledge bases for emergency medical treatment between ambulances and hospitals.	1	112	9	23	53	15	43	41	14	2
		2	96	6	25	53	16	42	45	13	1
		X	7					86	14	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	14	52	33	11	33	32	22					37	23	24	61	29	1	2	0
	11	57	31	8	35	41	16	9	62	16	11	37	20	25	75	24	0	0	0
	32	64	5	14	45	23	18	9	68	23	0	45	14	18	77	36	0	0	0
	12	43	40	4	26	36	30					82	0	1	57	13	0	4	0
	6	56	35	2	27	47	23	64	24	0	6	86	2	2	71	11	0	2	0
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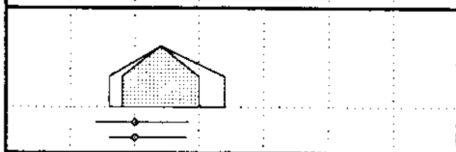	18	56	25	8	32	37	22					43	4	20	79	9	1	1	0
	16	59	25	4	38	39	19	22	48	15	13	51	5	19	91	5	0	0	1
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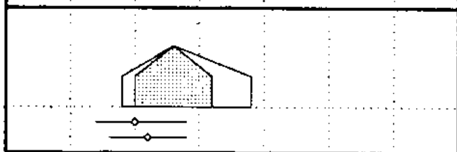	17	50	29	12	23	41	19					58	11	7	62	10	2	0	2
	14	58	26	5	30	49	14	26	47	7	15	69	7	3	79	8	1	0	0
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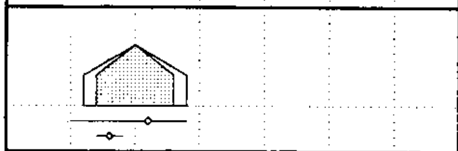	12	58	28	3	15	41	39					64	0	3	77	5	1	3	1
	6	66	25	1	16	47	35	66	23	0	5	82	1	1	84	4	0	0	1
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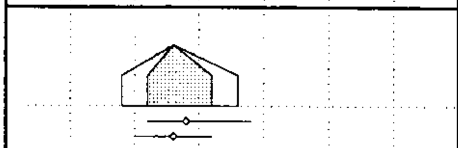	11	41	44	7	21	37	29					55	2	19	65	13	0	1	1
	7	43	48	2	24	46	26	31	42	4	17	63	4	14	82	9	1	1	1
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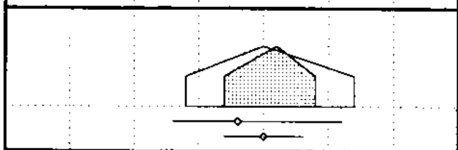	8	34	47	10	33	30	18					68	1	15	60	8	1	4	0
	5	38	54	6	41	33	17	21	44	9	23	80	1	15	78	5	1	1	1
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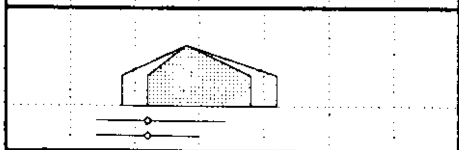	30	42	25	77	15	3	3					28	43	11	38	34	2	4	2
	30	50	20	82	15	3	0	17	71	7	3	22	54	6	55	39	1	0	2
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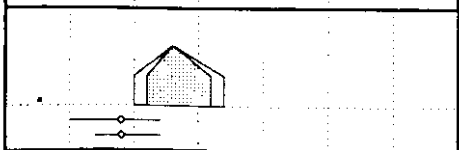	14	36	46	7	22	39	29					39	34	9	48	33	0	5	0
	7	42	52	4	24	47	24	18	46	15	19	38	35	7	65	31	0	1	0
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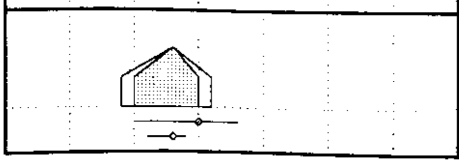
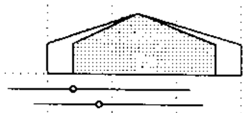
	13	46	36	5	21	42	28					44	35	8	39	27	4	4	2
	8	56	32	3	20	50	25	10	44	23	19	49	35	4	54	25	3	1	0
	43	57	0	14	43	14	29	14	71	14	0	43	43	0	71	14	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Networking technology	41. Practical use of telecommunications network with variable algorithms, enabling improvement in the efficiency of network equipment use, durability to communications traffic variation, and service reliability.	1	91	22	24	24	30	41	51	7	1
		2	81	22	25	25	28	35	62	4	0
		X	25					40	56	4	0
	42. *Advancement in the autonomous decentralized control in* wide-area communication network management, leading to the development of technologies for achieving no breakdown of communication networks.	1	92	21	28	22	29	54	40	4	0
		2	80	21	26	24	29	55	44	1	0
		X	24					67	33	0	0
	43. Practical use of integrated building monitoring systems and home automation systems which are interlocked with earthquake detecting systems and which take advantage of the delay of earthquake waves of nondirect-hit earthquakes, leading to significantly reduced loss of life caused by disasters.	1	68	4	11	38	47	40	46	12	1
		2	59	4	9	40	48	39	54	7	0
		X	4					75	25	0	0
	44. Widespread use of a community-level system, the combination of a number of home security subsystems, each with high-functional sensors for prevention of crime or disasters (automatic fire extinguishers, etc.) based on interconnection of home security systems.	1	96	5	18	50	26	21	53	24	1
		2	88	5	18	54	23	16	68	15	1
		X	6					67	33	0	0
Security technology	45. Widespread use of security communications systems offering reinforced confidentiality through use of identity verification technology based on fingerprints, penmanship, voice, facial expression and others.	1	92	8	20	42	29	28	59	11	0
		2	82	5	18	48	28	18	73	9	0
		X	6					33	67	0	0
	46. Development of a quantitative evaluation method for system security with evaluation criteria that are used as a basis for confidential communication and certification systems to reject unauthorized accesses.	1	73	5	17	35	44	36	48	14	0
		2	63	4	14	38	45	29	63	8	0
		X	4					75	25	0	0
	47. Development of new coded communication means using photons.	1	31	4	5	15	76	3	26	61	6
		2	24	1	6	14	79	0	33	63	4
		X	1					0	0	100	0
	48. Development of anti-hacker devices capable of detecting abnormal access or signaling/receiving based on knowledge acquired(i.e., learning)about past unauthorized access.	1	77	3	8	48	41	29	57	12	1
		2	66	2	8	48	42	23	64	14	0
		X	2					0	100	0	0
	49. Realization of high-security communication and practical use of electronic voting by individual identification numbers.	1	84	5	15	45	35	13	39	40	6
		2	76	4	17	46	33	9	42	43	5
		X	4					25	50	25	0
Intelligent communications technology	50. Development of switching technologies for translation telephones, characters and voice exchanges, etc. accompanied by human inflection.	1	96	13	21	40	27	21	43	31	4
		2	85	11	24	40	25	14	42	39	5
		X	12					25	50	25	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Degree of certainty (%) Medium	Degree of certainty (%) Low	Necessity of international joint development (%) High	Necessity of international joint development (%) Medium	Necessity of international joint development (%) Low	Necessity of international joint development (%) None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Comparison of current R&D level between Japan and other countries (%) Equivalent	Comparison of current R&D level between Japan and other countries (%) Other countries are more advanced	Comparison of current R&D level between Japan and other countries (%) Don't know	Constraints on realization (%) Technical	Constraints on realization (%) Institutional	Constraints on realization (%) Cultural	Constraints on realization (%) Cost	Constraints on realization (%) Funding	Constraints on realization (%) Fostering/securing human resources	Constraints on realization (%) R&D system	Constraints on realization (%) Others
	9	30	50	6	10	29	47					37	20	4	44	49	1	5	3
	6	30	57	5	10	28	52	28	38	1	28	44	15	3	62	57	1	3	0
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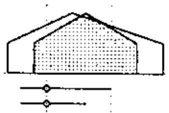
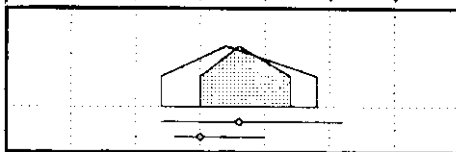
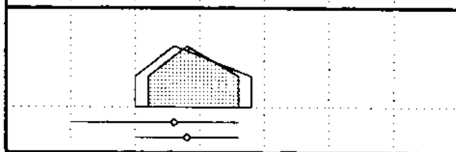
	9	32	53	13	8	28	46					57	14	6	51	20	3	8	3
	5	35	55	11	8	35	42	26	37	5	25	74	14	3	65	18	0	8	0
	25	75	0	25	0	50	25	100	0	0	0	75	25	0	25	25	0	25	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Intelligent communications technology	51. Development of automatic Japanese-English (and vice-versa) interpretation telephones operating in real time.	1	113	8	23	55	14	57	35	6	3
		2	102	7	25	57	11	61	30	7	2
		X	8					88	13	0	0
	52. Practical use of automatic directory assistance systems capable of providing needed telephone numbers even for vague enquiries.	1	102	12	23	43	22	19	55	25	1
		2	91	11	29	40	20	14	59	25	1
		X	12					25	67	8	0
	53. Practical use of automatic interpretation telephone services that could handle the work of international telephone operators.	1	107	8	20	53	18	28	50	18	3
		2	94	6	23	54	18	21	60	18	1
		X	7					71	29	0	0
	54. Practical use of network systems capable of freely defining the type of service, including secretarial functions, in response to individual requests of network users.	1	96	15	24	36	26	22	57	18	2
		2	80	13	27	31	29	16	66	15	3
		X	15					40	47	13	0
	55. Practical use of work stations to perform secretarial work, incorporating artificial intelligence and communications equipment, capable of handling enquiries and scheduling as well as accurately retrieving needed data in response to vague instructions through automatic data base access.	1	97	10	19	46	25	21	58	19	2
		2	84	8	21	45	26	17	64	17	2
		X	9					56	44	0	0
	56. Practical use of electronic mail communications and data base systems capable automatically converting between such multimedia as voice, text, still picture, motion picture, and others.	1	105	15	28	37	20	37	48	13	0
		2	92	15	26	39	19	32	61	8	0
		X	17					65	35	0	0
	57. Widespread use of character recognition technologies which enable a recognition rate with handwritten Chinese character of 99% or more.	1	96	8	19	47	27	35	58	5	0
		2	88	6	20	51	23	28	66	5	1
		X	7					86	14	0	0
Broadcasting technology	58. Widespread use of high-definition televisions (HDTVs) in the broadcasting, printing, communications and other fields.	1	123	15	31	48	5	54	43	2	0
		2	109	15	30	51	4	53	45	2	0
		X	17					82	18	0	0
	59. Practical use of high-definition large color flat displays that can be optionally wall-hung.	1	105	11	22	48	19	49	46	6	0
		2	91	9	23	49	19	46	48	5	0
		X	10					80	20	0	0
	60. Practical use of control techonologies for positioning sound images at any point in a space.	1	64	10	10	29	50	9	50	38	3
		2	55	9	12	27	51	7	55	36	2
		X	10					30	70	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	37	43	50	31	10	4					82	3	15	35	10	4	5	1
	10	44	44	56	26	13	2	52	29	5	10	94	1	14	49	7	3	3	0
	50	25	25	75	0	25	0	63	38	0	0	100	0	25	63	0	0	0	0
	14	43	37	3	21	33	38					77	6	12	38	8	4	5	1
	8	54	37	1	19	45	34	18	52	10	19	88	2	10	54	3	2	3	1
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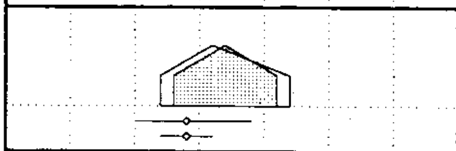	8	42	43	46	32	9	7					76	7	15	31	11	5	4	0
	5	44	49	50	33	11	4	22	47	6	21	91	4	16	48	6	1	0	0
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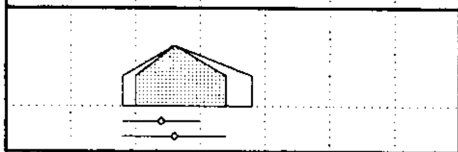	9	50	34	4	27	34	28					63	13	19	48	8	3	3	0
	9	58	30	1	28	46	23	6	59	20	10	79	8	19	55	4	0	1	0
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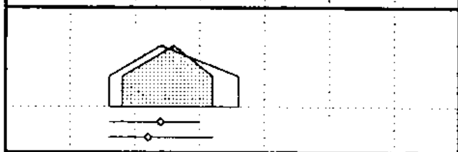	9	51	34	2	24	42	27					69	1	29	49	3	2	4	0
	6	57	33	1	20	55	21	7	48	27	12	80	0	25	57	1	0	0	0
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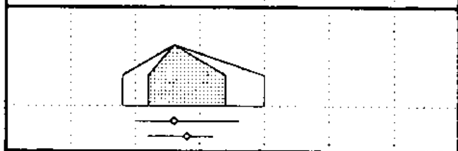	15	44	35	13	32	30	19					79	10	5	49	7	4	4	3
	11	55	33	10	43	35	11	4	48	32	11	88	8	4	62	4	1	1	1
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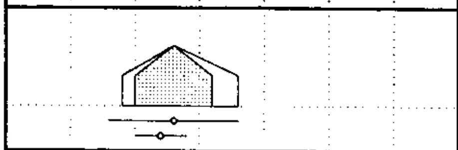
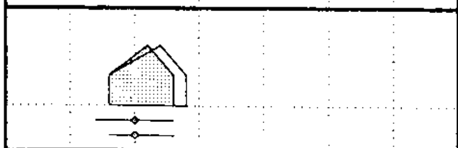
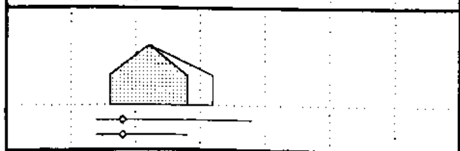
	11	51	30	2	9	41	45					76	1	5	58	4	4	2	2
	9	59	31	2	6	44	47	66	24	0	7	86	0	3	72	3	1	1	1
	29	57	14	0	14	57	29	71	29	0	0	100	0	0	71	0	0	0	0
	27	53	19	37	29	19	14					33	29	8	76	13	0	1	3
	24	61	16	37	36	18	9	76	21	1	0	39	23	2	86	7	0	2	5
	82	18	0	47	41	6	6	88	12	0	0	41	18	0	88	12	0	6	6
	20	51	27	2	24	36	36					79	1	1	75	9	1	1	0
	16	63	21	2	18	44	36	73	22	0	2	84	1	1	86	2	0	0	1
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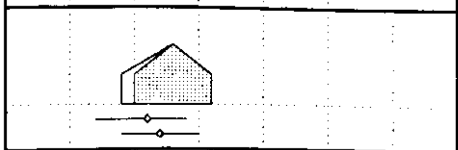
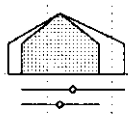
	11	39	42	3	20	31	41					75	0	2	44	9	0	3	0
	7	45	45	0	27	29	42	16	51	9	20	84	0	0	65	9	0	4	0
	30	70	0	0	40	20	40	30	70	0	0	80	0	0	70	0	0	10	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Broadcasting technology	61. Practical use of local satellite broadcasting systems each with a service area of prefectural size, applying multi-beams.	1	94	12	25	35	28	12	51	31	6
		2	82	9	26	37	28	10	55	29	6
		X	10					30	70	0	0
	62. Practical use of a coding method for a high-quality image/sound ultra-bit rate (10 Mbps or less for images equivalent to high-definition TVs, or 64 Kbps or less for sound equivalent to CDs) that will be almost impossible to distinguish from the original.	1	92	17	24	31	28	40	48	11	1
		2	81	17	21	34	28	40	49	11	0
		X	19					58	42	0	0
	63. Practical use of high-output microwave semi-conductor oscillators for broadcasting satellite use.	1	67	7	21	24	48	39	57	4	0
		2	55	4	24	21	51	29	67	4	0
		X	4					75	25	0	0
	64. Practical use of stereoscopic broadcasting based on development of displays for stereoscopic home television, which can be viewed without glasses.	1	88	8	19	42	32	20	49	30	1
		2	76	7	20	41	32	14	54	30	1
		X	8					63	38	0	0
	65. Practical use of high-quality speech synthesizing technologies for automatically turning written information into speech of a quality level nearly equal to that of human speech.	1	89	8	18	42	32	31	55	13	0
		2	75	9	16	42	33	20	71	9	0
		X	10					40	50	10	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	9	43	40	11	26	34	22					53	24	5	43	27	1	4	2
	5	45	46	7	30	35	23	18	41	28	11	60	22	5	56	27	1	2	1
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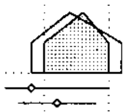
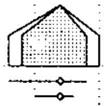
	20	45	30	23	39	20	15					79	9	5	43	4	3	5	2
	15	49	36	23	48	17	11	19	67	10	4	94	4	4	73	1	0	0	0
	47	42	11	37	53	5	5	5	84	11	0	100	0	5	68	0	0	0	0
	16	49	30	4	30	37	24					87	0	1	40	16	1	6	3
	11	60	29	2	36	42	20	42	40	7	9	89	0	0	56	16	0	0	2
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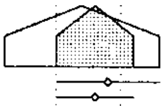
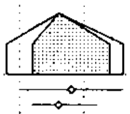
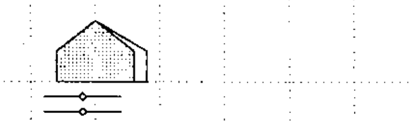
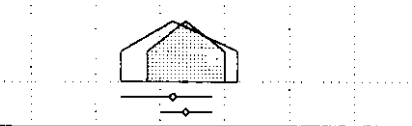
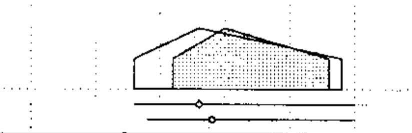
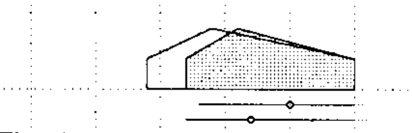
	7	38	51	20	23	31	22					77	7	10	58	5	2	2	1
	4	33	62	14	22	49	14	37	43	5	14	89	3	5	78	7	0	0	0
	13	75	13	63	0	25	13	50	50	0	0	100	0	0	63	13	0	0	0
	11	49	38	6	27	36	30					72	0	7	43	12	3	4	3
	8	53	39	3	23	52	23	27	45	15	12	89	0	5	69	5	0	1	3
	30	70	0	0	50	40	10	30	60	10	0	80	0	10	80	0	0	0	10

4.14 Transportation

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Railway and track traffic systems	1. Development of intelligent trains providing, automatic control of running speed and adjustment of support parameters in response to track or power line conditions, enabling improved riding comfort and reductions in the cost of ground facilities.	1	153	16	27	34	23	24	50	25	1
		2	140	17	29	34	20	21	56	23	0
		X	30					40	50	10	0
	2. Practical use of superconductive magnetic levitation railways with a maximum speed on the order of 500 km per hour.	1	169	15	29	41	16	51	36	9	4
		2	152	15	30	41	14	53	35	9	3
		X	26					77	12	12	0
	3. Practical use of magnetic levitation railways applying normal electric conduction with a maximum speed in the order of 500 km per hour.	1	160	11	29	41	20	28	38	25	9
		2	144	11	28	43	18	25	43	24	8
		X	20					35	35	20	10
	4. Practical use of trains that use linear motors to run on rails at a maximum speed of 500 km or more for transportation between large cities.	1	159	12	29	40	20	21	39	21	19
		2	142	12	30	39	19	18	46	20	17
		X	21					29	33	19	19
	5. Practical use of railcars capable of continuous operation at a speed of 300 km/h while still meeting environmental standards, using today's Shinkansen facilities and equipment.	1	159	20	25	36	20	70	26	4	0
		2	144	20	27	35	18	81	16	3	0
		X	35					97	3	0	0
	6. Practical use of commuter trains that provide high-frequency service at about 1-minute intervals in metropolitan areas by using controlling methods based on intertrain distance and relative speed and improving the facilities for boarding and deboarding (both on the ground and the vehicles).	1	151	19	21	36	24	66	25	5	5
		2	141	21	20	40	19	67	23	4	4
		X	36					92	6	0	3
	7. Practical use of systems to detect people, cars, or other obstacles on track and automatically brake trains, using lasers or ultrasonic technology.	1	159	15	28	37	20	43	38	16	3
		2	146	16	26	42	16	45	43	10	1
		X	28					71	25	4	0
	8. Substantial reduction of noise and vibration arising in the vicinity of rail lines due to train operation,based on the use of new materials for wheels and rails and improvements in railcar structure.	1	149	14	28	33	25	66	30	3	0
		2	136	15	29	34	21	71	26	2	0
		X	26					77	23	0	0
	9. Practical use of energy storage equipment on electrically powered trains to accumulate regenerative energy and reduce the load on transformer substation at peak time.	1	132	11	18	38	34	17	46	30	7
		2	121	11	20	39	30	17	53	25	6
		X	19					26	47	11	16
Road traffic system	10. Practical use of "intelligent" composite materials which change in response to external stimuli (e.g., change rigidity in accordance with load), achieving significantly improved vibration resistance, riding comfort, collision performance and other characteristics for motorcars.	1	89	3	14	29	54	13	45	35	7
		2	82	3	15	30	52	9	52	33	6
		X	5					0	80	0	20

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	31	44	23	2	8	31	56					36	14	3	59	24	6	16	4
	29	50	21	1	8	35	55	41	34	4	17	42	13	4	70	21	6	14	3
	63	37	0	0	10	33	53	37	50	7	3	47	13	0	57	17	17	17	10
	21	47	28	4	14	31	47					63	4	4	60	40	4	4	6
	16	55	27	3	15	30	51	75	16	1	5	72	3	4	66	28	3	4	6
	46	46	8	4	15	35	46	81	15	0	0	65	4	0	62	23	12	8	8
	14	34	40	8	27	30	25					61	4	3	48	33	4	13	7
	8	36	51	7	26	35	26	21	35	27	11	70	1	5	57	31	2	8	7
	40	35	20	20	15	45	15	15	5	70	0	65	5	0	50	25	10	0	10
	10	32	39	4	14	28	38					54	4	7	42	31	3	9	8
	12	32	44	1	13	32	42	35	32	5	18	65	3	5	50	32	2	7	7
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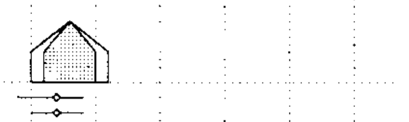
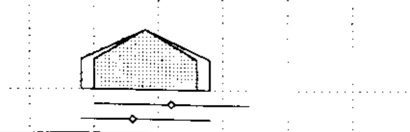
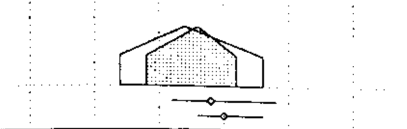
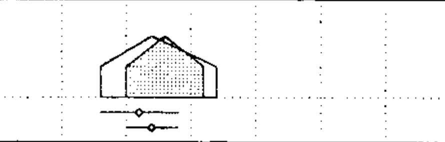
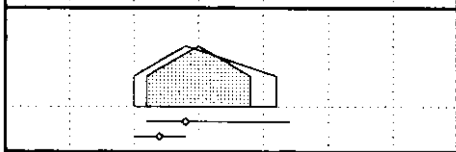
	48	41	11	4	10	23	62					57	16	11	40	18	4	8	4
	51	41	7	3	6	25	65	44	40	9	4	73	10	8	53	13	4	7	6
	94	6	0	9	9	23	60	60	31	6	0	77	20	9	49	6	3	14	0
	25	48	23	2	12	20	64					50	30	11	34	21	2	4	6
	24	55	18	1	8	14	74	60	22	6	8	58	30	10	38	17	2	2	6
	53	36	11	3	11	25	61	44	42	11	0	50	31	11	33	25	6	6	8
	32	43	20	2	8	23	64					52	14	6	47	19	2	6	3
	27	54	17	2	5	24	68	43	32	2	18	70	10	4	57	16	1	5	3
	46	50	4	4	0	25	71	50	36	0	11	61	11	7	61	11	4	7	4
	17	50	31	10	21	24	44					75	3	3	50	19	3	15	2
	15	53	32	8	22	25	44	44	33	7	12	85	5	2	59	15	1	13	1
	27	65	8	12	23	35	31	46	42	8	0	77	8	4	58	12	0	8	0
	16	30	42	5	17	33	39					67	2	2	64	16	3	7	1
	13	33	46	2	17	38	37	23	41	6	21	77	1	3	65	13	2	8	0
	32	37	16	0	11	42	32	26	37	5	11	68	0	11	32	5	0	11	0
	4	24	64	13	31	20	27					78	8	4	48	7	2	7	3
	4	24	68	11	44	17	24	10	49	7	29	83	4	1	62	5	2	10	4
	20	20	40	40	20	0	20	0	80	0	0	80	0	0	40	0	0	20	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Road traffic system	11. Widespread use of traffic control systems on roads, for optiomal control of the flow of traffic in cities based on determinations of types of vehicles on road, speed, and level of congestion.	1	146	11	22	41	26	53	38	7	1
		2	130	10	24	42	25	61	32	6	1
		X	17					88	12	0	0
	12. Completion of technologies for identifying cars on the ground from satellites through clouds by the use of radio waves, leading to practical use of systems that enable drivers to know the degree of congestion of each road ahead of them so that they can select the least congested routes.	1	136	7	19	43	30	19	43	31	7
		2	129	6	20	49	25	12	48	29	10
		X	10					20	30	30	20
	13. Development of dual-mode type automobile traffic systems which alternately may use wheels on guideways and employ the magnetic levitation linear method which enables travel on the systems at 300 km per hour.	1	116	6	18	36	41	6	37	40	16
		2	104	5	19	37	40	4	32	48	16
		X	8					0	75	13	13
	14. Practical use of ceramic engines which primarily consist of structural ceramic components, contributing to lighter weight and smaller size of motorcars.	1	129	5	18	43	34	19	53	26	2
		2	109	2	22	39	36	15	63	20	2
		X	4					25	25	50	0
	15. Widespread use of motorcars with extremely low fuel consumption that is 30% lower than the current fuel consumption for the same interior size owing to reduced weight achieved by significant introduction of new materials such as ceramics, aluminum and resins and improved output achieved by higher engine efficiency (e.g., the use of 2-cycle, direct-injection engines.	1	113	7	12	39	42	57	37	5	1
		2	92	4	16	34	46	59	39	2	0
		X	7					86	14	0	0
	16. Widespread use of non-stage transmissions called CVTs (Continuously Variable Transmissions) which are free from slippage and which are optimally controlled by computers, thereby accomplishing easier driving and reduced fuel consumption.	1	96	6	13	31	51	20	53	27	0
		2	81	4	16	28	52	15	64	21	0
		X	6					17	50	33	0
	17. Development of construction methods which make it possible to halve the time required for repairing paved roads.	1	71	2	7	27	63	49	48	3	0
		2	64	1	6	31	62	50	50	0	0
		X	2					100	0	0	0
	18. Practical use of automatic braking systems capable of identifying obstacles on roads ahead and obstacles such as walls, railroad bridges and other obstacles which are not on roads by using car-mounted ultrasonic or radar sensors when driving on general roads thereby securely avoiding hazards.	1	142	11	17	44	28	38	38	18	5
		2	127	9	17	48	26	37	43	15	4
		X	15					73	20	7	0
	19. Practical use of automatic driving technology based on vehicle guidance control to assure safety, reduce drive fatigue, and enable increased volume of traffic on highways.	1	136	13	15	41	31	36	35	20	10
		2	119	9	17	43	30	35	42	15	8
		X	16					56	31	13	0
	20. Practical use of a system which receives informations about intersections and sharp curves from the ground and displays the information on the windshield to give warnings to the drivers.	1	131	11	14	42	33	20	43	28	9
		2	117	8	16	44	32	13	52	26	9
		X	14					43	50	7	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	20	46	31	6	25	26	40					32	36	8	45	31	5	12	5
	13	57	28	5	32	25	37	23	55	5	13	38	42	4	55	27	3	10	4
	29	59	12	6	47	35	12	18	71	6	6	24	88	0	41	6	0	24	18
	10	41	37	22	26	22	21					49	15	1	59	21	0	9	1
	5	51	33	19	36	21	14	9	39	22	19	59	14	1	64	14	0	5	4
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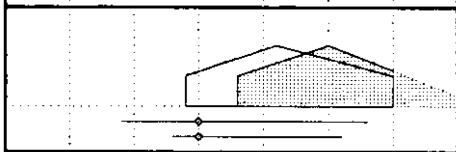
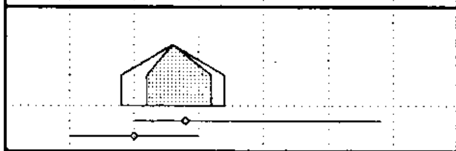
	6	25	48	8	17	24	34					53	13	5	51	19	1	8	1
	6	24	52	7	13	27	35	20	32	1	30	63	13	2	55	15	0	7	0
	0	50	38	13	25	38	13	13	63	0	13	50	13	0	63	38	0	13	0
	14	41	40	9	20	24	43					76	3	2	64	6	2	3	2
	8	48	40	7	24	22	44	41	37	2	15	84	2	2	77	3	1	4	2
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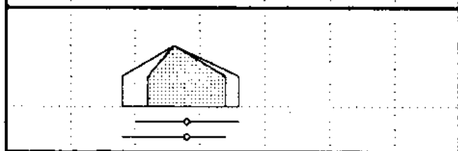	19	44	33	12	18	28	39					74	2	3	66	7	2	4	3
	9	55	35	8	21	34	38	54	30	3	10	85	1	1	80	4	2	4	1
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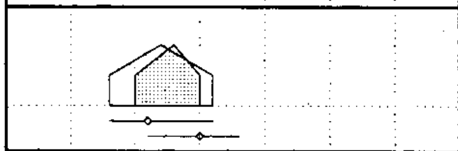	16	46	35	6	18	34	41					65	2	1	66	10	1	5	5
	10	58	30	4	23	35	38	38	43	4	11	75	2	0	79	5	1	4	4
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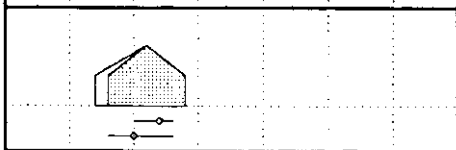
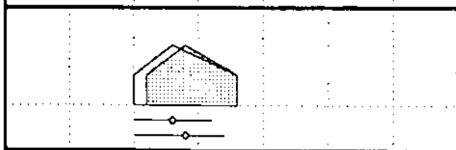
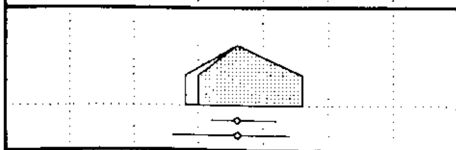
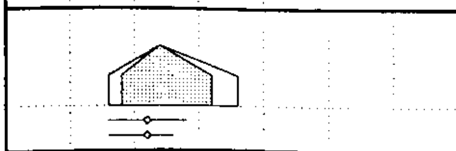
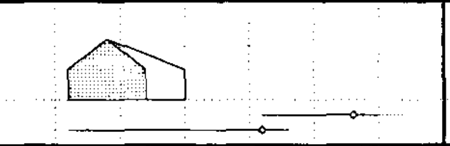
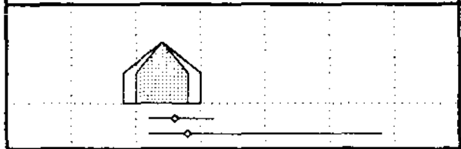
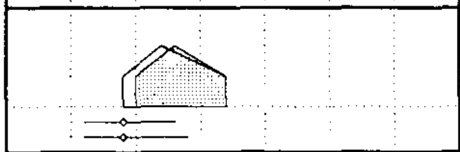
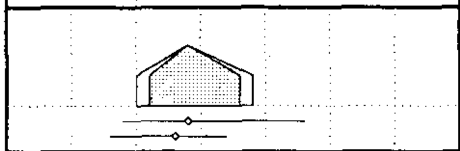
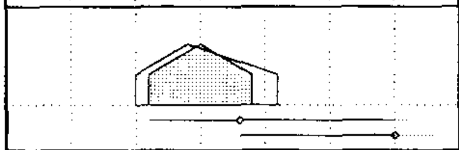
	14	44	39	7	18	31	39					61	10	6	55	13	4	10	4
	11	48	38	6	17	36	38	22	36	5	31	69	11	3	66	11	3	13	2
	100	0	0	50	0	50	0	50	50	0	0	100	0	0	100	0	0	0	0
	14	42	37	7	18	33	36					61	18	4	58	15	2	6	1
	9	46	39	7	15	36	35	19	48	5	20	72	18	0	69	7	2	4	2
	20	67	13	7	7	60	27	33	67	0	0	67	47	0	60	7	0	13	0
	11	35	43	13	19	28	30					51	24	4	49	22	3	6	2
	6	39	48	12	23	29	29	24	44	9	15	60	27	3	61	13	2	3	3
	6	75	19	25	25	38	13	31	63	6	0	81	56	0	38	6	0	6	13
	18	37	34	6	16	29	39					38	16	2	63	21	2	4	1
	13	44	38	5	15	31	43	32	35	5	20	52	19	2	74	16	1	1	3
	36	64	0	7	14	57	21	36	57	7	0	64	29	7	71	0	0	0	14

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Road traffic system	21. Widespread use of tires for the cold season which provide the same road surface gripping capability as that of spiked tires but do not cut roads.	1	103	3	13	37	47	50	44	7	0
		2	89	3	13	36	48	56	42	2	0
		X	5					60	40	0	0
	22. Practical use of technologies to give advance warning of bridge failures caused by fatigue. These are based on sensing fatigue by automatically observing distortion, ultrasonic characteristics, acoustic emissions, etc.	1	93	4	14	31	52	29	49	17	4
		2	82	3	13	32	52	23	56	16	5
		X	5					40	60	0	0
	23. Practical use of large buses and trucks powered mainly by alcohol, leading to significantly reduced exhaust gases.	1	115	5	13	42	41	39	40	15	5
		2	103	3	12	45	40	37	47	12	4
		X	5					40	60	0	0
	24. Widespread use of electric-powered automobiles capable of running in urban traffic, based on the development of batteries with a charged capacity sufficient for commuter trips.	1	141	8	16	48	28	50	35	13	1
		2	126	5	18	51	26	57	32	10	2
		X	9					78	22	0	0
	25. Reduction of the nosie of large freight vehicles to the noise level of the current regular passenger cars primarily through improved engines, transmissions, mufflers and tires.	1	115	5	16	38	41	48	43	9	0
		2	99	2	16	40	42	53	40	7	0
		X	4					50	25	25	0
	26. Practical use of apparatuses installed on roads to absorb road traffic noises in the form of energy, thus reducing the noise level to that which meets the environmental standard.	1	89	1	12	33	54	42	35	15	9
		2	79	1	11	35	54	43	34	19	4
		X	1					0	100	0	0
	27. Practical use of technologies for reducing the emission of nitrogen oxide from large freight vehicles to the emission level of current gasoline passenger cars (0.25 g/km or less).	1	104	5	12	37	46	65	30	4	1
		2	88	2	14	36	48	72	26	2	0
		X	4					100	0	0	0
Water-surface and underwater traffic systems	28. Widespread use of commuter and business sea traffic transportation network systems (including the traffic control systems) which use mass-transportation (300 passengers or more), high-speed (30 knots or faster) vessels in the areas around big citites.	1	102	10	13	29	47	13	41	32	14
		2	89	11	11	30	48	9	47	34	10
		X	19					16	79	5	0
	29. Development of marine freight transportation vessels using superconductivity, hydrofoils, etc. that enable crossing of the Pacific Ocean within two days (100 knots or faster).	1	104	11	12	31	46	23	35	29	13
		2	91	12	11	31	46	21	36	33	9
		X	21					14	52	19	14
	30. Practical use of ships with superconductive electro-magnetic thrusts.	1	114	8	15	36	41	16	48	28	8
		2	99	10	14	35	42	11	52	30	6
		X	17					6	53	41	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	18	50	26	18	19	21	38					67	8	5	60	8	2	5	1
	18	57	21	17	12	26	44	24	42	7	27	76	7	2	69	4	0	6	1
	40	60	0	20	0	60	20	40	60	0	0	80	20	0	40	0	0	0	0
	19	37	38	10	19	23	43					57	12	2	34	24	2	12	2
	13	41	41	13	12	30	40	21	41	5	26	70	9	0	48	22	1	9	2
	80	0	20	60	0	0	40	20	60	0	20	60	20	0	40	40	0	20	0
	13	40	37	13	29	25	25					58	17	3	55	15	0	5	3
	15	40	38	16	36	28	16	6	54	22	12	67	17	1	72	8	0	6	4
	40	60	0	0	40	60	0	0	80	20	0	80	40	0	80	0	0	0	0
	16	40	38	17	21	28	30					72	10	3	66	9	0	5	4
	14	46	37	14	29	29	25	13	60	8	14	82	6	0	79	9	0	2	5
	56	44	0	33	33	22	11	11	67	22	0	67	22	0	89	0	0	11	0
	12	39	43	8	26	28	36					63	12	2	65	13	2	6	3
	12	43	41	8	27	28	35	30	47	2	15	76	8	2	77	13	1	1	1
	25	25	50	0	0	75	25	0	100	0	0	100	0	0	50	0	0	0	0
	7	25	49	13	22	19	34					62	9	3	45	16	1	9	0
	11	19	63	13	20	24	39	11	37	5	39	80	6	1	56	23	0	3	0
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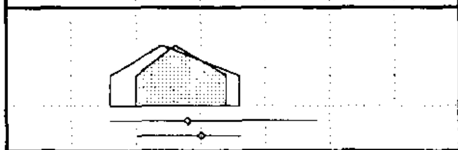	15	42	36	13	23	25	36					68	9	0	66	11	2	8	1
	9	49	38	11	30	26	31	52	27	5	11	84	9	0	80	9	0	2	0
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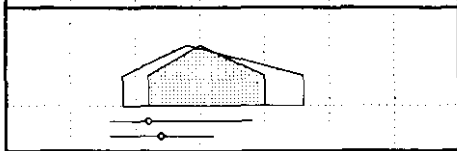	20	30	28	4	14	18	47					23	42	14	39	18	2	6	7
	18	39	34	3	9	22	56	24	36	12	18	28	49	11	46	22	0	2	3
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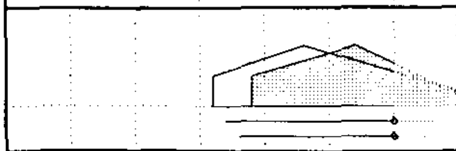	13	25	45	13	23	22	27					66	2	2	43	22	0	7	3
	11	21	58	12	27	20	32	31	32	10	15	79	2	2	56	20	0	4	1
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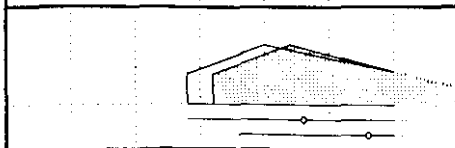
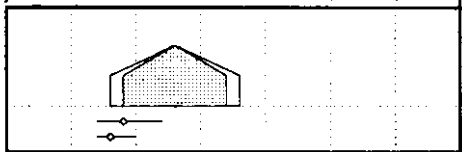
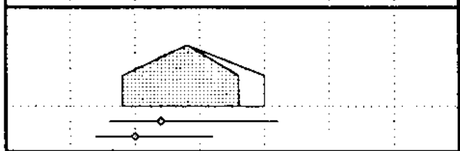
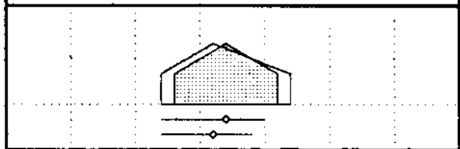
	17	25	49	6	24	33	33					78	2	3	59	25	1	5	2
	17	20	58	8	21	29	38	43	28	7	15	85	2	0	65	25	0	4	1
	59	0	35	6	18	29	47	71	29	0	0	94	6	0	76	12	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Water-surface and underwater traffic systems	31. Practical use of high-speed vessels in the 50 knots 1,000-dead-weight tonnage class for international voyages.	1	92	11	12	24	53	36	38	22	3
		2	81	12	10	25	52	36	41	20	1
		X	21					81	14	0	0
	32. Development of light-weight, non-steel-construction large-scale and high speed ships of about 500 gross tonnage based on new materials.	1	90	8	14	24	54	21	41	28	9
		2	75	9	12	22	56	17	43	32	5
		X	16					38	31	25	0
	33. Development of fully automatic ships which are able to navigate and dock automatically.	1	99	10	15	26	49	22	44	27	6
		2	86	11	12	28	49	16	49	28	6
		X	19					47	42	5	0
	34. Development of autonomous, unmanned, underwater investigation vessels employing artificial intelligence which are capable of investigating sea-bottom resources and undertaking other activities without receiving any energy supply or external communication.	1	83	8	12	23	57	25	48	23	4
		2	73	7	12	24	57	19	49	29	3
		X	12					42	50	8	0
	35. Practical use of nuclear-powered merchant ships.	1	101	6	13	34	48	11	26	37	27
		2	87	7	12	32	49	7	25	44	22
		X	12					33	17	25	17
	36. Practical use of underwater monorails on which linear-motor-driven trains travel across straits or similar stetches of water.	1	101	6	13	33	48	2	19	49	31
		2	89	7	11	35	48	1	17	45	36
		X	12					8	8	25	50
	37. Practical use of Computer Integrated Manufacturing System which comprise various types of softtware including design/production data bases, intelligent CAD/CAM and process management systems and so forth, thereby reducing the labor cost of shipbuilding to about one third of present levels.	1	88	9	12	24	55	44	41	14	1
		2	76	10	12	23	55	47	37	14	0
		X	17					82	12	0	0
	38. Completion of marine traffic control systems which enable safe and efficient movement of all ships in congested areas, such as Tokyo Bay.	1	102	9	15	28	47	43	49	8	0
		2	87	10	14	27	49	46	47	6	0
		X	17					71	24	0	0
	39. Practical use of high-reliability ships which can operate for roughly 2 years without maintenance, based on substantial improvement in reliability and maintainability of ship materials, engine, and other components.	1	80	8	11	22	59	30	51	16	3
		2	69	8	11	21	59	26	58	13	1
		X	14					57	36	0	0
	40. Widespread use of observation systems that provide ships with real-time information on wide-area sea and weather conditions.	1	104	6	16	32	46	48	44	8	0
		2	88	6	15	32	48	51	42	6	0
		X	10					80	10	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	26	38	30	7	18	26	43					57	14	3	59	18	1	7	3
	27	37	31	7	11	28	48	38	37	6	10	67	14	0	67	20	1	5	2
	67	29	0	0	5	33	57	48	43	5	0	52	29	0	67	29	0	0	0
	23	29	39	11	20	22	39					52	13	2	53	16	4	2	1
	24	28	40	11	15	25	41	31	33	9	15	61	19	4	63	13	1	3	0
	50	19	19	6	13	31	38	38	25	25	6	56	31	0	50	13	0	0	0
	14	37	39	20	21	31	21					56	37	5	37	19	2	10	3
	14	36	43	22	23	26	22	36	30	6	20	63	42	7	41	15	1	8	2
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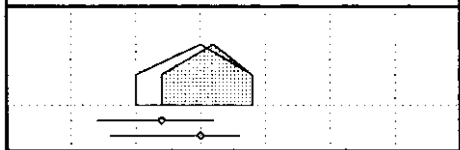
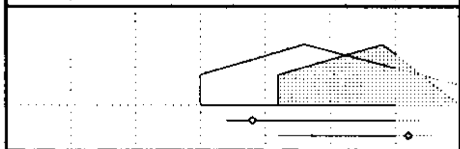
	18	40	36	19	31	20	25					67	0	1	30	45	7	7	2
	12	44	41	19	30	22	26	10	42	27	16	77	0	0	34	49	1	4	0
	42	50	0	17	25	25	25	0	58	42	0	75	0	0	17	67	0	0	0
	12	15	41	14	18	21	23					21	28	44	25	4	1	2	8
	8	20	49	13	17	23	25	1	20	47	10	21	24	55	30	3	0	0	8
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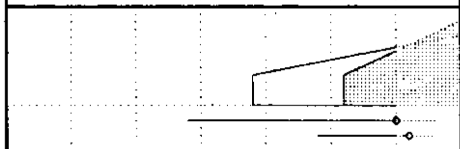	15	15	41	12	15	21	26					56	7	3	38	20	0	6	3
	12	16	52	11	9	22	40	16	18	2	47	65	4	3	51	18	0	6	1
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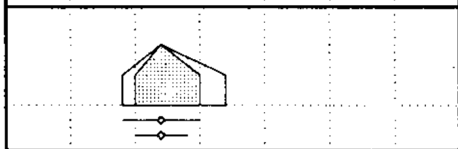	23	50	25	5	9	28	57					50	9	0	36	28	19	16	1
	24	46	28	5	5	25	62	63	17	4	11	59	8	0	46	24	16	14	1
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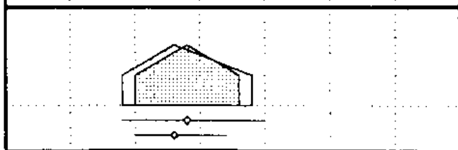
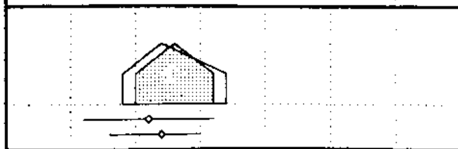
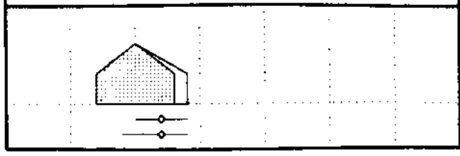
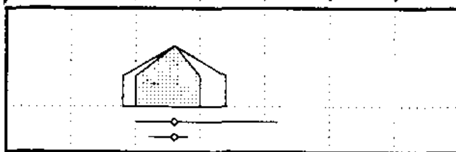
	18	44	35	11	13	30	44					31	48	12	36	27	2	10	2
	10	51	36	10	10	31	45	30	38	2	24	38	61	7	40	28	0	7	1
	24	59	6	24	6	24	35	53	41	0	0	41	76	12	35	12	0	0	0
	16	44	34	6	16	33	40					58	20	4	49	15	5	6	1
	14	48	32	7	13	29	45	48	33	1	12	68	14	1	68	12	1	6	1
	36	50	0	7	7	7	64	57	36	0	0	64	7	0	71	7	0	0	7
	33	45	21	39	33	20	7					26	29	0	53	33	2	13	2
	27	51	19	45	35	13	5	11	55	14	16	28	34	0	64	32	0	11	0
	60	30	0	40	30	20	0	20	40	30	0	50	40	0	50	10	0	20	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Water-surface and underwater traffic systems	41. Development of systems capable of providing weather forecast for about 10 days on a global scale.	1	84	4	8	32	56	51	37	10	2
		2	70	4	7	31	58	53	34	11	1
		X	7					86	14	0	0
	42. Practical use of disposal technologies for FRP ships.	1	79	5	8	27	59	56	32	13	0
		2	65	5	8	25	61	62	26	12	0
		X	9					89	11	0	0
Air traffic system	43. Practical use of flying boats for regular-service transportation between cities or to isolated islands.	1	117	13	19	28	40	4	37	44	15
		2	104	15	16	30	40	5	39	44	12
		X	25					12	40	44	4
	44. Development of passenger planes with a speed of Mach 4 (twice as fast as the Concord) and a seating capacity of 300 (triple that of the Concord) that are capable of transpacific flights in 2 hours or less.	1	118	16	15	29	40	45	44	7	4
		2	103	17	13	30	40	42	46	12	1
		X	29					55	38	7	0
	45. Development of super large-scale cargo planes with gross weight in the 1,000-ton class (three times as large as jumbo jets) for transpacific operation.	1	110	15	13	28	44	31	36	23	10
		2	98	16	12	29	43	33	38	26	4
		X	27					44	33	19	4
	46. Widespread use of high-speed turboprop aircraft capable of speeds (Mach 0.8) on a par with current jet aircraft, offering a superlative energy-saving advantage.	1	102	18	12	22	48	40	42	14	4
		2	88	17	13	21	49	42	47	11	0
		X	30					47	40	13	0
	47. Development of transonic air transport craft offering a superlative energy-saving merit, built completely of compound materials.	1	89	14	13	18	55	30	46	17	7
		2	82	16	11	20	53	28	52	15	5
		X	28					36	46	11	7
	48. Development of large-scale airships which are as large as jumbo jet passenger airplanes and which use helium for international passenger transport.	1	91	11	14	22	53	4	16	36	43
		2	84	12	12	25	51	6	6	40	48
		X	20					15	5	20	60
	49. Practical use of quiet, energy-saving vertical take-off and landing (VTOL) craft for intercity transportation.	1	112	17	12	28	43	27	43	22	7
		2	100	17	13	28	42	26	46	24	4
		X	29					48	38	10	3
	50. Practical use of worldwide air traffic control systems applying artificial satellites.	1	112	12	16	29	43	63	33	4	0
		2	101	10	17	31	42	72	24	4	0
		X	17					88	12	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	17	42	38	67	21	7	1					51	18	2	25	38	7	17	4
	10	51	37	81	13	3	1	4	50	20	21	66	13	1	23	49	7	19	1
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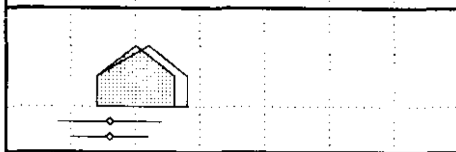	14	49	34	22	18	28	29					54	10	3	56	27	3	6	4
	12	55	32	20	20	32	28	17	38	8	34	60	11	3	66	25	2	3	0
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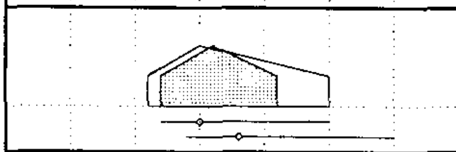	14	27	39	9	21	24	30					18	25	8	62	30	1	3	4
	10	28	46	12	24	23	29	13	33	30	10	15	25	4	67	35	1	4	6
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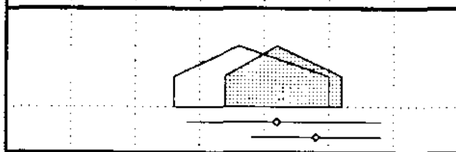	17	42	36	80	14	1	1					64	4	7	41	49	3	9	4
	15	48	36	87	8	1	2	1	3	91	0	84	1	2	48	47	0	10	3
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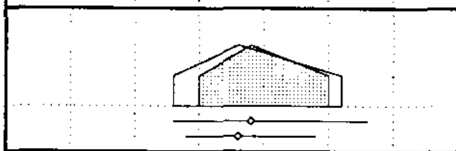	12	36	41	63	19	5	5					55	7	3	40	44	1	7	9
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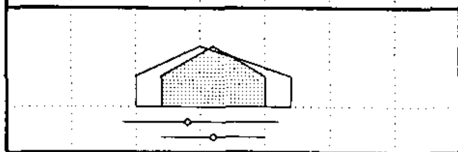	20	47	27	63	21	7	8					68	3	3	34	42	2	11	4
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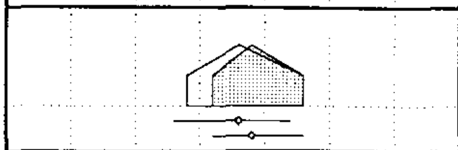	16	40	35	65	18	7	2					71	8	2	37	36	1	7	6
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	21	54	21	57	32	4	0	4	32	54	0	71	4	0	46	39	4	4	11
	13	15	32	24	19	9	12					29	2	9	30	15	2	7	10
	6	13	44	29	17	7	13	1	7	42	14	38	1	5	42	14	1	1	8
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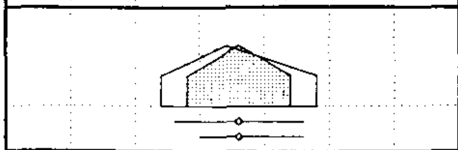	15	38	36	35	36	13	9					50	13	6	53	31	4	8	4
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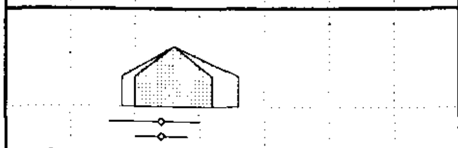
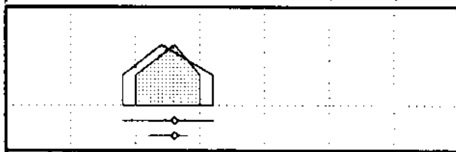
	26	39	34	85	9	2	4					36	36	3	27	45	2	21	3
	25	43	30	88	7	1	2	2	24	60	8	37	46	0	25	54	1	16	2
	53	47	0	94	5	0	0	0	41	47	0	29	47	0	24	47	6	12	6

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Air traffic system	51. Widespread use of new man-machine systems applying artificial intelligence for manipulation and control of regular flights (including landing and take-off), enhancing the safety or air travel.	1	117	11	21	28	40	58	36	5	1
		2	106	9	21	31	39	63	33	4	0
		X	16					88	13	0	0
	52. Development of four-dimensional control systems based on aircraft location and time, including on-board collision prevention systems, to address increased flight service frequency and safety.	1	103	11	19	22	47	69	28	2	1
		2	93	9	19	25	46	76	24	0	0
		X	16					81	19	0	0
	53. Practical use of floating marine airports.	1	114	13	16	29	42	32	46	17	4
		2	100	12	16	30	42	34	47	17	2
		X	21					57	29	10	5
	54. Development of innovative quiet helicopters that satisfy environmental standards even if taking off or landing near urban districts.	1	95	12	13	23	52	39	39	17	5
		2	82	11	13	23	53	39	45	16	0
		X	19					68	26	5	0
Other new traffic systems	55. Widespread use of walkways several hundred meters in length, which move a walking speed at entrances and exits and reach speeds of 10 to 20 km per hour in between.	1	115	4	13	42	41	10	44	35	10
		2	99	2	13	43	42	9	49	34	7
		X	4					75	25	0	0
	56. Practical use of robots to guide blind people in particular districts such as stations and shopping centers.	1	91	3	8	36	53	15	54	25	5
		2	76	2	8	35	56	14	57	21	7
		X	4					25	50	25	0
	57. Practical use of intelligent wheelchairs capable of handling staircases and escalators.	1	89	4	7	36	54	28	48	21	2
		2	73	4	5	34	57	27	51	19	1
		X	6					50	50	0	0
	58. Practical use of transportation information systems which show the transportation facilities or routes simply by entering destinations through portable terminals.	1	126	6	16	43	35	10	37	44	10
		2	108	6	15	42	37	8	37	48	6
		X	10					40	40	20	0
	59. Practical use of new, small urban transportation systems which freely enable trips between high-rise buildings through air corridors.	1	102	4	13	35	47	14	36	35	15
		2	86	3	11	37	49	8	41	34	17
		X	5					40	40	20	0
	60. Practical use of systems that can automatically transport in wide areas freight equivalent to that of 1- to 2-ton truck freight through conduit routes laid underground in big cities.	1	114	6	15	38	41	40	34	24	2
		2	99	6	13	39	42	43	35	19	2
		X	11					91	9	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	25	51	21	57	29	8	5					62	21	8	35	25	3	16	3
	23	58	18	68	23	5	4	5	30	56	6	72	23	2	44	26	3	16	1
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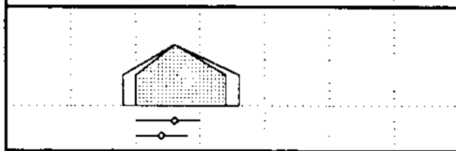
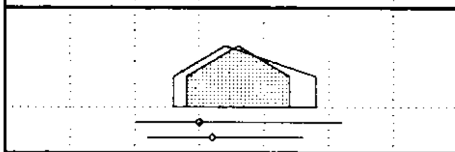
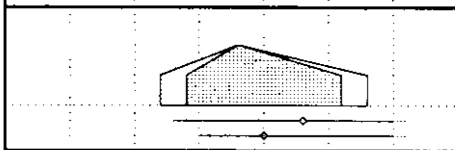
	19	50	27	66	24	7	2					59	19	1	33	39	3	18	2
	16	55	29	74	22	2	2	1	23	67	6	68	29	0	34	44	0	14	0
	38	50	13	63	31	0	6	0	19	75	0	50	38	0	31	44	0	19	0
	11	41	43	4	18	21	52					35	20	18	42	42	0	6	5
	11	39	48	6	14	27	51	42	29	4	20	39	19	14	54	50	0	3	4
	33	52	14	0	14	24	62	62	29	0	5	43	33	19	57	29	0	5	0
	13	43	38	41	31	15	7					77	12	4	35	20	3	8	3
	10	51	38	51	30	13	4	1	20	68	6	90	9	4	54	21	2	4	1
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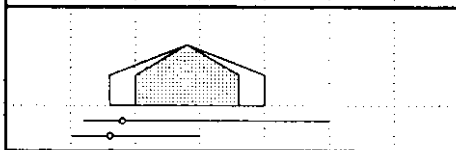	10	48	29	8	10	25	45					36	24	10	50	17	1	3	6
	7	53	31	9	9	27	47	15	37	14	24	48	24	6	69	13	0	2	4
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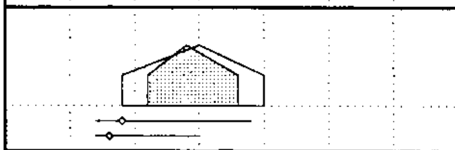	7	41	45	9	13	33	38					47	14	14	47	16	2	9	3
	4	36	53	8	13	30	42	33	32	7	17	61	16	17	63	11	0	7	0
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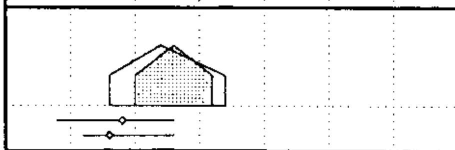	9	49	36	10	15	24	47					39	15	9	58	27	2	3	1
	7	49	40	7	11	32	47	22	40	7	22	55	11	12	67	15	1	5	1
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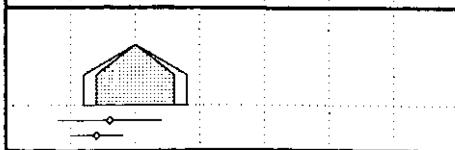	24	36	29	2	6	23	56					19	12	10	57	19	2	6	2
	23	41	30	3	5	24	62	38	27	6	19	23	13	7	78	19	1	5	2
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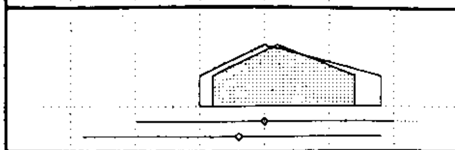	15	18	50	4	13	25	43					27	37	8	40	30	0	2	3
	10	20	55	2	8	29	48	12	34	8	29	31	44	3	49	27	0	3	1
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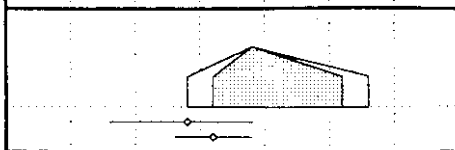
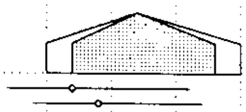
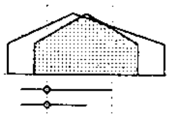
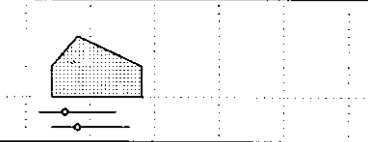
	12	35	46	7	10	32	46					34	32	5	49	46	2	4	1
	10	40	45	5	11	33	48	26	33	5	27	38	34	4	61	48	1	2	0
	27	55	18	18	9	36	36	45	45	9	0	18	64	9	27	73	9	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Other new traffic systems	61. Practical use of dedicated, unmanned high-speed systems such as linear railways or the like for carrying freight at 200 km or faster along underground roads or expressways.	1	119	8	16	37	40	29	45	20	6
		2	105	9	14	38	39	21	56	19	4
		X	15					47	47	7	0
	62. Practical use of vertical transportation systems for super high-rise buildings capable of providing a transporting capability per occupant volume which is at least five times that of current elevators. (e.g., systems equipped multiple car-gondolas, turn-back function, and passing function)	1	79	2	7	32	59	19	54	20	6
		2	65	2	8	28	62	17	58	20	5
		X	4					50	50	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	9	30	50	6	10	29	47					37	20	4	44	49	1	5	3
	6	30	57	5	10	28	52	28	38	1	28	44	15	3	62	57	1	3	0
	27	47	27	7	7	53	33	33	53	0	13	27	13	0	53	80	7	7	0
	9	32	53	13	8	28	46					57	14	6	51	20	3	8	3
	5	35	55	11	8	35	42	26	37	5	25	74	14	3	65	18	0	8	0
	25	75	0	25	0	50	25	100	0	0	0	75	25	0	25	25	0	25	0

4.15 Health and medical care

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Promotion of health	1. Establishment of methods for quantifying the health status in accordance with age.	1	143	29	32	29	11	37	45	14	4
		2	121	25	34	30	10	36	47	14	2
		X	34					59	35	3	3
Elucidation of disease onsetting mechanisms	2. Elucidation of the mechanism of a large number of autoimmune diseases.	1	127	12	30	38	20	57	43	0	0
		2	111	12	29	42	17	63	36	1	0
		X	16					100	0	0	0
	3. Elucidation of causes and onsetting mechanism of rheumatism.	1	118	9	34	31	26	48	48	3	0
		2	103	8	33	36	23	49	51	0	0
		X	11					91	9	0	0
	4. Elucidation of mechanism of canceration for virtually all types of malignant neoplasms.	1	134	13	36	34	16	86	13	1	0
		2	113	12	35	37	16	93	5	2	0
		X	16					100	0	0	0
	5. Elucidation of the onsetting mechanism of Alzheimer's disease.	1	120	13	29	34	25	71	27	3	0
		2	103	12	31	35	23	79	19	1	0
		X	16					94	6	0	0
	6. Elucidation of the origins of obstructive pulmonary diseases.	1	94	8	21	31	40	27	54	19	0
		2	79	8	22	31	40	23	62	14	0
		X	10					60	40	0	0
	7. Elucidation of the mechanism of atherosclerosis.	1	135	22	22	41	15	76	24	1	0
		2	113	20	23	42	14	86	13	1	0
		X	27					100	0	0	0
	8. Elucidation of the mechanism of disease onset for virtually all genetic diseases.	1	115	9	27	36	28	57	35	8	0
		2	95	9	26	37	28	54	42	4	0
		X	12					75	25	0	0
Improvement of preventive methods	9. Possibility of the prevention of diabetic complication and the prevention of its development.	1	116	12	34	26	28	66	33	1	0
		2	99	12	36	26	26	68	30	2	0
		X	16					94	6	0	0
	10. Possibility of prevention of the onset of insulin-dependent diabetes by immunosuppression.	1	102	6	27	32	35	34	51	14	0
		2	85	7	24	34	35	31	56	13	0
		X	9					67	11	22	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Degree of certainty (%) Medium	Degree of certainty (%) Low	Necessity of international joint development (%) High	Necessity of international joint development (%) Medium	Necessity of international joint development (%) Low	Necessity of international joint development (%) None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Comparison of current R&D level between Japan and other countries (%) Equivalent	Comparison of current R&D level between Japan and other countries (%) Other countries are more advanced	Comparison of current R&D level between Japan and other countries (%) Don't know	Constraints on realization (%) Technical	Constraints on realization (%) Institutional	Constraints on realization (%) Cultural	Constraints on realization (%) Cost	Constraints on realization (%) Funding	Constraints on realization (%) Fostering/securing human resources	Constraints on realization (%) R&D system	Constraints on realization (%) Others
	28	45	23	10	29	36	19					36	13	20	12	20	22	31	9
	25	55	18	9	31	47	11	9	55	12	19	50	12	20	11	15	23	44	3
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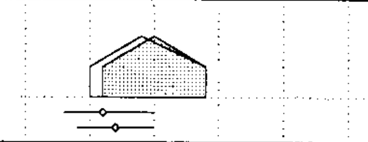
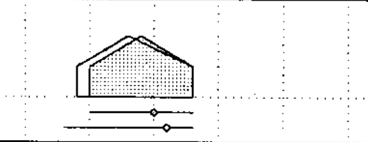
	16	47	32	53	35	8	2					61	2	2	8	41	24	34	0
	7	58	33	66	31	1	2	5	40	39	13	75	2	1	6	41	25	33	0
	31	56	13	81	19	0	0	0	56	38	6	69	6	0	6	44	6	50	0
	8	58	30	45	39	13	1					62	2	1	7	41	23	32	1
	5	65	27	50	44	3	1	5	47	33	12	75	1	0	4	45	22	32	1
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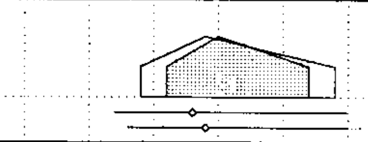
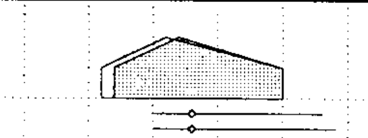
	16	39	41	75	19	4	0					63	3	1	9	44	23	37	1
	12	42	44	82	13	3	0	2	54	37	4	75	1	0	6	46	25	36	0
	38	44	19	88	6	6	0	0	56	44	0	81	0	0	6	31	6	75	0
	10	43	40	63	30	5	0					66	3	8	3	41	23	33	1
	10	47	40	74	21	2	0	3	26	54	13	75	2	4	2	45	20	35	0
	25	31	38	75	13	6	0	0	31	69	0	69	6	6	0	25	25	56	0
	10	43	43	28	52	15	3					62	1	3	4	36	28	35	1
	10	44	43	27	61	9	3	8	41	28	20	70	0	1	4	39	29	38	1
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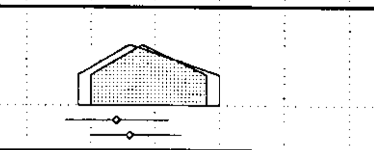
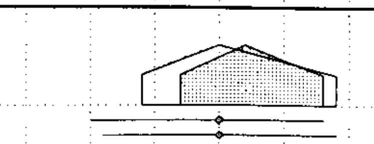
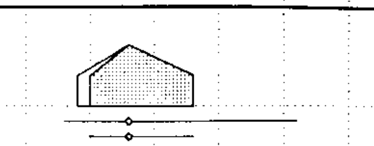
	15	45	33	56	30	8	1					61	1	2	10	42	22	30	1
	9	53	35	64	30	4	1	5	44	40	7	71	2	3	6	47	19	35	0
	19	67	15	70	26	0	4	11	48	41	0	74	0	4	7	52	7	44	0
	13	39	43	77	16	3	1					54	3	12	10	56	25	20	0
	14	34	52	81	17	0	0	2	27	58	8	65	1	9	6	65	20	22	0
	42	25	33	83	17	0	0	8	25	67	0	58	8	17	8	42	25	42	0
	16	47	31	45	40	7	6					58	2	5	10	40	19	33	3
	13	54	30	51	40	4	3	2	60	27	7	67	2	3	9	40	22	29	3
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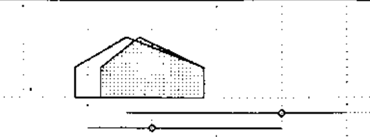
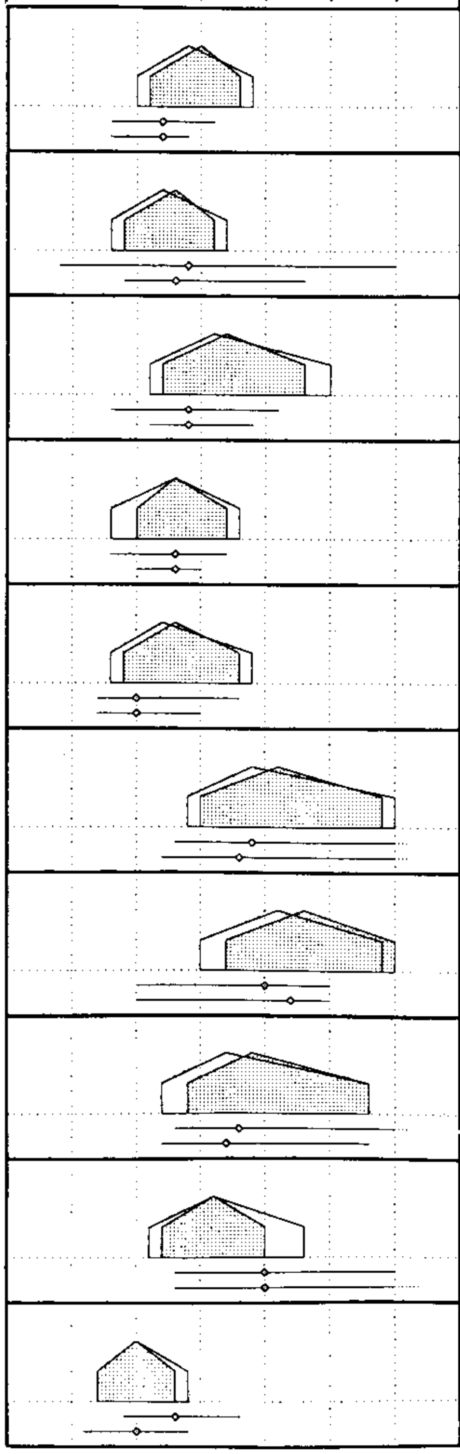
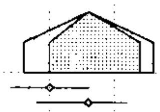
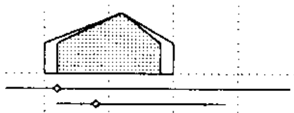
	7	39	44	49	33	9	5					56	1	1	8	36	26	29	3
	9	38	47	49	44	1	4	4	45	33	15	72	1	1	5	38	27	32	5
	22	44	33	56	44	0	0	0	44	44	11	89	0	0	0	22	33	44	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Improvement of preventive methods	11. Development of vaccine for many infectious diseases, leading to dramatically reduced infectious diseases.	1	118	10	23	41	26	54	39	6	1
		2	99	7	29	39	25	56	43	1	0
		X	9					78	22	0	0
	12. Development of an HIV vaccine.	1	109	8	23	38	32	67	32	1	0
		2	92	5	26	38	31	76	24	0	0
		X	7					86	14	0	0
	13. *Diffusion of standardized preventive methods against* cancer, utilizing various pharmaceutical and dietary means.	1	131	19	28	36	18	53	34	11	1
		2	111	15	28	41	17	59	36	4	2
		X	20					70	30	0	0
	14. Enhancement of secondary cancer prevention (early detection) system and social awareness of importance of same, resulting in an average survival rate exceeding 70% five years after outbreak for all types of cancer (current rate: 50%).	1	134	21	29	34	16	73	20	6	1
		2	111	17	32	35	17	77	19	4	0
		X	22					91	9	0	0
	15. Development of effective prevention method against adult T-cell leukemia (ATL).	1	103	10	22	34	34	43	45	12	0
		2	85	7	26	33	34	42	49	7	0
		X	9					56	33	0	0
	16. Development of effective methods of preventing Alzheimer's disease.	1	114	11	25	36	28	75	19	6	0
		2	97	11	28	34	26	82	16	1	0
		X	15					93	7	0	0
	17. Practical use of methods for securely preventing delayed neuronal death.	1	84	7	15	31	46	46	43	11	0
		2	75	8	12	37	42	56	39	5	0
		X	11					91	9	0	0
	18. Development of mental health techniques, enabling the prevention of mental disorders from stresses.	1	102	13	19	31	36	42	43	14	1
		2	87	12	21	33	34	48	41	9	1
		X	16					75	25	0	0
	19. Possibility of the prevention of chronic nephritis.	1	105	9	23	35	34	40	46	14	0
		2	88	8	22	37	32	38	53	9	0
		X	11					73	18	9	0
	20. Possibility of preventing secondary tooth decay based on application of lasers for painless, vibration-free removal of tooth and increased adhesion between cavity filling resin and tooth.	1	69	4	10	29	56	28	45	28	0
		2	57	5	9	29	56	23	53	25	0
		X	7					86	14	0	0



Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	11	49	35	54	32	5	4					53	5	2	22	38	18	28	3
	8	59	30	62	31	3	2	8	53	24	11	64	6	0	15	47	17	34	0
	44	56	0	78	22	0	0	33	44	22	0	44	11	0	22	56	11	44	0
	18	47	30	74	19	2	1					67	6	5	13	34	21	25	2
	16	51	29	85	10	1	1	3	23	63	8	83	5	2	7	38	24	22	1
	43	43	14	86	14	0	0	14	14	71	0	86	14	0	0	43	14	29	0
	14	44	34	36	34	17	5					39	8	30	10	26	18	31	5
	9	47	41	37	39	18	4	12	59	14	10	50	7	31	6	26	16	40	2
	25	60	15	55	30	10	5	20	70	10	0	40	15	20	0	40	20	60	0
	23	51	20	27	33	25	11					37	23	17	23	31	20	24	3
	16	59	22	24	40	25	8	33	44	11	6	50	24	13	19	32	18	24	1
	41	45	14	36	32	23	9	55	41	5	0	32	27	18	36	32	27	23	0
	21	46	31	30	40	17	12					60	4	4	15	36	26	32	2
	15	56	27	27	47	16	7	41	35	16	4	76	6	4	9	40	19	27	1
	33	56	0	33	33	22	0	56	33	11	0	56	11	0	11	44	11	33	0
	7	39	49	61	27	9	0					70	2	4	6	38	19	33	3
	8	40	48	75	19	3	0	3	29	56	8	79	0	2	4	45	16	35	1
	33	33	33	93	0	7	0	0	40	60	0	67	0	7	0	47	20	40	0
	11	26	56	54	33	8	0					73	1	5	4	40	14	32	4
	7	32	57	64	28	4	0	1	35	44	16	81	1	4	1	45	17	29	1
	18	45	36	91	9	0	0	9	27	64	0	73	0	9	0	45	9	55	0
	14	34	44	26	41	19	10					47	9	27	5	27	31	25	7
	14	33	51	29	53	15	3	3	40	31	21	60	9	24	3	24	44	20	3
	38	44	19	44	38	19	0	19	56	25	0	50	19	25	6	6	50	19	13
	10	45	38	30	38	22	4					63	2	3	6	38	19	31	2
	7	50	36	32	48	15	1	7	51	18	15	76	2	1	6	39	16	33	0
	36	36	27	82	18	0	0	9	45	45	0	55	0	9	0	45	36	27	0
	19	45	33	16	30	33	14					58	1	0	23	35	17	20	0
	14	60	23	18	37	37	4	21	39	12	23	70	0	0	21	42	21	14	0
	43	57	0	43	29	29	0	57	14	29	0	100	0	0	0	14	29	29	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Improvement of preventive methods	21. Dramatically reduced fetal death and births of premature babies owing to advanced systems for acquiring and controlling information on fetuses.	1	101	6	14	44	36	35	47	18	1
		2	82	5	14	43	38	33	50	17	0
		X	7					71	29	0	0
	22. Reduction of births with congenital abnormalities caused during the embryonic and fetal periods to half of its current level based on advanced methods of prevention.	1	88	6	10	40	44	40	47	14	0
		2	71	6	11	38	45	41	49	8	1
		X	8					75	25	0	0
	23. Widespread use of preventive method for infantile cerebral palsies, reducing its incidence to half of its current level.	1	88	7	12	37	44	40	51	8	1
		2	73	6	14	37	43	42	52	5	0
		X	8					75	25	0	0
	24. Predominance of preventive medicine in medical science.	1	139	30	24	32	14	69	22	8	1
		2	117	30	21	38	11	75	20	5	0
		X	39					85	15	0	0
	25. Widespread use of scientific guidelines concerning lifestyle (nutrition, rest, exercise) for prevention of adult diseases, based on advances in nutriology and basic medicine.	1	132	25	32	27	16	58	33	8	1
		2	111	21	32	31	16	60	33	6	0
		X	28					79	21	0	0
	26. Elucidation of the mechanisms of biological changes such as space sickness, space anemia, and deteriorated immunological competence that take place in space environments, enabling the development of methods for preventing them.	1	80	6	11	34	49	11	43	44	3
		2	70	5	12	36	46	13	34	51	1
		X	7					43	43	14	0
Improvement of inspection and diagnosis levels	27. Widespread use of technomethods for various types of infectious diseases, capable of rapidly identifying the microorganisms causing them and determining their susceptibility.	1	115	9	31	32	28	48	47	3	0
		2	95	6	33	33	28	44	52	4	0
		X	8					63	38	0	0
	28. Identification of causal genes of gout.	1	82	5	18	29	48	16	51	28	2
		2	67	4	16	32	48	19	58	21	1
		X	5					40	40	20	0
	29. Practical use of diagnostic technology of cancer from primary focus (including peripheral lymph nodes) in the form of three-dimensional images.	1	116	12	29	32	28	42	47	9	2
		2	97	11	27	35	27	38	58	3	1
		X	14					86	14	0	0
	30. Practical use of early diagnosis of cancer risk based on gene analysis and cytological means.	1	109	9	26	33	32	59	34	6	0
		2	93	7	27	36	31	61	33	5	0
		X	9					89	11	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	13	48	33	23	35	29	8					49	15	33	11	20	17	19	2
	13	50	33	27	45	21	4	11	44	22	18	57	16	35	7	18	16	20	4
	29	57	14	57	29	14	0	14	57	29	0	71	14	29	14	14	14	29	0
	7	36	52	39	34	18	6					53	16	33	7	20	18	25	2
	8	38	49	46	37	13	1	1	42	30	24	68	11	38	4	13	14	30	1
	38	38	25	75	13	13	0	0	50	50	0	75	0	25	0	25	0	38	0
	9	40	45	27	33	28	7					58	9	13	6	35	24	27	3
	7	45	45	32	38	26	1	7	45	16	27	68	8	12	3	32	26	22	4
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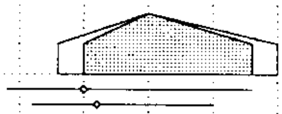	24	36	35	46	29	14	8					32	37	21	14	19	29	26	4
	16	44	36	61	26	9	4	9	38	38	12	39	46	15	14	17	40	21	1
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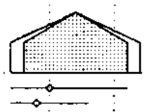	36	44	17	30	30	23	17					19	28	39	8	30	30	25	2
	32	44	21	30	32	26	9	12	54	23	8	17	32	41	6	29	36	22	1
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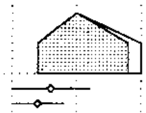	10	39	45	81	13	0	1					61	5	3	16	45	26	25	1
	16	34	46	81	13	0	3	1	9	80	6	63	4	3	11	56	24	24	0
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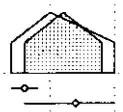	30	48	17	36	43	13	6					55	2	2	27	38	25	23	1
	26	52	19	45	41	11	1	6	63	20	7	65	1	0	19	45	31	15	0
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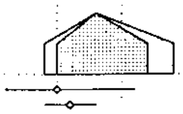	9	51	32	35	35	20	2					57	0	2	9	41	28	28	0
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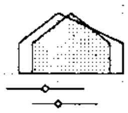	22	59	15	32	37	18	9					61	3	0	22	55	16	16	0
	22	56	21	31	45	13	8	22	48	20	5	72	2	0	16	63	16	12	0
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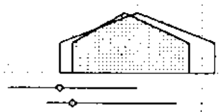
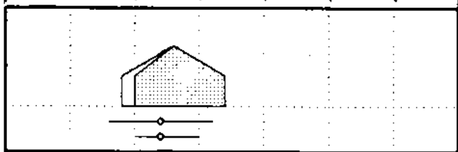
	15	50	30	54	32	9	2					59	1	9	17	47	20	25	2
	9	60	28	57	32	8	1	4	44	41	5	68	3	8	14	53	16	16	1
	56	22	22	78	11	11	0	11	44	44	0	44	0	33	33	44	0	44	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Improvement of inspection and diagnosis levels	31. Use of biochemical testing in mass cancer screening, making possible fairly early diagnosis of cancer.	1	136	16	32	38	14	63	32	4	1
		2	113	14	32	38	15	69	27	3	1
		X	19					79	21	0	0
	32. Possibility of accurate estimation of sensitivity of cancer of each patient to drugs based on testing of cancerous tissue or blood tests.	1	120	10	27	38	25	45	40	15	0
		2	98	11	27	36	26	51	41	8	0
		X	14					86	14	0	0
	33. Widespread use of automatic testing equipment for cancer cytodiagnosis on a par with that of current biochemical automatic testing equipment.	1	123	12	28	38	23	42	46	9	2
		2	104	13	30	35	22	42	49	6	3
		X	17					59	35	6	0
	34. Possibility of imaging methods for differential diagnosis of mental diseases, enabling classification and determination of phases of schizophrenia, in particular, by imaging diagnoses.	1	79	9	16	25	50	28	49	23	0
		2	66	8	17	25	50	32	50	18	0
		X	10					70	30	0	0
	35. Practical use of diagnosing methods for determining the level and spread of atherosclerosis focuses by noninvasive methods.	1	109	18	26	25	31	47	47	6	0
		2	92	16	30	24	30	51	43	4	0
		X	21					71	29	0	0
	36. Practical use of endoscopes for alimentary tract in capsule form (which, when swallowed, monitors the inner alimentary tract wall in the form of images, with movement controlled externally).	1	102	10	20	34	35	29	58	12	1
		2	89	9	21	37	33	28	61	9	1
		X	12					58	25	8	8
	37. Practical use in many fields of medical diagnostic aids equipped with basic intelligence and diagnostic functions on the specialist level, capable of indicating treatment guidelines.	1	129	17	23	40	20	30	49	19	2
		2	109	14	26	41	19	29	51	17	1
		X	19					53	32	11	5
	38. Practical use of the near infrared CT for clinical applications.	1	77	9	17	23	51	17	52	29	1
		2	64	8	17	23	52	19	55	25	2
		X	11					18	55	27	0
	39. Development of methods for image-diagnosing changes to morbid states at the tissue level in a noninvasive manner.	1	102	9	19	36	36	51	38	11	0
		2	89	7	21	38	34	52	42	7	0
		X	10					80	10	10	0
	40. Practical use of many types of technologies for acquiring inspection data in a noninvasive manner by remote control without taking body fluids such as blood.	1	93	8	21	30	41	44	43	10	2
		2	78	7	20	32	41	47	45	8	0
		X	9					56	33	11	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	19	52	22	35	42	13	6					65	4	1	25	37	18	24	1
	18	58	21	35	53	8	2	16	49	20	11	76	4	0	20	51	16	18	1
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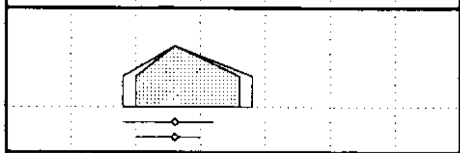
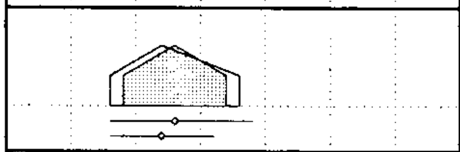
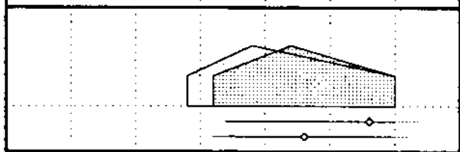
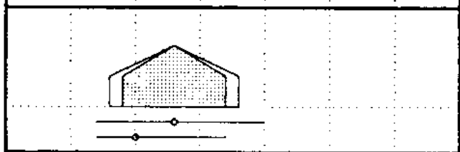
	13	50	35	30	46	17	6					66	6	0	18	40	22	23	2
	9	57	32	37	52	7	3	10	47	22	16	79	4	0	10	53	19	17	0
	43	43	14	71	21	7	0	14	50	36	0	71	7	0	36	43	14	21	0
	20	48	29	18	42	26	11					65	1	0	37	41	14	15	2
	13	56	29	21	54	16	5	16	52	12	15	73	1	0	32	52	12	13	1
	29	65	6	47	35	12	6	24	53	18	6	76	0	0	29	41	18	12	0
	11	35	48	24	38	27	5					67	1	16	10	29	16	22	5
	11	29	59	36	45	14	2	6	29	36	24	80	2	12	5	41	17	23	2
	30	10	60	60	30	10	0	10	30	60	0	70	10	30	0	30	20	30	0
	23	46	28	28	42	22	6					73	1	0	17	43	18	22	1
	20	50	27	28	49	17	3	7	54	22	12	82	1	0	11	52	13	22	0
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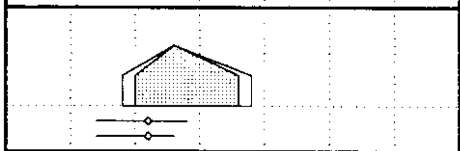	19	50	28	21	28	29	20					71	1	0	25	48	11	16	0
	13	49	34	18	36	34	8	38	31	9	16	79	0	0	24	51	10	13	0
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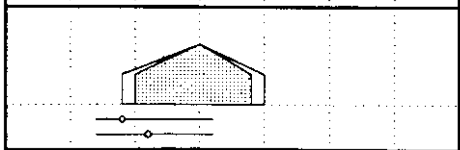
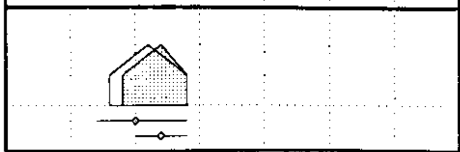
	18	47	32	18	36	27	16					47	12	8	25	40	16	21	4
	10	56	30	20	50	18	9	11	49	24	10	63	7	4	21	53	13	22	3
	26	58	5	42	21	21	11	16	42	32	5	58	5	5	26	37	26	16	5
	12	58	18	21	34	19	16					74	0	0	19	43	8	12	0
	16	61	19	22	45	16	13	14	53	16	11	81	0	2	16	61	8	13	0
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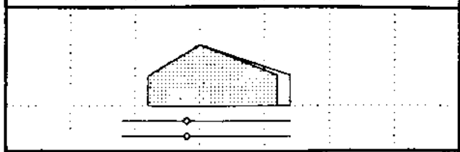	13	49	30	34	35	19	6					69	0	0	17	43	12	21	0
	9	58	30	38	46	11	2	15	51	18	13	78	0	0	12	62	9	19	1
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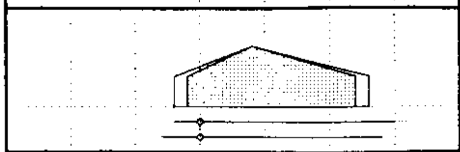
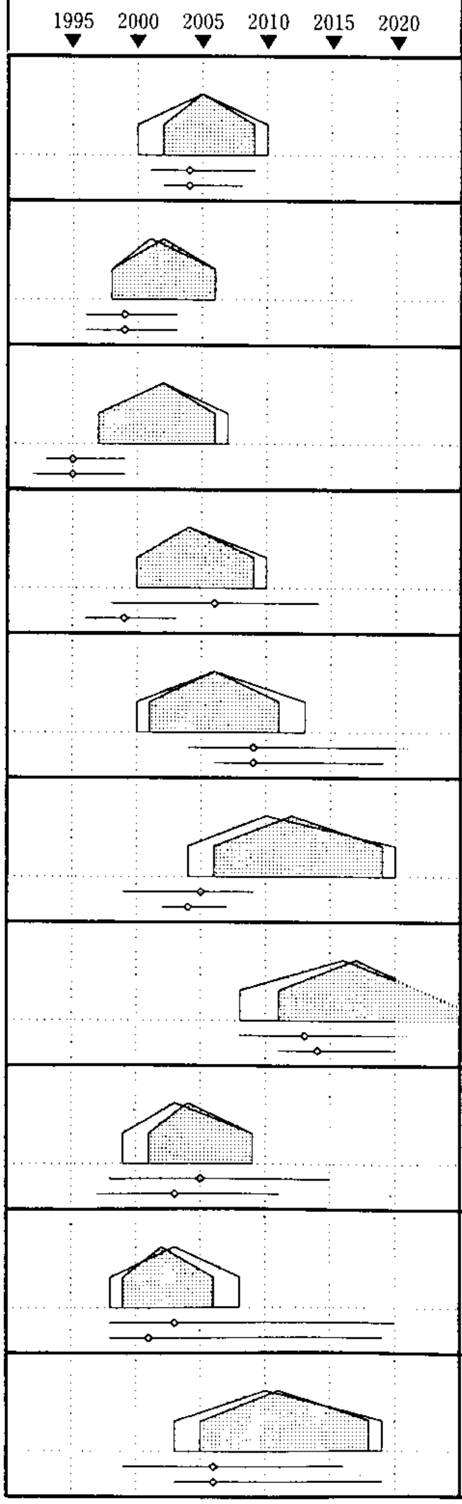
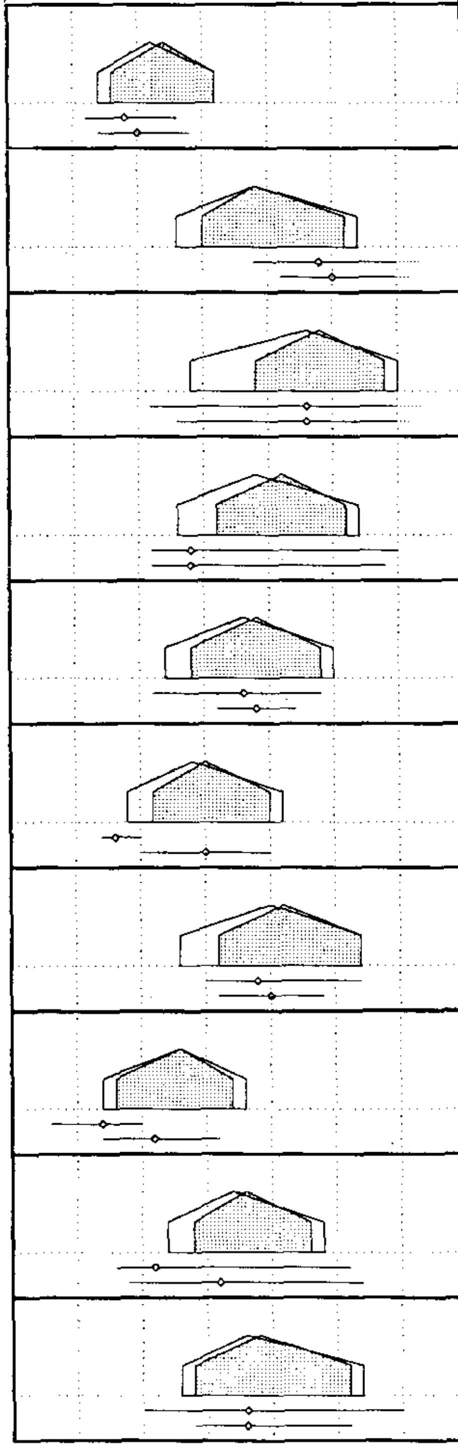
	9	39	41	33	30	16	11					76	0	0	19	37	12	16	0
	6	49	38	33	46	9	8	4	56	14	21	85	0	0	15	53	9	17	0
	33	44	22	33	44	0	22	11	89	0	0	89	0	0	22	22	11	11	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Improvement of inspection and diagnosis levels	41. Widespread use of diagnostic and therapeutic equipment enabling continuous monitoring of bio-information based on development of bio-sensor technology and materials enabling long-term use.	1	120	16	26	33	25	43	45	12	0
		2	101	14	23	39	23	43	49	8	0
		X	19					63	32	5	0
	42. Practical use of early diagnosis of the hemobio-chemical level of rejective reactions to organ and tissue transplants.	1	121	17	23	36	24	49	41	9	1
		2	100	14	27	34	25	52	45	2	0
		X	19					74	21	0	0
Improvement of medical care	43. Practical use of effective anti-cytomegalovirus agents.	1	81	8	17	28	48	31	51	19	0
		2	69	8	16	29	47	29	58	12	0
		X	10					70	20	0	0
	44. Practical use of pharmaceuticals for viral hepatic diseases.	1	105	6	22	39	33	68	30	2	0
		2	88	5	22	40	32	70	27	1	0
		X	7					57	29	0	0
	45. Establishment of cure for AIDS.	1	107	5	17	46	31	70	27	2	1
		2	90	4	20	45	31	77	21	1	0
		X	5					100	0	0	0
	46. Realizing of complete cure for many types of allergic diseases.	1	111	8	19	44	29	53	40	7	0
		2	96	5	20	48	26	57	36	4	0
		X	7					88	14	0	0
	47. Realization of complete cures for virtually all types of autoimmune diseases.	1	102	10	20	36	35	57	34	6	1
		2	84	8	18	38	35	63	32	2	1
		X	11					82	9	0	9
	48. Development of an effective insulin that can be administered orally.	1	91	6	24	28	42	36	44	14	5
		2	76	6	24	29	41	38	49	8	4
		X	8					25	63	13	0
	49. Eradication further of one or more infectious disease (e.g., malaria), ranking with the eradication of smallpox.	1	109	6	19	43	31	39	50	9	1
		2	90	4	19	45	32	39	51	9	0
		X	5					60	40	0	0
	50. Elucidation of function of main histocompatibility (MHC) gene complex enabling gene therapy for MHC-related allergies and autoimmune diseases.	1	83	6	20	27	46	43	49	7	0
		2	68	5	18	29	47	46	50	3	0
		X	7					71	29	0	0



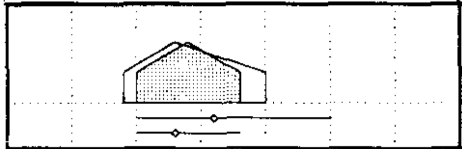
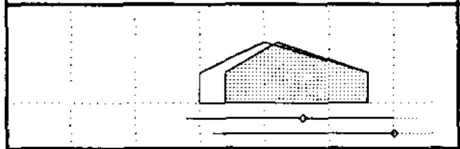
Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	13	53	28	32	35	23	8					79	3	0	23	43	9	19	0
	11	53	31	33	44	17	4	20	50	16	10	80	0	0	20	58	10	18	0
	32	63	5	37	32	21	11	37	37	21	0	79	0	0	11	63	21	11	0
	26	50	21	52	36	8	2					68	7	5	13	36	17	24	0
	21	54	23	62	33	3	1	4	30	57	6	79	3	6	8	50	14	25	0
	68	32	0	79	16	0	5	5	26	63	0	63	5	0	5	68	32	21	0
	21	49	28	41	43	16	0					69	1	0	22	40	21	19	0
	20	52	26	49	43	6	0	0	51	36	12	80	0	0	13	57	16	19	0
	70	30	0	60	40	0	0	0	50	50	0	80	0	0	10	40	20	30	0
	14	54	25	40	43	12	1					70	0	1	17	38	19	23	1
	16	49	30	47	43	7	0	7	49	24	17	82	0	0	9	52	15	18	0
	57	43	0	43	43	14	0	14	57	29	0	71	0	0	14	43	29	29	0
	11	42	40	79	16	1	2					68	2	6	7	36	21	28	4
	10	42	42	87	9	0	1	0	12	74	8	80	0	4	4	52	13	26	0
	40	60	0	100	0	0	0	0	20	80	0	80	0	0	0	80	0	40	0
	10	47	35	37	43	14	3					74	1	0	8	39	21	23	0
	9	47	36	40	48	8	1	1	53	25	17	81	0	0	6	46	18	27	0
	43	57	0	43	57	0	0	0	86	14	0	86	0	0	0	71	29	14	0
	7	44	39	46	37	11	1					72	2	0	6	44	17	21	0
	7	38	46	57	35	4	1	1	39	45	11	81	1	0	5	62	12	20	0
	18	45	18	82	18	0	0	0	36	55	9	82	9	0	0	73	0	36	0
	9	58	25	43	31	15	5					65	1	0	19	47	11	19	2
	8	61	28	57	29	7	4	5	46	33	11	75	0	0	13	57	8	17	3
	25	63	13	38	50	13	0	13	63	13	13	63	0	0	25	25	0	25	13
	17	42	34	75	14	6	0					42	12	13	15	32	29	26	2
	10	54	31	81	11	6	0	3	36	44	13	51	9	7	14	46	28	28	0
	40	60	0	100	0	0	0	0	40	60	0	60	40	0	20	40	0	40	0
	6	51	39	65	27	6	1					71	5	13	12	39	12	30	0
	9	51	34	76	16	3	3	0	32	57	4	79	3	7	3	49	12	28	0
	43	43	0	57	29	0	14	0	43	57	0	100	14	14	0	43	0	29	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Improvement of medical care	51. Mass in-vitro production and employment of several types of therapeutically effective antibodies based on gene manipulation.	1	105	9	23	35	33	47	47	7	0
		2	88	8	26	33	33	45	52	2	0
		X	11					73	27	0	0
	52. Possibility of the treatment using gene manipulation for insulin-dependent diabetes.	1	91	5	22	31	42	38	47	12	2
		2	77	5	24	31	41	38	53	8	1
		X	6					33	67	0	0
	53. Identification of a causal gene of non-insulin-dependent diabetes, enabling treatment using gene manipulation.	1	90	7	18	32	43	38	46	14	0
		2	74	5	21	32	43	38	51	11	0
		X	6					33	67	0	0
	54. Development of the treatment using gene manipulation for familial hypercholesterolemia.	1	89	7	20	30	43	34	51	13	1
		2	75	4	23	32	41	35	55	11	0
		X	5					40	60	0	0
	55. Practical use of chemotherapeutic methods capable of producing a total remission for at least 50% of all types of cancers, including those with a low response to conventional drugs, such as stomach, lung, and colon cancer.	1	103	11	21	33	34	62	31	4	2
		2	90	10	24	35	31	70	27	1	2
		X	13					85	8	0	8
	56. Development of effective radiation sensitizer, boosting the effectiveness of cancer radiotherapy by at least 30%.	1	95	6	22	32	40	41	45	13	1
		2	84	4	25	35	37	40	51	7	1
		X	5					60	20	0	20
	57. Practical use of effective means of preventing cancer metastasis.	1	113	12	25	35	28	72	24	4	0
		2	96	10	22	41	27	74	22	4	0
		X	13					92	8	0	0
	58. Development of treatment methods for cancers which use heavy corpuscular beams.	1	68	5	15	24	56	37	49	15	0
		2	59	5	19	22	54	41	46	14	0
		X	7					86	14	0	0
	59. Development of a therapeutic methods, for cancer based on biological and immunological theory, ranking after chemotherapy as a cancer therapy.	1	107	12	21	35	32	64	32	5	0
		2	93	11	23	37	29	71	26	3	0
		X	14					93	7	0	0
	60. Development of methods for moving desired drugs to desired parts in the brain.	1	94	8	23	28	41	41	47	11	1
		2	82	8	23	32	37	45	48	6	1
		X	11					73	18	0	9



Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	28	41	27	46	41	12	0					69	4	2	30	45	14	21	1
	24	47	26	53	35	8	0	5	48	38	7	77	3	1	22	55	9	18	1
	36	55	9	45	45	9	0	9	55	36	0	73	18	0	36	36	9	27	0
	8	38	46	47	41	8	1					74	4	14	13	37	12	22	2
	9	34	51	60	30	4	1	1	32	51	13	82	3	6	6	51	8	23	3
	33	33	33	33	67	0	0	0	17	67	17	100	0	0	0	83	0	0	0
	7	40	44	43	43	8	2					71	6	13	14	40	12	21	2
	7	35	51	54	35	3	3	1	27	53	16	78	3	7	8	53	8	22	3
	33	17	50	33	50	0	17	0	33	50	17	83	0	0	17	83	0	0	0
	8	42	43	47	38	8	3					76	4	13	13	37	13	24	0
	9	40	45	59	32	3	1	4	27	57	8	83	1	7	3	49	11	25	0
	20	60	20	40	60	0	0	0	40	60	0	60	0	0	0	60	0	60	0
	10	51	33	48	38	9	1					68	2	1	13	50	14	26	5
	8	51	38	57	31	4	2	12	48	28	7	74	1	2	4	59	12	28	1
	23	62	8	69	15	0	0	23	23	46	0	77	0	0	0	69	0	31	0
	13	37	46	38	44	14	1					72	3	0	17	42	17	16	3
	11	43	44	38	51	6	0	6	49	30	12	74	2	0	11	60	17	13	0
	20	40	20	20	60	0	0	0	40	40	0	60	0	0	20	40	20	0	0
	9	46	40	47	35	12	2					73	4	1	5	45	18	19	4
	8	47	43	54	34	6	1	4	43	31	18	84	3	0	5	59	9	20	2
	31	62	8	69	8	15	0	8	38	31	23	85	8	0	0	77	8	15	8
	16	51	32	47	40	9	4					63	6	3	21	62	16	18	0
	15	61	24	47	44	5	0	3	46	44	5	66	7	2	17	69	15	14	0
	71	29	0	57	29	14	0	0	43	57	0	57	14	0	29	71	29	0	0
	14	45	37	52	33	11	2					67	3	0	8	46	23	23	2
	10	49	38	59	30	5	2	8	54	26	6	77	2	0	4	55	20	20	2
	36	57	7	57	21	7	7	14	71	0	0	86	0	0	7	64	7	29	0
	12	41	38	43	32	17	4					82	0	4	6	36	17	22	1
	6	48	41	52	32	10	1	7	37	33	17	85	0	0	2	46	15	24	1
	27	55	18	55	27	9	9	9	18	64	0	82	0	0	0	27	18	45	9

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Improvement of medical care	61. Development of devices to conquer motor paralysis with advances in rehabilitation technology.	1	113	10	26	36	28	44	47	7	0
		2	93	9	25	38	28	44	52	4	0
		X	12					67	33	0	0
	62. Development of effective treatment for Alzheimer's disease.	1	97	8	19	35	38	72	24	3	0
		2	86	9	20	38	33	79	19	2	0
		X	11					91	9	0	0
	63. Development of almost perfectly effective therapeutic drugs for schizophrenia.	1	86	6	11	38	45	59	33	7	0
		2	72	5	12	38	45	64	31	6	0
		X	7					100	0	0	0
	64. Practical safe control of pain.	1	106	10	25	32	33	53	41	5	1
		2	88	9	22	36	33	60	33	6	1
		X	12					92	0	0	8
	65. Development of effective treatment for muscular dystrophy.	1	89	6	15	36	43	42	46	11	1
		2	74	5	16	36	43	49	45	5	1
		X	7					71	14	14	0
	66. Development of effective treatment for amyotrophic lateral sclerosis.	1	82	4	13	35	47	39	44	16	0
		2	68	5	14	33	47	41	47	12	0
		X	7					71	29	0	0
	67. Development of agents to suppress rejective reactions, superior to ciclosporin.	1	106	13	27	27	33	63	31	5	0
		2	86	12	26	27	35	72	24	3	0
		X	16					88	13	0	0
	68. Practical use of extremely effective treatment for atherosclerosis.	1	107	12	27	29	32	71	26	2	0
		2	90	11	28	30	31	76	22	2	0
		X	14					79	21	0	0
	69. Realization of free conversion between smooth muscles, striated muscles, and the myocardium.	1	72	5	17	24	54	25	49	22	3
		2	57	5	20	19	56	30	49	19	2
		X	6					33	67	0	0
	70. Elucidation of the mechanism of interaction between blood and the surface of artificial substances, enabling design and synthesis of artificial blood vessels and artificial valves which do not cause blood coagulation and which do not incur damage from fatigue from flexing or other stresses.	1	114	17	26	30	27	54	36	9	0
		2	91	18	28	24	30	63	30	8	0
		X	23					91	9	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	12	48	32	29	41	19	6					55	4	2	33	46	19	21	0
	10	53	32	29	55	11	3	6	44	34	10	66	3	2	27	56	15	20	0
	25	67	8	50	33	8	8	17	58	25	0	75	25	0	33	50	0	8	0
	10	42	42	59	32	7	0					72	2	8	8	42	21	26	2
	8	44	44	66	29	2	0	1	33	52	10	81	2	0	3	51	17	26	1
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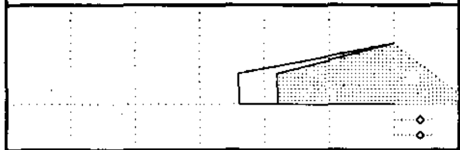
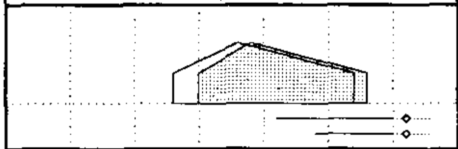
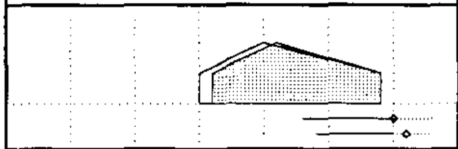
	12	36	44	48	38	10	1					78	1	10	6	33	15	28	5
	13	33	49	58	35	4	1	0	32	40	26	88	0	4	3	42	14	29	1
	43	43	14	71	29	0	0	0	29	71	0	100	0	14	0	43	0	29	0
	12	51	30	37	38	15	6					67	4	3	15	37	17	22	2
	8	51	36	43	41	9	3	3	43	31	17	78	1	1	13	51	14	15	0
	25	42	33	75	17	8	0	0	67	33	0	92	8	8	17	50	0	8	0
	9	42	44	44	43	11	1					74	3	3	10	44	15	27	3
	5	41	51	54	42	3	1	3	43	34	18	82	0	1	3	50	14	30	3
	43	29	29	71	29	0	0	0	43	57	0	86	0	0	14	29	29	43	0
	4	43	48	45	39	13	1					78	1	4	9	40	16	32	4
	4	43	49	53	38	4	1	0	38	40	19	84	0	1	3	49	10	34	3
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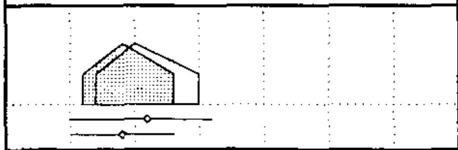	30	46	22	52	33	9	5					60	3	1	18	45	13	24	1
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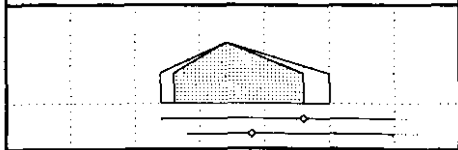	9	49	39	53	31	12	2					76	1	1	12	43	12	21	2
	4	58	36	56	23	8	1	1	44	39	11	84	0	0	11	60	6	18	0
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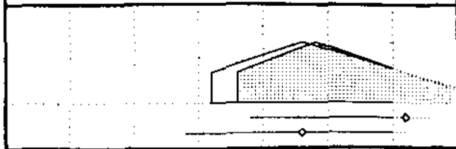	11	35	39	39	36	8	7					75	0	4	6	35	15	21	3
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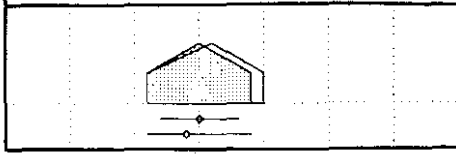
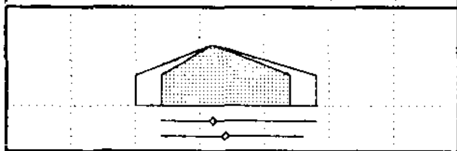
	16	56	25	48	35	10	4					78	0	0	21	40	11	15	1
	15	57	27	56	35	5	3	9	49	33	5	87	0	0	9	54	10	21	1
	35	57	9	74	22	0	4	9	52	35	0	91	0	0	9	48	13	17	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Improvement of medical care	71. Practical use of an implantable battery as power sources for artificial organs (like pacemakers).	1	102	14	18	31	37	41	49	10	0
		2	82	15	21	26	38	44	54	2	0
		X	20					60	30	10	0
	72. Development of many types of functional blood purifiers capable of selectively removing desired constituents from blood.	1	109	18	20	31	31	46	46	8	0
		2	92	18	23	30	30	50	45	4	0
		X	23					78	17	4	0
	73. Fabrication of safe, high-polymer materials with hemoglobin functions, which come into widespread use in place of red cells.	1	112	13	23	34	30	38	48	13	2
		2	92	11	27	31	31	43	47	8	2
		X	15					47	47	0	7
	74. Development of totally implantable artificial hearts powered by high-output energy sources.	1	109	14	21	33	31	50	43	6	1
		2	89	16	20	32	33	49	43	8	0
		X	21					57	38	5	0
	75. Clinical application of artificial lungs.	1	101	16	18	30	36	44	46	8	3
		2	84	19	16	29	36	48	45	5	2
		X	25					52	44	0	4
	76. Possibility of complete cure of obstructive pulmonary diseases by medicines.	1	82	4	16	32	48	37	49	15	0
		2	72	3	18	34	45	36	53	11	0
		X	4					75	25	0	0
	77. Development of attachable or implantable artificial kidneys to replace blood dialysis for patients with chronic renal failures.	1	117	18	21	36	25	59	37	4	0
		2	97	18	21	35	26	72	25	3	0
		X	24					83	17	0	0
	78. Clinical application of implantable artificial pancreas using the micro-machining technologies or other similar technologies.	1	98	11	22	29	38	43	45	10	2
		2	78	13	19	27	41	41	54	3	3
		X	17					47	47	0	6
	79. Development of artificial liver (external devices supporting liver functions) usable on a long-term, continuous basis.	1	104	10	23	33	34	53	39	7	1
		2	80	11	18	32	39	59	35	6	0
		X	15					87	7	7	0
	80. Clinical application of artificial metabolic and endocrine organs in a hybrid form (i.e., with living cells and artificial substances in coexistence).	1	114	15	24	33	29	44	42	12	2
		2	90	16	22	30	32	43	47	9	1
		X	21					57	38	5	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	13	53	30	42	32	14	9					80	1	1	21	46	7	19	0
	12	51	33	48	35	9	5	10	40	37	9	83	0	0	12	65	6	18	0
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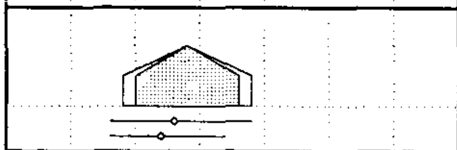	15	53	30	38	34	20	6					77	3	1	25	39	12	13	1
	13	59	24	36	43	12	4	20	51	18	5	82	1	1	17	54	4	16	0
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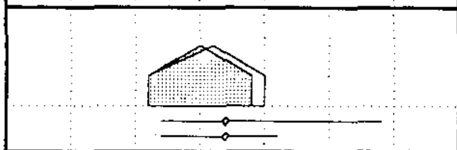	10	57	26	33	39	16	7					78	4	3	19	42	9	12	1
	11	59	25	34	49	9	4	14	52	25	3	80	3	0	21	55	4	11	1
	40	53	7	27	40	13	20	33	60	0	0	73	13	0	13	47	7	27	0
	18	42	34	50	31	9	6					79	4	6	23	53	7	9	0
	18	45	34	56	34	6	1	7	43	40	6	82	1	2	15	66	6	12	0
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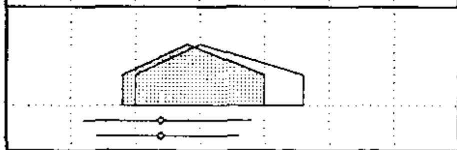	21	44	25	37	36	12	8					77	1	1	18	43	10	12	0
	24	48	24	42	39	8	6	10	40	39	7	83	1	0	10	61	8	12	0
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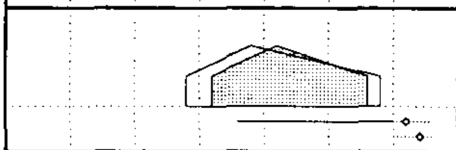	2	40	49	27	49	16	4					74	0	1	11	40	16	22	2
	3	40	54	28	57	13	1	0	46	32	18	83	0	1	7	54	13	21	1
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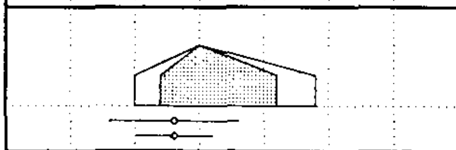	13	53	32	34	42	14	9					76	3	1	28	44	9	15	0
	14	57	27	36	43	9	9	21	55	14	7	86	1	0	19	58	7	13	0
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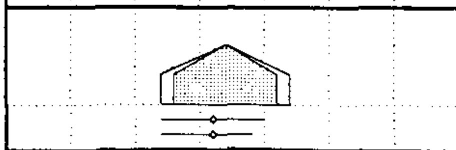	14	51	28	35	36	14	9					76	0	1	17	47	9	16	0
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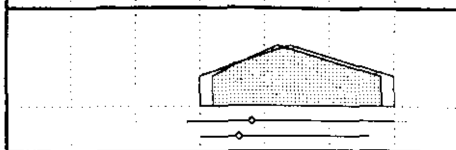	13	44	33	40	39	9	5					76	0	1	14	47	9	14	1
	10	50	35	48	40	8	1	14	41	30	10	84	0	0	13	60	4	16	1
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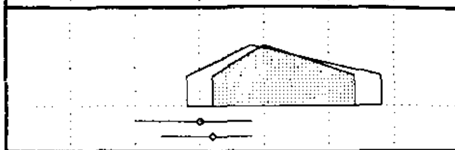
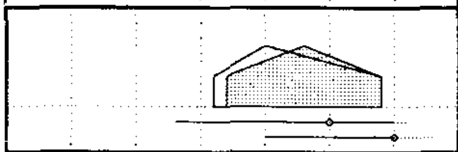
	10	48	37	46	34	11	4					74	0	2	12	51	9	18	1
	12	51	32	53	32	9	2	6	43	34	11	81	1	0	9	64	4	16	1
	29	62	10	57	29	10	5	14	57	24	5	90	0	0	5	62	5	14	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Improvement of medical care	81. Development of treatment for congenital abnormalities (*e.g., malformations and metabolic abnormalities) in* the fetal period.	1	87	5	11	41	44	45	45	9	1
		2	76	4	13	43	41	45	42	12	0
		X	5					80	20	0	0
	82. Widespread use of autotransplantation of tissue damaged by injury or disease, using tissues extracted and cultivated in advance.	1	112	7	28	36	29	29	47	21	4
		2	93	3	27	40	29	26	51	19	3
		X	4					25	50	25	0
	83. Elucidation of mechanism of tissue regeneration, leading to use of techniques to promote the healing of wounds in medical treatments.	1	104	8	23	35	34	40	46	13	0
		2	84	5	26	33	36	44	46	8	0
		X	7					43	43	14	0
	84. Practical use of gene therapy for a number of gene disorders.	1	98	8	15	39	38	53	32	12	2
		2	80	8	18	36	38	54	33	11	1
		X	10					90	10	0	0
	85. Development of systems for determining combinations of nutritive elements necessary for recovering from morbid states or for maintaining health.	1	102	11	22	31	35	27	50	19	3
		2	84	8	25	32	35	26	55	18	1
		X	11					27	64	9	0
	86. Performance of kidney, heart, lung, and other organ transplantation in Japan with a regularity on the order of that in Europe and in North America.	1	135	21	26	38	15	53	36	10	1
		2	111	20	28	36	16	50	40	10	0
		X	26					85	4	8	0
	87. Practical use of hetero-organ transplantation as means of treatment.	1	108	20	20	29	31	33	40	22	5
		2	89	18	22	29	31	38	40	16	4
		X	23					61	30	4	0
	88. Perfection of systems to lengthen organ preservation, enabling worldwide supply of some kinds of organs for transplantation.	1	127	23	20	37	21	49	35	13	2
		2	105	20	23	37	21	48	42	7	3
		X	26					73	15	0	8
	89. Development of methods for partially cutting off and absorbing internal tissues in a noninvasive manner.	1	83	6	17	30	47	37	42	16	4
		2	68	6	18	28	48	35	47	12	4
		X	8					63	13	13	13
	90. Practical use of medicines capable of sensing abnormalities in living bodies and performing controlled dosing for such sensed abnormalities. (For example, the polymer gel in a micro-capsule swells and the antifebrile in it is diffused into body fluids if a fever is sensed, while the gel shrinks to stop the dosing when the fever has abated.)	1	87	8	16	32	45	24	47	23	5
		2	68	7	16	29	48	22	51	24	3
		X	9					33	33	33	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	8	47	36	49	39	7	1					77	5	23	7	31	17	22	1
	7	47	38	54	37	5	0	0	36	43	16	84	4	20	4	36	11	22	0
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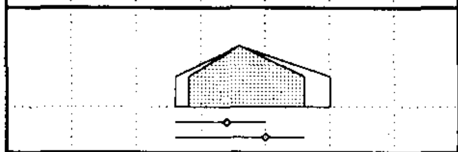	14	45	34	29	33	21	9					56	13	17	24	32	11	19	2
	9	54	32	29	37	22	6	1	37	38	14	60	11	14	19	45	6	17	2
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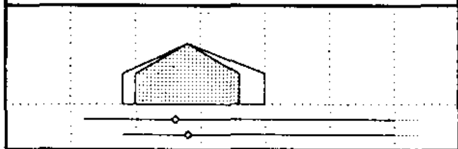
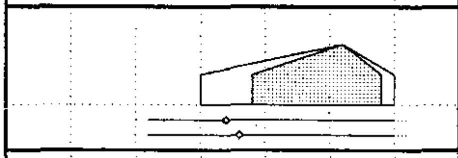
	13	57	29	31	45	16	6					69	3	0	10	43	17	25	1
	10	61	29	29	56	11	2	1	50	30	14	76	0	1	10	54	13	26	0
	43	29	29	29	43	14	14	0	86	14	0	43	0	0	29	43	29	29	0
	15	34	46	62	26	6	1					68	8	29	9	45	14	10	1
	10	44	43	68	24	4	1	1	24	63	8	75	1	28	6	51	14	6	1
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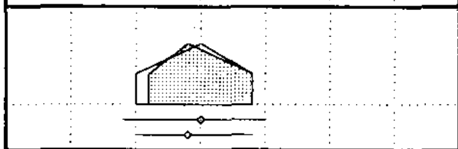	10	55	29	22	39	26	9					54	6	4	21	37	19	20	4
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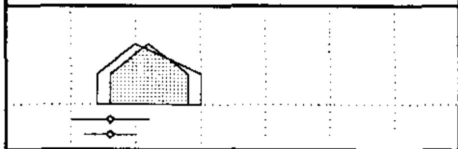	31	45	19	30	31	12	22					21	50	72	6	10	7	12	1
	25	53	19	33	32	8	23	5	6	77	6	21	60	77	3	10	5	9	1
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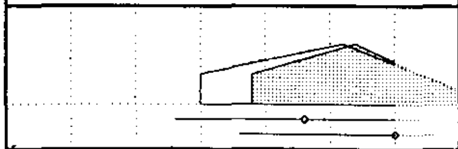
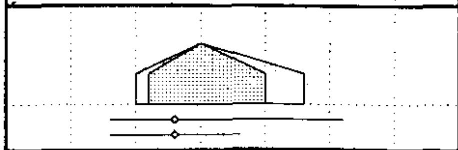
	14	44	31	45	26	13	7					60	22	41	4	17	8	15	1
	15	44	35	54	24	10	7	3	10	71	8	62	20	48	7	16	6	17	0
	35	39	26	74	17	4	4	4	9	78	4	74	30	35	4	0	9	26	0
	24	43	28	78	11	4	3					35	51	47	12	19	3	14	2
	13	57	28	82	9	4	4	1	14	74	7	39	57	52	9	16	6	10	0
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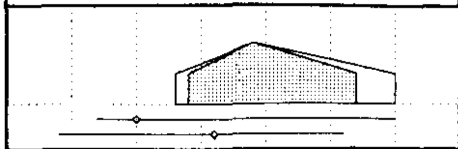	8	48	34	36	39	13	6					83	1	2	11	33	14	20	0
	12	49	34	37	46	10	3	3	35	31	26	87	1	1	7	50	10	21	0
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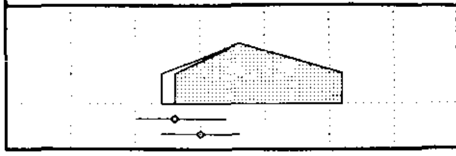
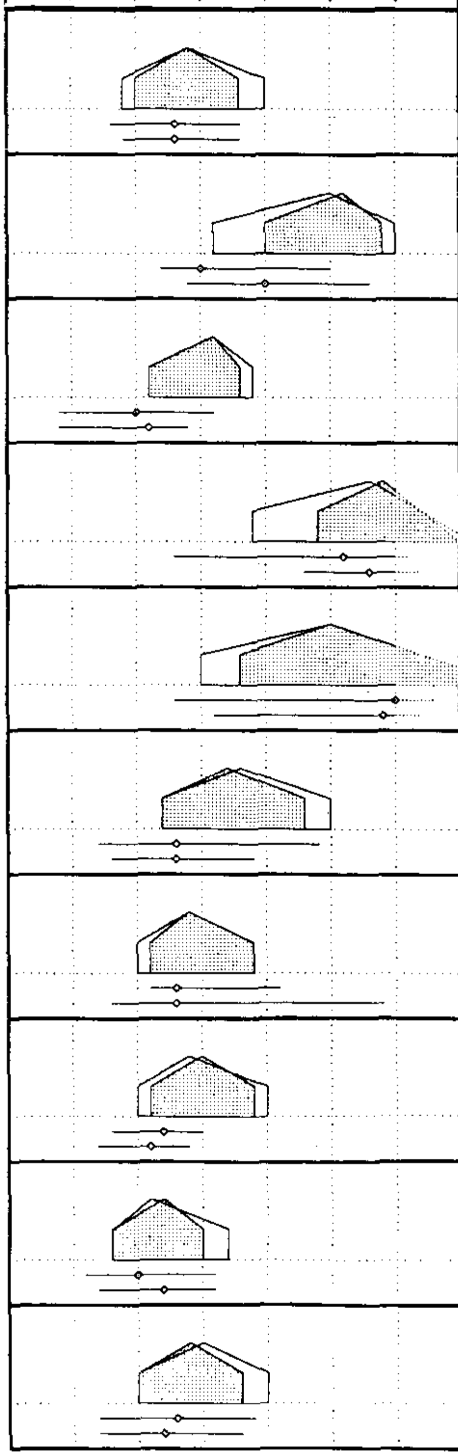
	17	37	39	30	39	15	10					75	5	3	20	38	8	15	3
	10	50	37	26	50	13	6	7	46	25	19	81	0	0	12	57	9	12	0
	33	33	33	56	22	0	22	11	33	44	11	89	0	0	0	44	11	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Improvement of medical care	91. Development of rapid and sure methods of determining the efficacy and safety (i.e., mutagenicity, teratogenicity, and toxicity) of pharmaceuticals.	1	104	12	25	29	35	64	31	4	1
		2	89	12	25	31	32	73	25	2	0
		X	16					88	13	0	0
	92. Practical use of treatment for repairing genes by incorporating particular genes in target tissues or internal organs.	1	91	6	20	32	42	43	40	15	1
		2	76	5	21	33	41	45	43	9	1
		X	6					50	50	0	0
Improvement of functional recovering and aiding levels	93. Practical use of implantable artificial ear effective not only for conductive hearing disorders but also for certain perceptive hearing loss.	1	74	6	13	28	53	31	51	18	0
		2	56	5	13	25	57	32	55	13	0
		X	7					57	43	0	0
	94. Development of electronic circuits capable of connection to nerves and brain cells, making a possible application for artificial eyes.	1	78	6	13	30	51	41	44	14	1
		2	60	7	14	25	54	42	47	10	2
		X	9					56	33	11	0
	95. Development of methods for recombining severed central nerves.	1	76	8	13	27	52	54	39	5	1
		2	58	7	13	25	55	62	34	2	2
		X	9					67	22	0	11
	96. Development of controlling devices which help the cooperative muscular actions enabling object-oriented movement.	1	82	8	13	31	48	39	46	12	1
		2	62	8	12	28	52	39	50	8	2
		X	10					70	10	10	10
	97. Widespread use of artificial legs equipped with computer-controlled actuators and small-sized power sources.	1	101	7	17	40	36	36	53	10	0
		2	77	7	17	36	40	35	57	6	0
		X	9					67	22	11	0
Integration (systematization)	98. Practical use of systems for monitoring family health and providing information for an appropriate diagnosis at home in event of accident or diseases.	1	136	18	27	40	16	43	41	13	3
		2	114	15	28	42	15	46	44	7	3
		X	20					50	45	0	5
	99. Extensive use of centers supplying medical updates to physicians nationwide using on-line networks.	1	140	16	30	40	14	44	37	17	1
		2	116	13	30	43	14	47	38	15	0
		X	17					71	18	12	0
	100. Completion of efficient medical-care system achieved by systematizing medical facilities.	1	135	22	28	33	17	52	38	7	2
		2	114	19	27	38	16	57	35	7	0
		X	26					73	19	8	0

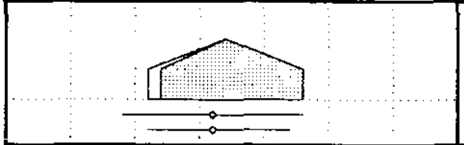
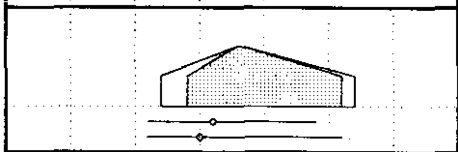
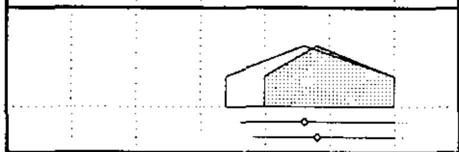
Forecasted realization time (Year)

1995 2000 2005 2010 2015 2020



Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
13	60	21	48	35	12	1					66	16	4	22	34	8	22	1
16	61	21	64	25	6	1	1	42	47	7	74	13	3	21	48	6	22	0
44	56	0	50	50	0	0	0	56	44	0	63	31	6	25	44	0	25	0
10	42	44	52	34	9	3					74	8	24	9	34	9	21	1
7	50	42	63	24	7	3	1	28	62	7	78	7	24	4	41	11	20	1
33	50	17	67	17	17	0	0	33	67	0	83	0	33	0	33	0	50	0
16	46	32	36	34	18	8					80	1	1	20	38	9	19	0
18	43	36	45	34	11	5	7	41	36	13	84	2	0	18	46	11	21	0
86	14	0	43	29	0	29	0	57	43	0	86	0	0	29	14	29	0	0
6	27	54	35	36	13	8					81	3	3	12	36	12	17	0
7	27	63	47	42	5	2	3	32	42	20	92	2	0	13	47	10	17	0
44	22	33	78	22	0	0	0	33	67	0	100	11	0	0	11	33	11	0
11	37	42	43	34	13	3					86	0	5	7	30	13	21	0
10	36	50	50	38	7	0	3	36	40	19	93	0	2	3	45	12	21	0
56	44	0	56	44	0	0	0	44	56	0	100	0	0	0	33	11	33	0
6	46	44	29	39	20	10					77	1	0	17	45	11	15	0
6	53	39	40	39	10	6	10	42	34	11	87	0	0	15	56	6	15	0
20	60	20	50	40	0	10	20	20	50	10	100	0	0	10	30	0	10	0
12	54	28	32	29	26	10					67	2	1	27	48	9	15	1
16	52	30	38	32	14	10	17	36	30	13	74	1	0	22	57	8	17	1
67	22	11	44	33	0	22	11	67	22	0	100	0	0	11	33	0	11	0
15	51	27	13	31	26	24					37	27	4	35	37	14	15	2
12	59	25	14	39	21	19	16	45	21	14	48	26	2	39	42	10	18	2
35	55	5	20	25	15	25	30	65	5	0	45	40	0	20	40	10	20	5
27	49	19	14	19	31	31					24	32	9	37	36	12	19	2
26	58	14	15	23	33	25	15	30	34	17	19	37	5	47	44	9	22	0
65	35	0	41	12	12	29	29	53	18	0	24	35	0	41	47	6	35	0
19	53	23	10	17	25	44					16	51	11	27	26	15	21	3
18	61	19	12	12	31	40	12	34	34	15	13	60	9	39	32	11	22	1
38	54	8	19	8	27	42	23	50	19	8	19	62	12	31	23	8	23	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Integration (systematization)	101. Application of robots in nursing the physically or mentally disabled in hospitals or the home, performing most of the heavy labor required.	1	121	16	19	40	25	40	45	12	2
		2	101	14	21	40	25	36	55	8	1
		X	19					53	47	0	0
	102. Advancement in software technology enabling assessment of the cost effectiveness of medical treatment, resulting in optimization of medical care in all fields on a constant basis.	1	105	16	15	35	34	31	50	14	4
		2	89	13	16	38	34	30	58	11	0
		X	17					41	59	0	0
Basics (primarily the elucidation of biological functions, constitutions, etc.)	103. Elucidation of molecular mechanism of memory.	1	92	9	13	36	42	41	47	10	1
		2	77	11	11	38	41	43	45	10	1
		X	14					64	36	0	0
	104. Establishment of method of directly measuring and displaying cerebral functions, enabling application in determination of brain death.	1	98	11	20	30	38	46	38	12	3
		2	80	11	19	31	39	48	44	9	0
		X	14					79	21	0	0
	105. Development of hybrid artificial intelligence using ICs connected with living cells (e.g., micro-processors employing cells).	1	83	8	17	28	47	27	43	22	7
		2	67	8	15	28	48	27	52	16	4
		X	11					64	27	9	0
	106. Elucidation of individual aging mechanism, being applied for prevention of aging.	1	111	14	23	33	31	59	28	10	3
		2	94	15	23	34	28	64	28	6	2
		X	19					74	21	5	0
	107. Advancement in the research into the ABO blood types at the genetic level, leading to a single blood type.	1	68	2	16	27	56	4	35	31	26
		2	58	0	16	30	54	7	47	19	28
		X	0					0	0	0	0
	108. Possibility of artificial production and transplantation of cells with certain potential organic functions, dispensing with need for extraction from a fetus (e.g., as treatment for Alzheimer's disease).	1	86	6	16	33	46	30	43	20	5
		2	72	4	17	35	45	35	43	21	1
		X	5					40	40	20	0
	109. Development of methods for storing living bodies by hibernation or the like.	1	86	5	18	31	46	10	44	24	20
		2	70	4	17	32	47	13	39	34	14
		X	5					60	40	0	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	11	55	30	16	33	30	17					53	9	14	48	37	12	9	1
	9	55	34	20	40	31	9	25	47	13	13	58	6	8	62	36	11	9	1
	37	58	5	16	47	21	16	37	47	11	5	74	16	11	53	26	16	0	5
	10	48	33	14	31	28	20					29	45	20	22	24	19	12	6
	6	52	39	15	35	33	17	9	30	37	20	28	53	19	20	29	12	18	3
	24	65	12	29	35	24	12	18	59	24	0	35	65	12	18	29	12	18	0
	10	39	47	50	37	9	3					72	2	1	4	42	22	24	3
	9	40	48	65	29	3	3	0	38	48	12	78	0	0	4	55	18	23	4
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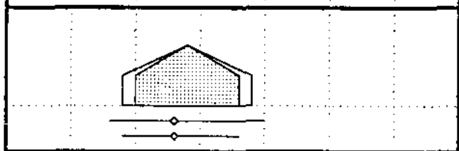
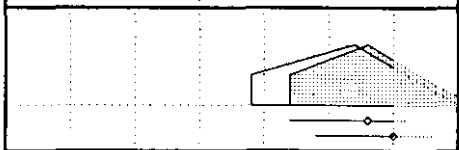
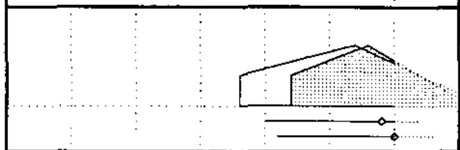
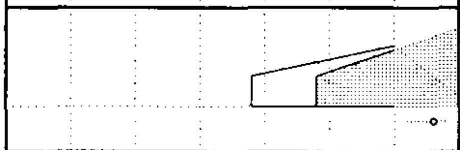
	16	51	29	36	37	12	12					64	13	27	15	26	9	15	1
	14	55	29	49	38	8	5	6	44	40	9	69	11	25	11	31	10	19	1
	43	50	7	57	29	0	14	21	36	43	0	64	14	14	7	36	7	21	7
	7	43	41	35	35	14	7					73	0	7	11	40	7	20	0
	9	42	45	46	36	12	1	6	45	24	21	79	0	4	6	58	10	15	0
	45	45	9	64	27	9	0	9	55	36	0	73	0	9	9	55	0	18	0
	7	45	42	50	32	9	5					72	2	6	4	45	14	25	1
	9	43	48	66	26	5	2	1	40	38	17	78	2	3	4	60	11	28	0
	21	68	11	84	5	5	5	0	47	53	0	68	5	5	0	58	11	37	0
	4	25	49	22	32	15	9					59	1	16	9	25	12	18	1
	5	31	48	36	34	10	7	3	28	29	29	69	0	14	5	41	7	21	2
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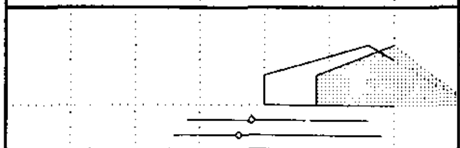	9	31	52	45	33	10	5					74	5	16	8	27	13	16	3
	8	36	54	57	26	11	4	0	25	50	24	83	0	10	7	47	7	18	6
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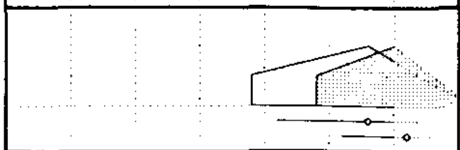
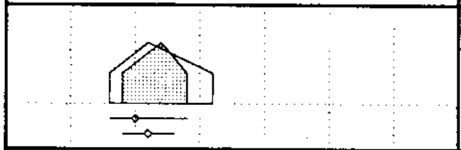
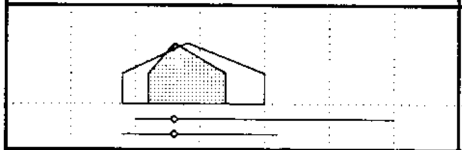
	9	22	52	31	35	12	6					58	7	29	10	20	12	17	1
	10	31	49	33	37	13	7	1	26	49	16	69	4	34	7	30	9	16	1
	20	60	20	40	40	0	20	20	20	60	0	80	0	20	0	40	0	20	0

4.16 Lifestyles and culture

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Survival functions (physical and mental autonomous living strength)	1. Widespread use of personal nutritional indices that take individual differences, age, and regional idiosyncracles into account through the scientific elucidation of the interrelationships between nutrition and metabolism, exercise, physical strength, etc.	1	74	8	13	36	44	18	49	34	0
		2	65	7	16	35	41	20	48	31	0
		X	8					50	50	0	0
	2. Widespread use of home diagnostic systems based on daily health check-up criteria for home health care.	1	93	5	14	52	30	23	61	15	1
		2	79	5	15	50	29	22	71	6	1
		X	6					83	17	0	0
	3. Widespread use of artificial intelligence-based home devices that check the state of health of elderly and mentally or physically handicapped persons and give advice on daily-life matters (diet, exercise, work, recreation).	1	89	4	15	48	33	18	49	30	2
		2	78	3	17	50	30	22	56	21	1
		X	3					33	33	33	0
	4. Practical use of systems that enable preliminary medical examinations and check-ups of the state of health at home without visiting a clinic.	1	89	5	14	48	33	29	55	12	3
		2	81	4	17	52	28	33	57	7	2
		X	4					50	25	25	0
	5. Widespread use of interactive visual telephone systems that facilitate friendly contacts between volunteer centers and unattended elderly and handicapped persons while respecting individual privacy.	1	87	5	21	40	34	40	39	17	3
		2	81	4	26	43	27	47	41	10	2
		X	4					50	0	25	25
	6. Development of devices that detect needs of individuals affected by senile dementia as a contribution to improving the welfare of the senile.	1	54	2	5	34	59	24	37	26	13
		2	50	2	5	38	55	22	50	20	8
		X	2					50	0	0	50
	7. Development of effective methods for preventing dementia in senescence by making use of special abilities of the elderly.	1	76	2	11	45	42	51	39	8	1
		2	67	1	10	50	40	51	45	4	0
		X	1					0	100	0	0
	8. Development of comprehensive techniques and systems to promote the maintenance of mental and emotional stability through the scientific elucidation of the mechanisms of securing psychological stability.	1	69	5	10	37	48	38	45	16	1
		2	61	4	12	39	46	34	56	8	2
		X	4					0	75	0	25
	9. General application of findings from the scientific study of the psychological and physiological effects of sound to music therapy.	1	84	6	14	44	37	15	56	27	1
		2	74	4	17	46	34	12	65	22	1
		X	4					25	50	25	0
Living environment, living means (living infrastructure, food/clothing/shelter)	10. Practical use of technologies that will eliminate the NOx, and other pollutants that cause today's air pollution.	1	76	2	12	44	42	82	16	3	0
		2	67	1	13	47	40	94	4	1	0
		X	1					100	0	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Degree of certainty (%) Medium	Degree of certainty (%) Low	Necessity of international joint development (%) High	Necessity of international joint development (%) Medium	Necessity of international joint development (%) Low	Necessity of international joint development (%) None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Comparison of current R&D level between Japan and other countries (%) Equivalent	Comparison of current R&D level between Japan and other countries (%) Other countries are more advanced	Comparison of current R&D level between Japan and other countries (%) Don't know	Constraints on realization (%) Technical	Constraints on realization (%) Institutional	Constraints on realization (%) Cultural	Constraints on realization (%) Cost	Constraints on realization (%) Funding	Constraints on realization (%) Fostering/securing human resources	Constraints on realization (%) R&D system	Constraints on realization (%) Others
	16	59	20	9	24	47	18					22	20	26	16	16	28	32	12
	14	69	14	11	20	55	9	15	42	18	18	25	22	31	15	6	38	37	6
	63	38	0	38	25	25	13	13	63	25	0	25	0	25	38	0	38	50	0
	20	54	24	5	33	43	17					24	29	12	53	16	14	20	2
	14	66	19	8	25	53	9	18	38	19	22	22	35	13	65	9	13	22	1
	67	33	0	17	50	33	0	17	50	33	0	33	33	17	50	0	33	17	0
	13	47	31	12	28	38	17					36	18	18	51	18	8	17	3
	12	63	22	15	26	44	9	10	37	26	21	44	15	19	64	8	9	21	0
	33	67	0	33	33	0	33	0	100	0	0	33	33	0	67	0	67	0	0
	22	43	29	11	37	31	18					36	39	11	47	12	7	13	3
	17	56	23	15	42	30	9	16	37	23	17	32	51	12	56	10	9	12	2
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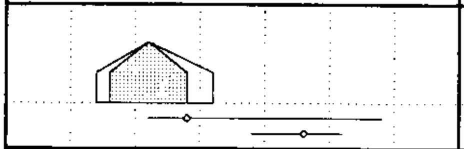	24	47	23	8	29	30	31					25	20	22	53	18	13	13	6
	19	60	16	6	28	31	26	31	23	25	12	26	17	22	60	15	16	12	2
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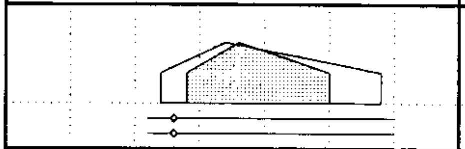	7	26	52	20	43	13	9					65	2	9	24	13	11	19	6
	2	34	58	24	50	14	2	8	34	14	30	76	2	12	30	10	14	20	2
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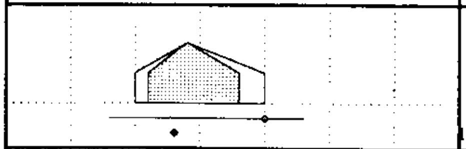	16	45	34	28	33	24	14					49	9	21	21	12	33	24	3
	6	63	30	27	42	24	4	7	42	16	25	67	4	19	18	10	42	24	0
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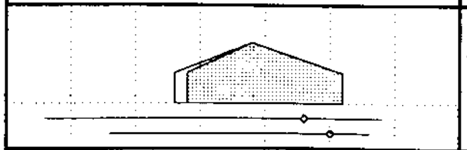	14	42	38	29	43	17	9					57	13	19	20	12	13	32	7
	8	52	36	23	56	15	2	5	34	33	20	74	8	23	16	8	23	28	0
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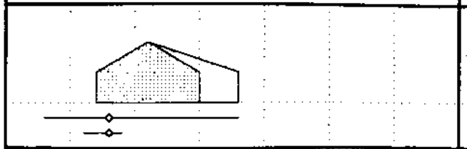	24	38	33	18	39	30	8					37	10	25	12	7	30	19	5
	22	47	30	18	46	28	5	14	41	32	7	51	5	30	12	8	41	20	1
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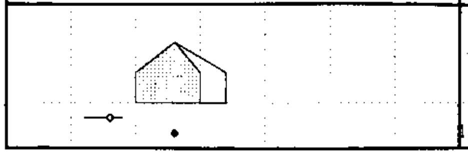
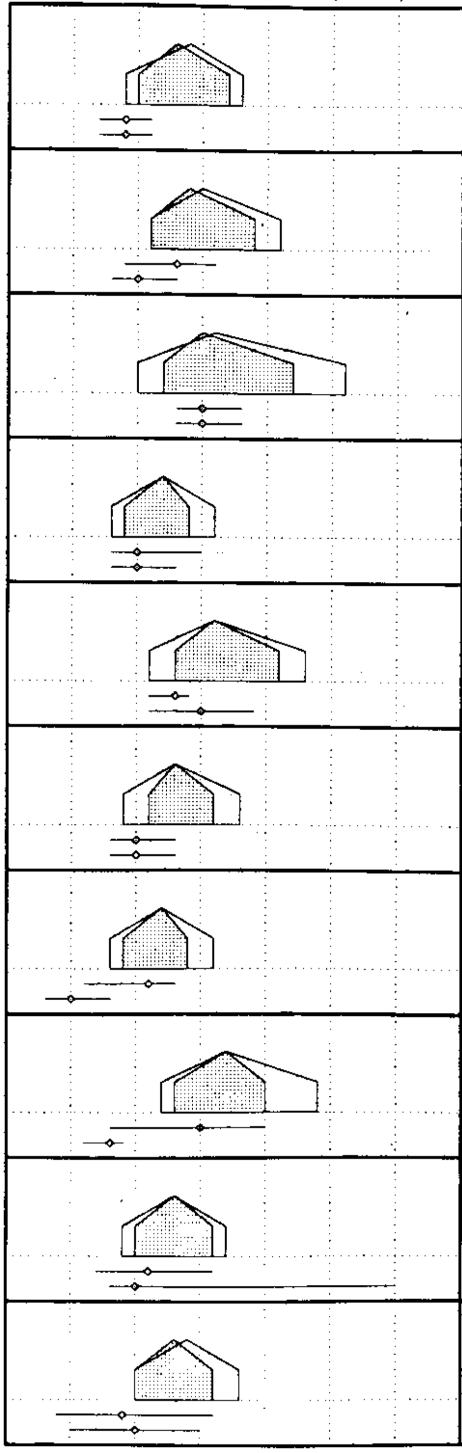
	26	37	30	64	25	4	4					51	13	4	50	32	12	14	3
	22	52	22	70	16	7	3	46	24	12	9	57	13	1	55	31	9	18	1
	100	0	0	100	0	0	0	100	0	0	0	0	0	0	100	100	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Living environment and living means (living infrastructure, food/clothing/shelter)	11. Widespread use of water quality control systems that supply safer and better-tasting drinking water through the scientific elucidation of the relationship between substances in drinking water and physiology.	1	64	2	8	38	52	38	47	14	2
		2	59	3	9	42	46	32	54	12	2
		X	3					67	33	0	0
	12. Widespread use of techniques of urban planning, silviculture, and landscaping through scientific elucidation of the relationship between contact with forests and other plant life in natural settings and physiology and psychology.	1	69	2	11	39	48	42	43	12	3
		2	60	2	12	41	45	48	42	8	2
		X	2					100	0	0	0
	13. Widespread use of household trash boxes capable of automatically sorting refuse for easy carrying of the sorted refuse.	1	71	2	10	42	46	30	39	17	14
		2	57	2	8	42	48	37	39	16	7
		X	2					50	50	0	0
	14. Widespread use of recycling systems for fabrics and apparel, food packaging materials, and other home materials.	1	81	3	11	47	39	52	40	7	1
		2	67	4	11	46	39	66	31	3	0
		X	4					75	25	0	0
	15. Development of new technologies for preserving the freshness and nutritional value of foods to replace today's food canning and freezing technologies, through elucidation of the mechanisms of aging at the cellular level in animals and plants.	1	54	5	7	29	59	28	46	22	4
		2	48	6	7	31	56	29	46	23	2
		X	6					50	50	0	0
	16. Development of technologies for controlling indoor environments so that mite and fungal populations can be kept at almost the same levels as those of outdoor population densities (which do not trigger allergies in children) through scientific elucidation of the mechanisms of acarid and fungal propagation.	1	58	2	8	35	56	14	53	29	3
		2	48	2	8	34	56	10	60	29	0
		X	2					50	50	0	0
	17. Practical use of technologies and systems for coping with disasters in super high-rise buildings such as fires and earthquakes.	1	64	5	8	36	52	55	36	8	2
		2	55	2	11	37	50	67	27	5	0
		X	2					100	0	0	0
	18. Practical use of technologies and systems for coping with disasters such as fires and earthquakes that may impact facilities at great underground depths.	1	55	3	8	31	58	36	49	15	0
		2	48	2	7	35	56	42	52	6	0
		X	2					100	0	0	0
	19. Widespread use of lightweight and highly durable new home construction materials which provide good air-permeability and other features that match the climate in Japan.	1	67	5	9	36	49	25	48	24	3
		2	53	4	9	35	52	23	57	21	0
		X	4					0	75	25	0
	20. Practical use of technologies that enable control over housing environments by each home through accumulation of cryogenic energy and waste heat.	1	73	5	11	39	45	36	40	25	0
		2	61	4	12	40	45	39	43	18	0
		X	4					50	50	0	0

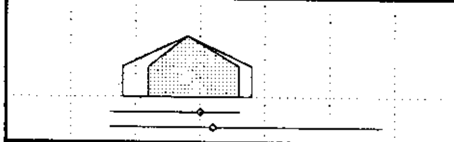
Forecasted realization time (Year)

1995 2000 2005 2010 2015 2020



Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
25	36	31	25	19	23	27					47	13	6	48	25	6	13	5
17	47	34	24	20	34	17	46	27	5	15	54	10	3	66	25	3	15	3
33	67	0	33	0	67	0	100	0	0	0	100	0	0	67	33	0	0	0
13	48	30	39	25	20	10					32	14	22	26	30	12	20	4
15	53	27	47	27	18	3	12	30	42	10	43	13	12	35	42	7	27	0
50	50	0	50	50	0	0	0	100	0	0	50	0	50	0	100	0	0	0
18	30	35	10	18	30	25					41	15	11	44	8	6	14	4
16	33	40	18	14	33	23	30	30	7	19	54	19	9	58	12	2	14	2
50	0	50	50	0	0	50	50	0	50	0	100	0	0	50	0	0	50	0
27	37	32	20	33	27	17					26	25	21	57	14	6	9	5
24	48	27	16	46	27	7	28	33	15	19	33	31	19	76	6	3	7	0
25	75	0	0	75	0	0	50	25	25	0	50	50	0	75	0	0	25	0
22	37	33	31	24	30	7					67	6	4	41	9	6	20	4
15	46	33	31	19	35	4	23	42	8	17	75	2	2	44	10	6	31	0
50	50	0	67	17	17	0	33	33	33	0	83	0	17	33	0	0	33	0
21	36	33	9	21	34	29					40	5	10	52	12	9	17	2
17	44	38	10	19	44	25	27	44	4	21	50	4	10	69	13	13	17	0
100	0	0	0	50	50	0	50	50	0	0	50	0	0	100	0	50	0	0
23	47	25	25	34	27	11					47	19	5	42	19	3	20	3
22	51	27	24	47	20	7	27	31	27	13	56	16	5	53	16	2	22	2
100	0	0	50	0	0	50	50	50	0	0	50	0	0	0	50	0	50	50
16	35	47	20	38	27	13					56	25	7	38	27	2	16	2
10	40	48	21	44	27	6	21	33	19	23	73	19	2	56	23	2	13	0
100	0	0	50	0	50	0	0	100	0	0	50	100	0	0	0	0	50	0
16	52	27	6	16	31	43					40	7	12	60	19	4	12	1
13	64	23	8	17	40	34	66	13	2	15	62	6	15	72	9	4	11	0
0	100	0	0	0	75	25	75	25	0	0	75	0	50	75	0	0	0	0
14	48	37	15	26	36	22					38	12	8	66	14	3	15	3
11	57	31	11	34	31	21	26	49	7	13	54	10	5	75	15	2	16	0
50	50	0	25	25	50	0	75	25	0	0	75	25	0	100	0	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Living environment, living means (living infrastructure, food/clothing/shelter)	21. Widespread use of air conditioning systems utilizing sunlight (solar heat) for public buildings and houses to reduce the emission of carbon dioxide.	1	86	6	12	47	35	50	41	9	0
		2	72	5	13	48	35	68	28	4	0
		X	5					100	0	0	0
	22. Enhancement of standardized units and modules of houses and their structures, leading to widespread use of systems that enable free choice from among many types of housing components to change the structures of houses in response to changes in tastes and family make-up.	1	76	5	13	40	42	11	47	38	4
		2	62	3	14	40	44	13	40	39	6
		X	3					33	33	33	0
	23. Development of technologies that enable control of traditional tastes, flavoring and seasoning to one's taste.	1	60	6	7	33	54	5	18	48	28
		2	53	7	8	33	52	4	23	51	23
		X	8					0	25	75	0
Daily behaviors	24. Widespread use of diverse artificial products that provide the touch similar to that of natural substances such as mink to enhance the conservation of nature.	1	68	4	6	41	49	9	25	56	10
		2	54	3	5	41	51	9	19	65	7
		X	3					33	0	67	0
	25. Elucidation of the mechanisms to stimulate cerebral and neural activities by handcraft, etc. to be applicable to improvement of cerebral nerve functions.	1	51	2	5	31	61	22	49	29	0
		2	46	2	6	34	58	15	65	20	0
		X	2					0	100	0	0
	26. Widespread use of methods of enhancing the sleep environment in accordance with a person's physical and mental state (by structurally modifying beds and other sleeping apparatus, controlling the reating environment prior to sleep, etc.) through elucidation of individual sleep patterns.	1	66	3	11	37	50	6	44	44	6
		2	60	3	14	38	45	5	50	42	3
		X	3					0	67	33	0
	27. Widespread use of comprehensive home security systems that check for overheating, short circuits, gas leakages, etc. and if necessary, automatically activate safety devices to enable inhabitants, including the elderly, to feel secure even during their absence.	1	97	4	17	52	27	36	49	13	1
		2	83	4	21	51	25	37	55	7	0
		X	4					25	75	0	0
	28. Establishment of manufacturing standards for home electrical, gas, and water utility appliances enabling them to be operated and controlled safely with around 30% attention during normal operation (aircraft, for example, are designed to be flown safely while the pilot devotes around 60% of his attention to piloting the aircraft) through scientific elucidation of human behavioral patterns in emergencies.	1	67	2	12	36	49	40	39	18	3
		2	57	1	16	35	48	46	44	7	2
		X	1					0	100	0	0
	29. Widespread use and networking of terminals and high-function, intelligence-based system to provide first-aid and other information in the home for injuries in case of disasters or accidents as well as for poisoning or sudden illness.	1	79	5	15	40	40	37	38	20	5
		2	66	3	19	38	40	42	47	11	0
		X	3					67	33	0	0
	30. Incorporation of fire-fighting robots capable of extinguishing fires at industrial complexes and detecting and rescuing human beings in the process.	1	80	2	10	48	40	35	48	16	1
		2	68	2	9	51	38	37	56	7	0
		X	2					50	50	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	51	30	33	31	23	9					48	8	5	77	20	2	7	5
	11	64	24	35	32	24	8	29	44	14	10	61	6	3	85	18	0	6	3
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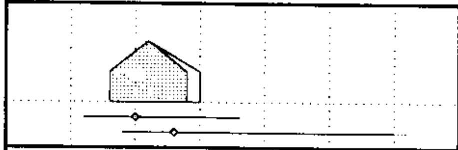	18	50	24	5	20	34	32					14	13	29	58	12	1	8	5
	10	63	18	8	16	40	24	34	32	11	10	13	15	39	71	8	0	10	2
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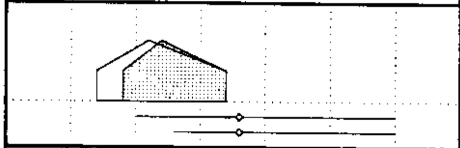
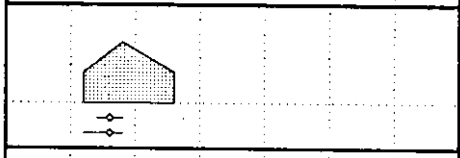
	17	28	30	5	5	25	42					27	2	38	12	7	13	7	10
	13	38	30	6	2	26	49	53	8	0	15	42	0	55	21	4	15	9	9
	38	63	0	13	0	38	50	88	13	0	0	63	0	63	13	0	25	13	25
	21	38	31	10	29	26	24					29	3	56	25	9	4	6	4
	22	44	28	13	30	28	26	33	26	15	17	31	2	67	41	7	2	2	6
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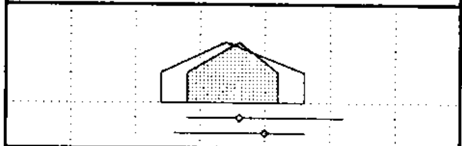	8	37	51	35	41	16	6					61	8	6	10	18	25	27	8
	2	41	57	41	50	4	2	2	43	30	15	67	2	2	2	22	41	37	4
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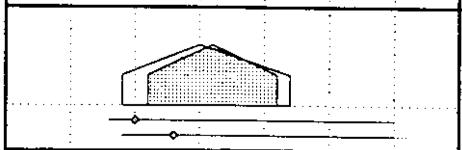	11	35	45	6	30	33	21					38	3	15	42	11	15	24	5
	7	35	53	10	28	42	13	12	40	22	15	52	2	15	43	8	13	30	2
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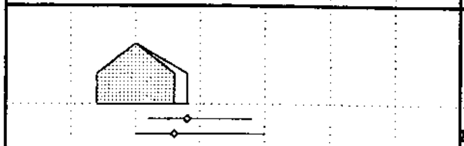	30	43	24	6	22	39	30					21	18	6	81	19	3	3	1
	31	52	17	7	19	42	29	42	33	10	10	24	17	7	87	22	1	5	1
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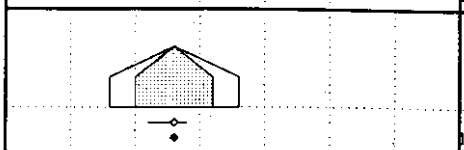	9	45	40	22	27	31	13					39	24	7	31	18	7	22	3
	4	58	35	21	32	28	12	25	26	21	16	68	19	4	37	9	0	30	2
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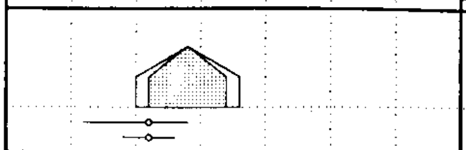	14	47	30	20	27	27	19					34	25	5	48	23	8	9	5
	5	61	35	23	27	36	11	20	45	14	14	44	24	5	64	23	3	9	2
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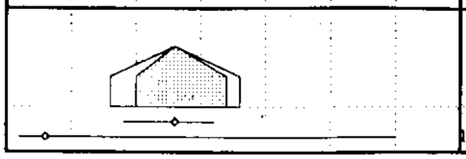
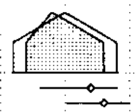
	13	48	35	20	31	35	11					61	13	0	46	25	5	16	1
	13	51	35	24	29	40	4	32	38	12	12	75	4	0	56	22	1	18	0
	100	0	0	50	50	0	0	0	100	0	0	50	50	0	50	0	0	50	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Daily behaviors	31. Widespread use of two-way paging devices capable of calling for help in case of emergencies or of receiving replies to such calls and detecting their locations.	1	74	5	10	42	44	24	43	26	7
		2	69	4	11	47	38	17	57	22	4
		X	4					50	50	0	0
	32. Elucidation of feasibility to live extremely deep underground with respect to the physiological and psychological aspects of human beings.	1	60	5	9	32	55	7	38	43	12
		2	48	5	7	32	56	4	42	46	8
		X	5					20	40	20	20
	33. Elucidation of feasibility of living in hyper high-rise buildings (500 m to 1,000 m) with respect to the physiological and psychological aspects of human beings.	1	61	5	9	32	54	16	38	34	11
		2	47	4	9	30	57	15	43	32	11
		X	4					75	0	0	25
	34. Widespread use of a medical system capable of measuring the degree of physical and mental fatigue of individual workers in a short time and of indicating the proper amount of rest required.	1	62	3	8	36	53	23	45	26	6
		2	57	3	10	38	49	25	58	16	2
		X	3					33	67	0	0
	35. Emergence of a variety of work places extensively incorporating machines designed to have interfaces with senior citizens.	1	80	7	16	37	40	30	45	23	3
		2	67	5	19	36	40	28	54	16	1
		X	6					83	17	0	0
	36. Dramatic improvement in plant convenience and safety through facilities equipped with sophisticated technological systems focused on human interface.	1	79	8	20	32	40	42	46	13	0
		2	67	7	20	32	41	46	46	6	0
		X	8					50	50	0	0
	37. Development of living systems offering comprehensive support for faculties of the aged.	1	77	5	12	42	41	39	47	14	0
		2	67	3	16	41	41	45	51	4	0
		X	3					67	33	0	0
	38. Practical use of "behavior alarm" systems based on elucidation of physical and psychological mechanisms causing human to mistake.	1	70	5	15	32	47	39	37	17	7
		2	61	3	13	38	46	43	39	11	7
		X	3					67	0	0	33
	39. Widespread use of at-home performance of work in general office divisions (excluding interviews and negotiations) based on advances in video telephones, on-line computer systems, and facsimile equipment.	1	111	11	29	43	17	14	55	24	5
		2	94	11	29	43	17	12	63	21	4
		X	12					17	83	0	0
	40. Spread of different kinds of information needed by consumers on a daily basis (information searches, guiding, reservations, orders, etc.) through home terminal systems providing information (still & animated graphics, hard copies, voice/sound, etc.) at any time of day or night in response to natural-language questions posed by the consumer.	1	108	15	29	37	19	20	45	33	1
		2	94	14	31	38	18	16	57	27	0
		X	16					31	63	6	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	23	47	26	14	12	41	30					31	30	7	55	15	0	7	7
	16	57	25	10	14	45	26	39	35	7	14	33	38	3	62	20	0	4	4
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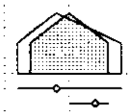	7	35	42	18	28	30	8					37	10	22	12	27	12	23	3
	4	35	50	17	19	50	2	13	23	31	17	42	6	25	10	29	10	42	2
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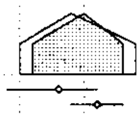	5	43	39	21	33	25	10					38	11	15	15	21	11	31	7
	0	47	43	21	36	26	4	4	23	40	13	55	4	15	6	17	15	43	2
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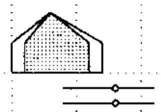	11	34	45	15	34	32	11					37	23	11	23	18	13	19	5
	9	44	44	16	40	37	2	9	47	14	21	56	26	12	32	14	11	19	4
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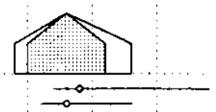	20	43	31	13	40	28	16					21	21	16	44	24	11	18	4
	13	52	30	7	49	30	9	12	37	27	18	30	24	9	67	19	4	19	1
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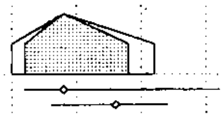	20	42	33	35	33	22	9					38	14	15	27	22	18	27	5
	16	49	30	31	43	18	3	18	39	25	10	55	7	9	40	19	12	34	1
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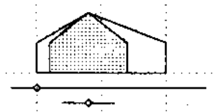	21	30	45	14	39	31	13					31	17	21	42	27	10	16	3
	12	36	49	19	45	28	4	9	28	42	12	48	13	18	54	28	7	16	0
	33	0	67	0	67	33	0	0	33	67	0	33	33	0	33	33	33	33	0
	19	26	44	36	39	13	1					54	7	11	26	13	13	30	4
	11	28	52	33	48	7	2	3	46	21	16	67	0	15	26	8	8	39	3
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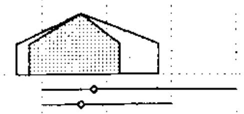
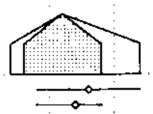
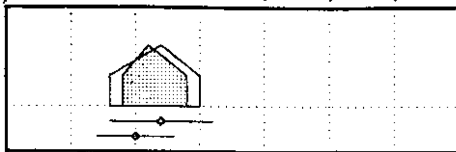
	27	40	26	8	21	31	33					14	45	54	27	8	2	3	8
	21	51	22	7	21	29	34	31	19	28	11	12	59	56	29	5	1	3	3
	67	33	0	8	25	33	33	50	17	25	8	8	75	67	25	0	0	0	8
	30	45	25	11	33	31	25					19	19	23	71	14	2	5	6
	24	56	19	18	31	28	21	33	34	17	9	18	16	37	76	15	2	5	4
	69	31	0	25	38	25	13	38	31	19	6	25	0	50	75	19	0	13	6

Division	Topic	Round	Number of respondents	Degree of expertise (%)				Degree of importance (%)			
				High	Medium	Low	None	High	Medium	Low	Unnecessary
Daily behaviors	41. Widespread use of multimedia equipment enabling entry of text, voice, images, etc. and their retrieval whenever necessary at home.	1	108	16	19	45	20	9	47	39	5
		2	94	16	21	46	18	6	53	36	4
		X	18					17	67	17	0
	42. Widespread use of home electronic cameras and album systems with alphanumeric wrirting-over and voice-recording capabilities.	1	85	11	16	36	37	6	22	66	6
		2	77	7	19	41	32	4	22	70	4
		X	8					13	25	63	0
	43. Widespread use of new ID systems (e.g., systems for identifying genes, fingerprints, and voiceprints) that replace the card-based ID systems.	1	79	4	13	42	41	10	48	38	4
		2	68	4	11	47	39	10	54	32	3
		X	4					25	50	25	0
	44. Practical use of telephones capable of reading the name card of the other party and automatically reaching the other party in response to a voice instruction.	1	82	6	17	38	39	2	24	54	20
		2	68	4	18	39	40	0	25	59	16
		X	4					0	25	50	25
	45. Widespread use of personal vehicles provided with equipment capable of automatically sensing traffic signals, the distance between cars going in the same direction, and optimal driving route.	1	82	2	17	43	38	26	43	32	0
		2	69	2	13	48	38	19	52	28	0
		X	2					50	50	0	0
	46. Development of personal vehicles capable of traveling anywhere including flat surfaces, staircases, and slopes.	1	62	1	8	38	53	13	31	42	15
		2	53	1	6	41	52	9	30	51	8
		X	1					0	100	0	0
	47. Practical use of equipment capable of changing water according to the applications (e.g., drinking, cooking, bathing, washing, and fish aquarium).	1	56	2	5	35	58	9	30	46	14
		2	50	0	9	36	55	10	28	50	12
		X	0					0	0	0	0
	48. Widespread use of equipment capable of adjusting the freshness and ripeness of perishable foods at home.	1	55	5	9	27	58	4	29	49	18
		2	50	5	14	27	55	4	28	58	10
		X	5					20	40	40	0
	49. Development of baby nursing systems (robots) capable of memorizing the specific characteristic of mothers and baby-sitting them when necessary.	1	67	2	11	38	50	1	12	31	55
		2	55	1	13	36	50	2	15	25	58
		X	1					0	0	0	100
	50. Development of housework robots that clean houses, wash clothes and other domestic tasks by learning the habits of people who do those domestic tasks.	1	80	2	12	46	40	4	40	45	11
		2	69	2	17	44	37	4	43	48	4
		X	2					0	100	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	17	55	25	14	29	25	29					23	9	17	68	12	2	3	7
	17	60	21	13	29	27	29	34	29	23	6	35	5	14	85	7	3	5	5
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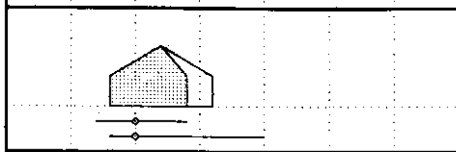	21	40	32	5	15	40	33					21	0	18	65	7	0	2	8
	21	42	34	4	14	43	34	61	19	4	8	32	3	17	79	8	0	0	6
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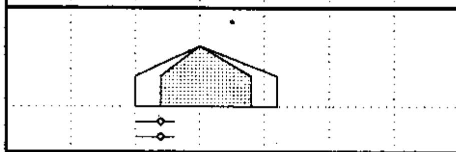	13	48	32	15	24	35	20					34	32	30	41	8	3	9	3
	12	49	37	15	19	44	18	32	38	10	13	32	50	34	53	7	0	6	0
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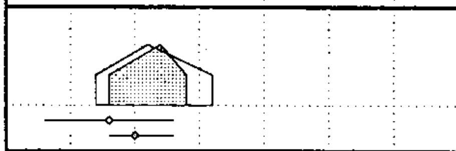	12	29	37	7	11	32	29					17	7	11	44	9	1	5	10
	12	35	40	4	9	41	31	43	21	9	13	24	6	16	68	9	0	3	0
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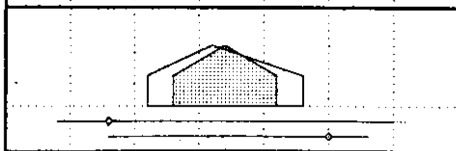	16	34	46	18	33	35	13					44	24	5	63	15	0	6	4
	9	36	51	17	26	41	13	30	35	10	19	51	25	3	72	14	0	3	7
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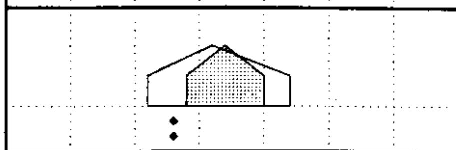	6	31	45	11	27	34	13					44	10	3	47	26	0	5	5
	6	32	51	6	21	58	6	13	34	21	21	58	11	4	55	23	0	9	6
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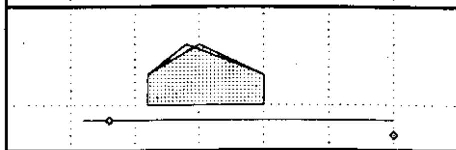	7	27	46	13	14	29	23					32	5	9	54	16	4	11	2
	4	30	54	10	16	34	24	26	34	8	18	44	2	6	64	10	2	10	4
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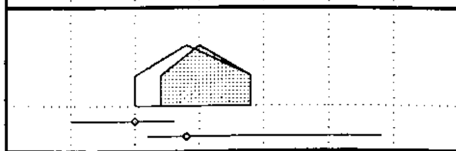	11	38	31	4	9	42	25					35	5	18	56	4	2	4	2
	6	42	42	2	8	52	26	36	36	2	14	52	6	10	72	2	2	4	2
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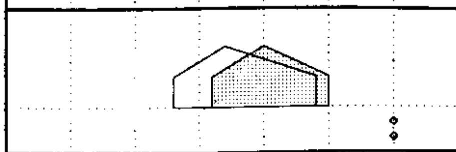	1	16	37	3	9	22	19					21	0	33	10	6	4	7	3
	0	18	47	9	5	33	18	7	13	13	33	31	4	47	18	4	0	7	5
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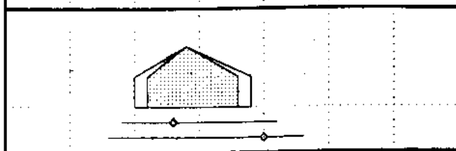
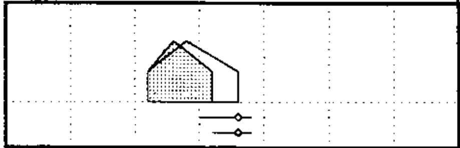
	9	41	39	8	15	40	28					46	3	18	49	14	0	8	5
	9	38	52	6	16	41	33	42	32	6	16	61	3	14	68	12	1	10	6
	100	0	0	0	50	0	50	0	100	0	0	100	0	0	100	0	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Daily behaviors	51. Practical use of multipurpose nursing robots that take care of the personal hygiene and bathing requirements of bedridden elderly and handicapped persons in a manner that suits each person needing care.	1	78	4	11	45	41	53	36	9	3
		2	65	2	14	44	41	63	29	6	2
		X	2					50	50	0	0
	52. Development of cosmetics that enhance the metabolic function of the skin and are specially suited to Japanese' skin.	1	35	2	2	22	73	3	23	69	6
		2	28	1	3	22	75	0	21	79	0
		X	1					0	100	0	0
	53. Development of cosmetics that keep skin youthful many years longer than it would normally remain so, through bioengineering, microparticulate engineering, dermatology, and other branches of science.	1	34	2	0	23	74	3	32	59	6
		2	26	1	2	21	76	0	23	69	8
		X	1					0	100	0	0
	54. Development of equipment capable of decomposing the constituents of odors themselves so that odorless states can be obtained quickly, and of enabling one to produce his/her favorite smells.	1	54	4	5	32	59	4	35	56	6
		2	43	3	7	29	61	5	28	65	2
		X	3					33	33	33	0
	55. Predominance of electronic media for individuals as advertisement media.	1	71	6	17	31	46	4	30	55	10
		2	61	5	18	33	45	5	28	59	8
		X	5					0	20	80	0
	56. Development of capsules that make us grow younger while asleep.	1	29	1	2	19	78	7	10	45	38
		2	21	0	5	15	81	10	10	48	33
		X	0					0	0	0	0
	57. Development of interactive communication systems (robots) that alleviate the loneliness of urban inhabitants.	1	84	6	16	42	36	13	33	40	13
		2	67	5	16	40	40	15	30	49	6
		X	5					20	20	60	0
Education (knowledge and culture, technology-aided capabilities)	58. Development of systems to alleviate emotional disorders in autistic children through the elucidation of the mechanism of autism.	1	65	5	13	32	51	37	49	12	2
		2	59	5	13	33	48	32	63	5	0
		X	6					33	50	17	0
	59. Development of equipment systems capable of learning survival technologies for coping with difficult situations such as disasters, accidents, and emergencies.	1	50	1	9	28	63	2	18	48	32
		2	41	0	11	25	64	5	24	54	17
		X	0					0	0	0	0
	60. Practical use of a knowledge pursuit and consultation system (e.g., encyclopedias and system/legal consultation systems) provided with voice and image recognition capabilities and personal data base functions so that it immediately answers questions in terms of voices and images.	1	105	15	22	40	23	23	50	24	3
		2	89	17	22	39	23	19	62	18	1
		X	19					26	58	16	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%) High	Medium	Low	Necessity of international joint development (%) High	Medium	Low	None	Comparison of current R&D level between Japan and other countries (%) Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Constraints on realization (%) Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	10	44	41	26	31	31	10					37	8	26	54	23	1	21	5
	6	55	37	20	38	32	8	20	32	18	22	55	6	23	63	20	0	11	3
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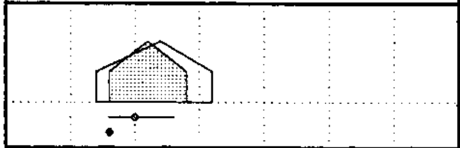	20	26	43	3	11	34	43					43	0	14	23	11	11	6	9
	11	29	54	4	4	32	57	50	18	4	25	57	4	14	39	11	4	4	7
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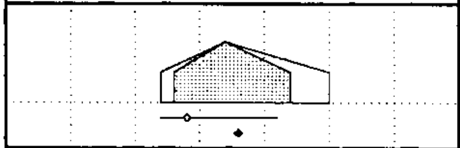	12	29	47	9	29	35	15					47	3	6	12	18	9	21	3
	4	23	62	8	12	58	12	19	42	8	19	69	4	0	35	8	4	19	4
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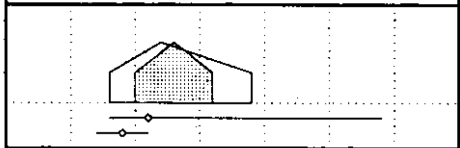	9	41	43	6	28	28	31					44	0	17	39	15	0	7	7
	7	30	58	5	21	30	37	21	33	7	30	67	0	16	56	9	0	2	7
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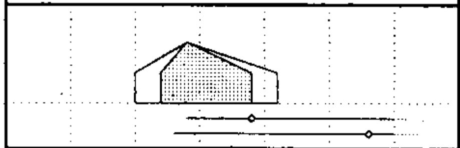	10	35	39	10	17	21	38					15	11	32	45	3	0	6	6
	10	36	48	8	16	23	44	33	25	13	18	21	13	51	57	2	2	2	8
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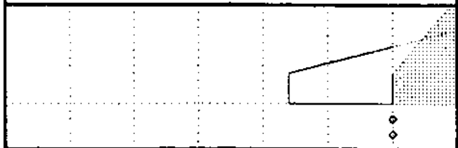	14	10	41	17	21	14	21					48	0	21	7	10	3	7	3
	19	10	48	14	24	14	29	0	14	10	52	62	0	38	14	0	5	10	5
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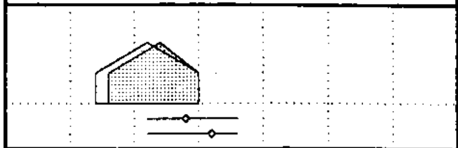	15	38	30	8	18	24	35					13	20	29	31	7	7	8	5
	13	40	40	6	18	34	31	31	22	7	24	18	19	49	43	4	6	4	3
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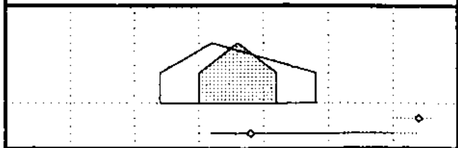	9	26	54	38	32	15	6					49	3	17	11	12	26	34	5
	5	20	69	34	32	24	3	8	24	27	25	63	2	19	12	8	32	31	2
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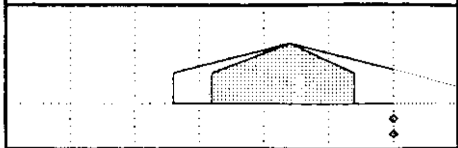	4	18	40	14	18	16	14					30	8	10	8	14	6	18	4
	5	24	56	17	29	27	15	5	27	27	27	66	2	7	7	22	15	24	5
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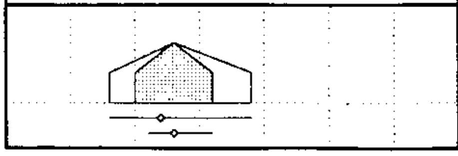
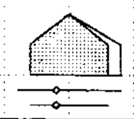
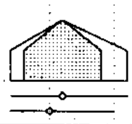
	26	39	30	26	30	21	17					41	5	11	51	18	4	10	8
	22	46	28	22	42	17	15	27	36	13	13	58	1	12	71	15	1	10	3
	53	37	5	26	42	16	11	11	42	32	5	63	0	16	79	0	0	11	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Education (knowledge and culture, technology-aided capabilities)	61. Widespread use of a system enabling overseas Japanese in their homes or schools abroad to utilize Japanese domestic educational information networks via satellite.	1	112	15	28	39	18	24	43	31	2
		2	92	16	28	37	20	21	52	26	1
		X	18					56	28	17	0
	62. Widespread use of bidirectional, multi-point remote education systems using satellite communication.	1	106	19	24	34	23	19	45	33	3
		2	89	19	24	34	23	17	53	28	2
		X	22					36	41	23	0
	63. Utilization of computer systems which play the role of students for small schools with fewer children and which are capable of comprehending the conversations between teachers and students and giving responses that urge multifaceted thinking.	1	97	21	22	29	28	7	24	42	25
		2	81	20	22	29	30	5	23	57	15
		X	23					13	22	52	13
	64. Development of advanced individual learning support systems capable of recognizing the psychological conditions of learners such as confidence, interests, and nervousness and utilizing such information to enhance the educational effefcts.	1	95	19	21	31	29	8	46	38	7
		2	85	19	22	32	27	6	58	33	4
		X	22					23	64	14	0
	65. Development of classwork simulators for training teachers based on cognition models of learning processes of teaching.	1	95	22	19	29	29	16	47	32	5
		2	83	23	18	30	28	13	53	30	4
		X	27					30	56	15	0
	66. Development of systems which are provided with knowledge data bases of teaching materials and teaching measures and which pick up teacher classwork images in an interactive manner to automatically generate CAI useware (software used).	1	93	22	17	30	31	14	43	37	5
		2	80	22	20	28	30	9	55	31	5
		X	25					24	44	28	4
	67. Widespread use of a question & answer-type artificial intelligence-based educational system that enhances teachers' abilities by drawing on built-in high-level expertise, including the knowledge and experience of veteran educators and actual programs of proven effectiveness.	1	93	22	19	27	31	18	37	34	10
		2	80	22	22	24	31	13	51	30	6
		X	26					19	54	23	4
	68. Elucidation of the physiological and psychological mechanisms of the formation of personal independence, the fostering of individuality, etc., the findings being applied to new educational curricula.	1	80	20	13	26	41	25	51	21	1
		2	72	18	16	28	38	19	63	17	1
		X	21					33	52	14	0
	69. Systematic organization of programs incorporating resources with traditional craft, and arts and culture to enrich lifelong education.	1	98	13	23	36	28	28	42	26	5
		2	85	12	21	41	25	20	54	24	1
		X	14					57	43	0	0
	70. Development of an educational system that enables responses to stages of human development through scientific elucidation of the human life cycle.	1	90	16	21	30	33	38	36	23	3
		2	78	16	21	32	32	36	45	18	1
		X	18					56	33	11	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	25	45	27	35	24	20	17					13	30	15	55	27	4	6	3
	22	53	22	41	25	16	14	27	32	21	12	15	38	9	70	28	4	4	1
	33	50	17	67	17	11	6	17	50	28	0	28	33	11	67	28	0	6	0
	24	43	27	25	25	27	16					12	26	13	58	25	8	9	3
	20	53	21	28	33	19	12	20	37	27	6	15	36	11	74	20	4	6	1
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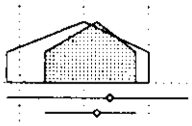	13	28	33	10	16	23	26					24	20	21	19	10	13	9	4
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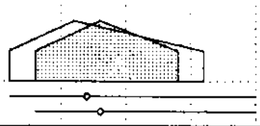	11	35	42	16	32	20	24					46	7	15	24	17	9	16	6
	6	39	49	14	36	22	21	16	27	14	34	66	9	20	36	11	8	15	4
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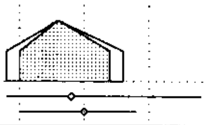	14	49	29	19	29	26	17					33	21	19	16	16	19	15	8
	11	54	31	17	29	35	13	17	33	19	23	59	20	24	20	13	17	11	6
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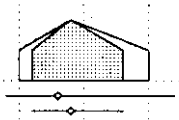	17	31	42	19	27	27	18					46	10	11	19	18	13	19	9
	14	41	43	14	33	31	18	10	44	24	16	69	8	18	25	14	14	14	5
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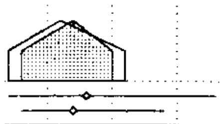	13	41	33	15	26	30	17					41	12	12	25	18	11	17	4
	14	48	36	15	23	43	16	11	40	21	19	70	8	10	39	16	11	16	4
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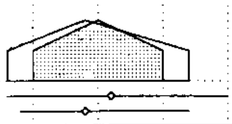
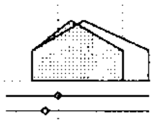
	10	44	38	25	31	23	16					44	16	25	5	20	16	23	8
	8	53	35	18	40	24	14	13	36	26	19	65	13	33	6	10	21	26	4
	19	62	14	29	38	14	19	19	33	33	14	57	29	33	5	0	24	38	0
	13	47	29	4	13	29	46					8	15	32	15	33	24	18	3
	9	59	26	6	13	28	46	25	26	12	26	9	15	51	14	44	25	13	1
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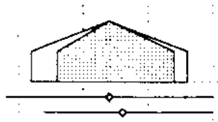
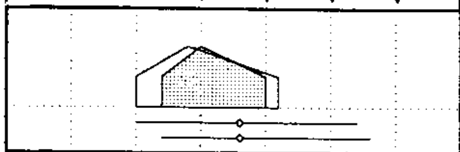
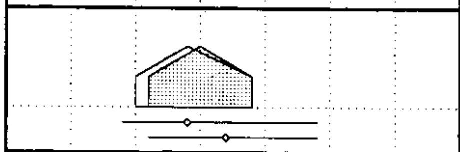
	14	34	40	14	32	29	16					26	10	21	10	20	14	30	8
	12	41	42	14	44	26	10	13	33	18	24	49	12	26	9	19	8	33	6
	33	56	11	22	44	28	6	22	28	17	22	39	28	39	0	17	11	28	11

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Medium	Low	None	Degree of importance (%) High	Medium	Low	Unnecessary
Education (knowledge and culture, technology-aided capabilities)	71. Widespread use of an independent sociability training system designed for groups of children of different ages enabling them to be trained in social interactions.	1	76	12	20	24	44	22	46	18	13
		2	65	11	21	25	43	25	52	14	9
		X	12					58	33	8	0
	72. Development of individual learning systems based on measurement of the faculties of eyesight, ability to support by hands, hearing, judgement, etc. of the middle-aged and elderly.	1	80	10	19	30	41	18	50	28	5
		2	69	8	24	29	39	14	57	28	1
		X	9					44	56	0	0
	73. Widespread use of sophisticated training systems in career-development planning directed to acquisition of new knowledge and technical skills by individuals in the middle and upper age groups.	1	91	9	25	33	33	23	49	24	2
		2	78	9	23	37	32	17	64	18	1
		X	10					20	60	20	0
	74. Development of ability-evaluation systems focusing on comprehensive personal ability, such systems to replace Japan's present system of school entrance examinations.	1	100	20	21	33	26	43	31	19	7
		2	87	20	18	37	24	54	30	13	3
		X	23					70	22	9	0
Leisure and hobby, culture (creation and art)	75. Widespread application of art education and artistic production using computer graphics in four or more dimensions.	1	79	7	16	36	41	8	33	54	5
		2	71	4	17	40	38	10	35	54	1
		X	5					40	20	40	0
	76. Widespread use of image synthesis processors which, analogously to today's word processors, will enable the design and drawing of graphics using built-in color codes, color elements, image units, and color and image synthesis.	1	91	7	17	43	33	10	47	43	0
		2	81	4	20	46	30	11	54	32	1
		X	5					40	40	20	0
	77. Increase construction of science museums that foster scientific ability enjoyably using methods of natural history and science teaching.	1	97	14	18	39	29	21	52	27	1
		2	84	11	22	40	28	17	63	18	1
		X	13					54	46	0	0
	78. Widespread application of systems enabling users to obtain instructions in dance, sports, traditional oriental board games, etc. using expert systems in schools and regions that lack appropriate instructors.	1	93	8	19	42	31	10	30	51	10
		2	80	6	21	43	30	6	35	50	9
		X	7					43	14	29	14
Social contribution and social exchange (local activities, communication)	79. Widespread use of local disaster prediction and prevention systems against earthquakes, land-slides, etc.	1	68	3	7	41	49	65	29	6	0
		2	55	3	8	38	51	78	20	2	0
		X	3					100	0	0	0
	80. Widespread use of community-level systems for prevention of crime or disasters (automatic fire extinguishers, etc.) based on interconnection of home security systems.	1	84	5	14	43	38	35	48	14	4
		2	70	4	15	43	38	37	53	9	1
		X	5					80	20	0	0

Forecasted realization time (Year) 1995 2000 2005 2010 2015 2020	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	12	39	32	9	20	29	25					16	32	46	7	7	21	11	5
	11	43	37	9	22	29	31	11	28	29	22	14	48	62	6	5	28	5	5
	25	67	8	17	25	25	33	8	33	50	8	8	58	83	0	8	33	8	0
	14	35	41	14	34	30	13					38	5	13	19	21	20	28	5
	6	43	46	10	39	35	12	7	33	22	30	59	7	13	14	20	17	30	1
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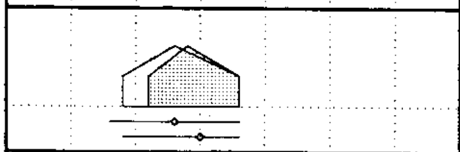	13	35	43	8	25	37	21					23	16	13	24	18	19	23	8
	8	36	51	9	24	42	19	15	24	17	35	36	19	8	41	18	21	19	3
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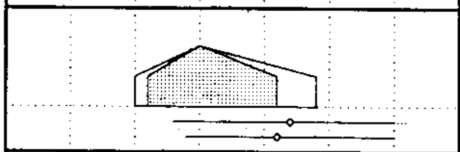	19	33	31	14	15	26	30					22	38	32	3	5	14	26	6
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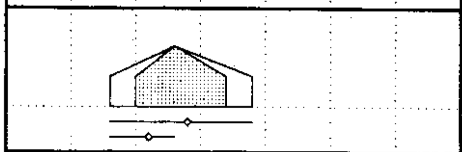	16	39	34	27	28	23	13					35	4	14	35	20	16	13	5
	15	49	31	23	42	21	10	8	32	35	15	66	1	14	56	14	14	6	1
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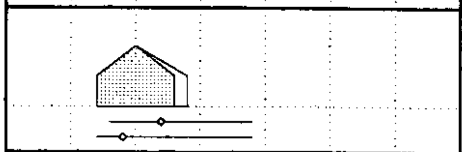	26	38	29	20	27	26	18					42	2	10	53	14	11	8	7
	15	57	25	15	36	32	12	22	26	30	14	59	4	7	72	11	7	2	4
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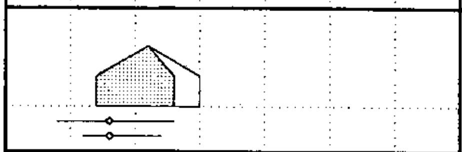
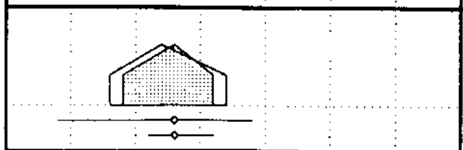
	27	43	27	18	36	29	12					13	13	19	31	42	26	10	2
	18	56	24	12	48	25	10	8	24	48	11	15	10	24	45	46	27	2	2
	46	46	8	31	46	8	15	8	23	54	8	15	0	23	62	31	38	15	0
	15	39	34	5	14	31	39					16	16	17	40	17	16	9	5
	9	45	41	4	18	28	44	25	26	16	19	19	20	19	56	16	19	4	4
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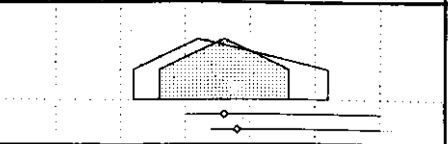	16	38	43	50	19	16	10					66	15	4	21	28	12	19	4
	11	40	47	64	20	7	7	36	35	7	16	80	9	0	22	29	9	15	4
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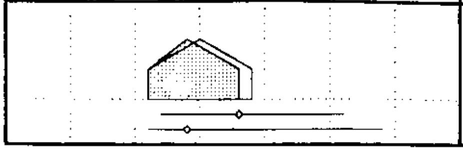
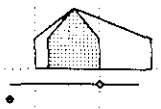
	14	48	32	18	17	32	27					26	32	18	60	15	0	5	5
	10	53	34	21	17	37	20	23	27	21	21	27	39	9	76	7	0	3	3
	20	80	0	40	40	0	20	20	40	20	0	40	60	0	100	0	0	0	0

Division	Topic	Round	Number of respondents	Degree of expertise (%) High	Degree of expertise (%) Medium	Degree of expertise (%) Low	Degree of expertise (%) None	Degree of importance (%) High	Degree of importance (%) Medium	Degree of importance (%) Low	Degree of importance (%) Unnecessary
Social contribution and social exchange (local activities, communication)	81. Widespread use of inexpensive and practical electric automobile systems for physically handicapped people, to facilitate their local community interactions.	1	73	1	11	41	46	40	45	12	3
		2	63	1	11	46	42	44	46	6	3
		X	1					100	0	0	0
	82. Widespread application of systems permitting easy access from home or work locations to educational video data bases with information on domestic and foreign languages, climates, customs, social systems, etc.	1	102	10	25	40	24	20	45	32	3
		2	88	8	31	41	21	16	55	28	1
		X	9					33	44	22	0

Forecasted realization time (Year)	Degree of certainty (%)			Necessity of international joint development (%)				Comparison of current R&D level between Japan and other countries (%)				Constraints on realization (%)							
1995 2000 2005 2010 2015 2020	High	Medium	Low	High	Medium	Low	None	Japan is more advanced	Equivalent	Other countries are more advanced	Don't know	Technical	Institutional	Cultural	Cost	Funding	Fostering/securing human resources	R&D system	Others
	15	49	30	33	22	25	14					23	16	8	66	29	4	10	7
	10	56	30	35	24	22	13	13	32	35	14	30	10	8	84	41	3	3	3
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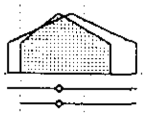
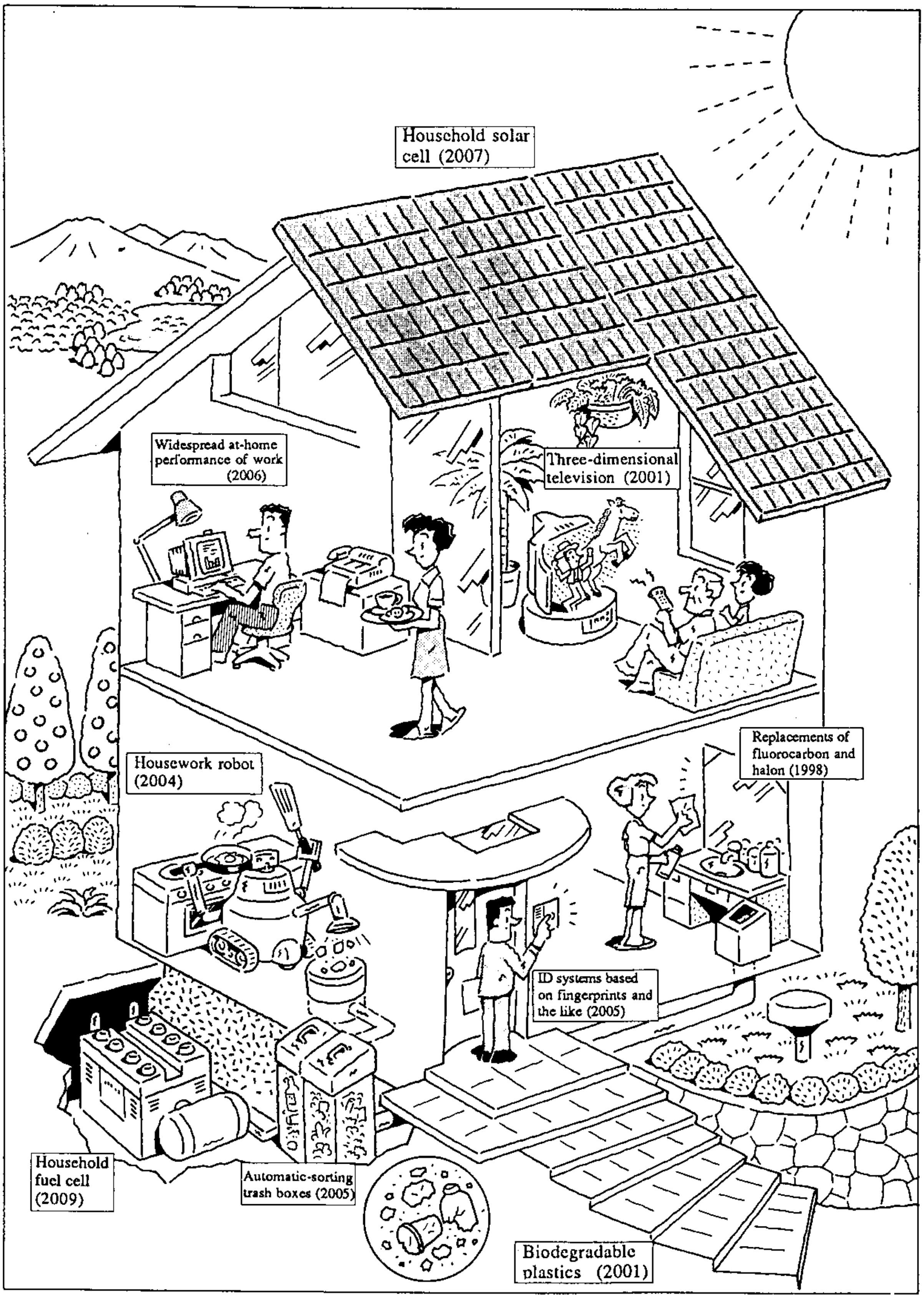
	20	43	34	32	30	19	15					19	17	15	53	26	10	13	3
	11	57	30	42	34	13	9	20	40	17	15	18	14	16	73	34	6	6	3
	67	33	0	67	33	0	0	11	44	33	11	33	22	33	67	22	11	0	0

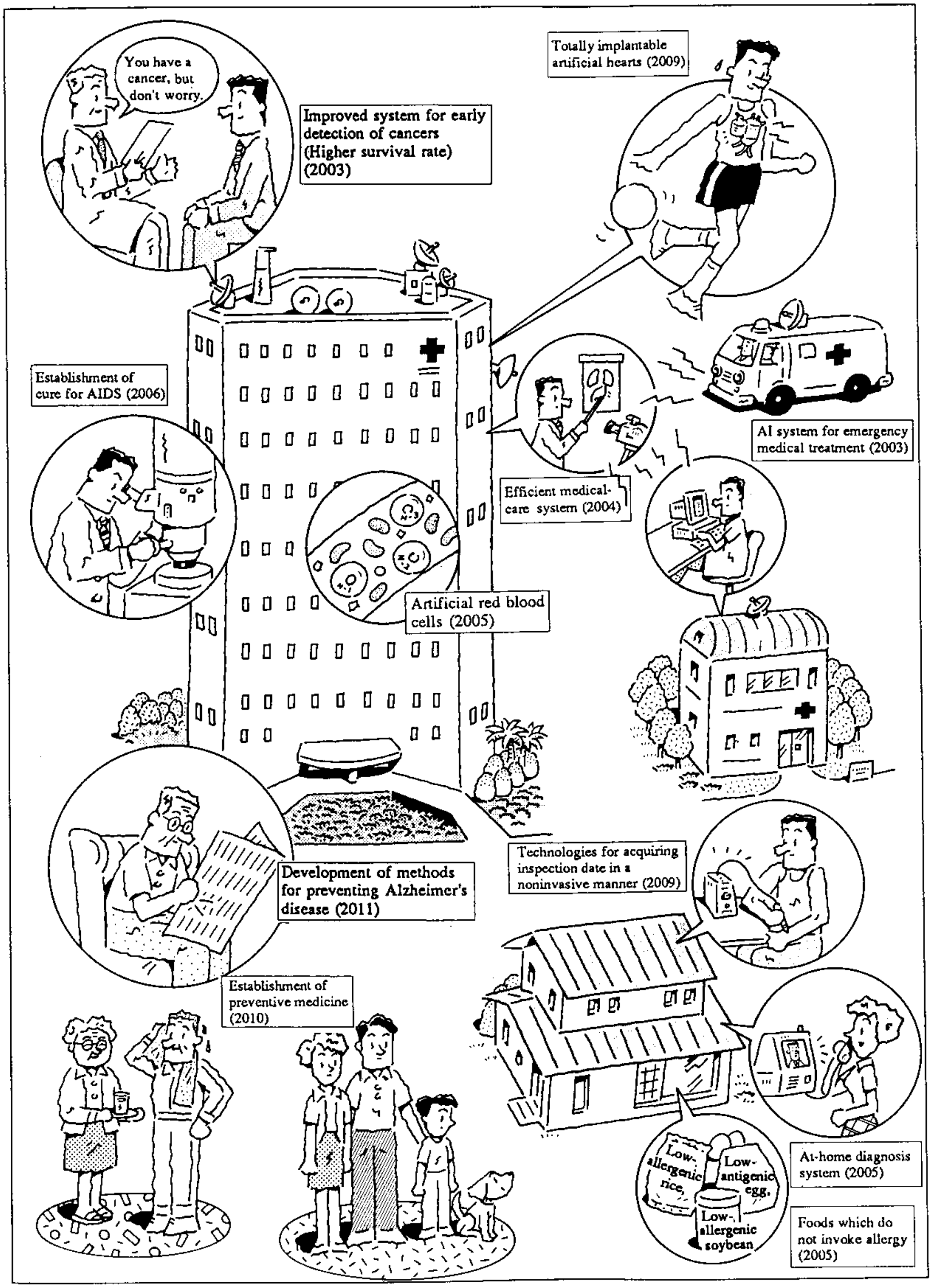
Appendix 3 Forecast technologies illustrated

The purpose of this illustrated appendix is to help readers understand this report.

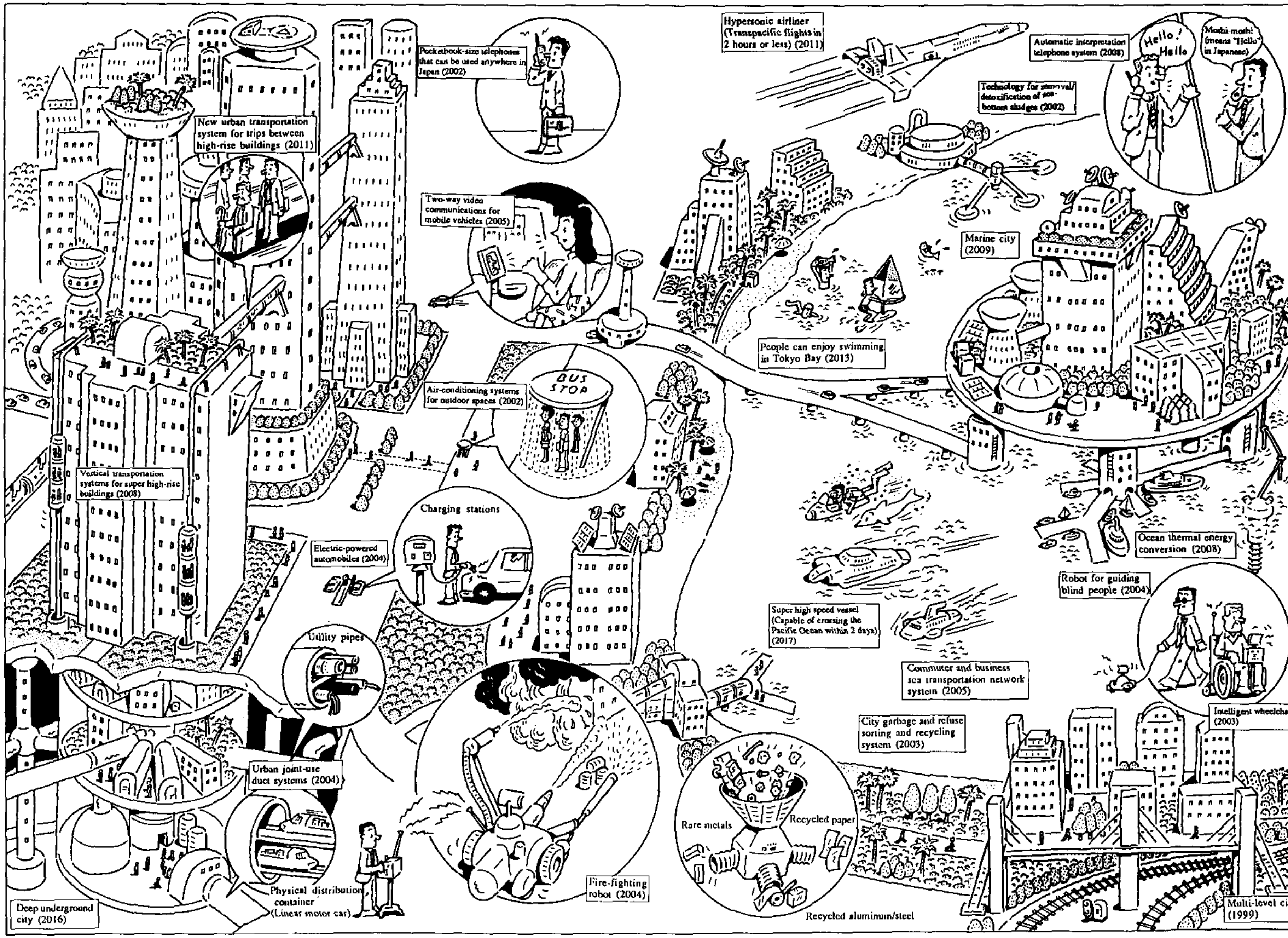
1. Tomorrow's home



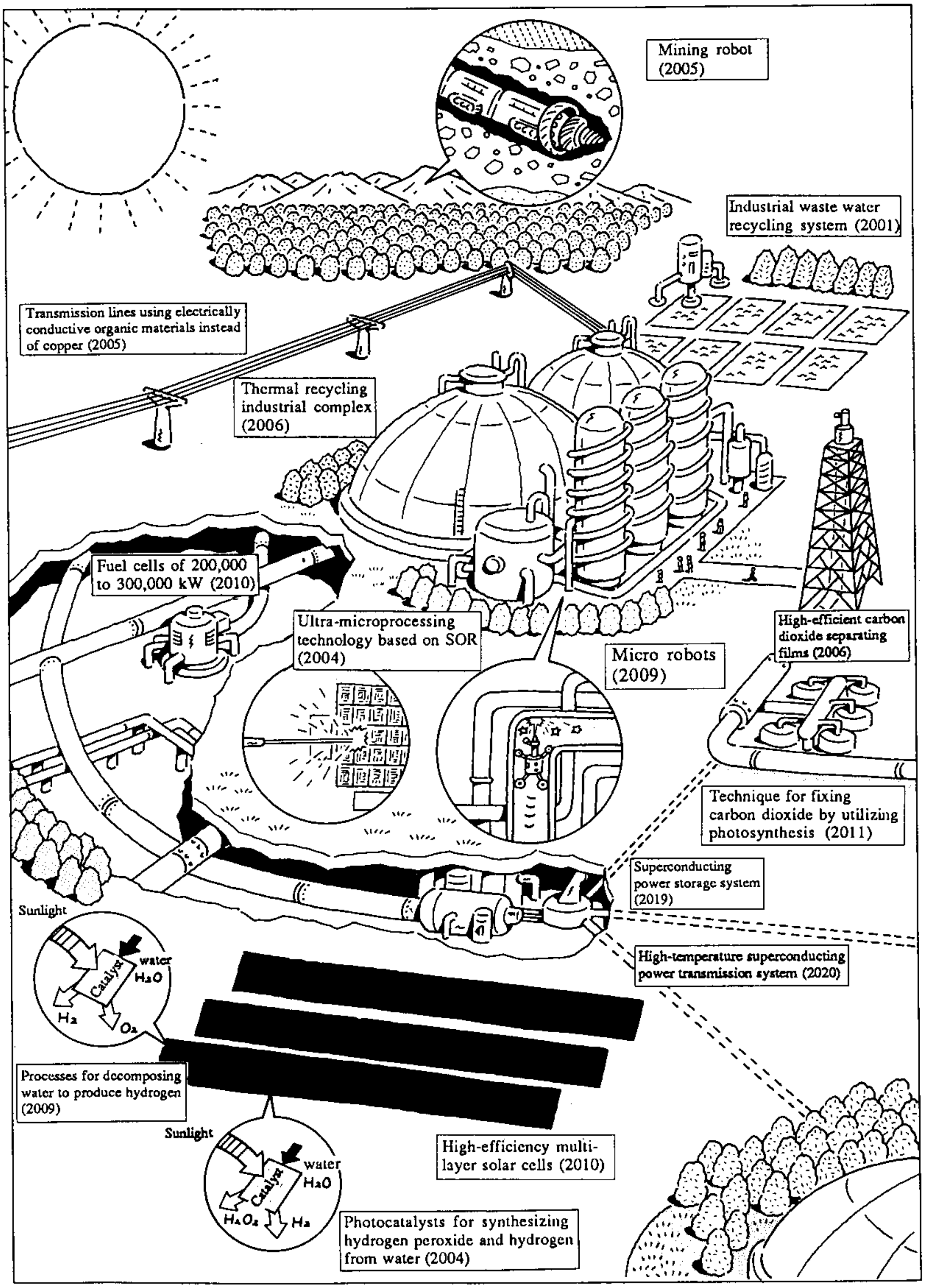
2. Tomorrow's health and medical care



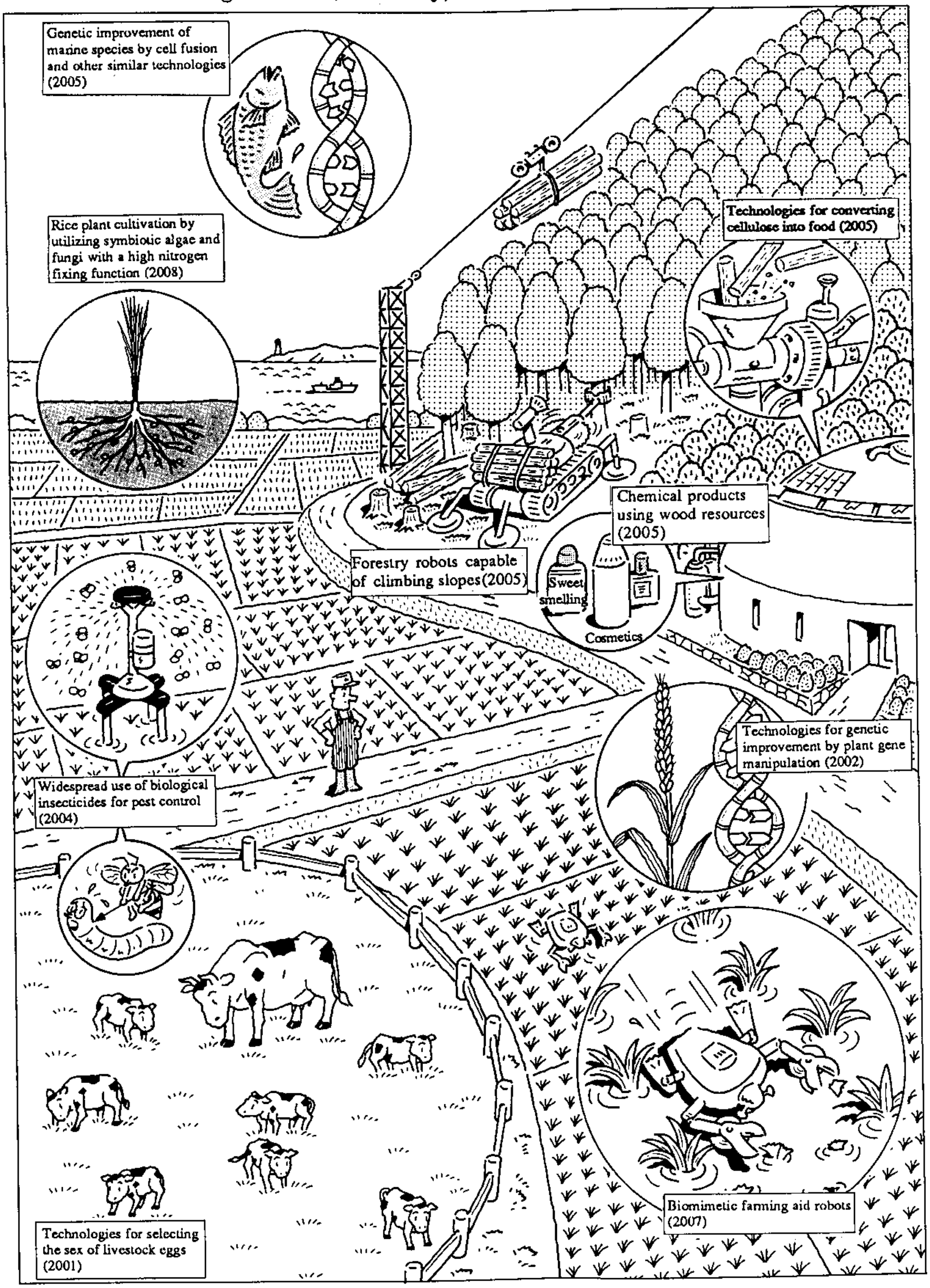
3. Tomorrow's cities, transportation, and communications



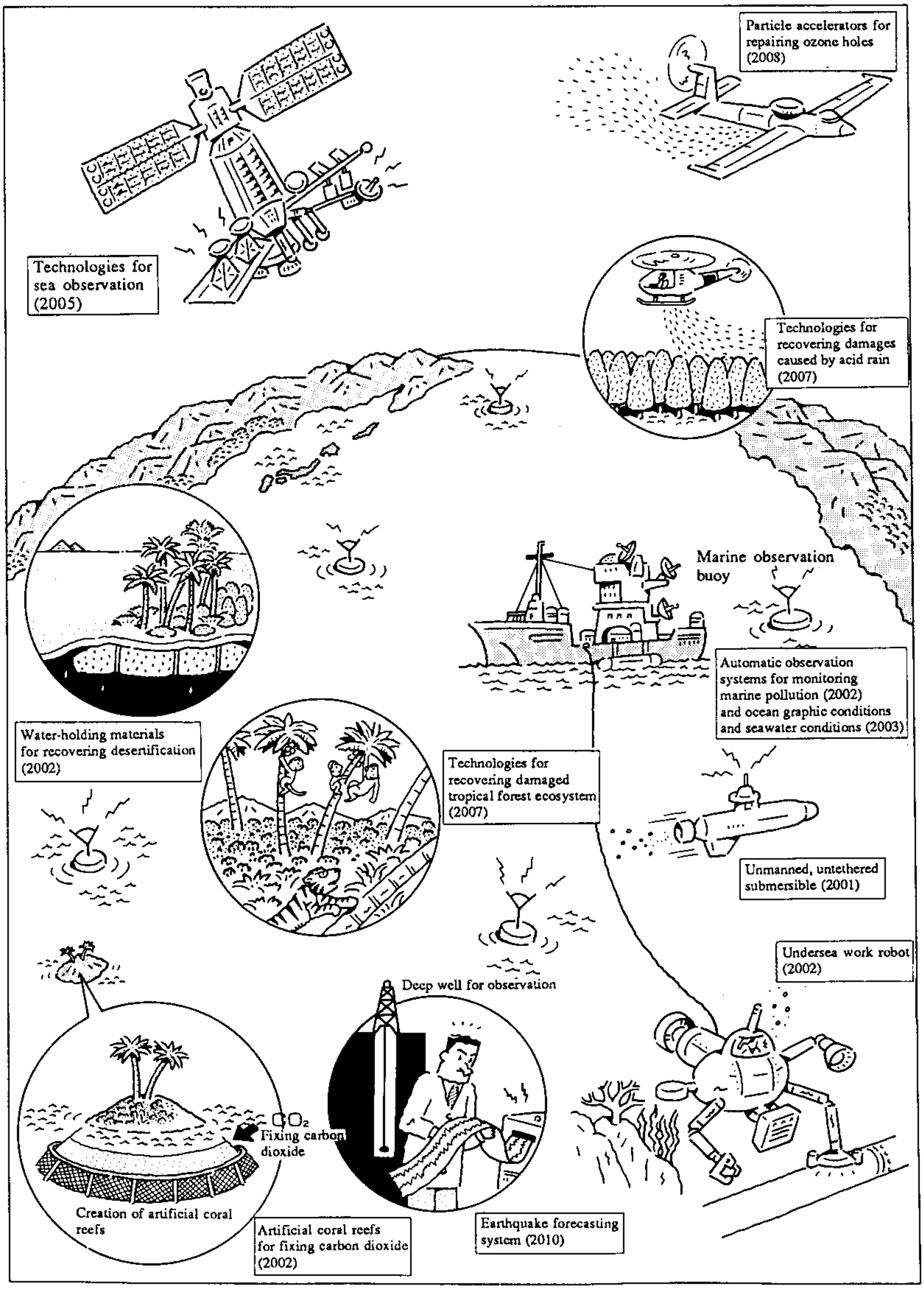
4. Tomorrow's mining and manufacturing industries



5. Tomorrow's agriculture, forestry, and fisheries



6. Tomorrow's earth



7. Tomorrow's outer space