

GSI Research and Development Basic Plan

Abstract

Aiming to define the basic direction for research and development (R&D) to be performed by the Geospatial Information Authority of Japan (GSI), this plan clarifies what kind of R&D should be executed by the GSI in the future as well as necessary policies for the execution of such R&D in light of social needs for R&D based on the “Basic Plan for the Advancement of Utilizing Geospatial Information” (hereafter, “Basic Plan for the AUGI”), the “Long-Term Plan for Basic Survey,” the “Promotion of Research and Observation Program for Earthquake and Volcanic Eruption Prediction (proposal)” suggested by the Council for Science and Technology, in addition to achievements and issues of the previously-conducted plan, the “GSI Research and Development Five-year Plan.”

The period of this plan is set to five years from FY2009 to FY2013 in order to maintain the continuity of R&D, while taking expected changes in social conditions and rapid progress in technologies into consideration. Note that, however, this plan will be partially or entirely revised as needed, even within the period.

The GSI aims to solve various issues through this plan within the planned period and make every effort to achieve this goal.

1. Introduction

Digitalization and utilization of information-communication technology (ICT) have been accelerated in the field of surveying technology. On the premise of such situation, the society where distribution and utilization of survey results and geospatial information are taken for granted is coming to the realization.

Under such conditions, in order to promote further utilization of survey results, the Survey Act was revised in May 2007, which regulates the electronic provision of survey results, and the promotion of a one-stop service for approval for reproduction/usage. Furthermore, the Basic Act on the Advancement of Utilizing Geospatial Information (hereafter, “Basic Act”) came into force in August 2007, and the Basic Plan for the AUGI was decided by the cabinet based on the Basic Act in April 2008. Besides, the Aerospace Basic Act was formulated in May 2008, and the Basic Plan for Space Policy is scheduled to be defined based on the original version of the Aerospace Basic Act in June 2009. Accordingly, it is expected that the development and utilization of space technology will be further promoted in the future.

Additionally, after the “Promotion of Research and Observation Program for Earthquake and Volcanic Eruption Prediction (proposal)” was suggested by the Council for Science and Technology in July 2008, a

proposal has been submitted to the Minister in charge. In March 2009, the Headquarters for Earthquake Research Promotion revised “Comprehensive Basic Policies for the Promotion of Earthquake Research through the Observation, Survey, and Research.” These documents emphasize importance of basic observation/investigation such as survey for understanding crustal movement and active fault.

Based on the progress in technologies and revisions in legal system as well as various plans, the GSI revised the “Long-Term Plan for Basic Survey” that shows a direction of the future survey and various policies needed for its promotion in June 2009.

Besides, as for policies regarding the field of science and technology, the Third Science and Technology Basic Plan was decided by the cabinet in March 2006. This plan defines the social infrastructure area as one of prioritized R&D areas, and promotes R&D that makes contributions to the society through achievements and puts an emphasis on human resource development and competitive environment as basic concepts. Based on this, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) developed a “MLIT Technology Basic Plan” in March 2008.

As for the research evaluation method, the “National Guidelines for Evaluating Government Funded Research and Development” was formulated based on the Science and Technology Basic Plan in October 2008.

The guidelines aim to revise the conventional evaluation method in order to ensure that research evaluation leads to the appropriate execution of R&D.

With the background mentioned above, the “GSI Research and Development Basic Plan” (hereafter, “this plan”) summarizes what kind of R&D should be executed by the GSI in the future as well as necessary policies for the execution of such R&D. As for the name of the plan, note that the name of previously-conducted plan, the “GSI Research and Development Five-year Plan” has been replaced by the “GSI Research and Development Basic Plan” in order to clarify that this plan should be created along the lines that it is important to identify the direction of R&D in the midst of drastically changing social conditions and technology trends.

The period of this plan is set to five years from FY2009 to FY2013 in order to maintain the continuity of R&D, while appropriately coping with expected changes in social conditions and rapid progress in technologies.

Note that, however, this plan may be partially or entirely revised as needed, even within the period.

2. Basic concepts

The GSI aims to ensure planning and smooth execution of administrative policies regarding survey and development/utilization of geospatial information, and conduct R&D exactly to promote these efforts. The GSI covers a wide variety of areas from basics to application pertaining to survey. Especially, the GSI is expected to intensively conduct R&D that involves political research and is essential for administrative policies, or R&D that is indispensable to obtain achievements which can be utilized as a common infrastructure in the society.

Besides, the GSI should steadily advance not only R&D that can produce achievements and be reflected in policies in a short term of five years or so, i.e. within the period defined for this plan, but also R&D that will produce achievements and be reflected in policies in distant future, making a contribution to appropriate development of the society.

Furthermore, it is important to have a vision to

make full use of R&D results for other R&D, in addition to administrative policies.

Considering these points as basic concepts, this plan firstly aims to identify policies required for promotion of R&D, which are clarified based on achievements and issues derived from the previously-conducted plan, social needs for R&D, and other plans including the Science and Technology Basic Plan. With this purpose in mind, this plan also aims to determine fundamental issues to be addressed in GSI’s R&D (hereafter, “basic issues”), and issues which should be given high priority among them (hereafter, “prioritized R&D issues”). Finally, policies to promote these R&D will be established.

3. Current conditions and backgrounds of R&D

3.1 Achievements and issues of the previously-conducted R&D plan (“GSI Research and Development Five-year Plan,” July 2004)

Achievements and issues of the previously-conducted plan are summarized below, quoting from the outcome of the interim evaluation released in October 2007 and the subsequent progress of the R&D.

(1) R&D supporting actual work of survey and administrative policies

In the “Standardization of survey method and survey results,” the GSI conducted investigations and research on digital aerial photogrammetric techniques, network-RTK GPS survey and other survey-related techniques, and then created a draft of an operation manual for public surveys. At the same time, the GSI conducted R&D on how to promote standardization of geographic information and establish the implementation method for the standard, and formed the Japan Profile for Geographic Information Standards (JPGIS). In April 2008, the rules for the operating specifications were formulated based on these achievements and applied to public surveys. Furthermore, the GSI implemented investigations on the installation of long-distance baselines regarding the traceability system of survey equipment, and conducted research and review on

techniques to improve the degree of accuracy in GPS survey, taking antenna calibration into account. In order to ensure the survey quality, it is necessary to continue to make efforts for the standardization of geographic information and establishment of a verification method for new technologies.

In the “R&D for the geo-referencing infrastructure and Fundamental Geospatial Data,” the GSI successfully established a technique to identify a coordinate value at the control point rapidly and accurately, and also obtained other achievements such as the semi-dynamic correction procedure to correct the effect of crustal movement in survey results acquired at different periods. Besides, R&D outcome pertaining to the management of vector data with different scales has been reflected in the development of system for managing Fundamental Geospatial Data and topographic information. The future challenges should be to consider map expression methods and map maintenance methods.

In the “R&D for quick understanding of the attribute and shape of the earth’s surface,” the GSI achieved an excellent outcome in developing techniques for understanding the attribute and shape of the earth’s surface as well as their changes, by processing/analyzing data obtained from various sensors mounted on satellites and aircrafts. Besides, this project also contributed to advance in preparing/updating of topographic information.

(2)R&D advancing near-future surveying technologies

In the “R&D for establishing the precise positioning social infrastructure,” R&D was conducted to assess the potentiality of the utilization of the Quasi-Zenith Satellite system, IC tag, and others in order to ensure the precise positioning environment everywhere, even in urban areas and underground spaces with bad condition of GNSS (Global Navigation Satellite System) radio waves. Besides, in the “R&D for the daily use of geographic information,” the GSI conducted R&D on information transmission through GPS-enabled mobile phones that provide easy access to the Internet in order to promote the utilization of the Information

Integration System on Digital Japan Web System.

From now on, it is necessary to conduct R&D that makes these achievements widely available and puts them to practical use.

(3) R&D contributing to disaster prevention/ environmental preservation

The research titled “Clarification of occurrence mechanism of natural disasters” involved the elucidation of plate movement with GPS observation, development of a real-time surveillance technique for crustal activities in volcanically-active mountains and surrounding area, and upgrading of simulation model for crustal activities based on observation data. The achievements provided a number of new insights into the mechanism of earthquake originating deep inside the earth crust, including the fault movement of past earthquakes, and the distribution of crustal movement on the surrounding inland active faults. Concerning interplate earthquakes, the research also offered abundant information about asperities on the plate interface and afterslip phenomena following the earthquakes. Additionally, the system to integrate the observation network data obtained from single frequency receivers which the Meteorological Agency placed in volcanically-active mountains and the data obtained from GPS-based control stations for analysis was constructed. This system began its regular operation for the surveillance of volcanic activities. Furthermore, the simulation system for earthquake generation that takes three-dimensional underground structure into consideration was developed.

In the “Development of real-time disaster response technologies,” the GSI developed analysis techniques for understanding crustal activities after a disaster by utilizing GPS observation data, and advanced technologies for understanding post-disaster situations by utilizing satellite image and laser scanner data. The achievements include the development of a base line analysis technique for real-time data to detect crustal movement in a short time, such as enabling immediate understanding of analysis reliability of GPS data with 1 second sampling. The technique to immediately identify disaster-affected areas and disaster scale by airborne

laser survey and make these information supported by the GIS (Geographic Information System) at the time of a massive widespread disaster was also developed. Besides, a guideline for the use of the real-time disaster information system was formulated, while understanding the damage situation of large-scale disasters that occurred in foreign countries with satellite image to confirm the photo(image)-interpretation ability.

The future challenges in the above-mentioned R&D related to disaster-prevention include the practical use of obtained achievements or further applications to actual work.

Through the research titled “Understanding and analysis of changes in global environment,” the improvement of accuracy in element technologies required to detect sea-level changes, such as tidal observation, GPS, VLBI (Very Long Baseline Interferometer), gravity observation, and leveling, has been on track through elimination of error causes and improvement of observation techniques. In the future research, it becomes important to promote observations to detect sea-level changes by adopting the sea-level change detection technology that integrates element technologies with improved accuracy, and also important to facilitate publication of the achievements. Meanwhile, as a result of an advance in mapping technique for the Global Map that is useful to calculate the amount of carbon dioxide absorptions and emissions, the GSI updated the global land cover and percent tree cover, and succeeded in publishing them in 2008. The future R&D challenges include the improvement of data accuracy and resolution, and the development of maintenance technology for time-scale data.

(4)R&D contributing to the scientific developments pertaining to the earth and national land

This R&D involving the research on the shape and rotation of the earth and the research on the earth’s surface layer has provided scientific insights and made achievements in the technology development. Major achievements are summarized here. The research on the former topic reveals that plates around Japan, excluding the marginal area, shows rigid motion at an extremely

high accuracy. Besides, a new geoid model for Japan, JGEOID2008, has been developed by combining a gravity satellite GRACE (Gravity Recovery And Climate Experiment)-based global gravitational field model with regional gravity data etc. This suggests that the mean sea level dynamic heights at tidal stations can be compared with approx. 10cm accuracy using this model as a standard. The research on the latter topic also made a wide variety of achievements: the elucidation of geomorphic characteristics in areas where slope failure occurred or buildings were intensively damaged through investigations of damaging earthquakes in recent years; the development of technology to identify changes in landscape (cutting and filling earth) with a high degree of accuracy by utilizing the time-series geographic information; the development of technology to easily understand land cover changes by colorizing monochrome photographs shot by the U.S. forces after the end of the Second World War.

From now on, it is important is to continue maintaining the collaboration among departments in the GSI in order to ensure the continuity of the research and the succession of technological resources.

(5) Issues identified across the whole R&D activities

At the time of the interim evaluation on the previously-conducted R&D, the Research Evaluation Committee pointed out the following issues identified across the whole R&D activities.

1) Promotion of political research

The GSI should conduct research for an administrative purpose to clarify what kind of geospatial information should be collected, processed, provided to and used by the public.

2) Promotion of research pertaining to a location identification method

The GSI should also conduct research on a location identification method of geospatial information, including those developed and provided by private companies, allowing the public to use the information with high reliability.

3) Consideration of a framework for long term research

As some R&D are required to advance R&D

based on a long-term perspective, it is necessary to consider an effective procedure for such R&D.

(6) Issues on policies for R&D advancement

At the time of the interim evaluation on the previously-conducted R&D, the Research Evaluation Committee pointed out the following issues on policies for R&D advancement.

1) Improvement of the project manager system

Although the project manager played a role of R&D adviser in charge of research evaluation in the previously-conducted R&D plan, its role and authority were unclear and its function should be reviewed.

2) Development and recruitment of human resources

It is necessary to consider improvement in the researcher recruitment system to stimulate research activities driven by young people's innovative ideas. Besides, as the fixed-term system of researchers does not always lead to the cultivation of talented researchers, the recruitment of researchers should be considered from a long-term perspective.

3.2 Social needs for R&D

As for social needs for R&D on surveying technologies and the preparation and utilization of geospatial information, it is necessary to advance the consideration in light of various policies, including the Basic Plan for the AUGI, reports on fundamental policies for future surveys at the Inquiry Panel on Survey Administration, the Long-Term Plan for Basic Survey, the Science and Technology Basic Plan, and the "Promotion of Research and Observation Program for Earthquake and Volcanic Eruption Prediction (proposal)" suggested by the Council for Science and Technology.

The Basic Plan for the AUGI aims for the smooth preparation of geospatial information, establishment of a base for its distribution and utilization, and creation of the society where geospatial information are widely utilized, which will lead to the creation of new business opportunities. Accordingly, R&D needed to achieve these aims should be promoted.

The Inquiry Panel on Survey Administration presented a report summarizing opinions on future

political activities concerning the advancement of utilizing geospatial information. This report suggests a wide variety of policies, including those needed to promote the Basic Act and the Basic Plan for the AUGI. Thus, R&D needed to drive them forward should be promoted.

The Long-Term Plan for Basic Survey aims for the preparation of geospatial information that is commonly used for the positional standard and the standard for map information representing the national land, and the development of environment for geospatial information utilization, the collaboration and R&D promotion for the advancement of utilizing geospatial information, in light of reports presented by the Inquiry Panel on Survey Administration. Therefore, R&D needed for these policies should be promoted.

The Promotion Strategies for the Science and Technology Basic Plan refer to the research on assessment and prediction of crustal activities, development of system for sharing disaster information as well as techniques for collection and transmission of disaster information, and development of system allowing users to seamlessly obtain information required for transfer through the use of IC tag or other devices as strategic prioritized science and technology areas in the social infrastructure field. Accordingly, these R&D should be promoted.

The MLIT Technology Basic Plan shows importance of R&D for realization of the society with advanced disaster prevention solutions that ensures full preparation for disasters, and R&D for realization of the universal society. Thus, R&D should be promoted in light of these aims.

The "Promotion of Research and Observation Program for Earthquake and Volcanic Eruption Prediction (proposal)" suggested by the Council for Science and Technology and the "Comprehensive Basic Policies for the Promotion of Earthquake Research through the Observation, Survey, and Research" proposed by the Headquarters for Earthquake Research Promotion emphasize importance of continuous observation and research including surveillance of crustal movement, earthquake, and volcanic phenomenon,

as well as promotion of R&D concerning earthquake and volcanic eruption prediction based on these results. Hence, R&D should be promoted in light of these purposes.

The Aerospace Basic Act states that it is necessary to develop policies to promote basic research and R&D on foundational technology concerning space development and utilization, taking the importance of maintaining and improving reliability on space development and utilization technologies. Therefore, R&D should be promoted in light of these aims.

3.3 Key considerations for R&D promotion

In addition to future directions pointed out in the interim evaluation, as already presented in Section 3.1 (6), this section presents other key considerations.

As for the R&D evaluations, the “National Guidelines for Evaluating Government Funded Research and Development” was formulated in October 2008. Following the guidelines, the timing of evaluation for individual themes should be modified. As the guidelines specifies that the research evaluation should contribute to the improvement of R&D, it is necessary to conduct R&D evaluation based on these purposes.

In order to promote the utilization of R&D results, the Third Science and Technology Basic Plan and the MLIT Technology Basic Plan encourage contributions to be made to the society through achievements. Thus, it is necessary to strengthen efforts to achieve this aim in the future.

For securing human resources and R&D funds, setting of prioritized R&D projects and appropriate allocation of human resources and R&D funds are required, as stated in the Third Science and Technology Basic Plan.

As for the promotion of development and utilization of intellectual infrastructure, the Third Science and Technology Basic Plan defines the development of intellectual infrastructure. The MLIT Technology Basic Plan also defines the construction of geospatial information platform as the social infrastructure. Therefore, appropriate efforts should be made.

In terms of ensuring cooperation and

collaboration with relevant organizations as well as international collaboration, it is necessary to promote international exchanges and joint research, as stated in various plans.

4. Setting of R&D directions and basic issues in this plan

Firstly, this section specifies basic issues for R&D in this plan in order to clarify directions that should be pursued over the next five years, taking social needs for R&D into account.

Basic issues should be examined based on the review of the previously-conducted plan introduced in Section 3.1 (1)~(6) and social needs for future R&D in Section 3.2. The vision concerning R&D directions on the basis of these backgrounds are shown below:

- Smooth preparation/distribution/utilization of geospatial information

Conduct R&D which can contribute directly to the promotion of geospatial information utilization as a common infrastructure in order to create the society where people live a safe and fulfilled life. Note that this R&D is basically required to produce achievements in a relatively short term.

- Realization of a next-generation, advanced geospatial information utilization society

Conduct pioneering R&D which helps promote the geospatial information utilization as a common infrastructure in order to create a more prosperous economic society and new business opportunities by looking ahead to the next generation. Note that this R&D should be basically performed from a mid-/long-term standpoint.

- Promotion of disaster prevention activities

Conduct R&D which can provide a common infrastructure and contribute to reliable precautions and prompt emergency management at the time of disasters in order to create the society where people live a safe and secured life. Note that, although this R&D is basically required to produce achievements in a relatively short term, part of the R&D should be

also performed from a mid-/long-term standpoint from a viewpoint of necessity to facilitate further disaster prevention efforts.

- Surveillance of crustal movement, understanding of current status of national land

Conduct R&D which can provide findings and achievements that will lead to advanced surveying technology, or improvement in application areas, e.g. disaster prevention and environmental conservation, through understanding of the earth and national land more scientifically. Note that this R&D should be basically performed from a mid-/long-term standpoint.

In this plan, four basic issues, each of which corresponds to the above-mentioned points, are defined as below.

Basic issue 1:

R&D to facilitate preparation/distribution/utilization of geospatial information

Basic issue 2:

R&D to realize a next-generation, advanced geospatial information utilization society

Basic issue 3:

R&D on disaster prevention

Basic issue 4:

Research to understand the earth and national land scientifically

Additionally, in order to clarify prioritized areas that should be specifically addressed, prioritized R&D projects should be decided for each basic issue based on this plan's basic concepts stated in Section 2.

4.1 R&D to facilitate smooth preparation/distribution/utilization of geospatial information

Prioritized R&D projects for this basic issue should be decided taking the following points into account.

- Standardization of geospatial information is indispensable to promoting diffusion of geospatial information. Besides, it is necessary to concurrently advance political research for promoting its distribution and utilization.
- Expecting that the needs for combining various techniques (e.g. GNSS) in survey will increase in the near future, it is necessary to advance R&D for ensuring consistency of survey results.
- It is necessary to advance R&D for promoting preparation/updating/utilization of basic geospatial information such as Fundamental Geospatial Data etc. to be used as positional standard.

In light of above-mentioned points, the following prioritized R&D projects should be set.

Prioritized R&D project 1: R&D to facilitate smooth preparation/distribution/utilization of geospatial information through standardization etc.

Prioritized R&D project 2: R&D to help advanced maintenance/management/dissemination of geo-referencing infrastructure

Prioritized R&D project 3: R&D to help advanced preparation/management/dissemination of basic geospatial information

4.2 R&D to realize a next-generation, advanced geospatial information utilization society

Prioritized R&D projects for this basic issue should be decided taking the following points into account.

- As geospatial information has a significant potentiality

for bringing affluence to people's life through its appropriate use, it is necessary to advance R&D in order to realize the society where geospatial information can be sophisticatedly utilized.

- It is necessary to conduct R&D that contribute to the development of future surveying technology, which will

lead to further progress and effectiveness of surveying technology.

- It is necessary to consider how to conduct survey, by seeing a progress of the next-generation Space-based

Positioning, Navigation and Timing technology.

In light of above-mentioned points, the following prioritized R&D projects should be set.

Prioritized R&D project 1: R&D on advanced geospatial information utilization technology that brings affluence to people's life

Prioritized R&D project 2: R&D on leading-edge technologies surrounding survey and geospatial information

Prioritized R&D project 3: R&D on how to conduct survey with the vision of next-generation Space-based Positioning, Navigation and Timing

4.3 R&D on disaster prevention

Prioritized R&D projects for this basic issue should be decided taking the following points into account.

- It is necessary to advance R&D that allows for smooth and timely information dissemination at the time of disasters, which contributes to execution of disaster prevention activities.

- It is necessary to promote advanced R&D required for natural disaster prediction using surveying technology and geospatial information.
- It is necessary to advance R&D that makes survey results and geospatial information more valuable in terms of contributions to disaster prevention.

In light of above-mentioned points, the following prioritized R&D projects should be decided.

Prioritized R&D project 1: R&D to contribute to real-time disaster response

Prioritized R&D project 2: R&D on natural disaster prediction

Prioritized R&D project 3: R&D to help advanced extraction of ground deformation and topographic information concerning disaster prevention

4.4 Research to understand the earth and national land scientifically

Prioritized R&D projects for this basic issue should be decided taking the following points into account.

- It is necessary to advance research which makes more understandings of phenomenon related to earthquakes and volcanic activities through mid-/long-term monitoring of crustal movement.
- It is necessary to advance research which helps

formulate from a mid-/long-term perspective, a concept of the definition and realization of future geodetic reference system, for example, by taking non-secular motions of the surface of the earth into account.

- It is necessary to advance research which makes more understandings of environmental changes and disaster occurrence through observing the current condition and transition of the earth's surface environment.

In light of above-mentioned points, the following prioritized R&D projects should be decided.

Prioritized R&D project 1: Research on elucidation of crustal activities

Prioritized R&D project 2: Research on advanced geodetic reference system based on scientific understanding of the earth and national land

Prioritized R&D project 3: Research to scientifically understand the earth's surface and national land

5. Prioritized R&D projects

General descriptions and goals of each prioritized R&D projects are provided below. As for more details of R&D and goals, an R&D actual plan should be defined every fiscal year to cope with new themes flexibly.

5.1 R&D to facilitate smooth preparation/distribution/utilization of geospatial information

(1) R&D to facilitate smooth preparation/distribution/utilization of geospatial information through standardization etc.

In order to promote distribution and utilization of various geospatial information, this project involves research on handling of intellectual property right and personal information related to geospatial information and research on standardization of geographic identifiers and others, aiming for providing standards and guidelines. Besides, to contribute to the improvement in the degree of accuracy and efficiency for control point survey and leveling, this project also involves R&D to understand ground subsidence more generally and efficiently with InSAR (Interferometric Synthetic Aperture Radar) technology, and R&D concerning the advance of physical geodesic elements including understanding of geoid model and geomagnetic distribution, aiming for findings and achievements required at survey. Furthermore, seeking for advanced utilization of geospatial information, this project involves R&D for integration and utilization of geospatial information including those collected from past to present through various media, and R&D to promote efficient use of Digital Japan Web System and Fundamental Geospatial Data for specific application fields such as administrative services, aiming for obtaining applicable achievements.

To contribute to the understanding of the global environment changes, this project involves R&D on provision of new specifications, and the technique for high-accuracy and efficient data preparation of Global Map Version2 as well as R&D on its utilization, aiming for establishing specifications/data preparation method.

(2)R&D to help advanced maintenance/ management/ dissemination of geo-referencing infrastructure

In order to maintain the geodetic reference system and improve its quality, this project involves

R&D on integration analysis technique with improved consistency for different geodetic observations, such as VLBI, GPS, and leveling, aiming to obtain findings and achievements useful for the practical use. Besides, to promote the utilization of GNSS survey (e.g. GPS survey), this project also involves R&D for reducing various types of errors and providing positional information promptly, aiming to obtain findings and achievements necessary for survey.

(3)R&D to help advanced preparation/ management/ dissemination of basic geospatial information

In order to promote utilization of geospatial information in various areas, this project involves research on the establishment of specifications supporting temporal and spatial representation, and research on preparation and dissemination of geospatial information regardless of map scale, aiming to obtain applicable achievements. This project also involves R&D for the establishment of a mechanism and technique for efficient updating of Fundamental Geospatial Data and utilization of satellite images etc. that contribute to efficient update of basic geospatial information, in order to increase the frequency of update and provide information that meets social needs, aiming to obtain findings and achievements useful for the practical use.

5.2 R&D to realize a next-generation, advanced geospatial information utilization society

(1) R&D on advanced geospatial information utilization technology that brings affluence to people's life

In order to allow every individual to receive the benefit of geospatial information utilization, this project involves R&D that contributes to the establishment of technique for providing information services to the socially vulnerable through Digital Japan Web System, aiming to obtain findings and achievements applicable to the use of the next-generation Digital Japan Web System. Additionally, to develop the environment where everyone can use positional information with required accuracy at ease, this project also involves R&D which enables seamless positioning on the ground, in the basement, and inside the building through the construction of the geo-referencing infrastructure under

any of these conditions, aiming for findings and achievements applicable to other R&D.

(2) R&D on leading-edge technologies surrounding survey and geospatial information

In order to conduct high-accuracy control point survey, this project involves R&D for downsizing VLBI observation system with wider bandwidth, which is suitable for understanding the shape and movement of the entire globe, aiming to obtain findings and achievements that can contribute to the practical use. Furthermore, to expand opportunities for geospatial information utilization in the society, this project also involves research on utilization of geospatial information through new media expected to grow in the future, aiming for findings and achievements that will make contributions to the development of new application areas.

(3) R&D on how to conduct survey with the vision of next-generation Space-based Positioning, Navigation and Timing

In order to effectively utilize various next-generation Space-based Positioning, Navigation and Timing technologies for survey, this project involves research on restructuring of the GPS Earth Observation Network System (GEONET) to make it suitable to the future with the next-generation Space-based Positioning, Navigation and Timing, aiming to create principles for the restructuring. Besides, to diffuse various Space-based Positioning, Navigation and Timing technologies, this project involves R&D on the correction technology for high-accuracy positioning for survey and the application/utilization of next-generation positioning satellites for survey, aiming to obtain findings and achievements that contribute to the actual utilization.

5.3 R&D on disaster prevention

(1) R&D to contribute to real-time disaster response

In order to make contributions to execution of appropriate response at the time of disaster occurrence, this project involves R&D on monitoring/modeling of crustal activities, prompt acquisition/dissemination of disaster information, and technological progress of information transmission. The R&D on monitoring/modeling of crustal activities aims to

calculate the crustal movement using GPS technology with a high degree of accuracy (within a few centimeters) within five hours from the occurrence of earthquake or other disasters, and enable automatic estimation of the fault model. Another aim is to develop the surveillance technology for earth crust activities using sensors with GPS and obtain achievements applicable at the time of disaster occurrence. Besides, the R&D on prompt acquisition/dissemination of disaster information seeks to estimate the scale of damage within approximately one hour after disaster occurrence, and recognize the post-disaster situation over a wider area within 72 hours. Another aim is to develop technology to identify seriously devastated areas using remote sensing technology even during the night, and obtain achievements applicable at the time of disaster occurrence. Finally, the R&D on technological progress of information transmission investigates transmission of high-capacity information such as images using a communication satellite or other system, aiming to obtain achievements applicable at the time of disaster occurrence.

(2) R&D on natural disaster prediction

In order to contribute to precise prediction of natural disasters such as earthquake and volcanic eruptions, this project involves R&D to understand spatial and temporal change of crustal activities and its characteristics, aiming for new findings on the process of disaster occurrence. Besides, to contribute to the advanced utilization for hazard maps, research will be conducted to improve the accuracy in the vulnerability assessment on local disasters by using geomorphological classification information as a thematic map, with a goal of obtaining applicable achievements.

(3) R&D to help advanced extraction of ground deformation and geomorphological information concerning disaster prevention

In order to understand the situation of ground deformation more quickly and accurately, this project involves research for advanced technology to recognize ground deformation using SAR etc., aiming for applicable findings and achievements. Additionally, to obtain ground deformation information from local to wide areas, this project also involves R&D to analyze

GPS observation results acquired from other organizations by integrating them with GEONET and to get consistent solutions, aiming for applicable findings and achievements. Furthermore, in order to identify active fault in an area where photographic interpretation is difficult, R&D on survey technique using airborne lasers will be conducted, aiming to obtain applicable achievements.

5.4 Research to understand the earth and national land scientifically

(1) Research on elucidation of crustal activities

In order to make a contribution to elucidation of crustal activities, earthquake occurrence and its preliminary stage around Japanese islands, this project involves research to understand wide-area tectonics or detailed tectonics in each region, research of characteristics of crustal activities in plate boundary zone and around active fault, and research to understand characteristics of crustal activity mechanism by numerical calculation. The goal of these researches is to aim for findings and achievements applicable in other R&D in related fields.

(2) Research on advanced geodetic reference system based on scientific understanding of the earth and national land

In order to contribute to further improvement of the quality of the geodetic reference system, this project enhances elucidation of the earth dynamics, such as the dynamic behavior of the fluid envelope of the solid earth and its interaction with the solid earth, and comprehension of non-secular motions of the solid earth associated with the dynamics. The goal of these researches is to aim for findings and achievements applicable in other R&D pertaining to the geodetic reference system.

(3) Research to scientifically understand the earth's surface and national land

In order to make a contribution to understand the earth's surface or national land appropriately and scientifically, this project involves research to assess the actual status of each region (e.g. disaster vulnerability, environment) from a viewpoint of topography and land cover. Additionally, research concerning influence of

human-induced impacts on the earth's surface environment (e.g. change in land cover) is also involved. The goal of these researches is to aim for findings and achievements that can be used for future prospects of the national land.

6. R&D promotion policies

In light of points mentioned in Sections 2.2 (6) and 3.4, the following R&D promotion policies are intensively executed.

6.1 Execution of evaluation

As for evaluation on R&D, based on the purpose of the "National Guidelines for Evaluating Government Funded Research and Development" defined in October 2008, R&D issues and R&D policies should be evaluated by setting the Research Evaluation Committee consisting of external experts.

In the case of Special Research, evaluation of R&D should be conducted at both prior and final stage of the research. The evaluation to be conducted at final stage of the research should involve external evaluation based on estimation of expected final achievements in the last fiscal year of R&D. Previously, in the case of the R&D which requires a term of approx. five years, an interim evaluation was performed in light of achievements after three years from its initiation. However, this interim evaluation is not conducted for the R&D which does not continue over five years as a general rule.

When working on a long-term R&D that takes more than five years, the need for an interim evaluation should be examined at the time of the prior evaluation as a general rule. When deemed necessary, the timing of implementing an interim evaluation should be decided.

The target of the evaluation concerning R&D policies is this plan. More specifically, the evaluation should comprehensively cover the achievement status of goals for each of the basic issues stated in Section 3, and activities towards the development of R&D environment stated in this section. An interim evaluation should be performed at the middle point of the research period, while a final evaluation should be conducted immediately after the termination of the research. The details of evaluation should be considered at the time of each evaluation.

When evaluating the achievement status of R&D goals for each of the basic issues, the results of self-check for the attainment level and the utilization status of achievements should be combined as shown below:

- (1) Self-check whether the original goal has been achieved or not for each of prioritized R&D projects comprising basic issues.
- (2) The utilization status of R&D results in the GSI, relevant organizations, and private companies. Note that this would be replaced by the status concerning application or potential application of R&D results to other R&D, in the case of R&D which should be implemented from a mid-/long-term standpoint.

6.2 Understanding and management of R&D execution status

In the previously-conducted R&D plan, along the lines suggested in the “National Guidelines for Evaluating Government Funded Research and Development” in 2001, a mechanism for managing R&D was created by placing project managers in order to address each of prioritized R&D projects accurately. On the contrary, there is no clear provision concerning the assignment of personal for research management in the national guidelines revised in 2008. Likewise, although the Science and Technology Basic Plan states that a program officer (program manager) should be placed for competitive funds to promote both basic and applied research aiming for the development of innovative technology that will lead to creating a new value, there is no obligation to apply this to every R&D.

However, in view of the importance of the progress management in R&D, the GSI will form an R&D management team (tentative name) mainly consisting of researchers in charge (or heads of each division/office) for progress management of prioritized R&D projects during the period of the next R&D plan. Besides, as for prioritized R&D projects to be conducted across different divisions/offices, R&D coordinators (tentative name) who are in charge of coordination between associated divisions/offices and preparation of material for evaluation will be placed. R&D coordinators should conduct their activities within a framework of the GSI’s Internal Evaluation Committee.

Note that, as for prioritized R&D projects to be

completed within a single division/office, staff at a management level (e.g. heads of each division/office in charge) will manage the progress and prepare material for evaluation. Like R&D coordinators, they should conduct their activities within a framework of the GSI’s Internal Evaluation Committee (hereafter, heads who play a coordinating role and R&D coordinators are collectively referred to as “R&D coordinators etc. (tentative name)”).

6.3 Promotion of utilization of R&D results

R&D to be conducted by the GSI has the nature of common infrastructure pertaining to survey and geospatial information, and its achievements are useful not only to the GSI, but also to various organizations. Thus, R&D results should be spread through the Internet or other media as a general rule, and should be presented widely to the public in an easy-to-understand manner via mass media or at lectures.

Obtained achievements should be presented at academic conferences, or published in academic journals. Especially, submission to refereed journals should be strongly encouraged. Simultaneously, the exchange of information should be intensified at the GSI’s internal workshops, liaison conferences, and other meetings in order to ensure that obtained achievements will be utilized inside the GSI.

Furthermore, in order to promote the utilization of achievements, collaboration with other organizations should be sought not only in research supported by competitive funds, but also in the case of addressing each of R&D.

As for political research, efforts should be made to reflect achievements to related administrative policies.

Additionally, in order to make R&D more meaningful to the succeeding generations, utilization strategies should be examined for achievements having potential for further utilization. More specifically, opinions will be exchanged among the GSI’s departments and people concerned at other organizations conducting joint research with GSI, as required by using the GSI’s Internal Evaluation Committee, seeking for cooperation of R&D coordinators etc. (tentative name), and the outcome should be reported to in-house personnel in charge of R&D. Besides, the GSI tries to construct a system to use R&D results more effectively

by reporting a series of these activities to the Research Evaluation Committee at the stage of an interim evaluation concerning R&D policies and making contributions to the evaluation process.

6.4 Securing of human resources and R&D funds

In order to smoothly promote the R&D in line with the plan and produce sufficient achievements, it is necessary to cultivate and maintain excellent human resources. Therefore, efforts should be made to develop the environment to cultivate talented human resources in all aspects, such as personnel affairs, facilities, and budgets.

As for a strategy to secure human resources, external personal, especially young people, will be recruited through acceptance and invitation of outside researchers from private companies or through special researcher programs. Furthermore, interaction with researchers of relevant organizations or universities will be encouraged. Especially, in the case of research to be implemented from a long-term standpoint, researchers who can continuously work on a project should be sought.

Furthermore, the GSI tries to accelerate the development of environment including R&D facilities, and obtain budgets from the GSI's Special Research, MLIT's "Research and Development Budget for Construction Technology (General Technology Development Projects)," and budgets from other ministries including the Ministry of Education, Culture, Sports, Science and Technology (MEXT) to ensure R&D funds for this plan.

6.5 Development and utilization of intellectual infrastructure

The Intellectual Infrastructure Plan (defined in 2001, reviewed in 2007) defines that the world's highest intellectual infrastructure for prioritized points should be formed strategically and systematically by 2010.

As for the geographic information database included in the Intellectual Infrastructure Plan as a prioritized point, the pre-determined goal has been already achieved. As findings, techniques, and information obtained from related R&D definitely make contributions to the development of intellectual infrastructure, the achievements should be made widely

known, while examining their position by making them suit the government's efforts toward the intellectual infrastructure development in the future.

Additionally, the active utilization of intellectual infrastructure owned by external organizations will be an effective procedure to improve the efficiency in conducting R&D. Thus, the GSI should try to collect and utilize information pertaining to intellectual infrastructure owned by other research organizations and universities.

Furthermore, as for the geospatial information platform in the MLIT Technology Basic Plan, it is necessary not only to provide support for its smooth construction, but also to actively reflect R&D results onto the platform if possible.

And, a patent should be diligently sought at the time of obtaining excellent R&D results.

6.6 Securing cooperation and collaboration with relevant organizations and international collaboration

In the course of advancing R&D, collaboration with relevant organizations including those abroad, academic societies, universities, and private companies should be enhanced in terms of introducing new surveying technologies and promoting the diffusion of achievements, by promoting joint research with these organizations. Additionally, the GSI will move ahead on the establishment and diffusion of geographic information standard, the promotional activity for an international standardization concerning geospatial information in the ISO (International Organization for Standardization), and the implementation of R&D on foundational technology for geospatial information utilization, maintaining cooperation among government, industry and academia.

Likewise, in the research field concerning disaster prevention, the GSI should make efforts to promote R&D while maintaining collaboration with formal organizations and universities engaged in various types of disaster prevention, promoting R&D in light of progress of the Coordinating Committee for Earthquake Prediction and providing R&D results to these organizations.

The GSI also continues to promote international joint observation and R&D with the IVS (International

VLBI Service for Geodesy and Astrometry), the IGS (International GNSS Service), and other organizations, and participate in international conferences regarding surveying and mapping, such as the ISCGM (International Steering Committee for Global Mapping) and PCGIAP (Permanent Committee on GIS Infrastructure for Asia and the Pacific), to collect findings and spread achievements through such international framework.