

Long-Term Plan for Basic Survey and GSI Research and Development Plan

**ISHIYAMA Noburo, TAKI Shigeyuki, TACHIBANA Yukiko, FUJIMURA Hidenori,
ISHII Ayaka and TAKATA Taisei**

(Published online: 25 November 2024)

Abstract

GSI established the ninth Long-Term Plan for Basic Survey to clarify policies that GSI should aim at over the next 10 years, and also established the GSI Research and Development Plan to set the direction of research and development for next five years.

1. About the Long-Term Plan for Basic Survey

1.1 Background

There have been significant changes in social conditions and issues during the eighth Long-Term Plan for Basic Survey (hereafter referred to as “the LT Plan”). At first, the severity of natural disasters and impact of changes in geopolitical positioning of Japan made the public pay attention to security and disaster prevention. Besides, due to the development of surveying technologies, the environment of positioning has greatly improved. Furthermore, Covid-19 triggered off the acceleration of digitalization and it has changed the social situation dramatically, and the progress of digital transformation (DX) and expanded utilization of geospatial information is ongoing.

1.2 Basic policy and plan period

In order to deal with the rapid development of information technology, changes in social conditions and the increasing use of positional information, the following three basic policies of this plan will be adopted.

1. Measures related to the development of fundamental data that will serve as the basis for the digitalization of society, including DX in the field of infrastructure.
2. Measures to adapt the increasing roles of basic survey in the field of positioning as well as surveying.
3. Measures to improve the up-to-dateness of map information and promote three-dimensional mapping to meet the needs of a digital society using new technology.

It is necessary that the plan be implemented continuously for a certain period in order for various types of surveys to be carried out accurately and efficiently. That is why the plan period of this LT plan is 10 years from FY2024 to FY2033. Besides, it will be interim reviewed fifth year to ensure a high level of effectiveness amidst

ongoing changes in social conditions.

1.3 Positioning and survey based on national coordinates

GSI has a responsibility to conduct a basic survey which is the basis for all surveys, and to maintain and preserve national coordinates which are essential as a reference for the position of our country to support social infrastructures. Besides, the collision of multiple plates adds pressure to the crusts that make up the ground surface, which causes various degrees of crustal deformation around the Japanese Archipelago. GSI will enhance the transformation information necessary for accurate positioning and surveys, and conduct a national land survey which is essential for defining and preserving Japan’s territory and territorial waters through the accurate detection of crustal deformation by geodetic observation using a variety of technology. Furthermore, GSI will implement measures to support a high-precision positioning society. For example, GSI will advance the technology by utilizing space geodetic techniques such as VLBI and GNSS, and implement measures which achieve high-precision positioning environment based on GNSS CORS and improve the safety and disaster resilience of surveying environment.

As part of the maintenance of the highly accurate precise gravimetric geoid model, the value of nationwide elevation will be reformed on the basis of precise gravimetric geoid model data. In addition, the revision of elevation will be implemented smoothly, such as by providing information to the relevant organizations without delay, etc.

1.4 Maintenance of basic map information

GSI conducts development of map information that serves as the foundation of our national territory since

the inception of the organization in 1869. The map information maintained by GSI also plays a role in indicating Japanese territory externally, and the reliable maintenance and updating of such information is indispensable to internationally disseminate the view of Japan about its territory and place names. Therefore, basic geospatial information will be steadily maintained and updated which accurately makes explicit Japanese territory both domestically and internationally as well as relates to remote islands which form the basis of our territory.

GSI will implement the necessary measures in order to maintain and update high-precision geospatial information created based on surveys, such as the Fundamental Geospatial Data, Digital Japan Basic Map (Map information, Orthoimage (aerial photographs), Geographical name information) and three-dimensional data (height data), continuously and efficiently without delay, so as to create a society in which highly accurate and reliable geospatial information will be used by citizens, referred to for various forms of administrative planning, decision-making and disaster response, and also used as the basis of a variety of geospatial information, including the private sector.

1.5 Promoting disaster prevention/risk reduction and disaster response through the utilization of surveying technology

As natural disasters have become more severe and widespread in recent years, taking steps to prevent and mitigate disasters before they occur is becoming increasingly important. The government's Basic Disaster Management Plan (National Disaster Management Council decision of May 2023) calls for GSI to develop geographic information for disaster risk reduction and improve and strengthen observation systems and facilities that lead to disaster prediction and forecasting as part of efforts to prevent disasters or minimize damage if a disaster occurs. In order to play the necessary role in disaster prevention and risk reduction, GSI will efficiently develop and provide geospatial information for disaster risk reduction related to the risk of disasters caused by earthquakes, volcanic eruptions, torrential rains, etc., including information on geographic disaster risks about natural landforms and artificial embankments. In addition, measures will be taken to raise disaster awareness among local residents in order to protect residents' lives from natural disasters by maintaining and promoting the

utilization of information on Natural Disaster Monuments with administrative agencies.

It is necessary for disaster emergency measures at the time of disaster and recovery reconstruction to determine damage information quickly. GSI will provide accurate positional information after a disaster that contributes to recovery and reconstruction by identifying the extent to which the ground surface has been significantly deformed by seismic or volcanic activity through monitoring crustal deformation using InSAR technology and satellite positioning (such as GNSS CORS), in order to promptly provide the geospatial information necessary for lifesaving and emergency restoration of facilities. In addition, measures will be implemented, for example, to provide the results of investigation as understandable documents such as disaster maps of the current situation by conducting damage investigation by means of observing crustal deformation and emergency aerial photography using techniques, facilities and devices related to basic survey.

1.6 Provision and promotion of geospatial information

As the use of DX and geospatial information continues to expand in society, it is essential to have an environment in which people can get and use geospatial information as digital data. To this end, when providing basic survey results, etc., GSI will place emphasis on providing digital data, implement measures such as strengthening internet provision functions, and constantly review the methods of providing basic survey results and other information to provide data in a sustainable manner.

As well, the national government, local governments, related businesses, and research institutions such as universities need to cooperate with each other in order to promote the utilization of geospatial information. Moreover, with limited human and budgetary resources, the cooperation of various entities is essential to efficiently provide the geospatial information maintained by GSI in a stable manner and maintain an environment in which the public can effectively utilize the information. GSI will cooperate organically with the concerned government agencies, the ministries and agencies, local governments, private enterprises and academia by utilizing the frame of the Committee for Advancing the Utilization of Geospatial Information, Geospatial Information Utilization Promotion Office, Cabinet Secretariat and Geospatial Information Industry-Academia-Government Collaboration Council.

1.7 Surveying administration and international activities

In terms of eliminating the duplication of surveys which is the aim of the Survey Act, it is important that GSI coordinate between institutions conducting public surveys, consolidate information and make geospatial information maintained by GSI widely available. In addition, technological innovation in the field of surveying is expected to continue in the future, measures will be implemented which enable efficient and effective surveying by using new technology.

Activities will be conducted which raise the international status of GSI in the field of geospatial information as well as build and enhance trust relationships with partner countries through international cooperation to disseminate Japan's view of territory and place names internationally, and share Japan's stance and basic values by cooperating with the Ministry of Foreign Affairs.

1.8 Research and development and human resource development

Technological development will be implemented which contributes to the construction and maintenance of 4D national coordinates. For example, GSI will conduct research and development to contribute to disaster prevention by further sophistication of national coordinates, high-precision positioning techniques and monitoring crustal deformation. Furthermore, research and development will be conducted on the improvement of efficiency as well as an increase in the precision of map and topographic data creation. For example, research and development will be conducted in order to contribute to the improvement of the efficiency of maintenance and updating of geospatial information and advancement of geographic information for disaster risk reduction.

It is essential to train experts and engineers with higher level knowledge, and to implement measures for improving public literacy in order to promote continuous and proper implementation of basic survey, and maintenance and utilization of geospatial information including surveying results. Thus, GSI will implement measures such as improve the qualities of surveyors and assistant surveyors as well as reform the qualification system by cooperating with reskilling support initiatives by industry, academia and government entities.

2. GSI Research and development plan

2.1 Forming the policy of the updated plan

An overview of previous plans related to research and development is given below: The “Basic Act on Science and Technology” was established in 1995, followed by the cabinet decision of the “Basic Plan for Science and Technology” in 1996. In 1997, the “National Guidelines for Evaluating Government Funded R&D” were approved by the Prime Minister. On the basis of these trends, GSI established the “Geography and Crustal Dynamics Research Center” in 1998. The following year, GSI created the first plan related to research and development: The “Geographical Survey Institute Research and Development 5-year plan”. In 2009, in accordance with the rapid transition of social and technological situations, the “Geographical Survey Institute Research and Development 5-year plan” was revised to the “GSI Research and Development Basic Plan” to clarify the importance of the direction setting of research and development.

In 2016, revision of the “National Guidelines for Evaluating Government Funded R&D” led to following statements:

1. Effective evaluation of research and development programs
2. Promoting research and development focused on innovative ideas and economical, sociological impact
3. Alleviating excessive workloads associated with research and development evaluation

In addition, the revision of the “MLIT Research and Development Evaluation Guidelines” in 2018 stated that the strict evaluation of research and development is necessary for the efficient and effective implementation of projects, but also devotes a chapter to discussing how to avoid excessive workloads associated with the evaluation.

GSI had formulated two major plans: the LT plan and “GSI Research and Development Basic Plan”. In order to formulate efficient research and development plans, the “GSI Research and Development Basic Plan” was revised to the “GSI Research and Development Plan” (hereafter referred to as “RD Plan”). This renaming aimed to organize the roles of this plan and the LT Plan, and to prevent duplication among these two plans, thereby enabling more efficient and effective implementation and evaluation of the plans related to research and development.

In the future, GSI will formulate RD plans based

on the policies outlined in the LT plan, conduct cutting-edge research and development based on the latest technological trends and rigorous research evaluations, and strive to create an environment in which researchers can devote themselves to their research.

2.2 Basic concept “Mission”

The basic concept “Mission” of the RD Plan is set as follows; Geography and Crustal Dynamics Research Center contributes to implementing GSI policy through implementation of the RD Plan, such as conducting novel research that investigates disaster risk reduction, advanced utilization of geospatial information and accumulation of scientific knowledge with state-of-the-art surveying technology and ICT.

2.3 Vision of research and development and priority actions

Formulation of the RD Plan includes the following four medium- and long-term objectives “visions” with priority actions:

1) Sophistication of national coordinates

With the progress of a high-precision positioning society, national coordinates function as a major part of in the social infrastructure. For the development and the maintenance of national coordinates in this society, GSI will conduct research that advances space geodetic and crustal deformation analysis technology including the development of surface deformation models, calculation method of geoid models, observations and analysis technology of GNSS, SAR, etc.

2) Efficient production and higher precision of geospatial information

Automation and streamlining by utilizing aerial photographs, satellite images, laser survey data, etc., will be advanced to update, generate and express geospatial information including three-dimension efficiently and accurately. For instance, GSI will conduct research on technical development for the efficient generation of geospatial information such as the previous topography, surface layer height, etc., the development of replacement technology of satellite images for web maps with sufficient precision, and the increase of information accuracy for hazard map making.

3) Contribution to disaster risk reduction

To prepare for earthquake and volcanic eruptions, the technology for measuring crustal deformation and estimating asperities on plate boundaries will be improved to detect crustal activity with higher spatiotemporal resolution. With the aim of improving information regarding disaster hazards and damage conditions by improving the accuracy of understanding natural disaster hazards and predicting their occurrence, GSI will elucidate the mechanism of disasters such as earthquakes and landslides. Furthermore, GSI will conduct research and development to investigate and examine geospatial information for disaster risk reduction which will be useful to various parties.

4) Geoscientific investigation of geography and crustal dynamics

GSI will investigate earthquake and volcanic activity, the details of the Earth’s shape and its variation which serves as the basis of the reference system. By analyzing geographical information of the surface layer and topography, GSI will aim to examine the causes and mechanism of its variation.

2.4 Promotion policy

The RD Plan has been established with the following promotion policy consisting of five parts:

1) Evaluation

To evaluate research and development activities, the Research Evaluation Committee consisting of external experts is set up to evaluate aspects such as RD themes, RD organizations, RD policies, based on the “National Guidelines for Evaluating Government Funded R&D” and “MLIT Research and Development Evaluation Guidelines”.

2) Promoting the use of research and development results

The “sixth Science, Technology and Innovation Basic Plan” states that data produced from overall research processes should be strategically shared and utilized to promote open science. Referring to this statement, data produced from GSI research will be promoted to be strategically shared and utilized.

3) Nurturing personnel and securing funding for research and development

GSI will make efforts to maintain the number of researchers who are continuously assigned to research

conducted with a long-term perspective. If needed, GSI will endeavor to secure research and development funds through external sources of competitive funds.

4) Collaboration and alliances with related organizations

To proceed with research and development, alliances such as collaborative research with related organizations, academic societies, universities, public sector companies, both in Japan and abroad, will be promoted to introduce new positioning and survey technology as well as analysis technology of geodetic data.

5) Social contributions

By providing information for a wide variety of organizations in Japan, GSI will contribute to disaster risk reduction for Japanese citizens and society. For overseas, GSI will promote providing information about analysis results of crustal deformation caused by earthquakes or volcanic activities abroad, and cooperating and supporting international projects. Promotion and cultivation of Earth science, as well as assistance for skill acquisition will be conducted through various opportunities to nurture young people's interest in Earth science and science education.

3. Conclusions

GSI will perform a pioneering role in promoting the development and utilization of geospatial information, the enhancement and popularization of technology through the implementation of measures based on the “Long-Term Plan for Basic Survey” and “GSI Research and Development Plan”. During enactment of these plans, GSI will appropriately evaluate their impact and establish a short-term plan “Action Plan”. This plan will be reviewed annually in terms of effectiveness and suitability along the ever-changing social conditions. The full text of these plans is available on the GSI website (<https://www.gsi.go.jp>).

References

- Geospatial Information Authority of Japan (2024a): Long-Term Plan for Basic Survey, <https://www.gsi.go.jp/common/000262649.pdf> (accessed 5 Nov. 2024).
- Geospatial Information Authority of Japan (2024b): GSI Research and Development Plan, <https://www.gsi.go.jp/common/000257008.pdf> (accessed 22 Jul. 2024). (in Japanese)