

## **The National Geographic Information System in Taiwan**

Shen Jin-Hsiang and Chang Chung-Chi

Ministry of the Interior, Taiwan

Republic of China

moi0795@moi.gov.tw

### **Abstract**

With the rapid development of information technologies in recent years, the geographic information system (GIS) allows the government to acquire information and to play an active role with respect to policy making and service providing. Presently, GIS, nanometer technology, and biotechnology are considered three major newly developed industries. Apparently, GIS has been developed successfully and applied extensively in the last decade.

Taiwan's public sector has developed geographic information system for nearly 15 years, and has launched a series of projects under the name of National Geographic Information System (NGIS) since 1990. The phase I of NGIS data infrastructure plan was implemented in 2003; and the phase II plan has been undergoing in full swing since 2004.

As indicated by the recent research findings, public sector has been the major user of geographic information over the past years, and has demanded nearly all kind of geographic information developed by the NGIS data infrastructure plan. The data to be used for national development plan regards land utilization (for geographic planning), geographic conservation, disaster prevention and rescue, tourism, national health and medical services, disease prevention, and transportation development.

NGIS is substantially beneficial to public construction and public policies in a number of ways. GIS presents information completely and flexibly, and is capable of integrating the needed information for a certain purpose, thereby creating the most comprehensive information for decision-making purpose. However, geographic information has to be established in accordance with the needs of decision-makers together with the requirements of development projects in advance. Taiwan has been developing NGIS in the last 15 years. Therefore, data developers and users really have to analyze their needs and to initiate implementation plan based upon administrative system, mental attitude, and legal requirements, in addition to the data implementation requirements, as they carry out public policies to meet general public's needs.

This presentation provides the history of NGIS and the vision, goals, objectives and achievements of NGIS in Taiwan with the intention to share the experience in the development of geospatial data infrastructure from central government's perspective.

### **Introduction**

Since 1977, Taiwan has been undertaking plans related to application on the integrity of remote sensing and GIS technologies. At the same time, the central government continually united different levels of governments and certain private academic institutes to have relevant researches and founded the corresponding windows in local/county governments. In 1990, The central government formally

established a special committee, called the National Geographic Information System Steering Committee\_NGISSC\_, and defined its functions as determining the objectives, strategies, directions and working guidelines to propel the tasks. In late ten years, the committee regularly held symposia and worked in full scale of training programs, intending to ingrain the promoting ideas into the thoughts of both the governmental staffs and the public. Form 1998, the NGISSC has further engaged in a so-called The Geospatial Data Infrastructure of NGIS. The plan includes the establishments of most essential digital database, such as topographic maps, geological maps, soil maps, address geocoding data, public pipeline locations, viatic networks, regional and urban plan maps, location of canton and developing vital application systems about auxiliary land development plan, fire-fighting dispatching scheme, census, etc.

## **Development of NGIS**

The development stages, authorized promotion organizations of NGIS and the achievement of the plans are describe as follows.

### **1. *The first Stage (1990 and before)***

#### **(1) *The Beginning***

Council of Agriculture and other agencies affiliated to the Executive Yuan proposed the concept of GIS in 1976 and 1977. GIS technologies have just begun and Taiwan was short of the needed resources and manpower at that time and, consequently, Council of Agriculture's proposal was not echoed. In 1981, Ministry of the Interior initiated the draft of land administration e-processing project and presented the concept of regional land information system that entailed a database to store natural data and cultural data. The database would be designed to output graphic data for land planning and economic development decision-making purposes. In 1985, the Information Center of Ministry of the Interior started the tasks related to digitization of topography, which was similar to GIS. That's how NGIS began.

In 1986, National Development Council recommended to develop NGIS. Then, Council of Economic Planning and Development (CEPD), Executive Yuan, completed "Outline for establishment of NGIS" and CEPD established a taskforce in cooperation with Ministry of the Interior for the promotion of NGIS. Then, Ministry of the Interior formed "NGIS Steering Committee" and nine database groups in 1990 and take charge of the development of NGIS officially.

#### **(2) *NGIS organizations consist of three major groups:***

The operation group (NGIS Steering committee, comprehensive operation workgroup, and related sub-groups), the data produce and collection group (9 major database workgroups), and the data standard impelling workgroup. The organizational structure and its responsibilities describe as follows:

##### **A. *The operation group***

###### **a. *The NGIS Steering Committee (lead by Ministry of the Interior):***

This is a mission-oriented taskforce lead by Ministry of the Interior. Board members comprised Council of Economic Planning and Development (CEPD), Research, Development, and

Evaluation Commission, Directorate General of Budget, and together with the lead agency of nine databases groups and local government agencies. The Committee convened periodically so as to keep up with the progress of promotion and to deliberate, coordinate, and integrate all matters pertaining to the development of NGIS.

**b. *Comprehensive operation group (lead by the Information Center of Ministry of the Interior):***

Affiliated to NGIS Steering Committee, the Comprehensive operation group is lead by the Information Center of Ministry of the Interior, and is responsible for staff operation and matters of coordination and execution of all development plans pertaining to NGIS. The Operation Design Section of the Information Center carried out the day-to-day operation of this group. The group also comprised the information staff representing other cabinet ministries and local agencies. The group convened periodically for discussing, deliberating and deal with the matters of development plans.

**B. *The Data Standard workgroup (lead by Research, Development, and Evaluation Commission, Executive Yuan)***

At first, the Research, Development, and Evaluation Commission, Executive Yuan, lead the data standard workgroup; however, for some reason, the comprehensive operation group took the role since 2000. The group comprised the responsible persons of nine major databases, and convened periodically to discuss all matters regarding the data format standard, operation procedures, and laws related to NGIS.

**C. *The data produce and collection group (nine database groups):***

**a. *Natural environment database workgroup (lead by Information Center of Ministry of Economic Affairs):***

Comprising the government agencies responsible for water conservation, water resources, geology, mining, meteorology, agriculture, forestry, and construction, this group was chaired by Information Center of Ministry of Economic Affairs, and convened periodically to discuss all matters pertinent to implementation of database.

**b. *Natural resources and geological database groups (lead by Council of Agriculture, Executive Yuan):***

Made up of the government agencies responsible for agriculture, forestry, fishing, stock farming, water conservation, remote survey, and aerial survey, this group was chaired by the Forestry Department of Council of Agriculture, Executive Yuan, and undertook all tasks related to database planning and forestry digital database.

**c. *Environment quality database group (lead by Environmental Protection Administration, Executive Yuan):***

Comprising the Directorate General of Budget, Accounting, and Statistics, Council of Agriculture, Council of Labor Affairs, Department of Health, Ministry of Transportation and

Communications, Ministry of Economic Affairs, Construction & Planning Administration affiliated to Ministry of the Interior, and Central Weather Bureau, this group was chaired by the Environmental Monitoring and Data Processing Bureau affiliated to the Environmental Protection Administration, Executive Yuan, and was responsible for setting the environment quality-monitoring facilities, collecting dynamic data, and updating the environment quality database.

**d. *Social economic database group (lead by Directorate General of Budget, Accounting, and Statistics, Executive Yuan):***

This group comprised Government Information Office, Department of Health, Council of Agriculture, Ministry of the Interior, Construction & Planning Administration affiliated to Ministry of the Interior, Ministry of finance, Ministry of Education, Ministry of Economic Affairs, and Ministry of Transportation and Communications; and is chaired by the Directorate General of Budget, Accounting, and Statistics, Executive Yuan. This group was responsible for setting up the social and economic statistics database for all administrative districts.

**e. *Transportation network database group (lead by the Information Center of Ministry of Transportation and Communications):***

This group is made up of the Institute of Transportation of MOTC and National Police Administration of MOI together with the government agencies responsible for railways, highways, airports, mass transit system, as well as the agencies responsible for business management, engineering, and transportation of direct cities. Chaired by the Information Center of MOTC, this group had completed the overall planning of database together with a 25,000:1 transportation network digital map for the general public.

**f. *Land information database group (lead by the Land Administration of MOI):***

This group is made up of Land Administration of Taipei City Government, Land Administration of Kaohsiung City Government, and National Property Bureau of MOF. Chaired by the Land Administration of MOI, this group was responsible for initiating land standards and setting up the database of land registration, land prices, land usage, and land survey.

**g. *Regional and urban planning database group (lead by the General Planning Section affiliated to Construction & Planning Administration of MOI):***

Comprised the Urban and Housing Development Department of CEPD, Dept. of Land Administration of MOI, Bureau of Urban Planning affiliated to Taipei City Government, and Bureau of Public Works affiliated to Kaohsiung City Government, this group had completed the overall planning of database together with the regional planning data files for northern Taiwan, central Taiwan, southern Taiwan, Kinmen, and Penhu Islands, as well as the urban planning data files for Taiwan Province, Taipei City, Taichung City, and Kaohsiung City.

**h. *Public pipeline database groups (lead by the Public Works Section affiliated to Construction & Planning Administration, MOI):***

Made up of the Industrial Development Bureau, MOEA, Atomic Energy Council, Highways Administration Department, MOTC, and the government agencies responsible for telecommunications, water, electricity, gas, petroleum, and roads, this group was chaired by the Public Works Section of the Construction & Planning Administration, MOI, and had completed the overall planning for the database together with the implementation of pipeline database in cooperation with Taiwan Power Company, Chungwa Telecom, China Petroleum Corporation, and the natural gas corporations located in Taipei, Taichung, Changhwa, and Kaohsiung as well as the local government agencies responsible for public works.

**i. *Topographic database group (lead by the Dept of Land Administration of MOI):***

Comprising the government agencies responsible for public works and land administration together with scholars specialized in civil construction, survey, and remote survey, this group is chaired by the Dept of Land Administration of MOI, and had initiated the standards for “Topographic Database”.

**2. *Stage 2 (1990 – 2003)***

This stage concentrated on the overall planning, detailed planning, data standard system initiation, and database implementation with emphasis on the following, after the NGIS promotion organizations were established:

**(1) *Initiation of major plans***

**A. *To initiate “Proposal for implementation of NGIS”***

Ministry of the Interior completed “Proposal for implementation of NGIS” in 1992, and expected to carry out the Proposal within 9 years, starting from 1994 until 2002, with budgets NTD 6.78 billion for collecting, surveying, sorting, and creating eleven types of basic databases. The Executive Yuan had approved the Proposal and instructed the Ministry of the Interior to initiate annual working plans based upon the job division stated in the Proposal and to prepare annual budgets, to be carried out by all agencies.

Unfortunately, all execution departments couldn’t acquire the needed support when they initiated budgets and, to a worse extent, all staff members that undertook the day-to-day operations were part-timers. Without fulltime staff and funds, the Proposal encountered a number of difficulties and setbacks. Therefore, NGIS core data was implemented on the basis of top priority in the fundamental environment implementation plan.

**B. *To initiate and execute “Geospatial Data Infrastructure for NGIS”***

In 1995, The GDI for NGIS phase I was initiated. This plan called for a budget of NTD 2.04 billion in a period of 6 years, and contained 8

categories of tasks, which were further divided into 82 sub-tasks, related to the implementation of basic data. National finance and the continual promotion of NGIS are included into consideration of this plan. The data with urgent needs should be implemented on the basis of top priorities and in compliance with the NGIS. This plan was approved in March 1997, and has been implemented within 6 years, started from 1998 to 2003.

**(2) Preparation for promotion**

In an effort to promote the concepts of NGIS, share the experiences, report the current development status and facilitate the communication, the NGIS quarterly has been issued since April 1992, and was forwarded to all government agencies, academic institutes, and private corporations free of charge. Also, NGIS training programs were held each year from 1992 so as to promote the concepts of NGIS and to foster NGIS professionals, thereby facilitating the development of NGIS.

To facilitate the inquiry of NGIS for the government agencies and the general public, Ministry of the Interior has successfully implemented NGIS inquiry database system via the communication network, database administration technique, and e-bulletin technique in 1996, and then developed the Internet-base application system in 1997.

As far as coordination and promotion are concerned, Ministry of the Interior summons NGIS promotion taskforce meeting and general operation group meeting periodically in order to foster consensus and to reach decisions via discussion, coordination, and communication, thereby facilitating the promotion of NGIS.

In an effort to demonstrate the achievement of promotion in the last 10 years, two exhibitions were held in 2002 and 2003, respectively, to propagate the achievement of NGIS promotion.

**(3) Achievements of GDI of NGIS\_Phase1\_**

**A. Completion of major tasks**

44 sub-tasks were carried out in this stage, to be divided into 4 categories as follows:

- a. Establishment of regional and local geographic information application systems (incl. 15 sub-tasks under the regional geographic information application system, and 16 sub-tasks under the local geographic application system).
- b. Implementation of geographic information network flow system (incl. 2 sub-tasks).
- c. Implementation of technical and operation support organizations (incl. 7 sub-tasks).
- d. Seminars and manpower development (incl. 7 sub-tasks).

The annual plan is modified every year and 32 items are left now.

**B. The major application systems**

GIS application system was developed in this stage, including nearly 80 systems of government sector, which were exhibited in the NGIS seminar held in 2003 and are divided into 8 categories, such as geographic name information, Water resource data administration and supply system, Taiwan geological information service network, etc.

### 3. *Stage 3 (2003 – 2007)*

This stage concentrates on the tasks outlined in Stage 2 regarding GDI of NGIS. A number of crises took place in Taiwan recently. As a result, the government has been challenged for the issues related to economic construction, crisis relief, e-government service, environmental protection, water resource planning and administration, public works administration and land utilization, as well as the implementation of NGIS.

In 2002, the Executive Yuan launched “Implementation of government information service system” in compliance with the current economic policy outlines, and had included the NGIS into “government’s e-plan” as the flagship project. In June 2002, “Implementation of government information service system” was included into the digital Taiwan project under the 6-year national development plan. Meanwhile, all groups are expected to accomplish the GDI regarding NGIS in 2003.

In an effort to accelerate the development of NGIS, enhance the usage of NGIS, and to provide the space decision-making information needed by the perpetual development of NGIS, it is necessary to carry on the follow-up plan of NGIS.

Following are the goals and strategies to be accomplished and adopted in this stage:

#### **(1) *Vision and blueprint***

This plan calls for a high-quality national geographic information database and user-friendly information sharing environment, followed by value-added application so as to develop a wide array of information products derivatively, thereby enhancing the full-scale business application for both government and private sector and creating a comprehensive NGIS in order to accelerate the development of geographic information industry, to prosper the digital service industry, and to upgrade the overall competitiveness nationwide.

#### **(2) *Overall goals***

This stage concentrates on the promotion of NGIS so as to implement a comprehensive fundamental environment database, to expand the national geographic information application, and to integrate NGIS. This stage also entails improvement of government information environment so as to upgrade the quality of decisions and to prosper the digital service industries, thereby enhancing the competitiveness nationwide.

#### **(3) *Primary goals***

In consideration of the overall goals, the short-term, mid-term, and long-term goals are defined as follows:

##### **A. *Short-term goals***

- a. To expand the GDI of NGIS outlined in previous states, and to continue developing NGIS core dataset,
- b. To assist business service departments expanding their core dataset volume, to improve information operation environment and to integrate the business application system, and to upgrade government service quality for the convenience of general public,
- c. To plan the implementation of data sharing environment, and to

- upgrade the efficiency of national geographic information circulation and application, and
- d. To review the adjustment of NGIS promotion organization, and to initiate the legal basis for NGIS.

**B. *Mid-term goals***

- a. To encourage private sector taking part in the implementation, maintenance of national information and circulation service, thereby expanding private sector's participation in the implementation of national geographic information and enhancing the development of value-added service industries,
- b. To establish a nationwide geographic information system that provides an operation environment in accordance with national policy requirements, such as crisis prevention planning and administration, land utilization and planning, water resource administration, and nationwide census, and
- c. To participate in the initiation of international geographic information technological standards, thereby helping Taiwan build up her capabilities in geographic information R&D.

**C. *Long-term goals***

- a. To complete a nationwide geographic information database and maintenance & circulation system,
- b. To assist developing digital service industries and to compete for international business opportunities, thereby increasing information service revenue from international market, and
- c. To establish an overall NGIS, to be connected to countries around the world, thereby upgrading the national image and competitiveness.

## **Conclusion**

Since Taiwan government developing NGIS in 1990, it has gone through two phases of geospatial data infrastructure. The current stage comprehensively is heading to better development conditions. Especially after 2006, the Council for Economic Planning and Development, Executive Yuan has formally established the NGIS Steering Committee and takeover the original taskforce with higher administrative rank. At the same time, by incorporating the NGIS budget into the public infrastructure program, the graphic resource requirements of various national major construction plan infrastructure programs will become more clarified; the development of international GIS became a mainstream; Moreover, with the impact of Google Earth on the use and practical aspects, the development of NGIS will become more prevalent. We look at this from the policy, organizational, technological, and implementation aspects; at the same time, to promote the next phase, the new outline shall be described.

### **1. *Policy Aspect***

From the policy aspect, the ultimate goal of NGIS is to establish an effective and efficient government. Aside from continuing to develop various types of related application systems to raise the level of efficiency and quality of public policy implementation (such as: general survey of households, national infrastructure program, selection and development of new towns and cities, selection and



analysis of land to be used for major infrastructure projects, planning and management related to land policies, monitoring of environmental quality, disaster prevention and control, etc.), the country should use the basic information developed by NGIS and be needs-oriented. Based on the current development trends, it needs to consider the two major fronts below to meet present policy needs.

***\_1\_ To meet the need of major governance such as land planning,*** land conservation, disaster prevention for information, as well as major plans for disaster prevention, land planning, and land conservation, the business requirements of the NGIS are becoming clearer. The requirement items of the “Land Planning Implementation Program” include land utilization survey, national scenic information survey, national environmental disaster latent, national land database, land utilization monitoring, and land utilization monitoring. The above-mentioned land utilization survey and land utilization monitoring are also the items to be completed in the plan of land conservation. With regards to the disaster prevention plan, aside from its own thematic graphic resources, tangible needs have been presented by planning the establishment of a disaster prevention database.

***\_2\_ Accelerate the building of fundamental NGIS data***

As for the national geographic information needed as a reference by the above-mentioned major plans, the graphic resources needed by national land planning include fundamental graphics, cadastral map, environmental geological database, environmental quality database, and others. The fundamental information required by the disaster prevention plan, such as topographical maps, house number location database and natural environmental database, is included in the scope of this revised NGIS plan. In this plan, the digitized topographical maps for urban plans and the construction of house number location information all over Taiwan are scheduled to be completed in 5 years and 2 years, respectively, from 2006. Or when leveling system of graphic resources comes of age, replaceable base maps may be used to speed up the establishment of house number location information.

## **2. Organizational Aspect**

To overcome the system difficulties faced by the current steering committee as well as the professional technology, plans have been made to establish a “NGIS Professional Steering Committee” to assist the “NGIS Steering Committee” under the Council for Economic Planning and Development, Executive Yuan as well as serve as technical and administrative support for various branches of NGIS groups worldwide. At the same time, the business and academic sectors come together to draft the overall promotion policies and plans for NGIS to help in reviewing the relevant plans from different branches of government and in implementing related promotional tasks.

In addition, as for the promotion of the standard system of the NGIS, the Information Center of Ministry of the Interior has already completed the outsourcing of necessary organization framework outline. At the same time, drafts of land, administrative areas, water resource, and transportation standards have been completed; this allows Taiwan to keep up with the pace of international development; work on setting the standards will be carried out in 2006.

### **3. *Technical Aspect***

Navigation remote sensing technology and GIS application are closely linked. In recent years, the development of navigation remote sensing has greatly contributed to the development of GIS. Recently, the progress made in the field of aviation photography technology, LIDAR, and others have greatly benefited the promotion of NGIS.

Consequently, the responsibility for using information technology and high resolution navigation remote sensing images widely falls on the shoulders of the assigned agencies to carry out the task of establishing fundamental graphic resources and promoting value-added utilization. In the second phase of the construction project of fundamental environment, plan items considered for 2006-2007 include how to obtain digitized integrated results for cadastral map through high precision graphic resolution, construction of national land surveying information integrated circulation system, land utilization survey plan, national scenic resources survey plan, plan for database integration for potential national environmental disaster and disaster prevention facilities, establishment of geological database for major urban environments in the Taiwan province. Consequently, the agency may study how to effectively make use of these technological developments, combine them with the country's various GIS applications and come up with ways to promote and use the system; by aggressively getting involved with the second phase of the construction project of fundamental environment, the development of NGIS can be sped up.

In addition, to promote the circulation of GIS information internationally, the drafting of information standards and development of technology for the actual operation of the data warehouse or circulation platform must be constantly updated and upgraded. Some local companies have, on their own, conducted R&D to come up with better GIS software tools and technical solutions for GIS information utilization, ensuring that there are many turning points in NGIS development.

### **4. *Implementation Aspect***

The promotion agencies of NGIS are numerous and diverse, much of the work is shouldered by the nine major basic databases as well as local governments. From the results of the work verified by the annual NGIS Program (construction project of fundamental environment), we can see that the problems faced by local governments and the ones faced by the nine major databases are vastly different. The reason lies in the field of business and the nature of the area.

The problem of local governments in the implementation aspect has more to do with project presentation and application, making the budget, outsourced services, and management of the plan, technology, manpower, legal issues and implementation aspect. Fundamental databases face the problems of the positioning of their organizations, operational systems, and collaborative procedures. The steering committee faces the prospect of reorganization after 2006. However, in the implementation aspect, focus shall be on data construction, maintenance and upgrade, circulation supply, value-added use, and others, which will be complemented by standard operating procedures and comprehensive laws to effectively carry out the latter stage of NGIS.