Government GIS and its Application for Decision Support

Zhang Qingpu
(Chinese Academy of Surveying and Mapping,
Email: zhangqp@casm.ac.cn)

Abstract: Application of GIS in government agencies is called Government GIS. It has formed a special research and application field of GIS. In this paper, the following problems are discussed in detail: basic characteristics of government GIS, concept of decision support, design of Government GIS , establishment of data base, software development, data communication and application of Government GIS for decision making.

INTRODUCTION

Recent years, GIS rapidly developed at both technology and practice. Hundred thousands GIS systems have been installed at various levels of governments and large enterprises. Because of the strong functions of spatial analyses of GIS, it finds wide application in the fields of social and economical sustainable development. Application of GIS in government agencies is called Government GIS. The specialists of Information Sciences indicate that more than 85 percent of government business information applied in the central and local government agencies have close connection with the Spatial Data Infrastructure (SDI). Application of GIS in fields of natural resource management, population investigation, environment monitoring and disaster control prove that Government GIS is a powerful tool for government business management and decision making. That is the reason why Government GIS develops so fast and creates a special research and application of GIS. Since 1992, National Bureau of Surveying and Mapping in cooperation with Secretariat of the State Council of China started to set up "Government GIS of Comprehensive National Economy for the State Council"(9202 Project). Up to now, several professional government GIS has been established and put into routine application.

1 BASIC CHARACTERISTICS OF GOVERNMENT GIS

Practice of establishment and application of Government GIS in China proves that Government GIS is of the following characteristics:

(1) Government GIS possesses the fusion characteristics of GIS and government OA (Office Automation). At the moment, OA is the basic working model to the Government agencies, while GIS can provide OA with the additional function of spatial retrieval and spatial analyses. And therefore, Government GIS is an effective tool to raise OA' application level and to expend its application domains.

(2) Government GIS is a contributed spatial information system based at internet or intranet. This is because all the government business information should be obtained from different professional units located at different places.

(3) Government GIS is a social-technical engineering project. Establishment GIS not only depend on the advanced technology and authoritative data, but also relies on the

operation and management mechanism without which government GIS will not be able to run successfully.

(4) Government GIS is a routine application system. To fit this feature, Government GIS should work with high stability and reliability, and the data must be updated on time.

(5) Safety of Government GIS is extremely important. To meet these requirements, it is necessary to take various technical measures.

2 CONCEPT OF DECISION SUPPORT SYSTEM

What is a decision support system (DSS)? Davis points out: " Ask some one to explain the concept and application of DSS, and the answer given will most often depend on who you ask." Efrem Mallach gives a definition of DSS : " A decision support system is a computer -based information system whose primary purpose is to provide knowledge workers with information on which to base informed decisions." Generally speaking, DSS has the following themes:

(1) Decision Support Systems are information systems which incorporate the database of some sort..

(2) Decision Support Systems are used by the broad category of knowledge workers. In fact, anyone who makes decisions, in government agencies, in business, in the nonprofit sectors, or even in many areas of personal living, is a potential DSS users.

(3) Decision Support Systems are used to support, not to replace, people.

(4) Decision Support Systems are used when the decision is" semistructured "or "unstructured". Lack of structure means essentially that we can not program a computer to make a decision to total satisfaction in all cases. A decision that is not structured is a decision that requires some human judgment.

(5) Decision Support Systems incorporate models. A model is a computer representation of a real- life system that let users investigate the impact of a possible decision affecting that system. This capability, to forecast the impact of a decision without actually putting it into effect, is of great value when corporate future hangs in the balance.

3 OBJECTIVES OF GOVERNMENT GIS IN CHINA

In view of complexity of Government GIS and fast development of hardware and software, the objectives of Government GIS Project can not be realized at one step. And therefore, the overall objectives of Government GIS will be reached by several phases (steps):

3-1 The objectives of Government GIS at the first phase (1992--1993) is to develop an Electronic Map System of National Comprehensive Economy based on 1:1 million NSDI and comprehensive national economy situation. The concrete research subjective can be summarized as follow:

(1) To set up database of the National Comprehensive Economy based at 1: million topographic maps, government business information and statistical data.

(2) To develop software system of Electronic Map System used specially for Government GIS.

(3) To establish data communication network between National Bureau of Surveying and Mapping and Secretariat of the State Council.

3-2 The objectives of Government GIS at the second phase (1994--1997) is to set up the coordinated information system of national comprehensive economy which is used to provide the officers of government agencies with computer-aided analyses and decision making in fields of economical analyses, flood control and government business management. The concrete research tasks are listed below:

(1) To develop the software system "Geo/Windows" based at client/server which can provides the government GIS with good continuation and entirety.

(2) To set up the Flood Control Information System under support of which the government agencies can get the water message, rain fall information and flooding disaster message. This system has made possible to cope with flood disaster on time.

(3) In cooperation with the secretariat of provincial government agencies and Provincial Bureaus of Surveying and Mapping, to establish electronic map systems of thematic information.

3-3 The objectives of government GIS at the third phase (1998--2000) is to set up the Disaster Control information system and the Information Systems of comprehensive government business management based on the internet and analyses models. The concrete research tasks are:

(1) To build the Distributed Disaster Control Information Systems including flooding and earthquakes. Under support of these systems the officers of government agencies can master the necessary situation mentioned above on time.

(2) To establish the Information System of Comprehensive Business Management for government agencies.

(3) To set up the Decision Support Systems for Revamping –the-West.

(4) Development of distributed software system and analyses models.

(5) Integration of GIS and high resolving power of remote sensing data and its application.

4 ESTABLISHMENT OF GOVERNMENT GIS

4-1 Overall design of government GIS

4-1-1 Logical design.

The Government GIS (9202 Project) is composed of rear data supporting subsystems and front displaying subsystems. The rear data supporting subsystems are set up at National Bureau of Surveying and Mapping and relative provincial Bureaus of Surveying and mapping where spatial data collection, data editing, establishment of database, graphic matching, data format transforming and data revision are carried out; while the front displaying subsystems are built at Secretariat of the central and local government agencies where gathering of government business information and national economy information are completed, and the government GIS are put in application. Data communication between rear data support subsystems and front displaying subsystems are realized by means of intranet and internet.

4-1-2 Physical design.

In consideration of the current working models of government agencies, at the first stage of project, the multi-branch tree structure is used to store data entity. Each entity is a specific administrative region, such as continent, country, province and county. All the geographic data, government business data and statistical data closely connected with entity can be added and deleted dynamically on multi branch tree. In this case, the system is very flexible and convenient to retrieve the necessary messages. At the second stage of project, government GIS is divided into 2 categories of central government and local government agencies. The central government agency is able to get the necessary data from local government agencies. Information communication among information centers of local government agencies makes possible to share information. To this end, standard software and data specification is available. At the third stage of Project, it is aimed to set up GIS of comprehensive government business management and disaster control information system, the software Geo/Windows will be improved and upgraded. Configuration of hardware and software: SUN workstation, SUN Servers, high-quality microcomputers, digitizers, printers, large size displaying devices etc; Geo/Windows, ARC/INFO, MAP/INFO etc.

4-2 Establishment of comprehensive database

During past 9 years, a series of thematic database have been set up

(1) Construction of NSDI (national spatial data infrastructure). So far, the following spatial databases have been established:

1:1 million topographic database of China,

1: 1million DEM of China

1:1 million database of geographic names of China,

1: 250 000 topographic database of China,

1: 250 000 DEM of China,

DEM database of the largest river basins in China.

(2) Database of comprehensive national situation.

The contents of database consist of description of provinces, regions and counties, industries and agriculture, national economy and the people's livelihood, spatial distribution of poorly developed counties, distribution of large and middle size national enterprises, economical development areas, telecommunication and transportation, forestry, tourism, foreign trade business, population, culture and education, environment, foreign affaires and the hot-spot information etc.

(3) Database of the flood control information system

The contents of database include:

* Water information: real time messages about main rivers, reservoirs, main hydrographic stations, situations of flood control engineering projects, and special technical reports on flood development and flooding disaster.

* Meteorological information gathered from NOAA/AVHRR, FY(Feng-Yun) satellites made in China and meteorological stations, such as: information about meteorological clouds, precipitation broadcasting, precipitation forecasting and digital meteorological forecasting.

* Flooding information extracted from data of TM satellites, SPOT satellites, radar satellite and other space satellites, such as: flooding areas, flooding loses and flooding prediction etc.

* Database of social and economical information of 7 bigger river regions in china, including population, household by regions, areas under cultivation, sown areas of farm crops, members livestock, hospitals, schools, industry infrastructure, industrial output values by region etc.

4-3 Development of software systems

The software system "Geo/Windows" used for government GIS in China is developed by Chinese Academy of Surveying and Mapping. Besides the common used functions of commercial GIS software system, Geo/Windows has the following technical characteristics:

* Linkage of spatial data with thematic information is realized by means of geographic coding driving techniques.
* Multi-size reading of spatial data is solved by means of application of multi-scale and multi-sheet data management methods.
* Multi-layer operation interfaces are provided.
* Integration of vector and raster data at large areas and simultaneous display are realized.
* The response speed of Geo/Windows is fast.

4-4 Data communication

Based on the internet and intranet, data communication between rear data supporting subsystems and front displaying subsystems have been built.

5 APPLICATION OF GOVERNMENT GIS

Since 1993, the government GIS has been put in application at central and local government agencies.

(1) The Electronic Map System of Comprehensive National Situations has been used in the central government agency. It has been an effective tool for the officers of the Secretariat of the State Council to retrieve the necessary information and to make some economical analyses.

(2) The Electronic Thematic Map System of Comprehensive Provincial Situations are applied in more than 14 secretariat of provincial government agencies. System application proves that these systems can be used in many fields, such as: regional economical planning, environment monitoring, population analyses, distribution of educational infrastructure, planning of economical development areas and so on.

(3) The Flood Control Information System has stalled at the central government agencies. It is a real coordinated GIS. It creates a new working model that all the authoritative institutions can provide the cooperative information services to the government agencies under the support of internet and intranet. During flood period, this system is used to offer the important messages about water situations, meteorological data, precipitation data, flooded areas, disaster information and future development of flooding. Based on these data, the government agencies may carry on the macro analyses of flooding and do some decision.

(4) Decision Support GIS of the Revamping the West has been set up and put into application.

References

1, Zhang Qingpu, (2000), Establishment of Government GIS and its Application, Engineering of Surveying and Mapping.

2, Zhang Qingpu, (1998), Application of remote sensing data in flood control information systems, 5th Australian Space Development Conference, Sydney.

3, Zhang Qingpu, (2000), Revamping the West and Government GIS, Geoinformatics.

4, Efrem G. Mallach, (2000), Decision Support and Data Warehouse Systems, Irwin McGraw-Hill.

5, Milan Konecny, (1997),Information Infrastructure: GIS and Cartography Role, Proceedings of IEAS '97 and IWGIS '97.

6, Liu Jiping, (1997), Research and Development of Regional Information Systems for preventing Floods, Proceedings of IEAS '97 and IWGIS '97.