

The Status of Geospatial Information Management in China

Submitted by the National Administration of Surveying, Mapping and Geoinformation of China

1. Administration System

The National Administration of Surveying, Mapping and Geoinformation (NASG) of China, under the Ministry of Land and Resources of the State Council, is the central authority responsible for overall supervision and management of surveying, mapping and geoinformation work of the country. NASG consists of more than 20 sub-institutions and has a total staff of over 6,200. Other departments under the State Council take charge of related surveying and mapping activities in accordance with their mandates.

The competent departments of the governments at or above county level are responsible for management and supervision of surveying, mapping and geoinformation work within their own jurisdiction. Other departments take charge of related surveying and mapping activities according to the authorization of the governments at the same level. A national administration system for surveying, mapping and geoinformation has been gradually established, consisting of central, provincial, municipal and county levels. Local surveying and mapping departments manage and supervise surveying and mapping results within their jurisdiction, and submit the results to the competent departments at high levels. At the provincial level, 68% of the surveying, mapping and geoinformation departments are independent, while the remaining 32% are parts of land and resources departments or planning departments. At the municipal level, 86% of surveying, mapping and geoinformation administration authorities belong to land and resources departments, while the remaining 14% belong to construction or urban planning departments. At the county level, the ratio is 94% to 6%.

2. Legal Framework

Surveying and Mapping Law of the People's Republic of China is the legal foundation for regulating surveying, mapping and geoinformation activities in China. It establishes the four-level surveying and mapping administration system, and the unified supervision system in basic surveying and mapping management, surveying and mapping market admission, surveying and mapping results management, and surveying marker protection. Besides, there are 4 administrative regulations, 35 local regulations, 6 departmental rules and 74 local governmental rules in the legal framework of China. The 4 administrative regulations are *Provisions of the People's Republic of China on Map Compilation and Publication*, *Provisions of the People's Republic of China on Surveying and Mapping Results Management*, *Provisions of the People's Republic of China on Surveying Marker Protection*, and *Provisions on Basic Surveying and Mapping*. Local legislation in surveying, mapping and geoinformation cover various fields, such as basic surveying and mapping, surveying and mapping results, map compiling and publication management, surveying markers, aerial photography, surveying and mapping market regulation, surveying project tendering and bidding, surveying and mapping project classification.

3. Strategic Plan

In 2010, NASG conducted research on the development strategy of surveying, mapping and geoinformation. The overall strategy “to construct Geospatial Framework for Digital China, monitor national geographic conditions, grow geomatics industry, and build China into a leading country in geomatics” clearly defines the strategic goals, tasks and actions in the next period of time.

In addition, NASG formulated *The General Outline of the 12th Five-Year Plan for Surveying, Mapping and Geoinformation Development*. It defines the goals, tasks and measures in surveying, mapping and geoinformation development in the years of 2010-2015, emphasizing the major tasks of strengthening basic surveying and mapping, national geographic conditions monitoring and public geoinformation services, and promoting geoinformation applications and geomatics industry.

4. National Spatial Data Infrastructure (NSDI)

Major achievements in China’s NSDI development are elaborated below in the aspects of space infrastructure, fundamental geographic information system, geospatial framework for digital city, and geoinformation service platform.

4.1 Space Infrastructure

China’s Beidou Navigation Satellite System (also known as COMPASS) and remote sensing satellite system have provided an important foundation for the NSDI development. So far, 13 satellites were launched to form the Beidou Navigation Satellite System. In December 2011, the system began to provide continuous navigation, positioning and timing service to China and neighboring regions, and the positioning accuracy is 25m. By September 2012, there are 11 in-orbit operating satellites covering the most areas from longitude 84.0°E to 160°E and from latitude 55°S to 55°N. The horizontal positioning accuracy is 25m, vertical positioning accuracy is 30m, speed accuracy is 0.4m/s, and timing accuracy is 50ns. By 2020, Beidou will have more than 30 satellites allowing it to provide high-accuracy and high-reliability global navigation, positioning and timing service.

China's first civilian high-resolution stereo mapping satellite ZY-3 was successfully launched on Jan 9, 2012. The satellite, weighing about 2635kg and with a life expectancy of 5 years, operates in a 506km high sun-synchronous orbit and has a revisit cycle of 5 days. It covers the area between latitude 84°N and 84°S seamlessly in one cycle. The satellite carries three high-resolution panchromatic cameras and an infrared multispectral scanner (IRMSS), using a three-linear array arrangements of cameras to generate stereo images. The forward- and backward-facing cameras have a spatial resolution of 3.5m, and the nadir-facing camera has a spatial resolution of 2.1m. ZY-3 images have been applied in a variety of fields such as land resources, urban planning and disaster mitigation.

4.2 Fundamental Geographic Information System

National Fundamental Geographic Information System is a major component of NSDI in China. It stores and manages nationwide basic geographic data at multiple scales including control points,

water systems, residential areas, transportation, boundary, topography, vegetation and etc. The system consists of raster map database, vector topographic feature database, digital elevation model (DEM) database, geographic name database and ortho-image database. At present, China has completed the 1:4,000,000 topographic database; 1:1,000,000 topographic database and DEM database; 1:250,000 topographic database, DEM database and geographic name database; 1:10,000 DEM database and ortho-image database of 7 major river valleys; 1:50,000 digital raster graphic database, DEM database, geographic name database, land cover database and TM satellite image database. Each province is making efforts to establish 1:10,000 topographic database, DEM database, ortho-image database, digital raster graphic database and etc. By the end of 2011, 1:50,000 topographic maps have covered the entire land territory of China and 80% have been updated.

National Geomatics Center of China (NGCC) under NASG is responsible for managing and archiving national surveying and mapping results, constructing, maintaining, updating and developing national level fundamental geographic information system, and providing related services.

4.3 Geospatial Framework for Digital City

Geospatial framework for digital city is a key component of NSDI in China. Since 2006, NASG has been implementing geospatial framework for digital city projects all over the country. By August 2012, the projects have been implemented in more than 270 prefecture-level cities and more than 40 county-level cities. More than 120 projects have been completed and applied in various fields such as land management, urban planning, city management, public security, emergency response, environmental protection, public health, real estate, commerce and industry, water conservancy, meteorology, social services, and etc.

4.4 Geoinformation Service Platform

The national geoportals is a one-stop geoinformation service platform which links national, provincial and local geographic information resources throughout the country. The Platform consists of a host node, 31 partial nodes and 333 information bases. The host node, partial nodes and information bases are constructed and operated by National Geomatics Center of China, provincial geomatics centers, and municipal geomatics centers respectively. The nodes at different levels of the platform as well as nodes at different levels and relevant government agencies and professional departments are interconnected.

The website Map World (<http://www.tianditu.cn>), as the public geoinformation service platform, was formally launched in January 2011. So far 15 provincial nodes and 9 municipal nodes have been linked to the host node. Government agencies, enterprises and individuals can use Map World to browse, query and search location-based information and do measurements and route planning. Furthermore, they can take advantage of the APIs of Map World to develop value-added services and applications by embedding Map World into their own systems. The Map World website also supports a variety of mobile phone operating systems. Hundreds of millions of people from 216 countries and regions have accessed Map World. Over 1000 public or commercial applications have been developed on the basis of the Map World website in various fields such as

resource exploitation, environmental protection, transportation and public safety.

5. NSDI Coordination Body

In order to accelerate China's NSDI development, promote geospatial information sharing and application and grow the geomatics industry, as approved by the State Council, an inter-ministerial coordination body, National Geographic Information Coordinating Council, was established in October 1997, and the former State Development Planning Commission took the leading role. In April 2000, its name was changed to National Geospatial Information Coordinating Council (NGICC). The main tasks of the Council are to coordinate NSDI development, promote fundamental natural resources and geospatial information database construction, and facilitate application, management and coordination of geospatial information resources. The Council consists of 21 ministerial departments, including National Development and Reform Commission, Ministry of Science and Technology, Ministry of Land and Resources, Ministry of Finance, Ministry of Housing and Urban-Rural Development, Ministry of Industry and Information Technology, Ministry of Water Resources, Ministry of Transportation, Ministry of Agriculture, and Ministry of Environmental Protection. The NGICC office is hosted by the Department of Regional Economy, National Development and Reform Commission. Focusing on management of the natural resources and basic geospatial database project, the Council coordinates the NSDI development and utilization through policy guidance and multi-level exchanges, cooperation and training.

6. Geodetic Reference System Modernization

To keep pace with the development of modern technology and better satisfy the demand of economic and social development for high-accuracy positioning information, a geocentric coordinate system, the China Geodetic Coordinate System 2000 (CGCS2000) has been put to use since July 2008. The transformation of the national basic surveying and mapping results into CGCS2000 has already been accomplished.

The first phase China's Geodetic Reference System Modernization project commenced in 2012. The project will last for 4 years with investment of 517 million Yuan, mobilizing more than 3,000 technical staff from 31 provinces, autonomous regions and municipalities. The project aims to establish a high-precision, three-dimensional and dynamic modern national geodetic reference system to provide comprehensive and integrated geodetic datum services for various sectors. The first phase project consists of 360 GNSS continuously operating reference stations (CORS), among which 150 are newly constructed, 60 are rebuilt and the remaining 150 are directly utilized; and a satellite-geodetic control network consisting of 4500 points will be built too. A modern vertical control network will also be built to monitor elevation changes in combination with the satellite-geodetic control network. The project also includes the national gravimetric network, the national geodetic datum management and service system, as well as the national geodetic data processing center.

7. National Geographic Monitoring

National geographic monitoring is a trend for the development of surveying, mapping and geoinformation in the new era. The main task is, by make full use of the geospatial technology,

data resources and talent, to analyze, study and describe the geographic conditions from geospatial perspectives, conduct change monitoring and statistical analysis, dynamically monitor key geographic features, release results and analysis reports in a timely manner, so as to support scientific development. In September 2011, NASG was authorized by the State Council to take the lead in carrying out national geographical monitoring. And then the research project of national geographical monitoring application system was approved by the National Science and Technology Pillar Program of the Ministry of Science and Technology. To initiate the project, a general survey of the national geographical conditions has been started, and the overall design of National Geographic Monitoring has been completed. Geographic monitoring at national, provincial and municipal levels is going on at pilot areas of Shaanxi, Zhejiang, Qiqihaer, Fushun and Wenchuan.

8. The Geomatics Industry

With the growing social demand for geospatial information, China's geomatics industry develops rapidly in recent years. In 2011, the output value of the geomatics industry in China reached 150 billion Yuan, involving more than 20,000 licensed organizations and enterprises with more than 400,000 employees. The average annual growth rate exceeded 25% in the past 5 years. A number of competitive geospatial hardware, software and data products have been developed. Geospatial information is broadly applied in land resources, transportation, agriculture, environmental protection, emergency response, and people's daily life. At present, driven by the strong demand enterprises in the geomatics industry keep growing fast and more geomatic industrial parks are appearing. 10 enterprises have been listed in domestic or international stock markets. Some enterprises are expanding rapidly by means of acquisition and merging.

9. Capacity Development

9.1 Science and Technology Innovation System

China's science and technology innovation system for surveying, mapping and geoinformation has been continuously improving. It works in an industry-academia-research collaboration approach, and involves diverse bodies such as research institutions, universities, key laboratories, engineering centers, production organizations and enterprises. Geomatics innovation entities were successively established including 1 comprehensive research institution, 1 national key laboratory, 11 ministry-level key laboratories and 3 engineering centers. A great number of scientific and technological achievements have been made in areas of earth gravity field, high-accuracy positioning and navigation, mapping satellite, GIS software, and surveying and mapping equipment. Functions and performance of China's self-developed GIS software are at the internationally advanced level. Nearly 100 UAV aerial photography systems have been equipped for the national surveying and mapping system. New equipment such as emergency mapping vehicle has been successfully developed.

9.2 Personnel and Education

The total number of employees in the geomatics industry has reached 400,000, among which there are more than 300 national leading experts. From 2005 to 2012, the number of personnel with master or higher degrees increased 2.2 times; the number of senior and middle level professional and technical personnel increased by 35%. An interactive and collaborative personnel training

mode has been set up between normal and vocational education, and capable enterprises are encouraged to run vocational education and training institutions. More than 200 colleges and over 20 vocational schools have geomatics programs, and more than 200 research institutions conduct geomatics research. The discipline has expanded from traditional 3S to geospatial information engineering, earth observation, island mapping, environment and disaster monitoring, urban management and so on, covering surveying and mapping, mineral science, marine science and environmental science. About 130,000 people have national professional qualification certificates and 30,000 people have senior level professional qualifications.

9.3 Quality Control and Standardization

Since 1987, the National Quality Supervision, Inspection and Testing Center for Surveying and Mapping Products, and 30 provincial quality supervision and inspection centers for surveying and mapping products have been set up. In 2010, NASG reestablished the National Quality Inspection and Testing Center for Surveying and Mapping Products and enhanced its functions. By implementing a series of policies and standards, such as *Management Measures for Surveying and Mapping Quality Supervision*, *Sampling Measures for Surveying and Mapping Quality Supervision*, and *Quality Evaluation Standards for Surveying and Mapping Products*, a surveying and mapping quality supervision and management system has been basically established. Some specific campaigns were conducted to improve the quality of surveying and mapping products, including the quality inspection campaigns for the whole geomatics industry, engineering survey products, real estate survey, basic surveying and mapping results, and key surveying and mapping projects.

With regard to standardization, *Regulations on Geographic Information Standardization Management*, *Measures for Surveying and Mapping Standardization Management*, *Surveying and Mapping Standard System*, and *National Geographic Information Standard System*, were issued successively. During the 11th Five-Year Plan period, 63 new national standards, 34 industrial standards and 12 local standards were issued, while 67 national and industrial standards are under development or revision. The digital mapping production and results standards have become more complete. The results application and information sharing standard series have been basically set up. And the standards for national security and industrial development regulation have covered the key sectors.

9.4 International Exchange and Cooperation

The international exchange and cooperation in surveying, mapping and geoinformation fields between China and the other countries has helped China to learn from the outside and build its capacity in an efficient way. At the same time, China has also contributed to the geospatial information management capacity development in other developing countries through international exchange and cooperation.

Since the late 1970s, China have become members of many international professional organizations such as the International Society for Photogrammetry and Remote Sensing (ISPRS), the International Cartographic Association (ICA), the International Federation of Surveyors (FIG), the International Union of Geodesy and Geophysics (IUGG), the International Association of

Geodesy (IAG), and the Global Spatial Data Infrastructure Association (GSDI). Currently, the representatives of China serve as President of ISPRS (2012-2016), Vice President of FIG (2012-2016) and Vice President of ICA (2011-2015).

China has been playing a leading role in the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) since its inception in 1995. Currently, the representative of China is working as President of PCGIAP. China has also been active in the United Nations initiative on Global Geospatial Information Management (UN-GGIM) and contributed to the establishment of the United Nations Committee of Experts on Global Geospatial Information Management (UNCE-GGIM). China is making efforts to promote and implement the UN-GGIM initiative at the national and regional level.