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SOUTHAMPTON
SO16 4GU
United Kingdom

Polish National Geographic Information System

J Albin
Surveyor General
Head Office of Geodesy and Cartography
Poland

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J Albin
Surveyor General
Head Office of Geodesy and Cartography
Poland

Abstract

Consistent with the revised geodetic and cartographic law, the National Geographic Information System (NGIS) constitutes a state reference register, a standardised spatial database concerning the country's territory and also procedures and techniques serving the systematic collection, updating, processing and accessing of data.

The NGIS is constructed on three levels: national, regional and county.

Consistent with the approved principles, construction of the system at its various levels is based on data available in National Geodetic and Cartographic Information Centres. These Centres are responsible for winning, updating, issuing and integrating spatial databases. The Centres acquire data of specified quality which are treated as authorised source data.

The construction of the Polish NGIS is a consequence (expression) of the newly approved the Head Office of Geodesy and Cartography policy which requires that all geodetic and cartographic elaborations must be delivered in digital form.

All spatial data acquisition for the NGIS takes place according to a uniform national system of spatial coordinates using Gauss-Kruger equi-angular mapping.

Introduction

The hugely rapid development of electronics in the past 25 years has exerted an enormous influence on geodesy, particularly in the growth of techniques and technologies connected with winning spatial data. The appearance of electronic tacheometers, GPS receivers and high definition satellite images has resulted in a major question in contemporary geodesy to which an answer is still to be found, is how to record and organise spatial data.

What contemporary GIS systems and their related IT infrastructure are expected to do is to develop an ability to find information, gain it in a format fitting into our system, also the possibility to integrate with local databases and perform complex spatial analyses.

The problems encountered in expanding GIS systems at present are not the outcome of any lack of good software and inexpensive rapid computers, for these have been available on the market for several years but are connected with organisational complexities and the absence of appropriate data quality. The efforts undertaken by the Head Office of Geodesy and Cartography (HOGC) aimed at constructing a Polish National Geographic Information System (PGIS) will surely result in their substantial reduction.

Polish National Geographic Information System

Consistent with the amended geodetic and cartographic law, the Polish National Geographic Information System (PGIS) constitutes a national reference register for standardising spatial databases concerning the territory of the entire country, as well as procedures and techniques serving systematic collection, updating, processing and accessing these data.

The work performed to construct a new PGIS is aimed at coordinating the creation of province and county Spatial Information Systems (SIS) which will allow unnecessary duplication of the same spatial data by state, public utility and the private sector institutions to be avoided.

PGIS databases will be created principally based on implementing, among others, the following compilations in digital technology:

- General Geographic Database in a scale of 1:250,000,
- VMAP2 database,
- Topographic database,
- Orthophotomaps from aerial photographs and satellite images,
- Land and buildings register,
- Basic map.

Since general geographic database, topographic database and VMAP2 are relatively new concepts in Polish geodesy, they are described below in abbreviation.

General geographic database in a scale of 1:250,000

“The term general geographic data base comprises a spatial database of a detail minuteness corresponding to a scale of 1:250,000 and less. The term “general geographic” is taken from cartography where it is used to define small-scale maps, presenting fundamental objects and geographic phenomena.

The principal purpose underlying the appearance and managing of a resource of general geographic data is to give central and local government administration and also other interested parties access to updated and credible spatial information.

The information structure of the General Geographic Database (GGD) is divided into the following subjects:

- administrative division,
- settlements and anthropogenic objects,
- hydrography,
- land surface sculpture,
- transport,
- growth of vegetation, land usage,
- protected and closed-access areas,
- geographic names.

The Vmap level 1 base, containing much information imperative when compiling a GGD, was an important source of data used when drawing up a General Geographic Database.”

VMAP2

"The vector map level 2 is elaborated by the Military Geography Section of the Polish Army's General Staff, and produced within a national initiative. Its detail minuteness corresponds to a 1:50,000 scale. The substance of this product is defined by a conceptual pattern comprising 110 classes of objects grouped in nine functional subject layers. Its degree of information completeness is conditioned by access to reliable source materials attainable during the data introduction stage. Original elaborations as regards the power engineering and railway systems were used for the area of Poland as the principal material, apart from the 1:50,000 scale map. The "Atlas of Polish Lakes" published by the Meteorological and Hydrological Institute was also used in this work. The present state of legislation as regards road classification, administrative division and protection of classified information was also taken into consideration. Restricted access to specialist data held by individual trade institutions also exerted a substantial influence on the cramped degree of completeness of available attributes.

A system of spatial references, distribution format and manner of encoding semantic features are identical for all NATO standard products, including Vmap2.

The standard spatial reference system comprises the following elements:

- WGS-84 system of horizontal reference,
- Mean Sea Level (MSL) system of horizontal reference, Kronshtadt'86,
- Map projection UTM.

The remaining elements of the vector products standard specified by the Digital Geographic Information Exchange Standard (DIGEST) were elaborated by the international Digital Geographic Information Working Group (DGIWG). The Vmap2 standard distribution format is VPF, the theoretical ground for which is the second part of DIGEST: "Theoretical Model Exchange Structure and Encapsulation Specification".

Topographic Database

"Topographic Database (TDB) is the official name of a conceptually cohesive national system for collecting, managing and accessing topographic data, functioning under appropriate legal regulations. The term "Topographic Database" comprises data resources, IT management system and also an appropriate financing and organising system. Its information and functional scope as well as its technological quality are defined by appropriate technical recommendations and instructions.

TDB is comprehended as the source of data of a new quality compared with present topographic maps which are the outcome of the evolution of data- winning and -management methods. The TDB creation process should be reviewed in the context of continuation of the achievements registered by Polish topographic cartography. The TDB model has been designed on the basis of the cognitive machinery of contemporary topography and centuries-long experience in this discipline as regards chorography. The Topographic Database will constitute an essential element in the National Land Information System, in the widest sense of the term".

PGIS Institutional Structure

The PGIS is constructed on three levels:

- national level – by the Surveyor General of Poland, comprising the whole country, basing on the General Geographic Database in a 1:250,000 scale,
- province (voivodeship) level by the head of the province assembly, comprising one province, basing on the TDB in a 1:10,000 scale and VMAP2 in a 1:25,000 scale,
- county (powiat) level – by the head county administration officer, basing on the land and buildings register and also the basic map.

Consistent with approved principles, the construction of the system at individual levels is performed basing on Geodetic and Cartographic Documentation Centres. These Centres should establish specialist units (sections) of the PGIS to be responsible for winning, updating, issuing and integrating the spatial databases from which the PGIS is created. These Centres obtain data of a specific quality which are treated as authorised source data.

Province Land Information Systems (PLIS) are established by the offices of province assembly heads, with Province Surveyors accepting responsibility for them. The province-level Geographic Information System is a component part of the PGIS and is created by the Province Office of Geodesy and Cartography. A similar state of affairs exists at county level and in cities.

The Head Office of Geodesy and Cartography recently approved three major principles related to constructing the National Geographic Information System:

1 separating spatial databases from cartographic compilations,

2 standardising geodetic and cartographic products,

3 elaborating metadata bases.

Separating spatial databases

The concept to separate spatial databases from cartographic compilations was established in the early 1990s (1). This consists of substituting a topographic map in a digital form with two products:

- Digital Landscape Model (DLM) - the purpose of which is the faithful modelling of reality and which constitutes the ground on which to construct a GIS,
- Digital Cartographic Model (DCM) – the purpose of which is to prepare a topographic map for printing.

This idea has been adapted by geodetic services of many countries for the needs of construction topographic databases. It was also used in Poland to construct the TDB, where the DLM creates the basic resource and DCM – the cartographic source.

PGIS derivative products

The TDB, VMAP2 and register maps are rich sources of information, but cannot always be used immediately to compile thematic maps due to their systematic features. It most frequently suffices to change the names of objects and their attributes, reduce the number of attributes or the graphic presentation of objects. Integration with other databases or performing simple operations on object geometry, like their removal or linking, are required only rarely. In the presently accessible GIS technologies, such operations may be performed on-line, using the databases from which NGIS is formed. These consist of creating appropriate interfaces (windows through which spatial databases can be observed). Such interfaces are created, depending on local requirements, by NGIS sections in Geodetic and Cartographic Information Centres, thereby creating “NGIS derivative products”.

Standardisation

Since all compilations forming parts of the PGIS are drawn up in digital form, it is absolutely essential that standards be introduced, unambiguously defining the data models as well as the standards of data exchange between systems.

Though all products from which PGIS is created have an unambiguously described data model:

- 1:250,000 general geographic database – in Express language,
- Vector map level 2 – in DIGEST standard,
- TDB – in GML language,
- Land and Buildings Register – SWDE (Register Data Exchange System) , SWING3 (Geodetic Information Exchange Standard) - (for editing layers) standard and in enclosure 4 instruction G5 (Land and buildings register),
- Basic map – in SWING standard and also instruction K1 (Basic map of Poland),

difficulties appear in connection with the correct functioning of data exchange standards, essential for systems updating and feeding. These do not consist solely of choosing an appropriate standard but rather on its proper implementation connected, inter alia, with the unambiguous interpretation of the data model (the matter of the basic map and SWING standard).

SWDE is, at present, the best tested and introduced standard. This came about in conjunction with the introduction of the IACS system as well as with the newly developed A-SWDE and V-SWDE software. The A-SWDE checks the syntax correctness of a file, i.e. whether a data-generating software really does generate data consistent with the SWDE standard. On the other hand, V-SWDE software monitors whether the transmitted register data are correct.

A-SWDE and V-SWDE software are excellent instruments assisting in the introduction of SWDE standard, allowing the correctness to be checked of the software to manage Land and Building Registers and also the quality of the geodetic jobs performed.

Similar software is to appear for the newly-formed topographic database for GML standard.

Work is also planned on developing enclosure number 4 to instruction G5. This work is aimed at defining the operational layer of systems to manage Land and Building Registers, the present enclosure defining the information layer. This will make it possible in the future to ensure full data migration between systems and substantial simplification of the method to elaborate a land and buildings register. Geodetic firms will be able to use a single

technological line to compile a register, since SWDE and SWING3 standard data should be accepted by all register systems. The outcome of this should be full elimination of software-market monopoly.

Since successive versions of the GML standard, extended by OPEN GIS Consortium, are becoming the standard implemented in most GIS systems, work has commenced on its general employment in geodesy.

Metadata

For the emerging spatial databases to find recipients and for geodesy to find customers for the data accumulated in geodetic and cartographic documentation centres, an efficient mechanism is needed to search for information satisfying specific location, precision and time criteria. Such functions should be performed by metadata bases accessible in Internet websites.

With this in view, the construction is envisaged of metadata services, uniform for all Province Geodetic and Cartographic Documentation Centres integrated with the Main Geodetic and Cartographic Documentation Centre. Its construction is connected with the drafting of specialist GIS software in n-layer architecture which would give users access through standard Internet viewers. On the other hand, to introduce the system requires stock-taking by individual Province Centres which possess geodetic and cartographic elaborations and attribute to each the compilation of basic information allowing it to search out such data as: name, description, data of acquisition, validity, producer's area, supplier, structure and manner of access to the data.

With access to the European Union in mind and also the construction of the INSPIRE system, full or at least partial consistency with ISO 19115 standard is envisaged.

Orthophotomap

As was already mentioned, orthophotomaps constitute an essential element in constructing the NGIS, a fact of substantial importance when introducing the IACS system which requires an orthophotomap covering the entire country.

To cope with the task of managing such a huge collections of data, a System of Managing Photogrammetric Data has been introduced in the Main Geodetic and Cartographic Documentation Centre, rooted in the technology of the Intergraph TerraShare company. The concept of this system is based on recording data, that is digital photogrammetric compilations such as scanned aerial photographs, orthophotomaps, satellite pictures and metadata for related databases.

In conjunction with appropriate GIS software, such an approach allows the system to implement the following tasks:

- Archiving data and photogrammetric products,
- Standardising compilations,
- Performing initial quality control of received elaborations,
- Data management and access,
- Metadata access by Internet,
- Accessing Internet instruments for visualising data and submitting orders.

Conclusions

I hope that concept of a National Geographic Information System which I have submitted in outline will enable the joint creation and coordination of work to construct province and county SIS, thereby to avoid unnecessary duplication of the same spatial data by state, public utility and private sector institutions.

The positive effects of activities to standardise geodetic and cartographic products will include: possibility of integrating databases originating from various areas elaborated in diverse software, possibility of unrestricted data migration between systems, simplification of methods to win and update data and the creation of convenient conditions for the expansion of technologies connected with generalisation of spatial databases and automating topographic map editing processes.

The described processes concerning the construction and management of a National Geographic Information System can be found in the executory provisions to the amended “Geodetic and Cartographic Law”

(1) Gruenreich Konzeption und erste Erfahrungen aus der Ausbauphase des digitalen Landschaftsmodell 1:25000 (DLM25). In: Proceedings XIX FIG Congress, Helsinki (1990)