THE NATIONAL SPATIAL DATA INFRASTRUCTURE

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ABSTRACT

The paper described the principles on which the National Geographic Information System is created, also its target structure, principles of functioning, designation as well as the principal foundations on which the Spatial Data Infrastructure was constructed.

One of the System's major purposes is to coordinate work being performed on the creation of province (voivodeship) and county (powiat) Geographic Information Systems, eliminate superficial, expensive proliferation and gathering of the same data by various recipient-users of data (central, state institutions, public utilities and the private sector).

The major task to be performed by the Spatial Data Infrastructure is to facilitate access to, with usage of the restricted resources of standard procedural principles, protocols and applications of established data bases.

The Head Office of Geodesy and Cartography has undertaken the following activities related to the construction of the National Spatial Data Infrastructure:

1. Elaborating metadata bases at central, province and county levels
2. Standardising geodetic and cartographic products, in particular the introduction of 19100 series ISO standards
3. Coordinating efforts in the construction of IT systems in various areas of the economy by appointing an inter-ministerial Spatial Data Infrastructure group
4. Initiating activities aimed at elaborating a theoretical model of the National Spatial Data Infrastructure
5. Cost-free access to basic data in small scales.

KEYWORDS: Geographic Information System, Spatial Data Infrastructure

PREAMBLE

The growth of an information society is a priority task implemented within the frame of Poland's accession to the European Union. It is assumed that the growth of a society, in which everyone can create, obtain, use and share information and knowledge with others, takes place by ensuring access to a secure and wide-band infrastructure and also stimulating the growth of services, applications and substance in the public and commercial field. Public geoinformation is of particular significance in an information society. Estimates claim that more than 70 percent of decisions taken in public administration bodies of West European countries employ geoinformation. Polls taken in Poland by independent research institutions set that figure at the slightly lower value of 50 percent. To enhance access to data collected in the State Geodetic and Cartographic Resources to the general public and public administration, the Head Office of Geodesy and Cartography (HOGC) is pursuing work to construct a National Geographic Information System. This work will be the basis on which the National Spatial Data Infrastructure (NSDI) in Poland is to be built. The purpose of the National Geographic Information System (NGIS) is to construct reference spatial topographic databases for thematic databases in scales of 1:250,000, 1:50,000 and 1:10,000, also the construction of the Integrated Cadastral System and an Active Geodetic Network.

In that manner a geoinformation base will be established, allowing the implementation of the National Spatial Data Infrastructure by the HOGC and other official units and organizations. Taking INSPIRE directives into account in this process, concerning access to geoinformation, metadata base construction and introducing ISO standards will permit effective exchange of geoinformation among European Union countries

THE NATIONAL GEOGRAPHIC INFORMATION SYSTEM

The amended geodetic and cartographic law lays down that the National Geographic Information System (NGIS) is a state register composed of standardised databases holding information about objects on and below the Earth's surface in the whole country, also defining their location as well as procedures and methods for systematic data collection, updating, processing and accessing.
Work on constructing a new NGIS is to coordinate efforts to create province and county Spatial Information Systems, so as to avoid superfluous repetition of identical spatial data by government and public utility institutions and the private sector.

The NGIS is constructed on three levels:

- national – by the Surveyor General of Poland, comprising the area of the entire country, basing on the 1:250,000 General Geographic Database,
- province – by the head of the province assembly, comprising the area of a province, basing on the 1:10000 TBD and 1:25000 VMAP2,
- county – by the county head comprising the area of a county, basing on the land and buildings register and the basic map.

The approved principles lay down that construction of the system at various levels is based on Geodetic and Cartographic Documentation centres. These Centres should establish specialist NGIS cells (workshops) to be responsible for winning, updating, publishing and integrating the spatial databases of which the NGIS is composed. These centres acquire data of specific quality which are treated as authorised data sources.
Province Geographic Information System are established by Province Assembly Offices, for which Province Surveyor Generals are responsible. The Geographic Information System at province level is a component part of the NGIS and is created in the Province Geodetic and Cartographic Documentation Centre, the heads of PGiCDC being responsible for its creation and functioning.
A similar state of affairs exists at county level and in towns.

A major principle accepted when constructing the NGIS was to separate spatial databases from cartographic elaborations. That concept was developed in the early 1990s and was aimed at substituting a topographic map in digital form by two products:

- digital model of a landscape, its purpose being the faithful reproduction of reality and constituting the basis on which the GIS is constructed,
- digital cartographic model, its purpose being to prepare a topographical map for printing.

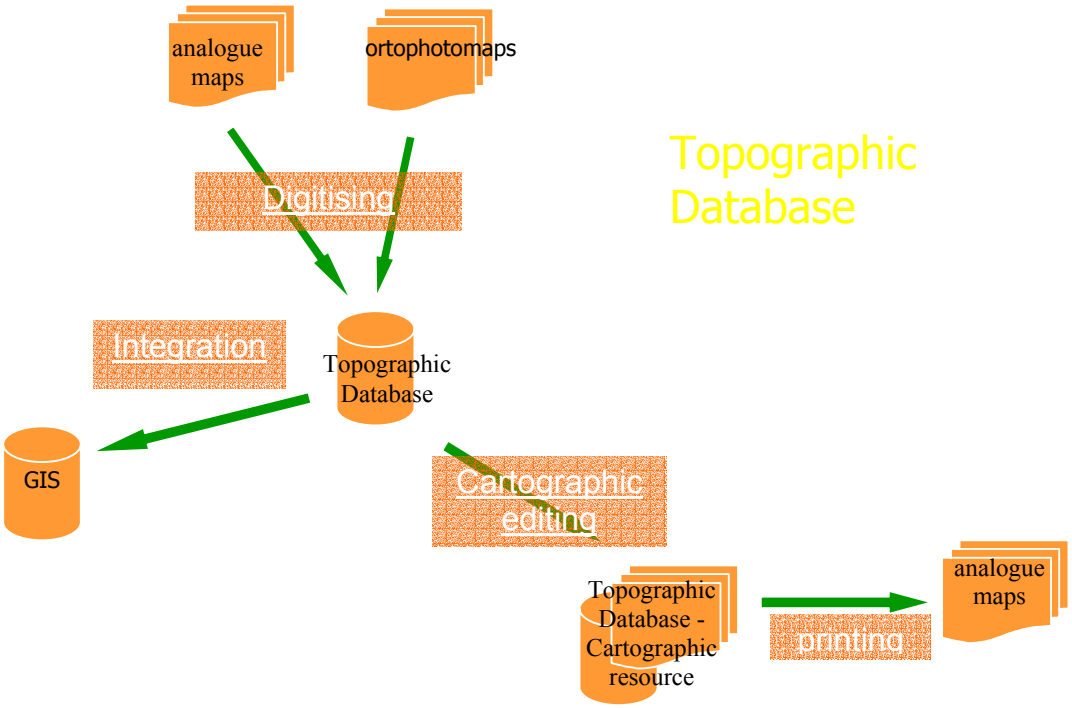

Figure 1: Separating spatial databases from cartographic elaborations

That concept has been adapted by the geodetic services of many countries for the requirements of constructing topographic databases. It has also been used in Poland to construct the Topographic Database where the digital model of a landscape creates the basic resource and the digital cartographic model – the cartographic resource, as illustrated in drawing 1.

The NGIS is constructed principally basing on existing elaborations, such as:

- General Geographic Data Base in a scale of 1:250K
- VMAP2 database
- Topographic database
- Orthophotomap originating in aerial photographs and satellite pictures
- Land and buildings register (implementation of the project to construct the Integrated Cadastral System
- Basic map
- Uniform system of spatial references (implementation of the project to construct an Active Geodetic Network).

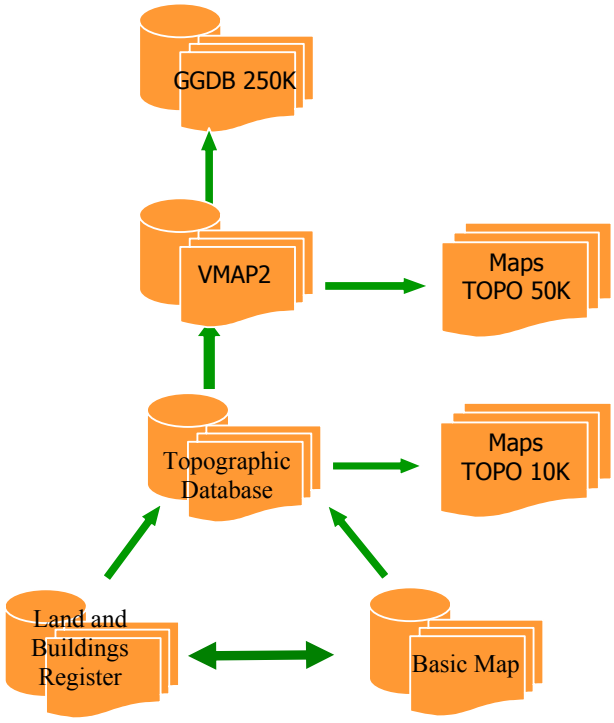

Figure 2: Target flow of data between vector data bases

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

1:250,000 general geographic database

"The concept of a general geographic database has been accepted to be a spatial database with a degree of detail minuteness corresponding to a scale of 1:250,000 and less. The term "general geographic" has been taken from cartography where it is used to define small-scale maps, presenting basic objects and geographic phenomena. (…..)
The principal purpose of creating and managing a general geographic data base is to give central and local government administration bodies and other interested parties access to updated and reliable spatial information.

The information structure of General Geographic Databases determines their division into the following subjects:

- administrative division,
- settlements and anthropogenic objects,
- hydrography,
- land structure,
- transport,

- ground vegetation growth and land usufruct,
- protected and forbidden entry areas,
- geographic names.

The VMap level 1 base, containing information imperative when drawing up a GGD, was among the most important data sources used when elaborating the General Geographic Database".

Vmap2

"The vector map level 2 is elaborated by the Military Geography Board of the Polish Army General Staff, and delivered within national initiatives. Its minuteness of detail corresponds to a scale of 1:50,000. The substance of this product is depicted in a conceptual diagram comprising 110 classes of objects grouped into nine utility subject layers. Information completeness is conditioned by access to reliable source materials accessible at the stage of data introduction. Apart from the 1:50,000 map, a basic material used for the whole area of Poland is the original elaborations of the Water Management Board as regards the electric power transferring network and the railway network. The "Atlas of Polish lakes" published by the Meteorology and Water Management Institute has also been used. The updated state of legislation has also been taken into account as regards road classification, administrative division of Poland and protection of classified information. A tangible impact on attribute completeness has been exerted by restricted access to specialist data held in industrial and economic institutions.

The following items are uniform for all standard vector products in NATO, including the VMap2: the system of spatial references, distribution format and the coding of semantic features.

The standard system of spatial references comprises the following elements:

- WGS-84 horizontal reference system;
- Mean Sea Level (MSL) horizontal reference system;
- Geographic projection.

The remaining elements of standard vector products are defined by Digital Geographical Information Exchange Standard (DIGEST) elaborated by the Digital Geographic Information Working Group (DGIWG). The standard distribution format of VMap2 is VPF whose theoretical basis is "Theoretical Model Exchange Structure and Encapsulation Specification" - the second part of DIGEST.

Topographic Database

"Topographic Database (TDB) is the official name of a nation-wide, conceptual cohesive system of gathering, managing and accessing topographic data, which functions on the ground of appropriate legal regulations. Topographic Database comprises both a data resource, IT data management system as well as an appropriate financing system and organisation. Appropriate directives and technical instructions define the scope of information and function as well as the technological level.

TDB is understood as a new quality source of data in relation to present topographic maps, as the outcome of the evolution of methods used to acquire and manage data. The process of creating the TBD should be considered in the context of the continuation of the achievements of Polish topographic cartography. The TDB data model is constructed on the base of the cognitive apparatus of contemporary topography and centuries-long experience which this discipline

acquired. The Topographic Database will constitute an essential element of a National Land Information System in the widest sense".

Orthophotomap

It has been mentioned that orthophotomaps are an essential element in constructing the NGIS, having particular importance when introducing the IACS system which requires the elaboration of an orthophotomap covering the whole country.

A Photogrammetric Data Management System has been drawn up in the Main Geodesy and Cartographic Documentation Centre on the base of an Intergraph TerraShare technology, to cope with that task relating to the management of such a huge collection of data. The system's idea is based on registering data, i.e. such digital photogrammetric elaborations as scanned aerial photographs, orthophotomaps, satellite pictures and metadata to a relational database.

Such an approach in conjunction with appropriate GIS software allows the following tasks to be implemented by the system:

- To archive photogrammetric data and products
- To standardise elaborations
- To perform an initial quality control of accepted elaborations
- To manages and access data
- To access metadata through the Internet
- To access internet tools for visualising data and delivering orders.

IPE/PTN Integrated Cadastral System

An integrated Cadastral System ensures safety of real estate trading, as the outcome of increased effectiveness of property rights registration and also allows access to comprehensive information comprising legal, physical and taxation data.

The cadastral system is constructed of three subsystems:

- the first subsystem is the land and buildings register (real estate cadastre). The information in a real estate cadastre concerns a geodetic and cartographic description of a property and is to be used by both departments of real property rights registers and the fiscal cadastre, that is by commune tax departments.
- the second subsystem comprises real property rights registers containing information concerning the legal status of a real estate (property),
- the third subsystem is the fiscal cadastre, constituting the source of tax assessment: property tax, farm tax and forestry tax.

The following are the areas of operation of the various subsystems:

- real property rights registers subsystem, basing its operations on the concept of a central data base accessing data from that level,
- the subsystem managing land and buildings registers, functioning at county (powiat) level,
- the fiscal cadastre subsystem, functioning at commune level.

ASG-PL Active Geodetic Network

A uniform reference system is implemented by the construction of an ASG-PL active geodetic network, the pilot unit of which was commissioned in February 2003. The network project comprises 6 automatic, service-free reference stations and a calculation centre. The principal part of the system covers Silesia Province and the region of Kraków city. Additional permanent stations operating in IGS and EPN systems were included in the ASG-PL system as an experiment, in 2003. The functioning of the various elements of the system was controlled in 2003, while tests

on the working of the ASG-PL calculation centre were carried out at selected points of the geodetic horizontal reference net, with technical directives being elaborated for carrying out GPS measurements with the use of the ASG-PL system. Software allowing data registration at one-second intervals was added to ASG-PL system reference stations, to meet the requirements of firms performing photogrammetric aerial photographs. Steps were additionally taken to appoint a group of experts to deal with the construction of a multifunction ASG-PL positioning system within Poland and also of ASG-PL promotion. This service was made accessible, cost-free, to users between 01.10 and 31.12.2003.

NATIONAL SPATIAL DATA INFRASTRUCTURE

The Spatial Data Infrastructure is a group of appropriate technologies, political and economic means and also institutional undertakings to simplify access to and make use of spatial data. Its principal purpose is to make it easier for individual persons and institutions to gain wide and also inexpensive access to spatial information with the use of standard procedures, protocols and applications.

In the present initial stage of constructing the national spatial data infrastructure, the HOGiC focuses its activities on:

1. Elaborating the legal grounds for the functioning of the National Spatial Data Infrastructure
2. Standardising geodetic and cartographic products particularly on introducing ISO standards of the 19100 series
3. Coordinating activities in the construction of IT systems in various fields of the economy, by setting up an inter-industrial group for Spatial Data Infrastructure affairs
4. Initiating activities towards the elaboration of National Spatial Data Infrastructure theoretical model
5. Elaborating metadata bases at central, province and county levels
6. Giving cost-free access to basic data in small scales
7. Constructing personnel training centres for the needs of NGIS and NSDI.

Metadata

An efficient mechanism to search for data, satisfying specific location, precision and time criteria is required to ensure that the emerging spatial data bases find recipients, and geodesy – customers for the data collected in geodetic and cartographic documentation centres. Those functions should be implemented by metadata bases accessible in the Internet.

With that in mind, the construction is envisaged of a uniform system for all Province Geodetic and Cartographic Documentation Centres (PGandCDC) of metadata services integrated with the Main Geodetic and Cartographic Documentation Centre. Its construction is connected with the elaboration of specialist GIS software in n-layer architecture, which will give users access through standard Internet viewers. But introducing the system requires that individual PGandCDC carry out stock-taking of the geodetic and cartographic elaborations they possess and ascribe to each elaboration the basic information they contain to allow retrieving, such as: name, description, data of obtaining, validity, the producer's area, the supplier, structure and manner of access to data.

The metadata bases are to be constructed according to ISO 19115 standard.

Standardisation

Since all elaborations included in the NGIS are in digital form, it is of exceptional importance that standards be introduced unambiguously defining the data models, as well as standards of data exchange between systems.

Though each component NGIS product has an unambiguously described data model:

- General geographic database 1:250,000 – in Ekspress language
- Level 2 vector map – in DIGEST standard
- TDB – in GML language
- Land and Building Register – in standards SWDE, SWING3 (for editing layer) and also in annex 4 of instruction G5
- Basic map – in SWING standard, and also K1 instruction

Problems are being encountered in the correct functioning of data exchange standards, imperative for system updating and feeding. The problem is not only of the choice of an appropriate standard but also of its correct implementation, including unambiguous interpretation of the data model (problem of the basic map and SWING standard).

SWDE is the best tested and introduced standard, which is the outcome of introducing the IACS system, as well as A-SWDE and V-SWDE newly elaborated software:. The A-SWDE software checks the syntactic correctness of the file, i.e. whether the data generating software did, indeed, generate them in accordance with the definition of the SWDE standard. On the other hand, the V-SWDE software controls whether the delivered registration data are correct.

A-SWDE and V-SWDE software are excellent tools assisting the introduction of SWDE standard, allowing the correctness of the software to manage the Land and Buildings Register to be checked, as well as the quality of performed geodetic jobs.

Activity has been commenced on elaborating similar software to control the quality of data creating the TDB vector database, registered in GML standard.

Since successive versions of the GML standard developed by OPEN GIS Consortium are a standard implemented in the majority of GIS systems, work has begun on making wide use of it in geodesy and, in particular, the Land and Buildings Register.

Recapitulation

I hope the outline concept of the National Geographic Information System which I have presented will allow the mutual creation and coordination of work when constructing province and county SIS, so as to avoid superfluous duplication of the same spatial data by state and public utility institutions and by the private sector.
Though we are still at the beginning of the road concerning the construction of a spatial data infrastructure, I am convinced that the work undertaken, particularly in constructing metadata bases, spatial database standardisation and introducing ISO standards of 19100 series will rapidly bring the expected results.

The described principles concerning the construction and management of the National Geographic Information System will be published as an ordinance to the new “Geodetic and Cartographic Law” Act.