SDI IN POLAND – CONCEPT OF TOPOGRAPHIC REFERENCE SYSTEM FOR THEMATIC, HARMONIZED DATABASES

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Abstract

In 2003 a new concept of the Polish National Geographic Information System was presented. It constitutes a national reference register for standardizing spatial databases concerning the territory of the entire country, as well as procedures and techniques serving systematic collection, updating, processing and accessing these data.

At present, the Head Office of Geodesy and Cartography is in the stage of defining the SDI in Poland. In this context, the existing spatial databases: TBD, VMAP L2 and BDO should be considered as reference data, which should be broadly unified and become the reference base for specialised thematic works. It seems particularly reasonable to uniform works concerning development of TBD and VMap L2 (second edition) databases. The result of such unification will be the Multi-level Topographic Database (W-TBD), which will store coherent topographic data (with respect to the conceptual model) for the entire country at two levels of details, corresponding to 1: 10 000 and 1: 50 000 scales level. The W-TBD relies on a MDRB (Mulitiresoluition / Multirepresentation Database) concept.

In 2003 a new concept of the Polish National Geographic Information System (pol. *KSIP* – Krajowy System Informacji Geograficznej) was presented. It constitutes a national reference register for standardizing 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 KSIP 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 institutions and in part the private sector to be avoided.

KSIP databases have been created based on existing geographical databases:
* Geographic Database (BDO) in the scale of 1:250 000, 1:500 000, 1:1 000 000 *(100% of the country's area),*
* Topographic database VMAP L2 in the scale of 1:50 000 *(100% of the country's area)*, adjusted to civil purposes
* Topographic Database (TBD) in the scale of 1:10 000 *(5% of the country's area,* Buczkowski K., Gotlib D., 2000*)*,
* Orthophotomaps from aerial photographs and satellite images *(100% of the country's area in the end of 2004)*,
* Land and buildings register (EGiB)   in the scale of 1:1000, 1:2000, 1:5000 *(100% of the country's area in the end of 2006)*,
* Digital maps in the scale of 1:500, 1:1000, 1:2000, 1:5000 *(for some urban areas)*

At the moment, particular components refer to independent databases, however, as a final solution the data flow should respond to the databases shown in figure 1. Two variants of this process are considered, "classical" generalization of spatial data or creation of the MRDB type database (Gotlib D., Lebiecki M., Olszewski R., 2004).
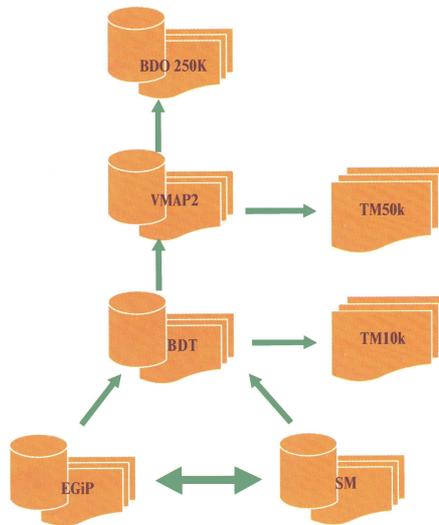
Fig. 1. KSIP in Poland

Besides of this databases three state institutions produce thematic databases concerning the environmental conditions in Poland: the Head Office of Geodesy and Cartography (Sozological Map and Hydrographic Map), the Polish Geological Institute (Hydrogelogical Map, Geological-and-economic Map, Geo-environmental Map) and the Institute of Meteorology and Water Management (Computer Map of Hydrographic Division).

At present, the Head Office of Geodesy and Cartography is in the process of defining the SDI (Spatial Data Infrastructure) in Poland. In this context, the existing spatial databases: TBD, VMAP L2 and BDO should be considered as reference data, which should be unified within the possibly wide scope and which should become the reference base for specialised thematic works. It seems particularly reasonable to uniform works concerning development of TBD and VMap L2 (second edition) databases. The result of such unification will be the Multi-level Topographic Database (W-TBD), which will store coherent topographic data (with respect to the conceptual model) for the entire country at two levels of details, corresponding to 1: 10 000 and 1: 50 000 scales level. It seems necessary to implement the concept of MRDB (multiresoluition/multirepresentation database) for development of the W-TBD (Gotlib D., Iwaniak A., Olszewski R., 2005).

The objective of the proposal is development of a coherent and complete reference data set at the national level for supplying Geographic Information Systems and map production systems and other systems using geographical information. Utilisation of the multiresoluition and multirepresentation database results from achievements and conclusions from performed works and from expertise carried out at the Head Office of Geodesy and Cartography, as well as from research projects financed by the Committee for Scientific Research (Makowski A., 2000).

Following the authors' opinions, the main objectives of the SDI implementation in Poland include:

♦ **Unification of activities concerning the development of TBD and VMap L2 W-TBD database**

Unification of activities concerning the development of TBD and VMap L2 (second edition) databases requires many operations, starting from modification of elements of the conceptual model of VMap to the decision concerning development of the TBD at two levels of details. It should be noticed that assumption of such a solution does not only mean acceleration of development of both products, elimination of doubled data storage and doubled costs; it also opens new opportunities in the field of utilisation of data and compliance with the recent world trends related to development of the, so-called, multirepresentation spatial databases (MRDB – Mulitiresoluition / Multirepresentation Database). The MRDB may be considered as a spatial database which models field objects at various levels of geometric accuracy or at various levels of conceptual generalisation. In a database of this type various geometric representations of the same, real object, are integrally connected and they may be called, depending on the user needs. The conventional approach to spatial data modelling in the MRDB database consists of integration of data characterised by various resolutions or various geometric accuracies.

The existing TBD concept assumes development of the topographic database with the level of details, which corresponds to the scale of 1: 10 000. Implementation of the TBD is performed for urban areas, covering only several

percent of the country's area. For other areas, implementation of the VMap L2, 2-nd edition topographic database is planned. The conceptual model of the VMap database (based on the NATO standard) considerably differs from the TBD concept. Therefore, the necessity of common utilisation of spatial reference data, which mode the continuous geographic space, forces to develop one, conceptually coherent topographic data model, which would allow for sharing of data stored in one system. Considering that the source of data for the VMap L2, 2-nd edition will be the orthophotomaps, the same as in the case of the TBD, implementation of this concept is possible based on the idea of a multirepresentation database (MRDB). This means that data stored in the W-TBD will be characterised by diversified levels of conceptual generalisation, but by the same geometric accuracy.

Integration of data stored within the programme of development of the Topographic Database and Vmap databases, may be simplified in the future due to unification of some standards concerning the development of those databases. This relates, among others, to ways of data model description, ways of defining spatial relations and metadata standards. It is necessary to introduce common models, which define mutual relations between systems and common standards of co-operation between those systems. An important element, which unifies reference databases and related thematic databases is development of common identifiers and dictionary tables, relatively connected with spatial data. This concerns, first of all, hydrographic networks, roads networks and places (towns, village). At present, every database existing in Poland, containing geographical data, has its own object identifiers and own dictionary tables.

♦ **Multiscale representation of a digital terrain model as a component of the W-TBD**

The current concept of digital terrain modelling in the Topographic Database assumes creating of DTM files (in TIN and GRID formats), in sectional (sheet) division. The currently developed novelty of Technical Guidelines of the DTM component of the TBD assumes that the terrain relief will de prepared as continuous, vector representation of terrain forms (breaklines, structural lines, characteristic points, areas of exclusions, mass points etc.). Such way of source data collection allows for development of procedures of automated selection of structural forms, which are representative for the given level of generalisation of structural forms of the terrain relief. This will allow for development of the concept of the multiscale (hierarchic) representation of the terrain relief. This approach (multirepresentation digital terrain model) is a unique concept, which has not been applied in Poland before. Outlines of that concept were presented in the research grant concerning the national topographic information system, performed at the Warsaw University of Technology. This Project assumes the complete development of that concept and its practical implementation for chosen territories.
The concept of the multirepresentation terrain relief model is the logical amendment of the idea of multirepresentation database (W-TBD), and thus allows to perform common analyses of all topographic components.

♦ **Soil, hydrographic and geo-environmental databases, with the use of W-TBD**

At present, thematic geographical databases and related cartographic works (thematic maps) concerning conditions of the natural environment in Poland are produced by three state-owned institutions: the Head Office of Geodesy and Cartography (GUGiK) (soil and hydrographic maps, 1: 50 000 scale), the Polish Geological Institute (PIG) (hydrogeological map, geologic-and-economic map, geo-environmental map, 1: 50 000 scale) and the Institute of Meteorology and Water Management (IMiGW) (Digital Map of Hydrographic Division of Poland, 1: 50 000 scale). Those maps are produced with the use of digital technology; however, they are produced in various co-ordinates systems and basing on various source materials, which are characterised by diversified levels of details and timeliness. Some of the discussed map do not cover the entire country and the majority of map sheets require updating; besides, some information is doubled on those maps.

The essence of works performed by the GUGiK and PIG, which are not only understood as analogue maps, but, first of all, as spatial databases, is the possibility to perform complex analyses, using various GIS tools. Therefore, from the user point of view the possibility of integration of data originating from various external data sources, is extremely important. Utilisation of various sources of the basic topographic data, as well as utilisation of diversified techniques of vectorisation of analogue maps, results in considerable differences between geometrical objects in spatial databases developed by the GUGiK, PIG and IMiGW. Direct integration of such data is not possible in practice. Development of a coherent, national reference database and its acceptance as the source of topographic data, will allow to solve that problem. Besides, partial harmonisation of conceptual models of thematic databases, developed by the above institutions, would allow for implementation of the concept of an inter-operating system, permitting for shared utilisation and analysis of diversified data.

In the current situation, when the concept of the official topographic database (TBD of the geometric accuracy corresponding to the 1: 10 000 scale level) and VMAP L2 (of geometric accuracy corresponding to the 1: 50 000 scale level) is implemented, which aims at supplying of topographic maps production systems, as well as geographic information systems with spatial data, it seems reasonable to:

- Using official topographic databases as source reference layers for all thematic databases,
- Developing thematic geographical databases as continuous vector layers (without sectional division into map editing sheets),
- Harmonising of the conceptual model of selected thematic databases (soil, hydrographic, geo-environmental, hydrogeological),
- Developing of uniform dictionaries of terms, which define particular objects and classes of objects, as well as ways of their classification,
- Standardising of particular works, following the ISO 19100 standards.

The objective of such a database would be to acquire and store thematic data concerning the geographic environment of Poland and their distribution for the needs of elaboration of various thematic maps and spatial analyses concerning the environmental conditions. This would allow the reduction of development costs of particular thematic maps, with the possibility of simultaneous comparability of thematic layers, all stored in the integrated system.

♦ **Thematic databases managment system in connection with the W-TBD**

Practical implementation of the outlined concepts will not be possible without implementation of advanced computerised systems. . High data diversity in respect to level of details, accuracy and content, as well as the fact that data are created and updated by many institutions, results in the necessity of developing a coherent system concept, capable of processing distributed data. The system will allow for increasing the efficiency of co-operation between particular institutions, which are data creators, and maintenaning high independence of existing and future specialised systems developed by those institutions. This will be an integrated system, which will allow for wide distribution of data between users. This system should be located at the level of surveying and cartographic data documentation centres, which should play the integrating roles.

Implementation of this concept will allow for common processing of thematic data stored in the GUGiK and PIG databases and for combining those data with the reference W-TBD data. This approach will simplify data processing considerably, as well as considerable reducing the costs of updating particular thematic works.

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