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Concept of Regional Geographic Information System - Resources, Effectiveness and Use

The administrative and territorial reform in Poland, effective from the 1st of January 1999, transformed governmental tiers and provided basis for autonomous management of space and its resources. By its very nature, it has also set chronological limits for the development of regional geographic information systems. The previously identified activities, no matter how far developed, have merely contributed to laying the foundation for entirely new patterns in geomatics. In the best circumstances, the designed territorially confined schemes gave birth to new regional geographic information systems, providing them with framework infrastructure for spatial data. In the worst case, work was to be undertaken from the ground. Irrespective of the situation, however, both considerable experience and a basic pool of data have been put in place.

In reality, it was not these two assets but raised awareness of politicians and their administration, technological knowledge and financial means – which formed a conglomerate of circumstances forging the way for regional geographic information systems. Parallel, at the end of the 1990s, aching formalities, which used to hamper launching of those systems, started to decline.

The status of some local systems designed in the majority of urban centres by qualified geodetic teams or external companies was somewhat different. The purpose of these systems remained unchanged, which allowed for making them extensive and successively upgraded, with vast informative scope but relatively limited administrative use. This, in turn, can be diagnosed as redundancy of technology over real skills in its application to routine public administration procedures. Changes introduced by the territorial reform did not bring significant disturbance in performance of the local GIS systems and even provided means for easier and more efficient support in the technological and economic fields. Although some of the local schemes were reported lacking contemporary standards, it is nowadays possible to transfer the managed data, formats and projections to newly developed and fully standardised systems.

In the recent ten years, the design of foundations for the GIS systems obtained momentum. In 1992 commercial GIS software products made by the MapInfo Corp. and ESRI Corp. were inaugurated on the Polish market and then complemented with successive products, some of them domestically manufactured. Despite the early start, the legal foundations for the geographic information systems at various administrative tiers were brought to life only in the late 90s and

not fully completed. Intensification of the efforts from 2001 has been apparently associated with a new approach to information tools in spatial management and according to the declarations by the Main Geodetician of the State, the process is to be finalised till 2004.

Basic determinants for developing regional geographic information systems are defined in the Act on Geodetic and Cartographic Law, and more specifically – in its chapter on databases within the National Geographic Information System. To some extent they are, however, attributed to expectations and regulations set forth in the spatial planning legislation. Obligatory provision of regional spatial management plans triggered interest in developing GIS systems, as market demands revealed weaknesses in routine decision-making processes, which did not keep up with. Wide and constantly extended offer of relevant software products, varied methodology in designing the systems, diversity of used projections, scarce data exchange and lack of co-ordination brought about dramatic inconsistency in the data format. From the end of the last century the tendency is improving, on account of issued legal regulations and developed data conversion modules.

The problems encountered were decisive for commissioning a concept of a coherent GIS system at the regional level, which would prove its compatibility with external sources and users of information. The concept provision in the Pomeranian Region was launched in 2000.

The essentials for the GIS on the Pomeranian Region resulted from needs and capacities of its regional administration. Planning purposes were acknowledged as the highest ranking priorities and among them – provision of the Regional Spatial Management Plan, designing of a monitoring system for socio-economic development of the region, managing land estates owned by the regional authority as well as managing of geodetic and cartographic data as parts of the National Geographic Information System. To elaborate on a coherent concept, the following components were incorporated:

- Analysis and identification of project partners and system users,
- Analysis of performed tasks and information flows,
- Analysis and modelling on desired information flows,
- Functional design of architecture of informative structure,
- Hardware layout design,
- Design of software and dedicated application products,
- Concept of contents and structure of databases,
- Concept of database glossaries,
- Identification of staff requirements,
- Timetable for implementation.

The strategic assumption was defined as to create a system capable of integrating spatial information derived from various users and systems and of compiling and rendering accessible data for interested entities – both within and beyond the regional democratic authority. Upon launching in 2000, this task was

considered difficult and unprecedented – due to the lack of Polish benchmarks in creation of regional systems. So far, no integrated information systems covering larger administrative areas and compiled from databases and section systems of different institutions and of different levels of state administration (communes and municipalities, counties and provinces) have been launched.

The majority of spatial information systems were initiated in big cities where geodetic resources management provided basis for IT work. Separate, most often not compatible systems were developed in administrative, academic and managing institutions and in commercial businesses – in keeping with specificity and needs of particular entities. Apart from systems for particular towns and systems dedicated to needs of specific institutions, few systems that developed at the central level were designed for governmental activities only.

A number of local and regional government projects relied upon co-operation of scholars and administration officers. Consequently, at the end of 1999, the first concept of the Information System on Pomeranian Region was formulated – co-promoted by GIS specialists graduated in geography at the University of Gdańsk. In 2001-2002 the concept was further developed and brought to use, compliant with the organisational structure and information flows presented in the Figure 1. At the turn of 2002 and 2003 the already matured regional system was subject to reconstruction and modernisation, starting with installation of fully professional and world acclaimed software tools of ARC/INFO and Oracle.

Basic functional objectives

From the very beginning, the target was defined as the complex development of the system to satisfy the demand for information from a number of users. Complexity of the undertaken project consisted at first in linking through IT tools tasks and activities of different structural units of the regional administration office.

The general results of over 4 years of the system development include inventory making, compiling and processing of data associated with geography, natural environment, infrastructure, culture and social community of the region, which allowed for producing about 130 thematic maps. These outputs were purposefully used in the process of drawing up the Spatial Management Plan for Pomeranian Region. The entire system is internally structured based on the sort of information stored, its usefulness and manner of exploitation. The entire resource is composed of circa 500 layers of vector data and comprehensive electronic material of thematic maps and photogrammetric images. Total volume of the system is estimated at more than 400 GB and is stored in separate databases referring to the functional division and competencies of its users.

The notion of maintaining and administering data in GIS assumes that there are dispersed database conceptually assigned to competencies of particular users in charge of establishing and updating of specific sorts of information and responsible for their substance-related scope. A GIS Team monitors whether their action is

correct and technically accurate, collects and keeps on file all the data and is responsible for the distribution of resources among other users – also for commercial purposes via the Regional Centre for Geodetic and Cartographic Documentation.

The Regional GIS system is put out in the scales ranging from 1:10 000 (geodetic and cartographic materials) to 1:200 000 (planning materials). Each user and developer of the system implements his own tasks and establishes his own data resources, which in their part of interest for others, is transferred to the general data resource, in line with statutory requirements kept in by the Geodetician of the Region. The system is maintained in the Gauss-Krüger projection, with flat co-ordinates set in the 1992/19. The data are stored in the MapInfo, ArcView and ARC/INFO GIS environment, with a transferable option to other software parameters. In 2003 the data are being transformed to comply with the ORACLE database.

Designed and maintained information modules

GIS for the Pomeranian Region was based on autonomously functioning IT modules deriving data from the same resource and symmetric with the same functional parameters (projection, desktop software, cartographic layers, scales) but which nonetheless may operate on a stand-alone basis. The modules serve statutory obligations of the regional administration. The core of the system is placed in the President's Office of the Pomeranian Region, whereas its separate modules are located at the complementary regional agencies (e.g. Board for Regional Roads Network, Regional Office for Land Survey and Agricultural Areas, Regional Fund for Environmental Protection and Water Administration). Those respective parts of the system through their scope of operations are affiliated with the competencies of particular agencies.

The core of the system consists of seven separate modules, notably:

- *Basic module* – containing general databases with information on the geographical space of the region and its administrative, natural, social and economic elements;
- *Land survey module* - containing geodetic and cartographic resources stored in digital form (1:10 000, 1:25 000, 1:50 000 topographic maps, orthophotomaps and raster maps);
- *Land estates module on the property of the regional authority* - containing complete inventory of spatial, legal and technical information on the stored items;
- *Planning module* – containing full text and map attachments of the regional spatial management plan along with the complete databases documentation for sites and areas areas to document information-related elements of the planning process (defined as spatial development conditions and trends);

- *Monitoring module* – containing databases at four levels of aggregation – regional, county, communal/municipal and single-case);
- *National and international information module* – containing elementary (administrative, natural, economic and social) data on the country and the Baltic Europe space referred to in a number of presentations,
- *Specific information module* – containing databases used in activities of specific service teams, like crisis management, nature conservation and rescue teams.

Apart from the enumerated core modules, the systems stores basic graphic layers with textual databases produced in effect of transactional and interregional co-operation projects, as well as digital versions of planning studies for selected functional territorial areas, including so called problem areas.

All the system modules are furnished with obligatory and facultative elements falling into the National Geographic Information System. That implies that there is no separate nationally-commanded system at the regional level, as it would distort the overall design of the regional GIS.

Each of the thematic modules has its internal structure of information storage. Homogeneity in that respect turned out to be unfeasible. The structure consists of three thematic-related clusters of information, with individual layers of maps and textual databases.

Progress in development and expected effectiveness

As mentioned, at the turn of 2002 and 2003 the GIS for the Pomeranian Region achieved the status expected at the year 2000 census. Already in 2002 it underwent the consequential stage of reconstruction and modernisation. Apart from a radical software upgrade, consisting of installing ARC/INFO and Oracle products, the noteworthy pioneer modules of a regional monitoring and digital resource of topographic maps were placed in the system. The latter resource is intended to contribute to the National Topographic Database, whose essentials were drafted by the State Office of Land Survey and Cartography in 2003.

Monitoring the processes in the Pomeranian Region is based upon commonly accepted rules of monitoring variability of phenomena in socio-economic and geographical space associated with activities of the regional government. Specifically, it co-relates with the issues on monitoring the progress and conditions for the socio-economic development of the region, tracing the environmental situation, monitoring the regional strategy and operational programmes implementation, as well as compliance of spatial planning activities with the basics of the regional spatial management plan. The module is therefore adjusted to the routines of the following administration departments: Regional and Spatial Development, International and Interregional Co-operation, Rural Areas Development and Environmental Protection, Social Policy. The monitoring module draws on and supplements the contents of databases established and maintained

under other modules of GIS. It aggregates information in four basic groups, notably: by regions (Pomeranian Region vis-à-vis the country), by counties and communes/municipalities (differentiation of phenomena in areas of administrative division) and by sites under individual monitoring. The latter include, e.g. network systems (transport, power supply etc.), lakelands, or littoral zone of the Baltic Sea.

The structure of data represents a hierarchical set of information set forth in the following system of hierarchical levels – by group, division, database and a layer of data.

Group – represents an elemental level of compiling information – provincial, county, communal/municipal, individuals objects;

Division – represents a general set of data of a specific, thematically homogenous sort;

Database – represents a set of thematically structured layers – recurring within a specific area on the level of county and commune/municipality, whereas on the level of region generated separately subject to the statistical and reporting-related needs. On the network level, databases contain selected types of communication issues.

Layer of data – represents basic file of information spatially referred to the administrative division map. The relevant map presents then, by way of carthogram or carthodiagram, spatial differentiation of monitored phenomena, as well as attributed figures and indicators.

Particular data layers (according to the needs) also contain, apart from the relevant database, the replicated statistical data in the format of Excel spreadsheets – for statistical calculation purposes. In five reference groups of the monitoring module, there are a total number of 20 databases, 52 data layers and almost 80 indicators. Those data may be used for the comprehensive work of the regional government wherever necessary to refer to specific spatial and administrative situations and comparative indicators. In parallel, they are used for setting up objectives for all sorts of development programmes. The separate purpose of the module is to monitor planning progress at the local government level.

In 2001 the first series of tasks related to the monitoring of spatial and socio-economic development was completed. The outcome of work includes more than 100 types of data and indicators for communes and counties of the region. The monitoring module thus helps determine the general spatial, social and economic situation of the region as a reference point for conceptualisation of further development in the respect that it facilities assessment of structural changes in the regional space. At the same time, the compiled information is beneficial at making mid-term and ex-post evaluation of the regional development strategy for Pomerania, its regional spatial management plan and the regional environmental protection plan. Data used and indicators for the purpose of monitoring and evaluation must, however, be co-related with other monitoring activities, including already a one year socio-economic monitoring or monitoring of pre-accession

programmes implemented in the region. It worth noting that some of the monitored socio-economic phenomena are studied from the very initial stage of the system operation, like: unemployment rate, demography, adoption of local development strategies and studies on spatial planning conditions and directions.

An entire novelty in Polish circumstances is the launching of a vector topographic map edition that had its origin in the Pomeranian Region in 2000. It consists in complementing traditional 1:10 000 scale maps with their digital equivalents, which are produced in the Microstation environment and then converted to the ARC/INFO software as graphic layers. Moreover, based on agreement with the Corps of Geographers of the Polish Army, the Pomeranian Region authority was granted 1:50 000 topographic maps in the 1942 grid of co-ordinates, then translated to the system-binding 1992/19. Further on, upon the decision of the State Geodetician, the traditional paper 1:10 000 maps were to be replaced by the digital National Topographic Database, thus giving room to new challenges for GIS systems in future.

The status of the system development achieved through three years of work was acknowledged to be very good at the stage of setting up and implementing this facility in the work of the regional administration. On the other hand, its future evolution required working out a new design concept. The concept of the GIS development was delivered at the turn of 2001 and 2002 and in 3-5 years should ensure a mature information system which would give remotely accessible data for a number of state and democratic administration agencies at all tiers in the Pomeranian Region. This target version of system should contain:

- 1:10 000 scale topographic maps – in a Topographic Database format
- Archival maps in: 1:10 000, 1:25 000, 1:50 000 and 1:100 000 scales – in a paper-based and digital raster formats
- Photogrammetric documentation i.e.: orthophotomaps, photomaps, aerial and satellite photographs
- Topological resources of data of spatial information in vector format and 1: 50 000 scale;
- Databases and thematic maps (e.g. for the needs of spatial planning, regional monitoring and administration of land estates in hand of the regional government)
- Databases and thematic maps for purposes of interregional and international co-operation.

Most data should be available through the Internet, with some access restriction for selected information resources. At present, some graphic information has been already visualised on the regional government homepage: www.woj-pomorskie.pl. The Internet should also serve as a means for the distribution of the documentation from the Regional Geodetic and Cartographic Data Library which is now offered and web-page described by the WODGiK.

On account of a variety of tasks being implemented with reference to the territory of the Pomeranian Region, growth in information resources should be expected in the near future along with an increase in demand for information. It will be essential to further develop the system, to expand a specialist GIS team office administering the entire system and to offer relevant technical conditions for granting access to information for decision-making bodies. These bodies include Regional Parliament, Regional Board as well as particular departments and divisions of both state and democratic administration offices at the regional tiers. Last but not least, the system in question and its resources should support information-related activities of the administration to the regional community and should be subject to commercial offers to beat the costs of running the system. It should be kept in mind that information qualifies as a valuable subject of business trade, whereas information concerning space is indispensable for most enterprises and for most industries of economy. The level of knowledge and IT determines the image of society and the region as such, which proves essential at the time of economic development and more and more important role of establishing links across Europe.

Conclusion

The target of developing the system into a regional tool for supporting administration and a consolidated platform of information for space-administering institutions on the supra-local level was to some extent met, as some agencies external from the capacity of the President's Office were assigned the status of system users. The already completed databases provide reference for two departments of the Governor's Office (Dept. for Emergency Administration, Civil Security and Defence-related Affairs, and Dept. for Environmental Protection), as well as the Regional Foundation for Environmental Protection. These agencies concluded a relevant agreement on co-operation and exchange of information with the President of the Region. Furthermore, a number of institutions launched co-operation which entailed exchange of information and checking technical possibilities of transferring space-related data in a digital form – the track list of those agencies include the Regional State Forest Board in Gdańsk,, Board of Regional Roads and the Regional Board of Water Administration in Gdańsk. The regional government also obtains GIS consulting services offered by the Institute of Geography of the University of Gdańsk. It is to be emphasised that the President of the Region, on behalf of regional geodetic and cartographic services, signed an agreement on co-operation and exchange of cartographic information with the Management of Military Cartography.

The government of the Pomeranian Region perceives the evolving GIS system as a target instrument ensuring consistent action, information and proper handling of administrative tasks. Hence, the system provides for a real consistency and availability of information yet posing a demand on its intensive application to a

daily routine administration. The costs incurred so far for setting up the GIS on the Pomeranian Region are rather low owing to use of existing IT infrastructure, obtaining of a lot of information and data at no cost, or safeguarding of external sources of finance. Financial involvement by other public and administrative institutions to developing data resources in the system may allow for keeping the costs low for system upgrading and maintenance. Nonetheless, the future of the system depends on some vital pre-requisites, like: financial and technical capabilities of extending the IT infrastructure in the regional government, further recruitment for the GIS Team, mastering relevant know-how by the office staff and willingness of consecutive administration departments and external agencies to start the collaboration. Of utmost importance is also co-ordination of activities with land survey services and provision of technical solutions linking the regional GIS system to other local and supra-local systems, both those existing and those under consideration.

Analysis on information flows in the GIS on the Pomeranian Region
in its building-up stage
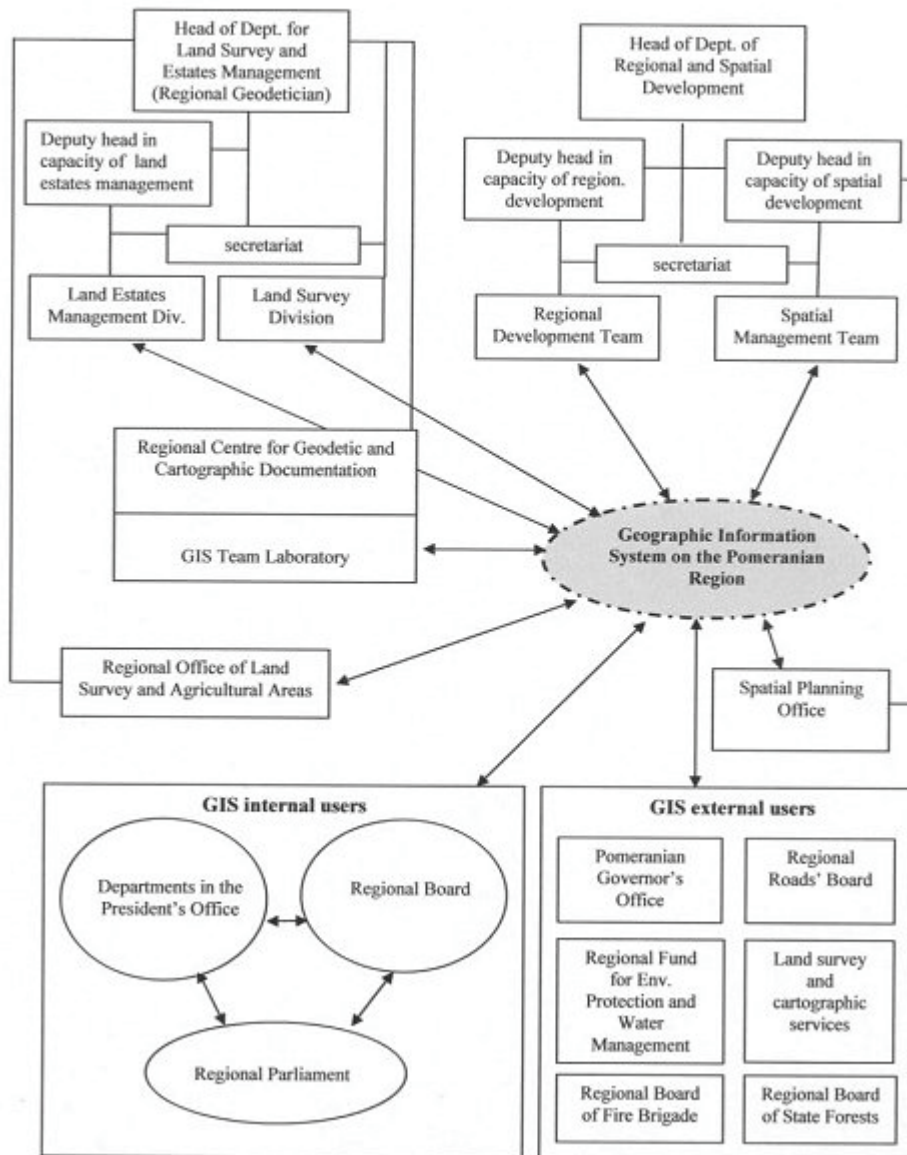
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**Concept of Regional Geographic Information System
- Resources, Effectiveness and Use**

S u m m a r y

In the second half of 1999 the Pomeranian Region authority decided on launching a regional Geographic Information System. Its purpose has been to integrate activities run by the regional administration and to provide tools for monitoring procedures in spatial planning and regional development actions. A preliminary concept of the system was delivered jointly by the Regional Land Survey office and the researchers affiliated with geography at the University of Gdansk. The implementation stage, which started at the end of 1999, has over four years led to astounding achievements, bringing on one of the most extensive systems at the regional level in Poland. The concept of the system implies its gradual upgrade from an internally used to an externally accessible instrument providing assistance to regional institutions in managing of the spatial resources. At present, the system is based on the ARC/INFO GIS software and complemented with additional ESRI software products, as well as an ORACLE database. The compiled information consists of almost 400 gigabytes of data, stored in the format of orthophotomaps, digital raster and vector topographic maps at 1:10 000 and 1: 50 000 scale, over 500 layers of structured geographic information data, and about 130 thematic maps

Keywords: spatial information systems, regional GIS, IT infrastructure

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**Koncepcja Regionalnego Systemu Informacji Geograficznej
- Źródła, Funkcjonalność i Użytkowanie**

S t r e s z c z e n i e

W drugiej połowie 1999 roku, w Urzędzie Marszałkowskim Województwa Pomorskiego podjęte zostały działania prowadzące do stworzenia regionalnego GIS, mającego spełniać funkcje narzędzia integracji działań służb Marszałka Województwa oraz realizacji i monitoringu planowania przestrzennego i rozwoju regionalnego. Wstępna koncepcja tego systemu opracowana została wspólnie przez

Geodetę Województwa i pracowników naukowych kierunku geografia na Uniwersytecie Gdańskim. Jej wdrożenie rozpoczęto pod koniec 1999 roku, doprowadzając w ciągu 4 lat do utworzenia jednego z największych w Polsce systemów na szczeblu województwa. Koncepcja systemu zakładała stopniową jego rozbudowę wewnętrzną, ukierunkowaną na obsługę prac pomorskich Urzędów – Marszałkowskiego oraz Wojewódzkiego – na czele z takimi kierunkami działań jak: gospodarka nieruchomościami, planowanie przestrzenne, zarządzanie infrastrukturę techniczną i komunikacyjną, ochrona przyrody oraz monitoring rozwoju przestrzennego i społeczno-gospodarczego. Kolejnym etapem rozwoju systemu było jego otwarcie na zewnątrz i włączenie do użytkowania instytucji o charakterze regionalnym, związanych z zarządzaniem przestrzenią województwa – jak np. Regionalna Dyrekcja Lasów Państwowych, Wojewódzki Fundusz Ochrony Środowiska i Gospodarki Wodnej, służby ratownicze, Zarząd Dróg Wojewódzkich i kilka innych. Współpraca Departamentów Urzędu Marszałkowskiego i Wydziałów Urzędu Wojewódzkiego doprowadziła do rozbudowy i znacznego unowocześnienia technologicznego systemu. Obecnie oparty jest on na oprogramowaniu GIS – ARC/INFO wraz z pakietem programów pomocniczych produkcji ESRI oraz bazie danych ORACLE. W zasobach posiada blisko 400 GB danych, w tym ortofotomapy, cyfrowe postacie map topograficznych 1:10 000 i 1:50 000 (rastrowe i wektorowe), ponad 500 warstw danych pogrupowanych w bazy i moduły tematyczne oraz około 130 opracowanych map tematycznych.

Koncepcja utrzymywania i zarządzania danymi SIT zakłada istnienie rozproszonych baz danych, przyporządkowanych tematycznie do kompetencji poszczególnych użytkowników. Nadzór nad ich prawidłowością prowadzi Pracownia SIT, która też gromadzi, archiwizuje i dystrybuuje dane z zasobów innym użytkownikom. Cały system jest już narzędziem znanym w województwie i w coraz szerszym stopniu wykorzystywanym przez użytkowników zewnętrznych, stał się też wzorcem dla rozwoju systemów w sąsiednich województwach.

Słowa kluczowe: system informacji przestrzennej, GIS regionalny, infrastruktura informatyczna, Województwo Pomorskie