EÖTVÖS LORÁND UNIVERSITY, FACULTY OF SCIENCE

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Theses of the dissertation

Principles of the publication of geological webmaps

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1. Research background, objectives

The Geological Institute of Hungary — the oldest scientific research institute in the country — has always been one of the leading thematic cartographic workshops in Hungary. Quite a number of outstanding geological maps have been compiled and cartographic procedures introduced during the 140 years of its existence. The geological GIS of the institute was set up in the 1990s — in many respects as a pioneer work — consisting of the complex of databases, different geological themes, system of rules and schemes.

The author of the dissertation has been working for the Geological Institute of Hungary since 2000. As a cartographer his tasks included from the very beginning the introduction of new GIS technologies involving the publication of webmap applications becoming today his main field of activity. These interactive map services are based on the available GIS. In compliance with the institute's strategy as much information should be shared as possible in a user friendly environment. The main method of this data sharing is the internet. These developments result in an increasingly complex service system: database content, map-, feature-, catalogue- and metadata services have to be superimposed on and linked with each other based on standards. Sharing spatial data on the world-wide web cannot be restricted exclusively to the publication of maps. Spatial data available should be

transferred in different ways, in different depths and detail and classified upon different methods.

The GIS made up of the triple system HARDWARE — SOFTWARE — DATA is very complex. The GIS specialist — the designer and operator of the system — has most freedom concerning the management of the DATA component [Turczi, 2000]. The HARDWARE — SOFTWARE double constitutes a system strictly restricted in functionality but combinable and parametrisable on a wide scale. Though the designers of the hardware and software elements give some recommendations concerning the optimal operation of the components but the harmonisation of the complete system is not their task. Given the complexity and the variability of the system several solutions and technological sequences exist to solve the problem. The STANDARDS which are the fourth component affect more and more elements of the previous triple. They cannot be disregarded at the management of scientific data, GIS design as well as at their operation and publication.
The dissertation is aimed at representing the solutions of a system optimised on the special needs of geological maps and data in this multivariable GIS with considering the whole set of components simultaneously.

2. Applied methods

The structure of the dissertation follows the logical process of the design and implementation workflow of optimised web services and considering its structure it can be divided in two parts: the first one examines the implementation process of the web-based geological map service in the following main steps:

1. setup of the database structure,
2. design, compilation and cartography of web-based digital geological map,
3. implementation of map service,
4. implementation of web-based application,
5. optimisation of the whole system.

The second part presents other internet services based on the already available data and service structures and complementing them including the GIS data and metadata services as well as the evolution history of the webmap service based on the 1:100 000-scale geological map of Hungary.

The development of web services is a complex task. The complexity is due to the high number of the related components and to the sophisticated relationships between them. The steps leading to the solutions presented in the dissertation are as follows:

1. Formulation of the objectives and the study of the international practice.
2. Selection of the available hardware and software components most suitable to meet the given objectives.
3. Getting acquainted with the recommended or practically applicable standards.
4. Collection and study of the required GIS and other data and modification of the limit conditions if necessary according to the given objective as well as applied softwares and standards.
5. Modification of existing technologies according to the requirements of geological maps and the elaboration of new technological sequences.
6. Execution of the elaborated work processes as well as the objective (benchmark) and subjective control and testing of the results and their correction if necessary.

The operator of the system had to keep pace with the continuous change of the HARDWARE — SOFTWARE — DATA — STANDARD components. The changes carry the potential of elaborating new solutions that must be adjusted to the specific features of geological data. Therefore — similarly to the softwares and standards — GIS data together with the map services processing them and the webmaps set up for their display never cease to change.

3. Theses

1. Considering the specific features of geological maps and the combination of methods provided by GIS tools I elaborated the optimal technological sequence starting from the native GIS database and finishing with the publication of the maps on the web. I used this technological sequence for the publication of geological webmaps in both Intergraph and ESRI systems.
2. Taking the map layers and their attributes in account I determined the optimal geodatabase system capable of supporting the traditional cartographic procedures, GIS operations and providing also the background of web-based maps and other on-line GIS services.
3. I established that the design of legends adopted for traditional geological maps cannot be used for web display. Instead of hatching and patterning colour shades should exclusively be used for distinguishing different geological formations. Similarly, instead of the composite graphic features of tectonic elements I advise to apply simple line types using maptips. Instead of the application of geological indexes of complex structure, fix size and consequently bound to scale I introduced dynamic, label-type unfolded geological indexes unbound to scale. The optimal setting of labelling parameters facilitates to distinguish the geological formations on the map independently of the scale.

4. I determined the change in information content of the geological webmap as a function of different scales (zoom-in and zoom out), providing the dynamics of the map, and at the same time compensating for the disadvantages of the necessarily simplified legend.
5. I determined the priority order of factors serving as the basis for the optimisation process of web-based GIS service as follows:
    1. Security
    2. Performance
    3. Stability
    4. Scalability

    I elaborated the platform-independent optimisation process and methods of HARDWARE — SOFTWARE — DATA components participating in the service and based on the above priority order and adopted them on the MÁFI's system.
6. I elaborated the strategy for the realisation of standard-based geological GIS data service and metadata search provided simultaneously with the webmap system.

4. Conclusions

The methods and solutions that I elaborated and presented in the dissertation were induced by the necessity of practical realisation. The method and direction of the changes in the services depends of several factors including the development of internet technology, the capabilities of the new softwares, user needs, the national and international responsibilities of the Geological Institute of Hungary, the Hungarian and the European Union's directives as well as the available human and financial resources. The developments have two main directions.

The first, increasingly more spectacular one is the satisfaction of the requirements for online maps easy to manage and providing a wide range of functionality and services. Their development concerns the continuous update of cartographic-, GIS-, application development- and optimisation work processes as well as the broadening of the circle of available themes.

The other one is the widening of the range of directly accessible map- spatial data- and metadata services. These latter serve as the foundation for a number of international co-operations and they make geological data accessible for other web pages and applications. These types of services react on the structure of the geodatabase and require to update the existing- and to introduce the new standards related to the

components involved in the process including the database scheme, maps, map service, metadata scheme and metadata service.

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