# Development of the Hydrological Subsystem of the Water Management Information System In Hungary

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## Abstract

The system for processing hydrological and hydrogeological data in Hungary, which was developed in 1989-90, can no longer be revised or reorganized. New communication technology (based on Lotus Notes groupware) which is being utilized, together with a new generation of relational DBMS (MS Access, MS SQL Server) offer an opportunity for planning and developing a new solution to the country's water data management needs. The new approach, which falls within a newly conceptualized information system of water management, involves a highly automated, standardized and shared hydrological information subsystem (HISS).

The process of implementing the new plan required several stages: conceptual planning in 1995, project approval in 1996, followed by base studies — definition of the study, the assessment of existing information applications, and the Conceptual System Plan — then the development of a pilot model of the automated Module for the reception of daily hydrological data and their distribution among the District and Central Water Authorities, followed by the development and installation of appropriate Geographical Information Software, and, finally, the launching of the new Hydrogeological Information Subsystem (or Hydrological Information Subsystem) — HISS.

This study describes the conceptual and topological structures of HISS, summarizes its data and functional requirements, and its GIS user interface.

## 1.0 Water Management Administraion

State water authorities are legally responsible for the governance of water uses which involves many functions: managing water works, sustainable development, assessment and management of national water resources including the operation of hydrological monitoring, measurements, and data management, the maintenance of flood controls, protection against water quality accidents, poor drainage, and state owned water infrastructure facilities and projects, etc.
The national authorities cardinal responsibility is to ensure good water quality. However, the collection of ground water quality data is still collected by various water management institutions such as the environmental authorities, the state meteorological, geological, and public health services, and regional and local communities. By and large, they cooperates in the execution of their respective duties.

The government body with the greatest control over national water affairs is the Ministry of Transport, Telecommunication, and Water Management (MTTWM). It should be noted that the Ministry's responsibility for water management does not extend to quality control. That is the domain of the Ministry for Environmental and Regional Policy. Communal waterworks institutionally fall within the purview of regional and loca authorities, but the professional control of their activities — e.g., assignment of specialists — remains with the MTTWM.

The National Water Authority, which is an agency subordinate to the MTTWM, is the principal administrative agency responsible for water management, and at the next level are the 12 District Water Authorities (DWAs). In addition to the central and district authorities, a key role in water data processing and information services is played by the Scientific Research Institute for Water Management (VITUKI). The hydrological data monitoring network is decentralised, with control and inspection of the monitoring network falling under district water authorities.

## 2.0 Information Requirements

An analysis of the data and information requirements of those agencies related to the water sector demonstrated that a fairly wide range of hydrologicl information is needed by practically for every user group. A similarl inventory of data made clear the necessity for identifying the key objectives of all user groups. These considerations induced information planners to cancel a plan for renewing an established hydrological information applicaiton package and instead to create a new hydrological information subsystem, with standardized definitions and terminology and root database subsystem as part of a future more complex water management information system.

## 3.0 Data User Groups and Data Requirements

The most important data and information user groups are:

| Professional Fields | Needed Information |
|---|---|
| Hydrometry | Daily time series data of surface water; inventory of monitoring network data; user inventory; geographical data on river bed watershed |
| Hydrogeology | Water use & users; geographical, geological data on aquifers and local withdrawals; waste water disposal; indus water supply; sewage systems; state investments |
| Agriculture | Water delivery & consumption; hydrological and agro- |

| | |
|---|---|
| | meteorological data; inventory of irrigation system; inventory irrigated crops and water uses |
| Lakes and Rivers | hydrological data; geography of river and lake bed; inventory of structures |
| Flood/Drainage Pollution Control | Daily hydrometrical and meteorological data of surface water; time series of same; hist. data of flood & drainage evens; inventory of pollution sources & protection structures; daily protection measures |
| Finance/Maint of Instit. Mgt | Inventory of hydraulic structures, operational & maintenance activities, statutes, & human resources; water resources & uses, infra-structure, water legislation, statistics, financing, settlement |
| Statistics | statistics, settlement-sorted integrated data of natural & artificial water cycle |
| Public Information | Some daily hydrometric data; statistics; mge. legislation; main user groups; main activities |

**4.0 Data Sources**

The District Water Authority oversees the daily operations of hydrological and hydrometeorological data gathering and reported to Domestic set of daily operational hydrological and hydrometeorological data which are reported to various users within the DWA and to VITUKI. The normal frequency of reporting is four times daily in the following volumes: domestic meteorological data are 300 KB, other meteorological are 1800 KB, and hydrological data are 700 KB. In addition to its data inputs, VITUKI sends flood forecasts and reports to the National and District Water Authorities from a set of domestic hydrological stations which monitor water more frequently — two to twelve times a day during the flood season, depending on the seriousness of the alert.

Data on the groundwater regimes and related water uses are provided much less frequently, sometimes quarterly, other times rarely. On the other hand, water quality data are transmitted from the District Environmental Inspectorates to the

District Water Authorities on a monthly basis. Statistical data collected by the National Statistical Institute are made available and purchased annually.

Data concerning water infrastructure and water use have been collected only recently. They are processed by each of the water units separately. Data on domestic and industrial water supplies are included in the statistics produced by the National Statistical Institute. River and channel bed data are collected in two operations independent of one another. One operation is focused on small rivers and drainage/irrigation channels, and another collects data on rivers with flood protection levees.

## 5.0 Water Management Information System: General Principles

1. Data projects and evaluation programs — e.g., databases, GIS, electronic communicanions, flood protection — are interdependent and therefore must be undertaken only after lines of cooperation and coordination are settled.

2. Hardware and software development should be determined on the basis of the study, currently under preparation, entitled "Alternatives in the Development of an Informational Infrastructure for Hungarian Water Management."

3. The nation-wide internal and external comunications system must be uniform and standardized in its applications, definitions, and nomenclature.

4. The structure of the new data and information system must be built on the foundation of a familiar, well tested database network which makes data easily accessible; data must be open and payments that impede accessibility must not be demanded.

5. A new information system should be compatible with standard relational, multi-platform software.

6. The implementanion of the data development plan should follow a recursive cycle of planning/programming/running; at and of the first cycle, the pilot model should be tested in one of the operational units.

7. In nation-wide application, should be, if possible, a GIS interface based on the ISO standard (ISO/ICE 9075:1992 (E)) compativle relational database.

8. Financing of the development, maintenance, and operation of the informational tools should made within a unified and co-ordinated framework.

9. The effective implementation of projects is dependent on quality training of professionals; such skills training should be integral to all planning and be a permanent part of the development of the information system.

## 6.0 Water Management Information System: Principles Governing HISS

1. Preparatory to the launching of a HISS project, a clear set of objectives and detailed terms of reference should be summarised in the strategic plan.

2. During the development of a HISS project, the standard recommendations of the World Meterological Organization (WMO) should, if possible, be applied.

3. A major goal of such an information system should be harmonization with the water management information systems of neighboring countries, thus promoting international data exchange agreements and conventions.

4. Surface water and meteorological data sets of a HISS project should encompass the entire Danube basin.

5. The realisation of a HISS database project should meet any safety requirements and rules for the use of the information system that are set forth in the strategic plan.

6. A HISS hydrological database project should be implemented on a unified nation-wide basis; standardized user modules will be installed at water-related institutions.

## 7.0 Key Issues and Questions

*Communications*

There is planned a bifurcated approach: data that is urgent will be transmitted daily by the Lotus Notes Mail System while data that are not urgent, for example, inventory data, will be sent by RDBMS replication system; international communications will be carried by telex. (A recent pilot study of the MS Access RDBMS indicated that a RDBMS with higher capability would be needed. A follow-up study revealed preference for the SQL or Oracle 7 servers. This has resulted in a decision to undertake a comparative analysis of the best RDBMS.)

In the first phase of implementation, communications will go through telephone lines, plans call for communications between DWAs and the NWA to be transmitted by means of a special microwave channel system devoted exclusively to water management. This microwave system is already installed along the Hungarian stem of the Danube and will eventually extend to other regions of the country. Between VITUKI and the NWA there is already functioning a dedicated telephone line.

Public information will be accessed by means of the Internet through a Notes Domino server. For reasons of security, Internet access will be separated from the local LAN systems.

*Openness*

This particular design of the communications system derives from both international agreements and the recommendations of the WMO with a view to complying with the principle of open access to data, free of charges. Both aufies derived from the internafional agreements amd recommendafions of WMO mofives keeping principle of opelmess amd free of charge of dam access. However, this principle cannot be fully honored until there is secure funding for the development and maintenance of the information system. Consequently, during the first phase of development, only the most general information will be free of charge.

*Replication or Spatial Sharing ?*

In earlier planning, there was a general consensus that a spatially shared distributed database system should be created, wherein each local data manager would receive only part that part of the data relevant to his functions, and VITUKI would be given the responsibility of running the integrated information system. However, good experiences with the Notes replication changed the bias toward using replication which would provide all those who had need of data with access to the entire information system. Replication also would solve the problem of data consistency and security. The only problem remaining was when the public is given access over the Internet, that data would be vulnerable to the whims of computer hackers and those who would use the data illegally.

*Real-Time or Discrete System?*

The issue of rapid distribution of data is related to the problem of security. Various kinds of hydrological data such as those concerning protective measures or vital analyses must, of neccessity, be mde available very quickly. Notes mail, which is compressed, assures fast, inexpensive data transfer, while replicated data cannot move faster than the slowest part of the local network.

## 8.0 Design of a Future Data System for Hungary

At the center of the proposed system is the hydrological subsystem together with the resources inventory subsystem. These modular units provide data input, do the primary data checking and quality assessment, and store the data in an appropriated sub-database. Grenerally, In generally this central module will not be responsible for application oriented data selections, reporting, etc.; rather, it assures that data is immediately accessible to authorized users. User access for most aplications will be through a GIS interface.

The central hydrologigal database will consist of three main parts: the archive, the SQL database, and the operational database. The operational database will function as a bridge between Lotus Notes, Protecfion ISs, and the Operational Hydrological Module, and it will serve Notes oriented protection and other operational applications. Internal data storage in the HISS performs the whole process of data checking and correction, and providing tabular formats of verified data. Users will then need only to access the verified data tables.

## 9.0 GIS Interface

Most data that are in a managed system share three atributes: they have a value, a time and date, and a geocode. Data that is made more user friendly will normally be based on a GIS platform. There are two basic kinds of GIS software in general use, one is a very fast map-manager called HYDRA and the other is a dynamic, user progamable software called maGISter. Both use the same digital mapping.

HYDRA applications are Windows comatible, pre-programmed tools, which can be used for any SQL-compatible relational descriptional database. This software does not require frequent, expensive hardware upgrades and is very good for standard, regular use.

maGISter its own LISP program module that works for actual and dynamic selections and special topological procedures. This software is supplemented with a family of different ODBC drivers able to connect to the SQL descriptive databases too. It has a digitaliser module, which is useful for producing non-standard, high-seated maps.

The planning and develoment of GIS user interface for specific applications are the task of application development. The pilot HISS project will do only some standard GIS reports and use a general menu-group for data access and for the most frequently used categories. Parallell to the HISS development project, A GIS development project which uses both the above referenced software applications was installed at the end of 1997.