MANAGEMENT OF WATER SUPPLY SYSTEMS IN SLOVENIA AND ITS INTEGRATION ON THE STATE, REGIONAL AND LOCAL LEVEL

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Abstract. In this article, a new approach towards the management of water supply systems that is under implementation in the Republic of Slovenia will be presented. Current approaches are based on the integration of data at a horizontal level within the organization that provides the water supply service. One of the tasks of the service providers has always been reporting to the regulating authority. With increasing importance of the water supply service, the reporting requirements for other services is ever increasing and therefore a new approach is under way which aims at reporting of an extensive set of non-aggregated data on water supply systems. The new approach proves to be very efficient especially regarding the improved analytical capacity for other sectors and activities beside the regulatory agency itself, such as: regional spatial planning, emergency services, health, etc. The work has put forward the importance of good definition and management of spatial units where the service is provided – agglomerations. Water supply systems were defined on the basis of their hydraulic homogeneity, which enables back-tracing of water from the pipe to the source. The resulting spatial database has strong analytical capacity and is already under implementation as a useful decision-support tool.

Keywords: water supply system; management; vertical integration; data management; performance standards.

1. Introduction

The vital importance of water supply systems has always put them in a special focus regarding the legislation and institutional framework for determining their

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efficient and effective management. In Slovenia, water supply systems have been largely developed by 1980 covering approximately 95% of the population.

With the adoption of the strategy to associate with the European Union (EU), the focus has changed, and wastewater collection and treatment has gained in importance. This infrastructure represented for the biggest gap in public services related to the implementation of EU standards.

In recent years, water supply systems in Slovenia have again become a focus of attention, because of ecological and supply reliability issues, and also because of their lower priority in the past decade. Local communities, which are responsible for the water supply systems, are confronted with a set of demanding tasks in order to upgrade the entire water supply systems to face the challenges of the next decades.

1.1. FUNCTIONS RELATED TO THE EFFICIENT AND EFFECTIVE OPERATION OF WATER SUPPLY SYSTEMS

Basic functions of water supply systems are clearly to supply quality drinking water with sufficient pressure and discharge to satisfy the expectations of consumers. This requires integration of at least two sectors: the health sector with the responsibility for water quality, and the infrastructure sector with the responsibility for construction and O&M tasks.

1.2. ADDITIONAL RELATIONSHIPS AFFECTING THE MANAGMENET OF WATER SUPPLYS

Additional relationships can be defined corresponding to multi-perspective analysis (Linstone 1970). In the case of water supply, the following institutional aspects were defined:

- Integration within the water-cycle of the river basin – water management systems, according to the WFD[2], require development of tools to measure and model water abstractions and pollution loads to water bodies. To enable this, logical connections between water supply systems and water bodies from which they are supplied have to be established.
- Integration of water supply service into spatial planning procedures – water supply is one of the key services that enable population settlement and development of new production facilities.
- Emergency management – civil protection agencies perform emergency management in the case of natural and other disasters. Water supply systems provide the necessary water for basic human consumption and to satisfy fireflow demand, and also in case of emergencies.

When challenged with the task to develop a data structure that will enable horizontal and vertical integration of the data in order to enable decision support, it became clear that the common definition of service areas is of utmost importance.

2. Definition of agglomerations as a service areas

The definition of service areas for water supply systems is an important part of the process necessary for efficient development and management of water supply systems. The way they were defined depends to a large extent on the general availability of topographic and population data.

In the case of the Republic of Slovenia, the availability of different data on topography as well as data on population statistics in digital form is at a high level. The most important dataset describing population statistics is a registry of household numbers and population. The following approach was used to aggregate population data for the Republic of Slovenia. The entire area of Slovenia was divided into a regular polygon grid of 100 m x 100 m. For each polygon a query was performed in the registries regarding the number of inhabitants in the polygon. In the next step, adjacent non-empty polygons were dissolved into single agglomerations. The logical concept of agglomeration development is shown in figure 1.

Single non-void polygons were filtered out and defined agglomerations were communicated to the local communities for the verification. Different polygon size and distribution of polygons were tested and the resulting 100 x 100 m grid proved to be stable as well as of suitable resolution.

As a result of the procedure, 16,000 agglomerations for the entire Republic of Slovenia were defined as service areas, of which 3,266 have more than 50 inhabitants, comprising 82% of the population of Slovenia. The distribution of the population in the agglomerations can be seen in Figure 2.

The marginal value of 50 inhabitants was imposed by the implementation of the EU Drinking water directive. Due to the fact that the explicit limit value of 50 inhabitants could sometimes prove to be too restrictive, agglomerations with more than 40 inhabitants were considered for further analysis.

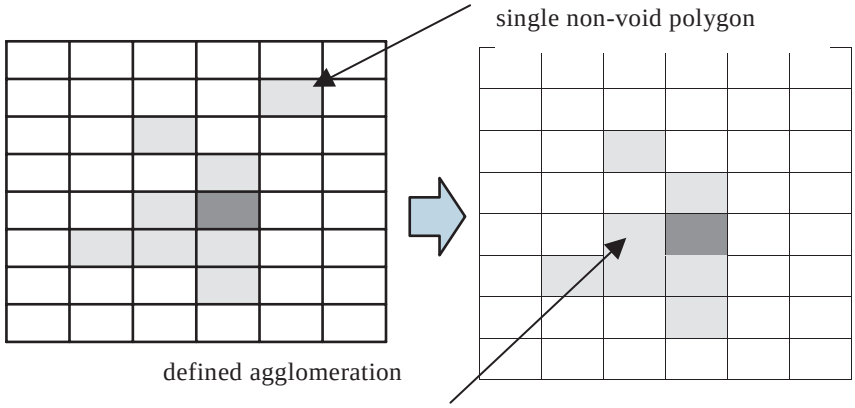

Figure 1. Procedure for the definition of the agglomerations

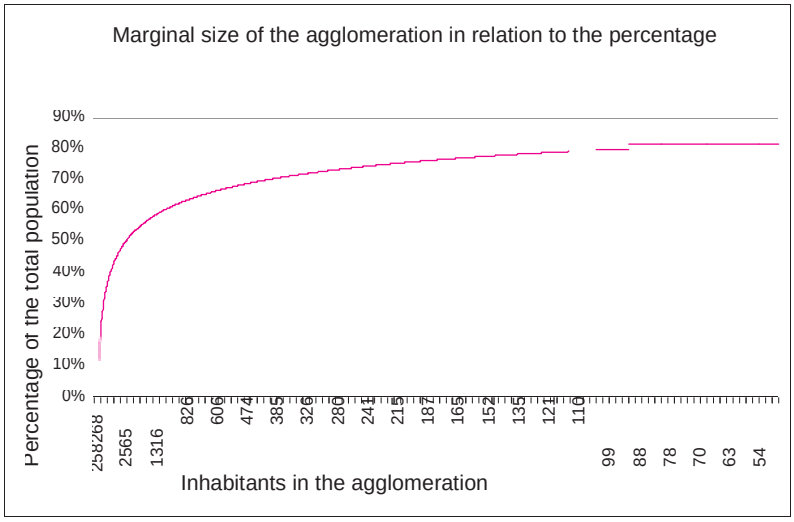

Figure 2. Marginal size of the agglomeration in relation to the percentage of the population contained

3. Definition of spatial entities of water supply systems (WSS)

Spatial entities for water supply systems are generally well known and broadly applied for different purposes, such as for operational management of WSS. Their use is essential for hydraulic modeling and derived analysis. In the case of vertical integration of data, another entity is of importance: the water supply system as whole. Certain data (i.e. water losses, pumping costs) could only be

assigned to an overall water system. For this purpose a new definition of water supply system was developed:

> *Water supply system is a system of technical elements that supply water from its source to the users that is being managed by one legal entity (usually a public service provider) and operates mainly as an independent system hydraulically separated from other systems.*

By this definition, we have resolved a problem of transactions of water between two service providers (a clear legal, economical and technical border condition could be identified), as well as hydraulic consistency of individual WSS, by which we can also enable analysis of material flow (water) within one WSS. A key attribute for any water supply system is the ID of the public service provider which is simply its VAT code.

Beside the identification of a water supply system, the following key spatial entities were defined, that enabled vertical data integration:

- water resources - ID of all wells (groundwater), and surface water intakes; this ID serves as a link to the state service that manages groundwater bodies;
- reservoirs ID;
- pumping stations ID;
- drinking water facilities ID;

For all those entities, standard attribute tables were determined with which more detailed information about a specific entity could be collected and analyzed. The basic conceptual structure of the interactivity of the water supply systems is presented in Figure 3.

4. Development of the spatial data base of the WSS in Slovenia

In 2004 and 2005, reporting by more than 80 performers of public service in Slovenia and 194 local communities was used to establish the database of the water supply systems. The large number of public service providers is due to historical developments in Slovenia the reporting procedure itself was performed by electronic means, which required a detailed description of reporting procedures, organized education and individual technical support. Figure 4 shows the service areas in addition to the agglomerations that indicate the settlement patterns for Slovenia.

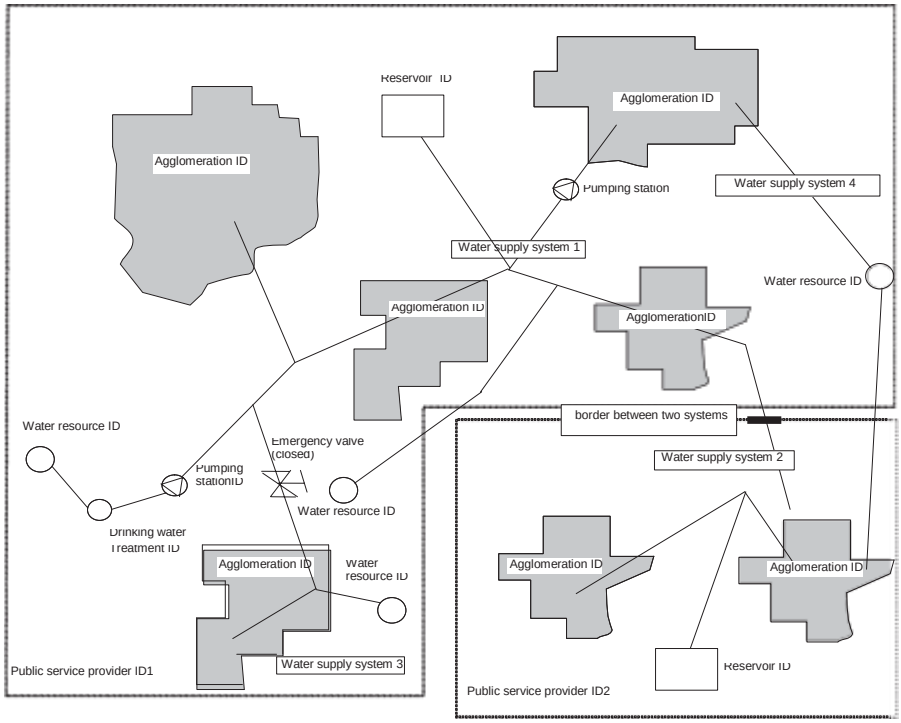

Figure 3. Conceptual scheme of different integration of different spatial entities

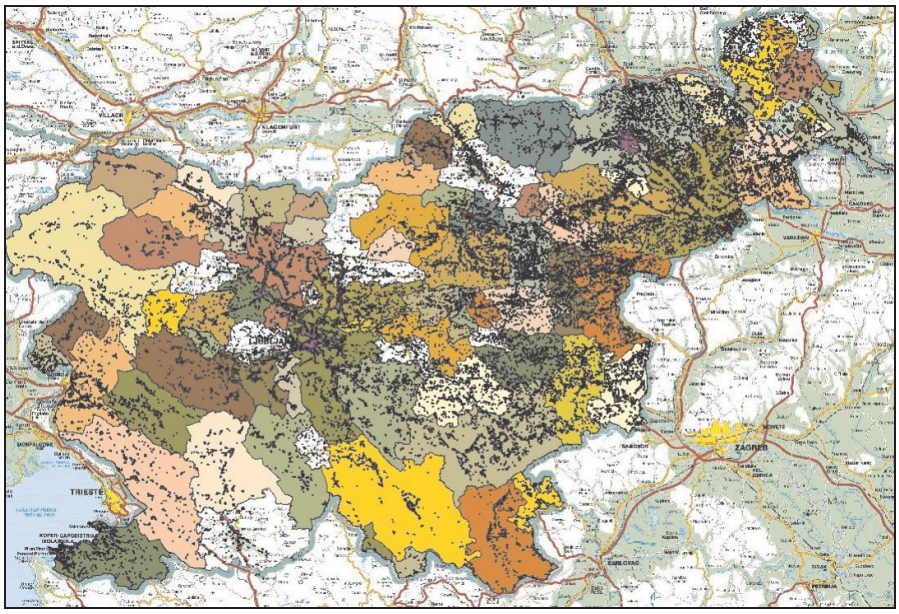

Figure 4. Overview of service providers and agglomerations in the RoS

The only spatial entity that was not part of the reporting at this stage was the spatial representation of water supply systems. Only attribute information was reported on water supply systems because they serve an important role in connecting all other entities (water resources, agglomerations, water treatment facilities, pumping stations, and reservoirs). The reporting scheme on the spatial representation of water supply systems (piping) is currently under preparation.

5. Conclusions

A comprehensive data model and reporting scheme was developed for the vertical integration of data on water supply systems. The developed data model is serving as a strategic support tool on the state and regional level, and is also of importance on local level.

Further improvement of the reporting system and database development is under way that will be able to perform partnership-based effective service among four main stakeholders in this area in Slovenia: local communities, state, water users, and providers of public services.

The implementation of this agglomeration-based approach will be demonstrated on some examples (modules), which are currently under development: (1) EU reporting module, (2) fire flow supply module, (3) water quality analysis module, (4) hydraulic performance module, and (5) water resources use module. Development of other modules is under consideration.

During the development of the reporting procedure and communication with different public entities, special attention was given to data protection and data availability as those high precision data which have extensive set of attributes have a dual character: (1) they represent public infrastructure and therefore should be made public, but (2) on the other hand they represent highly vulnerable infrastructure with potentially high risk impact to the public; therefore the access to these information should be limited.

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