

# Extracting and Maintaining Geo-Referenced Data during the Application Processing

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## 1 ABSTRACT

A lot of governmental offices process every day customer requests for obtaining different kinds of permissions, certificates and other kinds of legal documents. The majority of data collected and used in these documents could be geo-referenced and combined together with other geo-referenced data. Such combined information layers are excellent data sources for a variety of analysis used either for operational purposes or strategic planning. A particular case of processing the applications for the water usage permission will be our polygon to observe the extraction of this important information level from business.

## 2 THE STUDY CASE

Ministry for Environment and Spatial Planning, The Environmental Agency of the Republic of Slovenia is in charge issuing the permissions for water usage. S&T Hermes-Plus developed an IT solution to automate and support this process. On the Figure 1 we can see the top level process decomposition of the process for application handling.

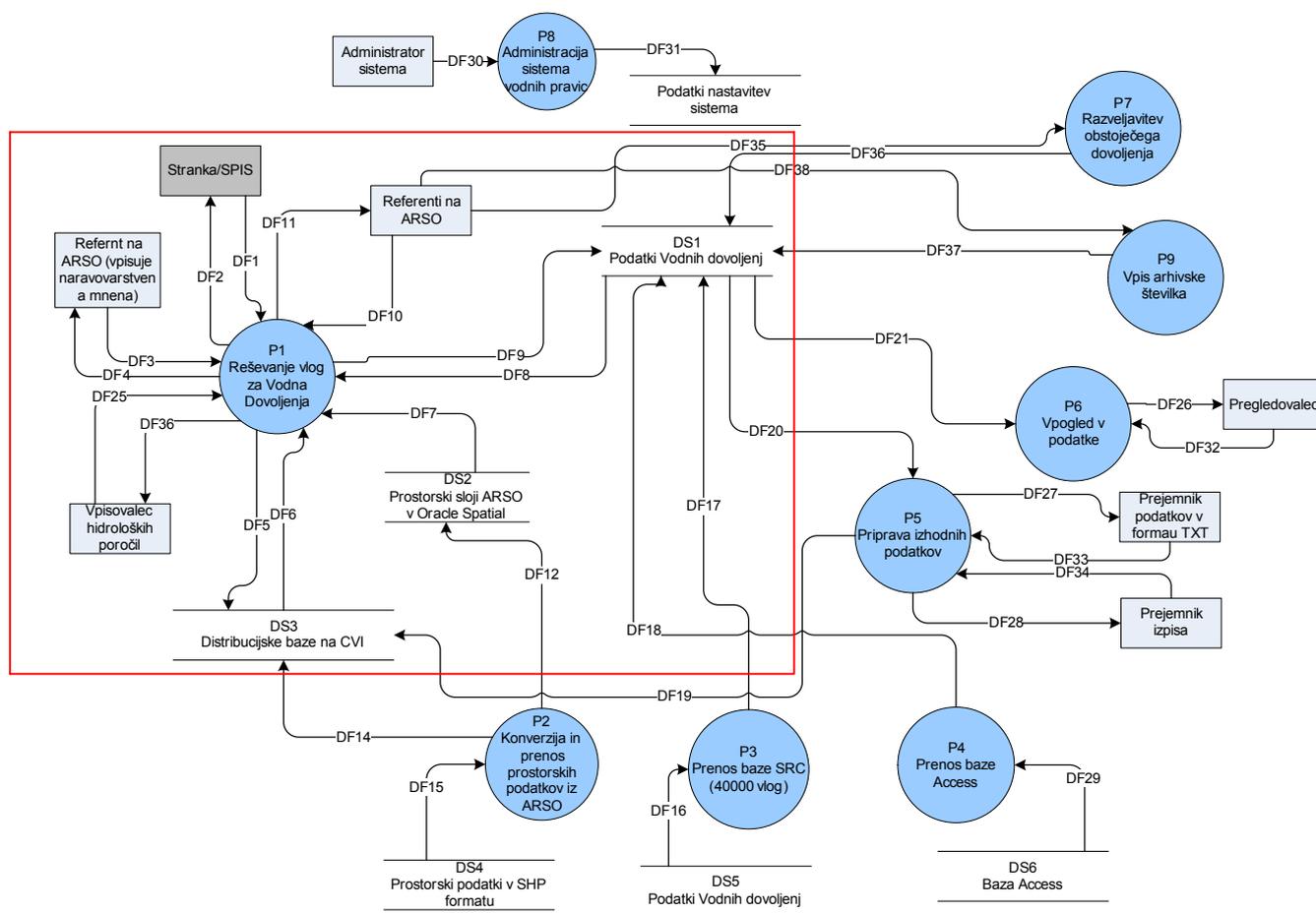


Figure1: External actors, data stores, data flows and processes

The process P1 (on the left part of the Figure 1 enclosed with the red rectangle) is the process of our interest. The purpose of this process is handling of the applications and issuing the permission for water usage. The P1 process, named “Handling of applications for water usage”, contains the following data flows:

DF1 – The paper application send by the requestor together with necessary data that form a file

DF2 – The permission issued

DF11/DF10 – Interaction of the clerk working on the application

DF8/DF9 – Data produced while handling the application together with the data from the application

DF4 – Data from the environmental report

DF3 – Environmental report

DF5 – Spatial data (geo-referenced), produced as result of handling of the application stored in the distribution databases

- DF6 – Existing spatial data required for proper application handling
- DF7 – Existing spatial data of Environmental Agency stored in Oracle Spatial
- DF25/DF36 – interaction required to capture the data from hydrological report

The further decomposition of the P1 process can be observed on Figure 2.

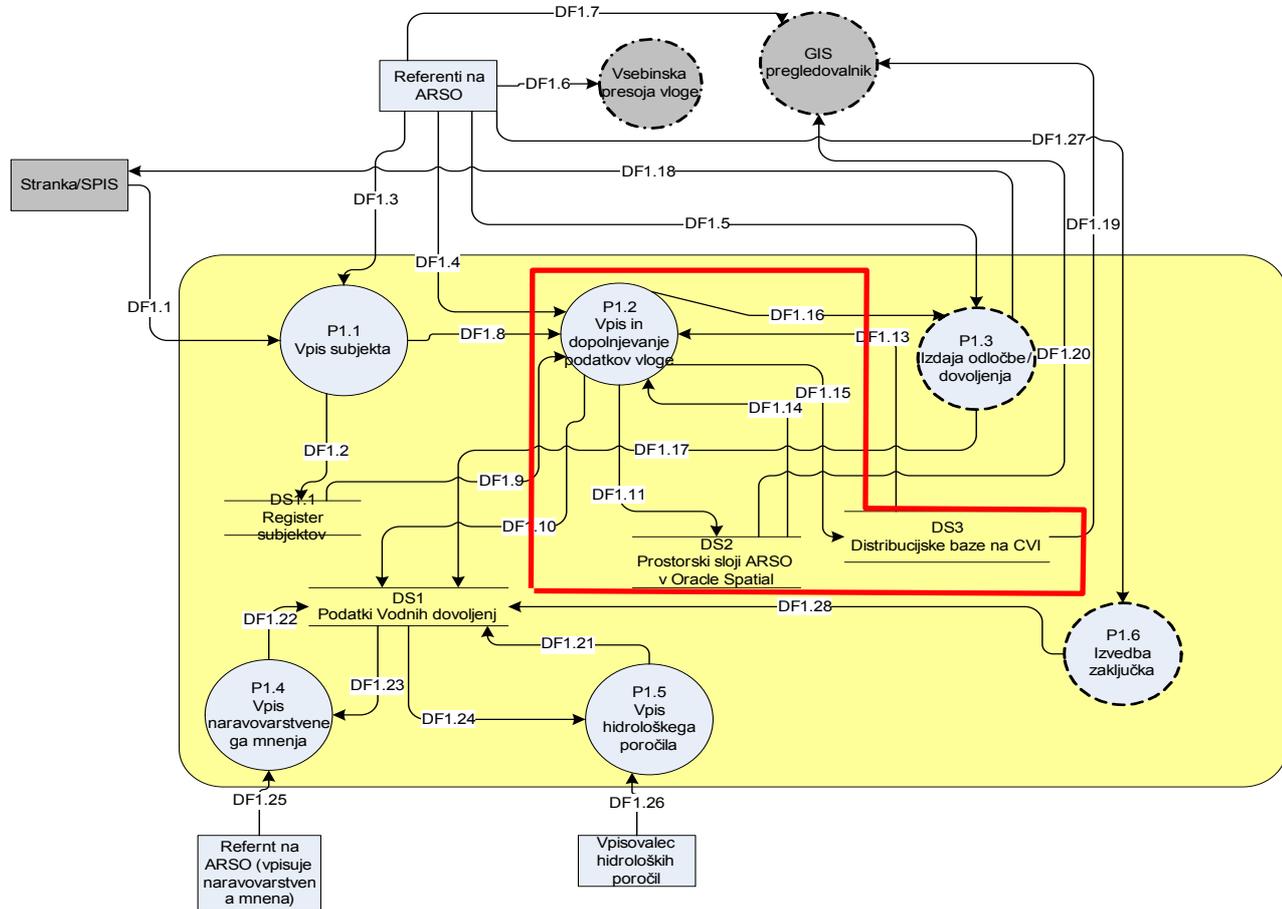


Figure2: Process P1 detailed decomposition

During the starting phase of this process the data from the application is entered into the system and later on if some of the data is missing, the required data is added. Thus in the final phase all the required data is present in the system and the permission for water usage can be generated.

- DF1.4 – Clerk's interaction
- DF1.9 – Customer data
- DF1.10 – Data from the application and data from the water usage permission
- DF1.11 – Spatial (Geo-referenced data) that form a special layer
- DF1.14 – Spatial data of the granted permissions for water usage
- DF1.15 – Spatial data that is extracted to the dissemination database
- DF1.13 – Spatial data from different sources that are used as reference data during the application processing

The process of data entry is controlled by different controls that were defined in the form of business rules. Some of the controls are executed during the data entry operation, but majority of them is executed at the end when the user presses the save button. The goal is to capture all the data from the application which may be even wrong. If the business rule is not broken no message is reported. For all broken rules the data entry module prints out the identification of the broken business rule and the error description. Then the user has to make an appropriate correction in order to clear the data entry errors immediately or later when the correct data is acquired.

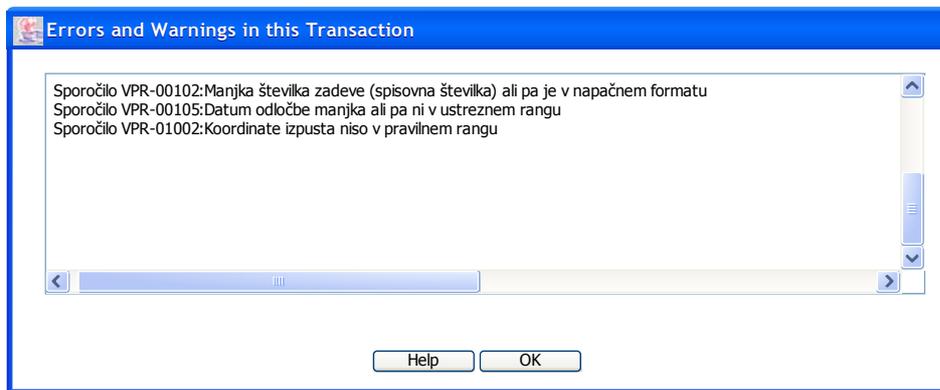


Figure 3: Broken Business Rules Report

There are different types of permissions for water usage and according to the type of the permission the customer must select the right form.

### 3 SPATIAL DATA ENTRY

To maximize the opportunity for future spatial queries the software solution determines the relationship with the spatial data layers for the place of water abstraction and water outflow. The result of this determination is the name of the element (data layer) where the water is abstracted (where water is physically moved from its natural site of occurrence) and the place of the outflow.

The relationships for water abstraction place and for the potential outflow are determined during this process and saved in the database. The data stored in the database is like the following:

MAP_ID	ABSTR_OUTFLOW	WATER_SOURCE	SPATIAL LAYER	OBJECT_NAME
12	Z	LJUBLJANICA	DKN	15/0
1244	Z	LJUBLJANICA	NASELJE	ZALOG
134	Z	LJUBLJANICA	OBCINA	LJUBLJANA
22	Z	LJUBLJANICA	HIDROOBM	LJUBLJANICA
7765	Z	LJUBLJANICA	DKN	15/0
283	Z	LJUBLJANICA	NASELJE	ZALOG
11	Z	LJUBLJANICA	OBCINA	LJUBLJANA
22	Z	LJUBLJANICA	HIDROOBM	SAVA
54	Z	LJUBLJANICA	HIDROPOSTAJE	ZALOG
7727	I	SAVA	DKN	45/1
1245	I	SAVA	NASELJE	PODGRAD
124	I	SAVA	OBCINA	LJUBLJANA
...	...	.....		

Table 1: Spatial Layer Relationship

Table 1 represents a schematic relationship to different spatial layers for a hypothetical case of water usage permission. This permission allows the water abstraction from river Ljubljana at place called "Zalog" and the outflow is in river "Sava" near the same place called "Podgrad".

As we can see from the Table 1 a spatial relationship with different data layers is determined when the location of the water abstraction and outflow is entered in the system. This relationship is later on used for creation of a special query mask which combines the spatial location together with different attribute data.

### Kompleksno povpraševanje

**Vloge**

Datum od  Datum do

V reševanju  Rešena

GEOZ  Mandič

**Raba vode**

MHE  Pitna voda - lastna oskrba

Mlin, žaga  Tehnološki nameni

Pitna voda - javna oskrba  Pridobivanje toplote

Namakanje  Zasnježevanje

Termalna voda  Drugo

Vodni organizmi  Podzemne vode

**Prosilec**

Naziv

Ulica

HŠ

Pošta

Občina

**Odločba**

Datum od  Datum do

Veljavno dovoljenje

Neveljavno dovoljenje

Zavrnitev

Zavržba

**Vodni vir - atributno**

IN pogoj  ALI pogoj

Pogoj	Izbor sloja	Naziv elementa sloja
Pogoj 1	Sloj <input type="text"/>	= Naziv elementa sloja
Pogoj 2	Sloj <input type="text"/>	= Naziv elementa sloja
Pogoj 3	Sloj <input type="text"/>	= Naziv elementa sloja
Pogoj 4	Sloj <input type="text"/>	= Naziv elementa sloja

**Vodni vir - prostorski**

V razdalji  metrov od

Lokacije X  Y

Poligona dovoljenja

Figure4: Screen mask for entering complex query conditions (combination of attribute and spatial conditions)

The mechanism used for spatial layer determination is using a lookup table of all spatial layers. For each spatial layer we can define a different size of the buffer around the point of water abstraction or outflow. Then the spatial relationship operation is used to determine the interaction of this buffer with the objects in certain layer.

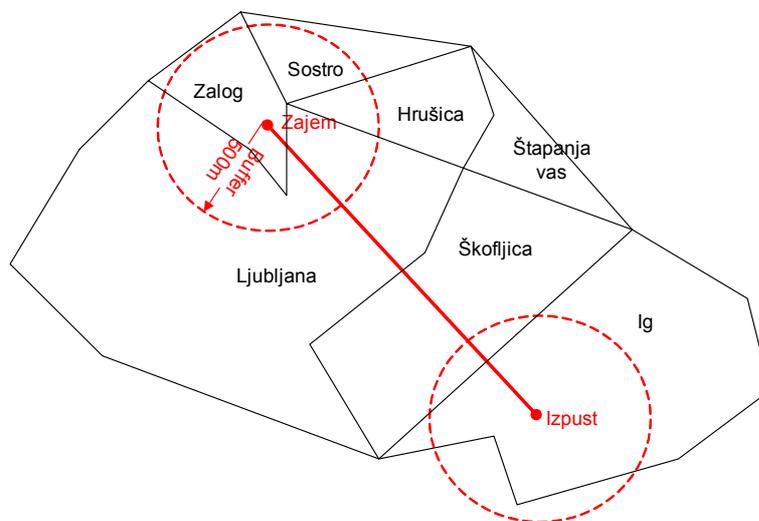


Figure5: Hypothetical spatial layer „settlements“ with buffer size of 500m

In Figure 5 the word “zajem” stands for the place of water abstraction while word “izpust” stands for the water outflow. The spatial determined relationship can be seen in Table 2.

MAP_ID	ABSTR_OUTFLOW	WATER_SOURCE	SPATIAL_LAYER	OBJECT_NAME
1244	Z	LJUBLJANICA	NASELJE	LJUBLJANA
1244	Z	LJUBLJANICA	NASELJE	ZALOG
1244	Z	LJUBLJANICA	NASELJE	HRUŠICA
1244	Z	LJUBLJANICA	NASELJE	SOSTRO
1244	I	IŠKA	NASELJE	ŠKOFLJICA
1244	I	IŠKA	NASELJE	IG

Table 2: Spatial relationships for the „Settlements“ layer

A similar spatial relationship is defined for the cadastral layer. In the cadastral layer the water abstraction and outflow place are determined as point objects without any buffer. Thus we get only relationship to one land parcel (sometimes there can be more parcels what depends of the type of the abstraction). Figure 6 displays such a theoretical case.

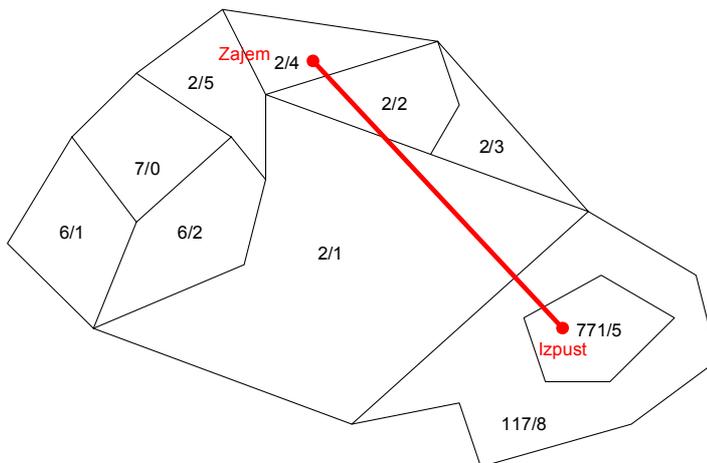


Figure 6: Spatial relationship for cadastral layer

#### 4 CONCLUSION

One can ask the question why the spatial relationship is determined as a relationship that is stored in the database because the relationship could be dynamically determined when necessary. The answer to such question is quite simple and somehow obvious – the reason lies in improved performance and simplified combination of combining attribute and spatial conditions. Of course there is always a possibility to perform a complex spatial analysis to get an answer for very specific questions. Nevertheless, the base data about water abstraction and outflow place are stored in the database and therefore can be used anytime to re-determine the spatial relationship and perform complex analysis as well. The drawback of such solution is that it uses additional space on disks for storing predetermined relationship with predefined conditions (like the buffer size, etc...). On other hand the benefit is highly improved response time for complex queries which doesn't include almost no spatial relationship processing. It is not just the improved response time that is the benefit of this solution but it also requires less capable underlying hardware what means less initial costs.

In the previous paragraph we were discussing only the technical benefits of the solution. We must emphasize as well that this solution integrated the administrative procedure of issuing water usage permission with entering the spatial data in one complex process. When the spatial relationship is determined it is stored in the database and checked against the set of predefined business rules that are defined in the system. In many systems which are GIS-centric the main purpose of the solutions is to maintain spatial data. Such kind of an approach can be very dangerous as it is focused only on GIS functionality and capability of the system. The opposite approach used in this solution is business-process oriented where GIS adds just a “graphical” environment for displaying attribute data and extends the capabilities of the system. The main focus of the system is not GIS-oriented, but an integrated administrative environment that contains all the necessary control functions for processing application requests. The vast conceptual problem in past was that many systems had a wrong focus on extending the system with spatial data and making them GIS-centric what somehow led to separate systems. The capabilities of relational databases to store GIS-data together with attribute data enabled integrated solutions where adding spatial data in the system extends the system functionality. Separation of capturing attribute and GIS data in different processes is never a good solution and leads to sub-optimal support for business processes. Therefore the optimal solution is a highly integrated solution which is focused mainly on support of business process(es). Such solutions improve the productivity and reduce the cost of the administrative tasks.