IT Solution for Security Management in the Cadastral Field

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There are presented the particularities of cadastral system which should be reflected in the software development. It is shown as well the design of the cadastral software application. The online solution for the security management in the cadastral field, it is projected in this way to accomplish all the requirements. Another step is to identify the risks and vulnerability for the future processes, which gather all the functionality of the security system. It will be determined all the functions and new functionalities of the security management solution for the cadastral system. The future system will assure the security of the cadastral content which will act as a content management system for the new cadastral software application. A new evaluation system will be created in order to track, optimize and define new feature to increase the security system for the related cadastral system.
Keywords: *Cadastral, Management, Security, Performance, Software metrics*

1 The cadastral field

The cadastral field represents the related economical field which manages all the types of terrains: from water to land, from mountains to plains, on a specific geographical area. All the gathered areas make the cadastral potential for a specific country. Also the cadastral field manages the land owners, and all the related operations which have the main activity object: land, like, selling, agriculture production and so on. In this field a lot of reports are created in order to evaluate the agriculture production potential of the covered areas. Besides these, evidences are made in order to track the number of agriculture producers; cadastral field prepares the evidences necessary for the financial field, in this way the taxes are calculated for the land owners.

Due to the fact that the actual organization in the Romanian public field, the main support for data storage is the classical paper registers, the necessity of creating a distributed database system is more than required. After the communist regime, the management of the cadastral field, knew some changes, due to the fact that the owners regained their lands. In this situation, from the previous only owner, the state, after the 1991, when the Land Law was issues, the numbers of the land owners increased a lot. Furthermore the new structure of the economic organization increases the pressure over the cadastral organization to add new functionalities, such as: reports which reflects the agriculture potential of specific areas, issuing producers certificates, for those land owners who wishes to merchandise their agriculture production, preparation for fiscal reports, required by the fiscal system, in order to calculate the agriculture taxes for the land owners.

Following the above changes the necessity of having the data storage into databases is more than a requirement. From this design, concludes the fact that the operations on databases will be accordingly on each type of databases: for example: on multimedia databases, only insert and find/consulting operations will be made, in opposite to textual, alphanumeric databases, on which all type of DML operations will be made.

As a normal result also the users management of the cadastral system knew an alteration, and the main three groups in this field are: the land owners, the employees in the cadastral organization and as well the employees in the financial organization, the last two represents the state, which in this case is Romania.

The volume of processing suffers as well an alteration, after the new organization of the cadastral field and it is influenced directly by the numbers of users, by the changes of the land owners over a specific area, and as well by the new financial requirements.

The important point in the cadastral field organization was the Land Law in 1991. In the graphic below it is presented the evolution of the private sector and the public sector, related to the property over the land [10] [11] [12] [13] [14] [15] [16] [17].

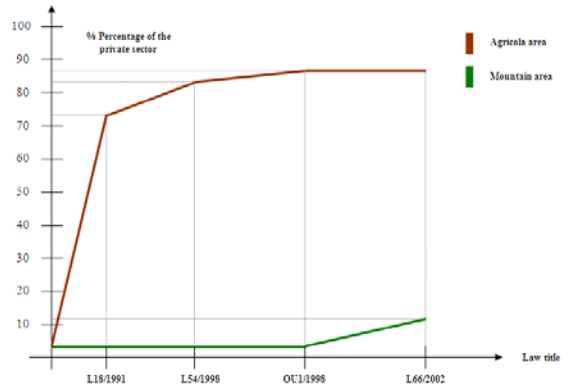

Fig. 1. Process of land distribution

After Romania entered in the European Union, as well the cadastral system entered in the global European cadastral organization, known as EuroGeographics. This organization connects the activities of all public cadastral agencies and cartography of all countries members of European Union, the main purpose of it is to create a European informational cadastral system.

Beside this, the organization is trying to create the common concepts used in the cadastral field to be applied for all affiliated countries, to support the cadastral and cartographical programs of European Committee.

Having this supporting points: the legal framework, the European standards, and the efforts to modernize the cadastral system, the population and especially the land owners will benefit over this system by having a modern online system which will automate all the cadastral operations, which will secure all the cadastral content, multimedia and alphanumerical information, and optimize the inputs and outputs, with their related flows.

2 Informatics System for Cadastral Management - ISCM

The public cadastral agency is a public institution which covers the area of a county, divided in the sub agencies, which covers cadastral areas related to minimum what is related to a village. It's a nonprofit society and it is under the public hall management. The main objectives of it are: cadastral supervising, management and control. The activity covers as mentioned above the entire geographical area of a country [6].

For the good functionality, the agency has economic and juridical relations with different economical agents, the population and as well with other public organizations and agencies. The relations are:

- Collaboration with all the land owners, either individuals or legal persons;
- Collaboration with the City Hall, Financial Administration and CourtHouse;

Having this collaboration with the all above, the cadastral agency maintains a good functionality of the tax system; manage all the changes in the cadastral area. From this point the main activities of the Cadastral Agency are:

- Land wealth statement with the sub activities:
  - Registration in the cadastral agency;
  - Actualization by adding a new auxiliary statement;
  - Data Validation in each statement;
- Issuing certificates with sub activities:
  - The registration of it in the cadastral agency;
  - Validation of the land owner as a producer;
- The invalidation, extension of producer certificates;
- Cadastral reports for land owners taxes;

The actual organization in the cadastral agency covers up to ten persons, who enters and validates the entries in the cadastral management, also up to 4 persons supervise their activities, and all the registrations are made on the classic support: paper. All the inputs and outputs are as well on the paper supports. Having this kind of storage the cadastral data knows a big level of vulnerability to all physical factors: humidity, fire and so on.

Having this type of organization is mandatory to create a new architecture for this system in order, firstly, to change the data storage, to create as well a security management over

data, and as well as content management is required for all types of the cadastral data.
The starting point in designing the new information system is entities identification [1] [2] [3], which are:

- Land owner
- Land field
- Land wealth statement
- Row of land wealth statement
- Certificate

The matrix entity association looks like in the Table 1.

Table 1. Matrix entity association

	Land owner	Land field	Land wealth stm,	Row Land wealth stm.	Certificates
Land owner		*	*		*
Land field				*	*
Land wealth stm.				*	
Row Land wealth stm					
Certificates					

How this matrix is interpreted: for example the first row: a land owner has more land fields and makes a land wealth statement, as well he can have only one or no certificate.
The next step is to create the structure of the databases which will be used in the cadastral management. Each entity defined above has a specific table, as well different auxiliary types of tables[4], for the data management and manipulation will be created. The table land owner looks similar as the following:

```
create table proprietari1(codp number(5) not
null,nume varchar2(20),prenume varchar2(20),seriab
varchar2(2),numarb number(6),strada
varchar2(20),numar number(5),bloc char(2),scara
char(2),apartament number(5),localitate
varchar2(20),judet varchar2(20),tel
number(15),picture long raw,constraint
proprietari1_primary_key primary key(codp));
```

Fig. 2. The sample description of the land owner table

In the design of databases, the most used data types are the alphanumerical data, followed by the date data. The multimedia data is used on limited processes, because these are only used at the insertion and viewing operations. The distribution of the data types depends as well by the database technology used for the cadastral databases design, for the multimedia databases, and also for the oriented objected, storing the binary information is very easy, starting using RAW and LOB data; the progress of the databases brought new types of binary data types such as BLOB, CLOB, NCLOB and BFILE. The first three types are stored in the database, and the last one only keeps a reference to the file stored locally on the disk system.

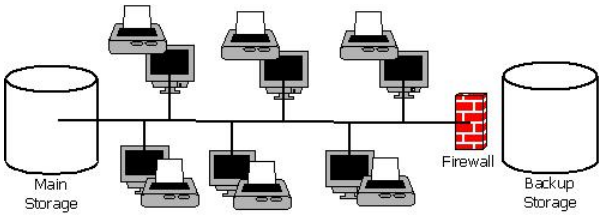

Fig. 3. Architecture diagram

The complexity of the data is done by the storage and altering the multimedia binary information. The new generation of the binary data brings the following facilities:

- The maximum size of the multimedia data is up 2 GB to 4GB;
- In the DDL phase, more than one attribute can be binary;
- Data can be stored either in the databases either outside on the disk;
- Direct access on bytes which gives the flexibility to have DML on specific memory zones;

When a user creates a table with multimedia LOB characteristics the value is saved into a LOB segment, and in the attribute is stored only the reference to the memory segment. The Blob is interpreted by Oracle, for example, as a bytes row, similar with long raw. How a Blob table is created:

```
create table multimedia( cod_teren number(10) not null, cod_p numeric (10) not null, denumire varchar2(20), suprafaţa number(10), nrtopografic varchar2(10), schiţa blob, descriereclob constraint multimedia_primary_key primary key(cod_teren), constraint multimedia_foreign_key foreign key(cod_p) references proprietari(codp));
```

Fig. 4. The multimedia sample table

The way the insert operation is made shows exactly the manageability and flexibility of the data

```
insert into multimedia values(1000, 100, 'DealulFlorilor', 1028, '1521/12', schiţa EMPTY_BLOB (), descriere EMPTY_CLOB ());
```

Fig. 5. The multimedia sample Insert operation

The analyses cost versus benefits is done by the price paid for the design of the ISCM, as well by the costs for employees training with the new system. Because there is no previous software implementation, the hardware architecture will increase the costs of new system. The estimation of time the implementation will be accomplished depends as well by the numbers of operators, who will enter data in the new software system. For a local cadastral agency, for example, a minimum 5 computers and one server are necessary, the acquisition cost is estimated at 4000 euros. *Ch hardware costs.*

The licenses of Oracle database, in order to permit an optimal functionality are 1500 euro, Cs, *software costs.* Another cost is the personnel training 400 euro, Cp, personal training costs. The design software costs are estimated at 1050 euro, and it is calculated by the 70 working hours done by software analysts. The software application costs, is 800 euro, the equivalent of 80 working hours,

The model of total costs calculated by adding to the application cost ***Cap*** is:

$$Cap = Nha\ X\ Tha + Nhpr\ X\ Thpr$$

where :

Nha – total number of hours for analysis;

Tha – price for 1h/analysis

Nhpr – total number of hours for programming

Thpr – price for 1h/programming

which include the analysis costs and design costs, the Cp and Cs costs. Due to the fact that the implemented system, will now act automatically, costs to add new functionalities are not expected to appear due to the fact only after an year new functionalities will, if it will be the case, be implemented.

$$Ct = Cap + Cp + Cs + Ch$$

where:

Ct – total costs

Cap – application costs

Cp – personnel training costs

Cs – software costs

Ch – hardware costs

The benefits of the system are done by the performance flavor of it, such as :

- Minimum response time;
- Accuracy of the responses;
- Safety of the stored data in the databases;
- Flexibility in data reporting;
- Easy maintenance of big data volumes.

3 Risks and vulnerability in ISCM

The risk concept comes from the potential that a chosen action or activity (including the choice of inaction) will lead to a loss (an undesirable outcome). The notion implies that a choice having an influence on the outcome exists (or existed). Potential losses themselves may also be called "risks". Almost any human endeavor carries some risk, but some are much more risky than others. [18]

Types of risks depends of the field that it is related about, ones are the risks in physics, others are the risks in financial systems and as well other are the risks in the software implementation, and as well others are the risks for ISCM.

ISCM risks:

- On the data level
- On multimedia level
  - Due to bytes operation, data can be altered;
  - Truncation of data to maximum 4gb;

On alphanumerical level

Invalidation of numeric and alphabetical information;
Date validation;

- On the network level
- At input level includes all types of data validations;
- At output level validations are done only the one who requested the related information;

Other risks that should take in account are development risks which can be related to appearance of software tool bugs, used to develop ISCM; the maintenance risks such as database corruption, network failure, hardware functionality, as well of encountering software bugs which can decrease the performance of the software application, or more to put down production.
The main vulnerability is the access to date to unauthorized as well the untrained personnel. In order to solve this as well an identity management and content management should be implemented in the ISCM. Vulnerability appears as well to unprepared users, such as land owners with the new online functionality of the software system

4 Security Solution for ISCM

The security solution for ISCM has two main components: identity management and content management. The first one is related to create a management system based on authentication level, and the second one come over with a strong authorization level over the stored content in the ISCM databases.
The first component which is added to the security solution is the Content Management component, which will grant access over the cadastral documents to the users, also will create the hierarchy of roles, groups for the above users. The enhanced system looks as the following, the Content Management is drawn blue, as in the diagram

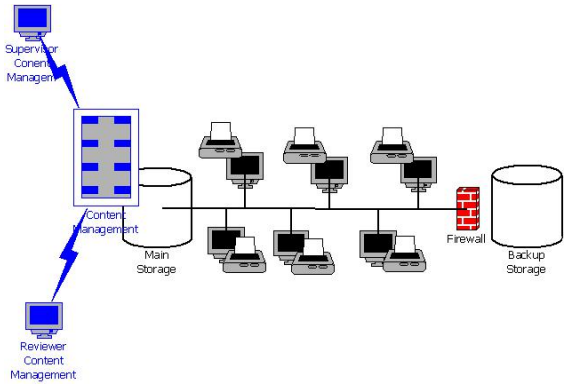

Fig. 6. Architecture having the Content Management component

Even in this moment the security model is not yet completed, another component is required, and which is *Identity Management component.* Having this component, the security will increase on the access level of the users in the cadastral online system. In order to include this component a Directory Service solution is required for users management, and one flexible, with a higher level of interoperability with other LDAP's systems, is the one from Oracle- Oracle Internet Directory. Furthermore OID will bring the Single Sign On concept in the intranet, this will increase the security over the authentication process of the online cadastral application.
In order to implement this solution, it can be used either one of the two storages, but to make a distributed, flexible and viable solution, the infrastructure storage database will be better to be allocated on another server-machine. In this way the new component will have an independent maintenance process beside the others component of the data and security components [7] [8] [9].
The security system can be extended and performed by adding newer and newer components and technologies on each layer for example: on the database layer, *Enterprise User Security* technology can be used to LDAP integration of the database users in the Directory System of ISCM, or implementing Data Vault for data protection on the Backup storage level [5].

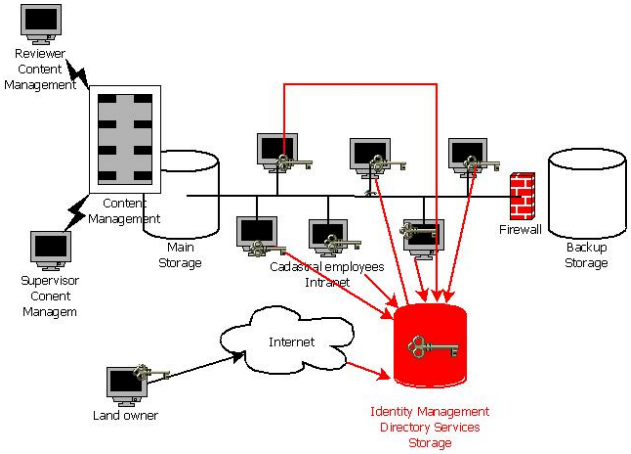

Fig. 7. Architecture having the Identity Management component

The security system can be increase more and more, but there are some limits: more complex the system is, harder the users will be able to fulfill their tasks, more components will increase all the related costs, all which were explained in the previous chapter.

5 Conclusions

The new solution will integrate one of the latest security concepts such as identity management and content management.

The new ISCM will cover much easily bigger and bigger geographical cadastral areas. The daily volume of data altered daily, weekly will increase as well. The flexibility to integrate with other cadastral systems will be achievable if the other systems will have the same structure and will integrate similar technologies as ISCM.

The maintenance risks will be avoided, the risk will low and under control by the software and hardware administrators. These as well will be preoccupied to identify future vulnerabilities of the systems.

Even if new security features will be implemented on each level, is mandatory to predict the impact of cadastral system on medium and long term. Also the flexibility of the cadastral employees and land owners to handle the new features, is another factor which will influence the security system, and with it the cadastral system activity itself.

These and other new security features, security problems, maintenance problems will be discussed in a future article

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