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PROBLEMS OF THE INTEGRATION OF CADASTRE INFORMATION SYSTEMS

Cadastre systems are mission critical systems designed for the registration of parcels, buildings and apartments as well as their owners and users. These systems belong to the most important public systems used by various organizations and individual persons. There is no integrated cadastre system in Poland. The maintenance of real estate cadastre registers is dispersed among above 400 information centres located in district local self-governments as well as in the municipalities of bigger towns which exploit their local cadastre systems. So the attempt to create a unified cadastral system over the country is one of the goals of Polish government in the field of information technology. Architectures of integrated cadastre systems on the central level as well as on the level of a province or a district are analysed in the paper. Two main IT projects aimed at the creation of an integrated system are presented and discussed. Also the approaches to assure interoperability between a cadastre system and land usage payment system and a financial-accounting system in a municipality are shown.

1. INTRODUCTION

In almost every bigger company or organization several heterogeneous but coexisting information systems are exploited. The access to consistent and up-to-date information is a necessary condition for decision making at corporation level. Combination of the functionality of different applications makes it possible to automatize greater tasks which are business processes. The approach to the integration should take into consideration different kinds of multiple data sources. Overview of such systems can be found in [1], [2], [3], [6]. Multiple database systems are often analyzed along three

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orthogonal dimensions: distribution, heterogeneity, and autonomy [3], [4], [6]. Distribution applies to the localization of the systems if they are deployed on a single or multiple, co-located or geographically distributed computers. Heterogeneity is analyzed on different levels for example hardware, operating and database systems as well as communication systems. Autonomy concerns in turn the autonomy of design, communication and execution. It indicates the degree to which individual system can operate independently. So, centralized and distributed systems are distinguished at different degree of distribution e.g. client-server or peer-to-peer systems. From the point of view of current study semiautonomous federated database systems and multidatabase systems, which have full autonomy, are the most interesting, and they are presented in Fig. 1.

![Fig. 1. Architectural model for distributed DBMS (source [4])](image)

2. ARCHITECTURES AND METHODS OF DATABASE INTEGRATION

Integration of information systems has been the subject of various studies for years. In [7] the integration methods are categorized basing on different layers of information systems and comprises such approaches as manual integration done by the user working with different systems, common user interface, integration assured by applications, using middleware to build integrated systems, providing unified global logical view of physically distributed data (uniform data access) and physical data integration
performed by transferring data to a new data storage. General integration approaches on different architectural levels are shown in Fig. 2.

3. CADASTRE SYSTEM FOR LAND AND BUILDING REGISTRATION

Cadastre systems are mission critical systems designed for the registration of parcels, buildings and apartments as well as their owners and users and they are comprised by the governmental information resources. Those systems have complex data structures and sophisticated procedures of data processing. At present, in Poland they are constructed in client-server architecture for LAN as well as in Web technology to be used in intranets and extranets. The maintenance of real estate cadastre registers in Poland is dispersed. There are above 400 information centres located in district local self-governments as well as in the municipalities of bigger towns which exploit their local cadastre systems. The module structure of the cadastre system and cooperating complementary systems is shown in Fig. 3.
Three main registers of the cadastral system are land register, building register and apartment register, emphasized in Fig. 3 by means of grey background. Spatial localization of land parcels and buildings is represented in a numeric map. The cadastral system exploited by a district government includes usually other modules such as premises price register, analysis and reporting, Internet access and data exchange. The complementary are the systems for management of geodesic works and for governmental real estate management. The function of data exchange is also important, because it exports data to external systems such as IACS (Integrated Administration and Control System) – the system of payments to agricultural land, a real estate management system, financial-accounting systems as well as to the IPE system (Integrating Electronic Platform), which is the core part of the Integrated Cadastral System in Poland. Cadastre systems belong to the most important public systems, since they provide necessary information for economic planning, spatial planning, and tax calculation, real estate denotation in perpetual books, public statistics, and real estate management as well as farm registration. So that the development of an efficient and reliable cadastral system integrated at the central level is one of main IT goals of Polish government.

The object structure of the cadastral system in the form of a UML class diagram is presented in Fig. 4. The diagram shows that registration units, containing subjects with their shares as well as land parcels, buildings and apartments respectively, are the main processing units in the system. Almost all modifications may be input into the database only in the window of a registration unit, where all objects comprised by the registration unit are available.
4. MODELS OF CADASTRE SYSTEM INTEGRATION

4.1. MODELING THE INTEGRATED CADAstral SYSTEM ON CENTRAL LEVEL

At present the Integrated Cadastral System is one of the biggest IT projects being accomplished in Poland, which is financed by the EC. It assumes that till 2008 the Integrating Electronic Platform will be constructed and the platform will unite some public systems as cadastral, perpetual book and mass appraisal systems as well as population and business registers (see Fig. 5). As a principal rule, it has been assumed that cadastral data will be delivered from source databases dispersed among 400 district centres to the central cadastral database in off-line mode using the specific text format, called SWDE format. Thus the central cadastral database will be updated with data coming from numerous and non-uniform sources each day in an asynchronous way. The cadastral data gathered centrally will be then coordinated with population and business registers and perpetual books. The replicas of central database can be accessed by different users through a web application. Such solution of maintaining the central cadastral database is complicated and risky. Therefore the success of whole project is endangered, because it is almost sure that the central cadastral database will be not up-to-date and consistent. Moreover it may turn out that the interoperation among the central cadastral system and population and business registers cannot be achieved completely, due to the known problems with matching personal data.
Fig. 5. Concept of the Integrated Cadastre System in Poland based on the IPE

Fig. 6. Architecture of the MATRA cadastre system
4.2. MODELING OF THE MATRA INTEGRATED SYSTEM ON PROVINCE LEVEL

The Matra in turn was an IT project financed from the funds of the Government of Netherlands and aimed at the construction a cadastral system integrated on the province level. The system has been developed using a web technology and the GeoMedia GIS environment. Each district has been assigned its private workspace in the central database and has been entirely responsible for the maintenance of its own cadastral data. Nevertheless all updates have been made remotely using thin client application run on a web browser (see Fig. 6). The advantage of Matra system was that data could be modified online, and the database at any moment was up-to-date. Moreover, the database was always consistent, since geometrical and descriptive attributes of spatial objects were placed in the same records and strong control procedures did not allow any data discrepancy to occur. The outer users could access the replica of the database through the Internet. Unfortunately, financing of the Matra project after completion of a pilot deployment has been abandoned. But this solution was prospective and gave the chance to create integrated central cadastral system.

4.3. CONCEPT OF THE INTEGRATION OF PUBLIC REGISTERS ON DISTRICT LEVEL

Irrespective of the two projects mentioned above, some municipalities tend to construct their own integrated systems. The architecture of these systems is shown in Fig. 7. It is very similar to the architecture of the central system based on the IPE platform. It also unites a cadastral system with business and population registers and provides information to the system of real estate taxes. And in this respect this solution is somewhat contradictory to the concept of the central system.

![Fig. 7. Architecture of the integration of cooperating systems at district level](image)
5. CONCEPTS OF THE INTEGRATION OF A CADASTRE SYSTEM WITH COOPERATING SYSTEMS AT THE DISTRICT AND MUNICIPALITY LEVEL

Integration can be managed at different levels. First, information can be exchanged across a network using basic facilities such as common databases, data tables and files. We call it the interface level. At the next higher level, a new layer of software can be created to connect data over the network. This layer can provide uniformity at the logical level, but sometimes it is not allowed. In our case, a cadastre system, land usage payment system and financial-accounting systems can not be connected directly due to the safety rules. Hence, our approach will be based on the first proposal. The communication between two systems could be bidirectional. What does mean? One system generates some data to another and vice versa. The architecture of such communication is shown in Fig. 8.

![Fig. 8. Bidirectional data exchange between two systems](image)

There are three models of such communication: Pull/Pull, Push/Pull and Push/Push. Pull means that one system takes some data from the other; on the other hand the Push model assumes sending data from one system to the second one.

We have implemented both unidirectional Push model and bidirectional Push/Pull model in our systems. At the first stage, the replication of selected tables from cadastre system to land usage payment system is done, see Fig. 9.

![Fig. 9. Integration of a cadastre system and a land usage payment system](image)
At the second stage, the generation of book-keeping notes from land usage payment system to exchange data tables and import these records to F-A system is performed, see Fig. 10.

![Diagram](image)

**Fig. 10. Model of the integration of a cadastre system and a financial-accounting system**

6. CONCLUSIONS AND FUTURE WORKS

The integration of the existing systems involves many activities from organizational to the technological issues. This paper has focused on the integration of cadastre systems with financial-accounting systems at the interface level using bidirectional data exchange mechanism. We decided to select this option due to the safety rules related to access limit of described systems. If you could deal with many applications, like in our case, it would be better to use the concept of an interface than a dedicated application.

This paper has identified some problems that arise during the integration process, but not all. Concepts such as meta equivalence level are very promising to further research. In addition, we are to develop tools to assist end users in their integration activities. There is a strong need for verification of transmitted data in both directions, not only from the source side.

REFERENCES


