A Complete, Free Solution for Cadastral Map Management

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Key words: Cadastre, Land Management, Land Registry, GIS

SUMMARY

Since the mid of the 90's the Unified Hungarian Land Registry has been operating in standardized environment. The cadastral database standard (MSZ 7772-1) and the standard-based regulations on surveying and the database have been elaborated by the Institute of Geodesy, Cartography and Remote Sensing (FÖMI). This solution is very similar to the Core Cadastral Domain Model (CCDM) produced by our Dutch colleagues. The Unified Hungarian Land Registry is a title registry, where the Hungarian State provides the authenticity of both data (map and land registry)[1,2,4,6-12,13].

Based on the experiences of the utilization of the standard (10% of the territory of Hungary covered by standardized database, approx. 800 000 hectares), FÖMI has developed a software (DATR) for the integrated cadastral map and land registry data management. [3]

The base idea of the development was to build-up a software, which provides a flexible, authentic and integrated management of cadastral map data and land registry. DATR is not a real GIS system, this software solution is able to manage any map data with the related land registry data. Cadastral map and land registry data are stored in the same database with the enforced integrity of them. Change management are only available via database transactions, therefore DATR has no map editing capacity. By this method we can enforce the authenticity of the two types of data (map and land registry). DATR is using an object-oriented database scheme, therefore the monitoring and management of business procedure is very flexible. DATR is using open APIs, therefore customization of the system, the business rules and procedures is very easy and flexible. DATR has certified its productivity in real life, since it is the graphic engine of Internet-based Hungarian Land Registry data service (TAKARNET). DATR has been developed by IT, cadastral and land registry professionals, therefore the continuous development and maintenance of the system is provided by FÖMI. DATR system is a full FÖMI development, all the source codes are owned and maintained by the Institute.

Based on the good experiences of DATR. FÖMI has decided to share this software with the land management community. This system will be available for free, only registration is needed to purchase or download the software. This system is not a free open source system, the kernel of the system is hidden, but open APIs and interfaces to the two types of RDBMS (ORACLE or MySQL) provide flexible tools for any customization on the system, the business procedures and rules.

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1. INTRODUCTION

In the mid of the 90's within the frame of Computerization Program of Land Offices the Hungarian Land Management Sector has developed the base information system for the Unified Land Registry, called TAKAROS. TAKAROS covers all the business procedure in the legal part of the Unified Land Registry (e.g. application registration, management of land records, data service, billing, posting etc.), but it does not manage the geometric part (cadastral maps).

Within the same project an intranet type network (TAKARNET) has been established, which connects all part of the Hungarian Land Management Sector (Ministry of Agriculture and Rural Developments, County and District Land Offices and the Institute of Geodesy, Cartography and Remote Sensing (FÖMI)), providing the communication and authentic data exchange among them. TAKARNET has provided an open access (via Internet) to the Land Offices' databases for registered users since 2003.

At the mid of the 90's digital (vector format) cadastral maps were available only for some part of Hungary, as the results of Land Compensation Program of Hungary. In order to increase digital cadastral map availability National Cadastral Program (NCP) has been established on the base of Digital Base Map Standard (MSZ 7772-1) and Digital Base Map Instructions developed by FÖMI. In the first phase of NCP 550 000 hectares has been covered by cadastral databases (5,5% of the whole territory of the country). In order to speed-up NCP two great projects has been established for the digitization of cadastral maps of Hungary (KÜVET for rural areas and BEVET for the built-up areas of the settlements). KÜVET project finished in 2005 and BEVET finished at the end of 2007. In BEVET project standardized cadastral databases has been produced for additional 300 000 hectares. This means approximately 9,5% of territory of Hungary is covered by standardized cadastral databases and for the rest 89,5% digitized cadastral maps are available.)[1,2,6-12].

A real integrated management of the legal and geometric part of the Unified Land Registry has been our main goal. Since there were no existing solutions for this problem, FÖMI has started the development of a Cadastral Map Management information system (DATR) for the real integration of the two parts. First version of the system has been introduced in 2005 for cadastral map services on TAKARNET network. Cadastral map service now is available for the entire country, the graphic engine of which is based on FÖMI's solution, DATR. [3]

2. DATR, FÖMI'S SOLUTION FOR CADASTRAL MAP MANAGEMENT

The base principle of the Hungarian Unified Land Registry is that, the management of rights, restrictions and facts registered in land registry and the handling of geometric representation of them (cadastral maps) are integrated and commonly realized in 120 land offices. TAKAROS system covers all functionalities of the legal part of Unified Land Registry. It is an important fact, that the continuous development (patching) and customization of TAKAROS based on user requirements are the responsibility of FÖMI. All source codes of the system are available within FÖMI.

In order to really integrate the two parts (legal and geometric) of the Unified Land Registry FÖMI has defined the following principles and visions: [3, 14, 15]

- DATR must map all the principles of Unified Land Registry,
- DATR must be compatible with the requirements defined in Digital Base Map Standard and Instructions,
- DATR must provide the authentic updating both the legal and geometric part of the unified registry,
- DATR must be independent of any commercial GIS system,
- DATR must cover all business procedures related to cadastral maps at the district land offices,
- DATR's solutions must fit in with the existing information systems (TAKAROS).

Based on these principles and visions the development team of FÖMI has decided that the architecture and characteristics of the system should satisfy the next requirements:

- Total integration with TAKAROS system
  - In database structure,
  - In ability system,
  - In transactions,
  - In data service,
  - In system administration,
- Uniform database structure:
  - One scheme,
  - Administration of changes,
  - Enforcing of database integrity,
- Tracking of temporal changes:
  - Archiving,
  - Displaying any arbitrary status of cadastral map,
  - Updating in background procedure,
- Real-time queries via TAKARNET network:
  - Integrated search with the real property registry,
  - Real-time map generating,
  - Minimizing network weighting,
- Modular, self-calibrating architecture
  - All the functions are in modules,
  - Explicit and implicit communication among modules,
  - No client side configuration is needed to insert any new module,
- Easy extendable

- Uniform calling interface and protocol
- Usable base modules,
- Opened module API

• Operation system and RDBMS

- Windows NT 4.0 or Windows 2000 server and client,
- ORACLE v8.05 RDBMS or higher (because it is operating at the Land Offices, but the functions are compatible with the higher version ORACLE RDBMS too.)
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2.1 Data model of DATR

The core data model of DATR is very similar to the Land Administration Domain Model defined by our Dutch colleagues. ([4], [13]) The data model is adequate to execute, supply and monitor all the functions, constrains and procedures operated in the Hungarian Unified Real Estate Registry. The core data model of DATR is shown on Figure 1. [16, 17]

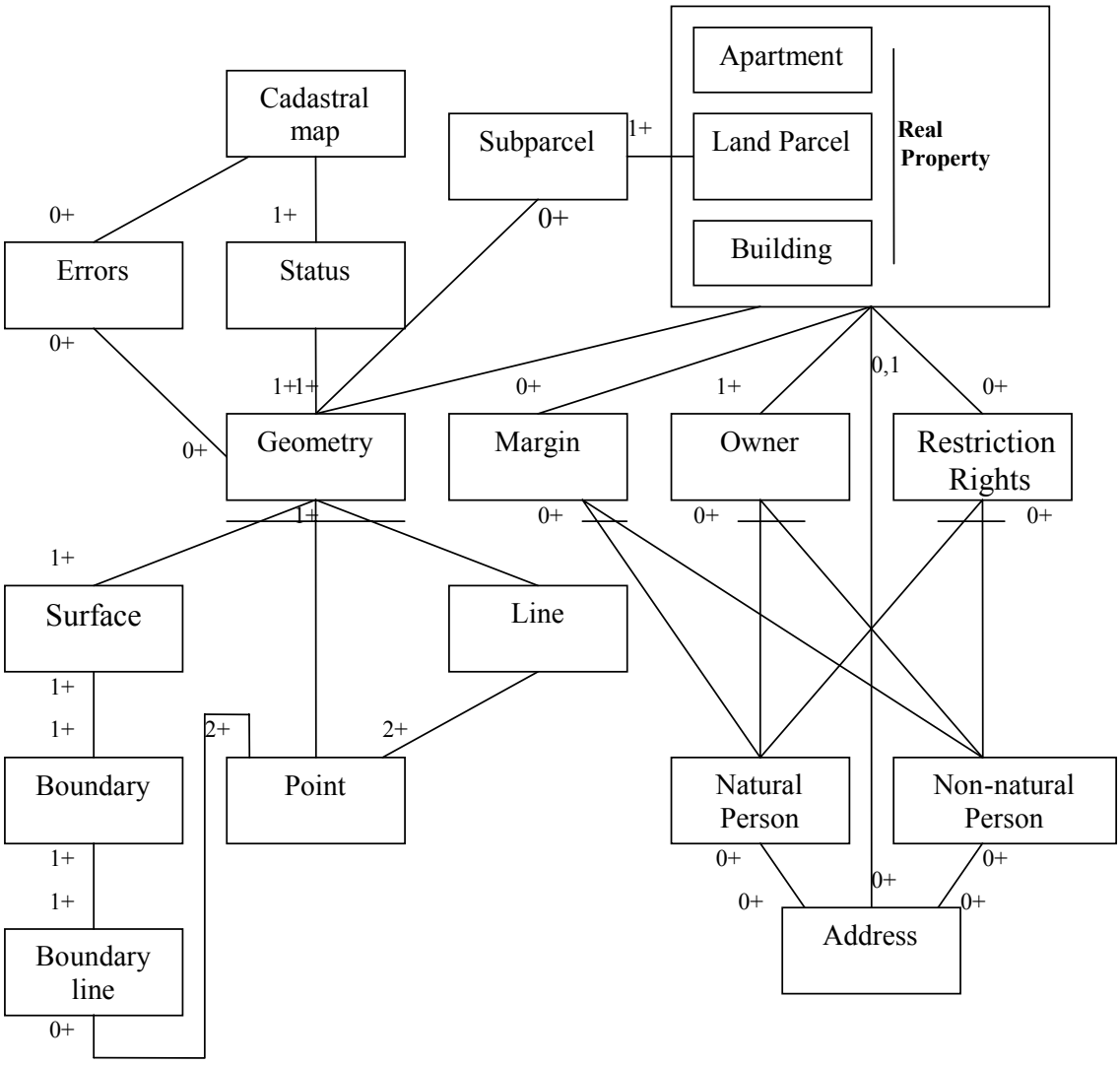

Figure 1.: Core data model of DATR

As shown on Figure 1., there could be three types of real property: apartment, building and land parcel, but a real property must be one of them. In Hungarian land registry the apartments have no geometric representation, but the land parcels and buildings.
In the part of geometry an object can be point, line or surface type object. Therefore if a cadastral map object has no connection to the land registry (e.g. railroad), there is no relation between the land and the geometric tables (0+ indicates, that there are zero or more relations to the tables). Structuring of geometric tables is unambiguous.
Object called Margin has a very special role in the land registry. Margin provides the ordering principle of land registry. If the Land Office receives any application related to the real property, the Land Office must register it and Margin shows the flag of the application on real property. Of course there could be zero or more margins on the real property (0+). The margin also register the person who made the application, therefore there is a link to the natural or non-natural person.
The role of the owner is unambiguous. One real property must have at least one owner (1+), which could be a natural or non-natural person.
The real property can have an address or not (0+).
There could be rights (e.g. easement, mortgage) and restrictions related to the real property. The Restriction object makes for this purpose. The Restriction can be connected to a person, too.
Each person (natural or non-natural) — who has any connection to the Land Office — is registered in the database with his address, too.
This core data model has been physically achieved in DATR system and is able to manage the cadastral map data and real property registry in an integrated way.

2.2. Real Property Transactions in DATR

Real property transaction is one of the most important procedure in the Land Office's activity. Its legal and surveying relations must be handled very rigorously in an integrated cadastral system. The real property transaction in DATR contain the following steps (see Figure 2.):

- Application registration in order to map data service,
- Allocation of affected real properties,
- Generating of changing area,
- Data service for changing (both map and land registry),
- Closing the legal procedure (end of data service for changing),
- *Changing data in an other system (e.g. ARC/INFO),*
- Application registration for uploading map changing
- Uploading changed map data to the work map,
- Automatic and manual checking of changed data,
- Adding a reservation for map change in cadastral part,
- Closing the legal procedure (end of changed data uploading),
- Application registration for changing land registry,
- Transactions in land registry part,
- Adjudication and updating (legally valid map and real property),
- Closing the legal procedure.

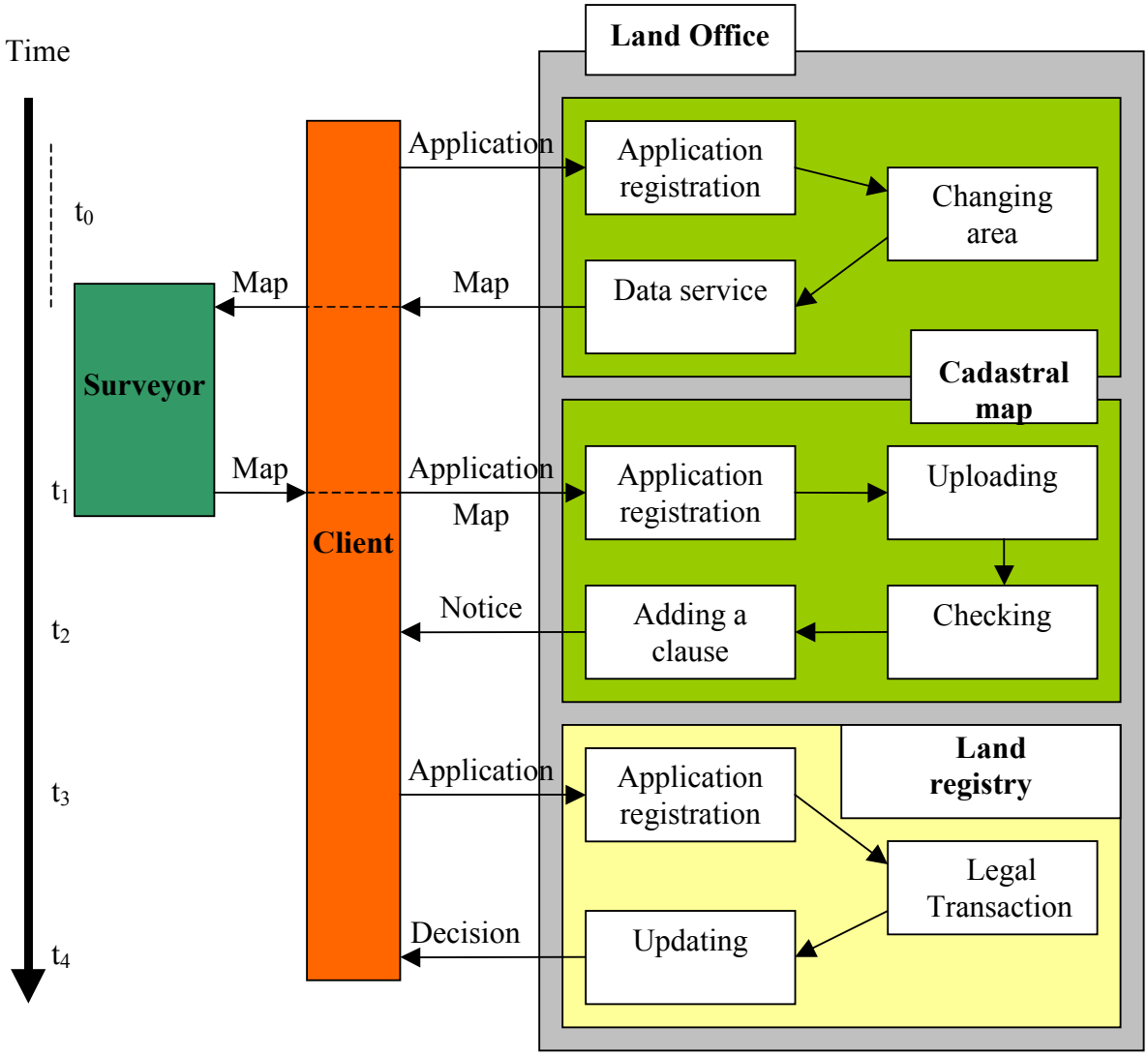

Figure 2.: Real property transaction in DATR

Application registration in order to map data service

This procedure is carrying out by the application registration module of TAKAROS system

Allocation of affected real properties
Allocation can be executed by three ways:

- Listing of lot numbers of parcels,
- Selection of real properties and other objects on the map,
- From the selection of the land registry.

Generating of changing area
DATR generating changing area with the boundary of the area, land parcels and objects belongs to the land parcels and other objects within the changing area.
Data service for changing (map and real property)
The client receives the map and real property registry data. Data service is available in different forms (e.g. ESRI SHAPE, DXF etc.).

Closing the legal procedure (end of data service for changing),

Changing data in an other system (e.g. ARC/INFO),

Application registration for uploading map changing
It is the same as in the case of data service

Uploading changed map data to the work map
Work map is a distinct area of the database.

Automatic and manual checking of changed data
Checking contains the following tasks:
- Formal and syntactical checking based on Cadastral Standard,
- Checking of inner consistency (e.g. links),
- Checking of geometrical consistency (e.g. topology),
- Temporal consistency checking (e.g. coincidence to the map data service),
- Checking of integrity (e.g. integrity with land registry).

Adding a clause
During the addition of a clause the following procedures are executed:
- Objects of the changing area will be erased (only logically),
- The objects of the working map will be uploaded to the legally valid map (flagged with clause),
- The new real properties will be uploaded to the land registry (flagged as preliminary),

Closing legal procedure (end of changed data uploading)

Application registration for changing real property registry
It is the same as in the case of data service

Transactions in real property registry
Legal checks are performed

Decision and updating (legally valid map and real property)
This task finalizes the changes consistently both in cadastral and land registry database. In the case of the cadastral map it means:
- The erased objects will be deleted physically from the valid map,
- The clause-flagged objects will become legally valid.

Closing the legal procedure
It is important, that the client has a one year period applying land registry changes after the clause on map change. If the client does not apply land registry changes within this period, the map change (and the clause) will be cancelled [14].

2.3. Architecture of DATR

The architecture of DATR is shown on Figure 3.

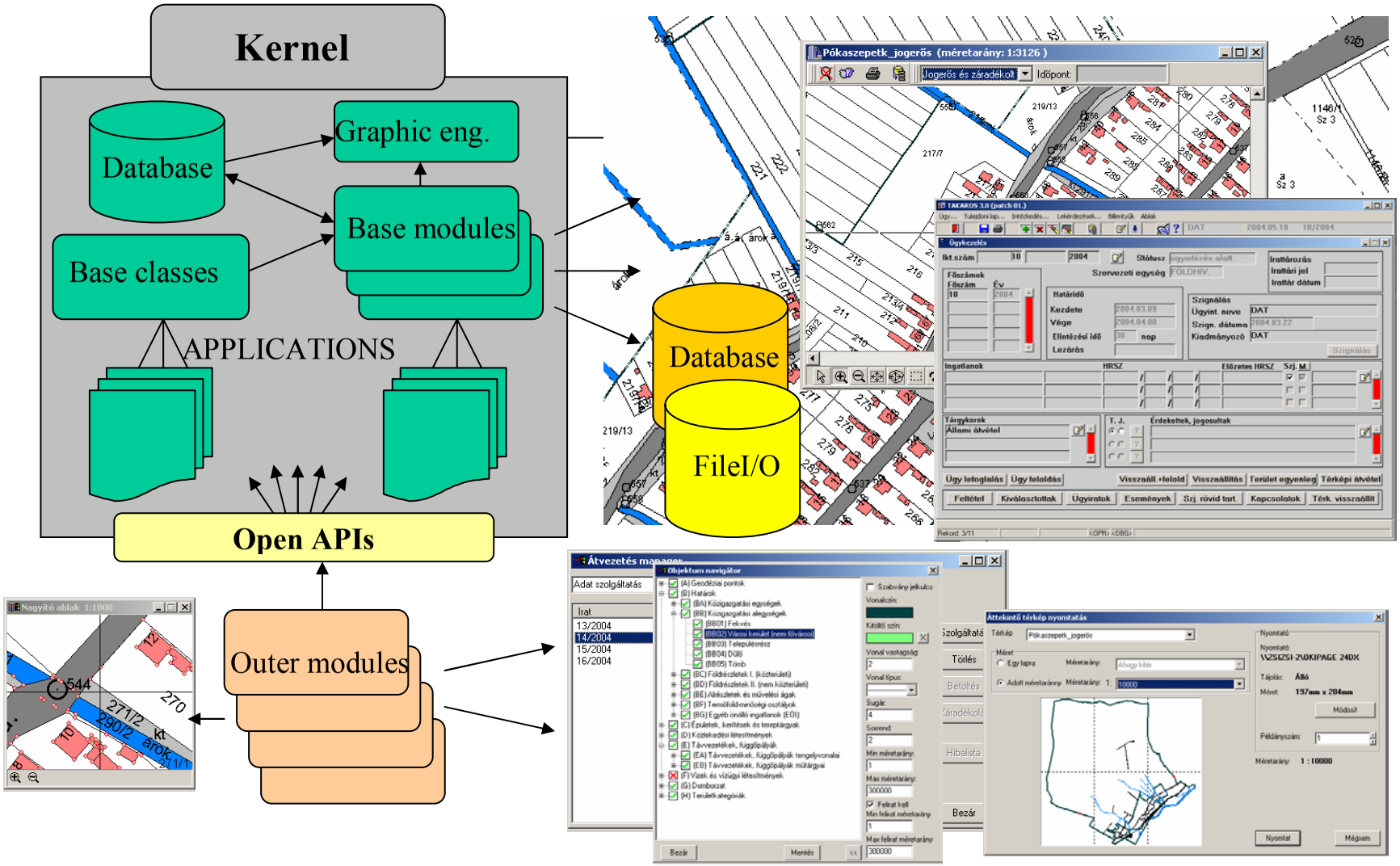

Figure 3.: Architecture of DATR

As shown on Figure 3. DATR has a kernel, which contains the database itself, the base modules, the base classes and the graphic engine, the last being responsible for the graphic representation of map objects stored in the database. The source code of this part of the system is hidden from users, however with the help of open APIs they are able to code different applications for the system using the base classes and modules. Applications are the manifestation of modules for the users, which means user is able to handle module functionalities via applications. The outer modules are communicating with the kernel via open APIs. The base modules are responsible for external database connections and file input-output [3].

3. DATR, THE INTERNATIONAL VERSION

As it was mentioned in last section on first stage DATR system has been customized to the Hungarian Unified Land Registry. The DATR system is managed flexibly, therefore FÖMI has decided to develop an international version of the system.

In the international version of DATR all modules and applications (including kernel) have a lingual description in XML format, which describes the lingual functionality of the module. Therefore each module can be customized into any languages including the graphic user interfaces.

With open API interface each module can be modified to any certain legal and technical environment.

The international version has two interfaces, one to ORACLE and the other to MySQL RDBMS. If client needs then interface can be developed to any other SQL based RDBMS.

The above-mentioned architecture and flexibility empowers DATR (with some customization) to use in any Land Administration system as a cadastral map management system. FÖMI as the part of Hungarian Land Administration is able to maintain this system in any environment both technically and professionally level, including professional guidance.

When the original abstract of this paper had been written it has seemed that FÖMI is able to publish the international version of DATR at FIG Working Week in Stockholm. However, the international version of DATR is not available yet, because at the beginning of February, 2008 FÖMI got a prompt and very positive development task from the Ministry of Agriculture and Rural Development, which fully engaged all development capacity of DATR. By the end of this year the software is expected to be published and freely downloadable from FÖMI's website free of charge, only registration needed.

4. CONCLUSIONS

In this paper the authors wished to show the developments of FÖMI in Land Administration Domain. The Hungarian Unified Land Registry is a good example for the integrated land registry and cadastral map management. Cadastral map management system, DATR is an

object—oriented approach and a flexible solution for the authentic unified land registry management. To introduce the Land Administration community to this system, FÖMI is ready to publish DATR, as a freeware software. FÖMI's capacity both in IT and land administration professionals guarantees the long-term maintenance and support of the system. Customization of the international version of DATR is very easy via linguistic descriptions. With the help of open APIs interface anyone can customize the system into his legal and technical environment. Naturally FÖMI is ready to undertake the task of customization and/or professional guidance for the users of DATR, as well.

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BIOGRAPHICAL NOTES

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Gábor SZABÓ (37): has a degree in coding and code planning mathematics from Roland Eötvös University of Budapest. He is currently the chief developer and system administrator of TAKARNET system. He has planned the structure of DATR system and chief coder and architect of the system.

Zoltán WENINGER (51): has a degree in mechanical engineering (faculty of system organizing). He is currently the head of Centre for Land and Geoinformation Developments and Operation at FÖMI. He has participated in the establishment of computer based land registry from the beginning. He is the leader of DATR project.

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