Development of an Advanced Cadastral Management System at the Survey of Israel

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SUMMARY

The Survey of Israel is a national agency for geodesy, cadastre and geographic information. The Survey is responsible for cadastral mapping, as a partner of other ministries cooperating in documentation and registration of rights to land, according to a British law dating back to the period of the British Mandate (Survey Ordnance, 1929). Private licensed surveyors are deeply involved in the cadastral activity. The cadastre system in Israel is based on the British initiated Torrens registration principles.

The responsibility for the inspection and the approval of cadastral block maps and mutation plans is shared by five district surveyors and a number of senior civil servants acting at SOI central office. This historical, geographic distribution led to heterogeneity of various local standards, working and management methods and procedures, data formats, hardware and software facilities, etc. In the era of worldwide standardization, the Israeli cadastre practice remained anachronistically non uniform and essentially not standardized.

At the end of 2003, a comprehensive project was initiated aiming at the establishment of a better, highly standardized and homogeneously regularized cadastral production and management practice. The existing working procedures have been critically studied and analyzed, and practical steps for their improvement were proposed. Furthermore, a software application was specified for control, follow-up, management and decision making. The application is fully integrated with the improved working procedure and with the existing national cadastral GIS.

The software system named "SHALOM" was developed. The beta-version was successfully implemented and rigorously tested in one of the district cadastre offices.

The paper summarizes the main ideas of the project, describes the main characteristics of the developed software and the results achieved, reports on the present status and surveys the tasks which remain to be solved or improved.

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1. INTRODUCTION

The land registration method in Israel is based on the Torrens system (registration of titles). The state (through the services of the Survey of Israel, SOI) is responsible for the description of the land parcel boundaries as registered in the Land Registry Office (Forrai et al, 2004).

SOI is the top professional geodetic and surveying authority in the country, setting standards, initiating legislations, licensing surveyors, supporting and initiating research and development, actively managing and maintaining the national geodetic infrastructure, the national GIS, and is responsible for mapping, topographical and cadastral. SOI supervises, approves, collects and maintains all cadastral mapping.

The land administration practice in Israel involves both the governmental and the private sectors (Kraus and Forrai, 2006). Although the part of the governmental authorities is relatively dominant, there is a growing trend of deeper involvement of the private resources in the process. This tendency is based on different backgrounds and motivations, some derived from ideologies and some based on economic considerations.

The private sector (which is composed of some 500 active licensed surveyors) carries out a great variety of tasks. One of the most important of them is the preparation of mutation plans, which serve as required technical documentation of any change in land registration.

According to the existing law, each mutation plan has to be carefully checked and approved by SOI before starting with its registration procedure. SOI should complete increasing supervising tasks with permanently decreasing professional personnel. These opposite trends result in queue of mutation plans waiting for the beginning of their examination.

According to the survey regulations, the Director General of SOI authorized private surveyors - by delegation of power - to execute the supervision of mutation plans prepared by other licensed surveyors. SOI keeps the right of the final approval to itself, but also commits itself to complete it within 21 working days (Forrai and Kirschner, 2007).

Each year, some 1200 – 1600 mutation plans and some 200 new cadastral block maps have to be examined and finally confirmed under the full responsibility of SOI. An optimal management method can essentially contribute to the effective completion of the task.

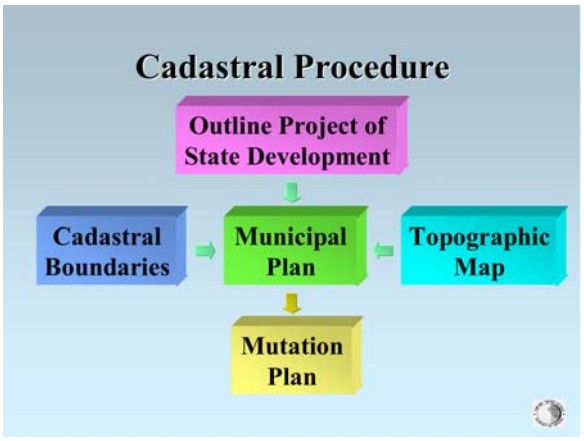
This idea resulted in a decision to develop a comprehensive, fully computerized management system for the management and control of the cadastral activity at the Survey of Israel.

2. THE CADASTRAL PRODUCTION IN ISRAEL

For the application of the Torrens registration method in Israel ("registration of titles"), the State is responsible for maintaining the geodetic control network which enables precise reconstruction of surveyed boundaries in the future.

According to the Torrens principles, the subject of registration is the land parcel. The boundaries of a parcel and the objects situated inside the parcel (such as buildings, walls and fences) are thoroughly surveyed, and the area of the parcel is calculated. This type of registration ensures an effective and convenient way for proper real estate management, effective planning and land transactions.

Any change in the original settlement of land rights (like merging or subdivision of existing parcels) has to be carried out by means of preparation of a so called mutation plan, made by a private licensed surveyor. According to the Israeli Law of Planning and Construction, the preparation of a mutation plan has to be carried out on the basis of municipal plans (urban plans) approved by the competent authorities of planning and development. The municipal plan, frequently drawn on the background of a topographic map, sketches the approximate position of new cadastral boundaries and the intended use of new parcels (e.g., residential area, industrial zone, public area etc.). The accurate position of boundaries is defined in a mutation plan, on the basis of precise surveying. (Forrai et al., 2004.)



Examination process of mutation plans starts in SOI in one of five District Surveyors' Offices, where the original cadastral drawings are kept and used for the mutation plan preparation by licensed private surveyors. The most important part of the checking process concerns the correct reconstruction of parcels boundaries according to available legal sources, while the registered area of the original parcels is strictly preserved. Another important part of the check process deals with performing the computerized test of submitted work files, prepared according to pre-defined standard formats. Following a successful examination procedure, these work files are uploaded into the database of the national cadastral GIS.

The surveyor provides the new parcels of a mutation plan with a temporary numbering (commonly, starting from number 1) and calculates the area of the new parcels. As soon as the plan is accepted by SOI as “approved for registration”, it may be presented to the Land Registry Office, which provides the new parcels with final numbering (starting from the last number of the parcel registered in the specific block), registers the area of each new parcel and its ownership. The "final numbers" of new parcels are transferred then back to the SOI in order to update parcel numbering on the original mutation plan drawing, on the cadastral block map and in computerized databases.

3. THE GOALS OF THE SYSTEM

The SOI, as part of the government, is engaged in promoting a government decision to accelerate land registration mainly where new housing projects have been developed and land settlement or re-parceling are needed in order to register land title.

The SOI has the task of supplying the cadastral data to the surveyors and running quality control on the mutation plans submitted by surveyors as part of the registration process. If these tasks are not managed efficiently they may take a long time and as a result delay of the registration. This problem has had a bad economic impact on real estate business during the last decade. Important development or business projects have been delayed for several months up to a year.

The goal of the SHALOM project is to create and implement an organizational change where new standards and unified work methods will be implemented, including the integration of a supervision and control application. SHALOM is a comprehensive solution aiming at the establishment of a better, highly standardized and homogeneously regularized cadastral production and management practice.

Once these goals are achieved, work efficiency will grow and as a result mutation plans will be examined and approved faster whilst keeping a high quality standard. This will contribute to a faster land registration.

The control application is integrated with GIS environment applications which provide spatial quality control tools.

4. THE PRINCIPLES OF THE SYSTEM DESIGN

The basic principle of the system design is to support the following subjects, using standard equipment and devices:

- Establishment of organizational integrative modular system that enables the **connection of cadastral processes** carried out in different departments of SOI, by the authorized private surveyors and by external bodies involved in cadastral process.
- **Defining unified standards** for loading, transferring and keeping the relevant data, according to the cadastral principles and the survey regulations.

- **Reducing the waiting time** for examination of the mutation plans and **the time of the examination** itself.
- **Reducing the updating time** of the cadastral data in SOI, following the registration of the mutation plans by the Registrar.
- **Improving the service** to the private licensed surveyors and others through providing of updated information in almost real time.
- **Managing control and supervision** process.
- **Controlled management of** annual and long-term **working plans.**
- **Enlarging the management options.**

The system enables managing of computerized processes for a project life cycle, starting with control and follow up the assignments, documents archiving, managing and documentation of telephone requests etc. The system is actually providing a computerized working tool for every function in the organization involved in the relevant process. eRoom software has advanced management and control abilities, supporting maintenance, managing users, authorizations etc. The system gives a flexible solution for the combination of WEB based systems with GIS and with a mechanism for management and control of projects and archiving.

5. THE IMPROVEMENT AND STANDARDIZATION OF THE PRODUCTION LINE

SOI regards the cadastre processes as a production line starting with survey data input from surveyors and ending with an updated cadastre map and database. The cadastre process includes also administrative steps.

The SHALOM system aims at some organizational changes and also a certain standardization of the cadastral activity:

5.1. Organizational change**s**

Changing work methods and habits of an organization is always a difficult task. We had to choose between automating the traditional work methods based on standards that were set 50 years ago or creating an organizational change where new standards and new work methods are set (including their automation). The first seemed much easier and faster – in less that a year automation would have been completed. The other is much more complicated and hence slower.

The choice fell on the organizational change although it is the long way. It is like a long journey with several obstacles to overcome.

An organizational research was launched to identify what should be changed and which method should be implemented instead. The existing working procedures were critically studied and analyzed, and practical steps for their improvement were proposed. Emphases

were put on full availability and transparency of data and knowledge gathered during a cadastral process.

The result was a new definition of the cadastral process including new standards and tools for control, follow-up, management and decision making.

The following new functions were designed:

- Front desk – for receiving and transferring data from surveyors and other clients and for all administrative processes.
- Planning and Control – estimating resources required for work and its duration, follow-up and work efficiency.
- Project manager – a qualified person who can manage a cadastral project. Each cadastral job is considered as a project having a beginning and an end point.

5.2. Standardization

- definition of milestones, checklists and go/no go steps
- definition of unified quality assurance steps
- compliance with surveyors regulations
- definition of a timetable for each cadastral project
- documentation of all relevant components

A very important part of applying standardization in a computerized system is connecting all the tools to one entity. All applications must 'speak' with each other and share the same data to prevent discrepancies of data and avoid redundant work by the quality assurance personnel. Applications that do not comply must be changed.

SHALOM and the main cadastral GIS driven database and its applications are designed to supply the needed tools for the standard quality assurance process.

Activities in SHALOM are connected to the cadastral GIS database. There are dependencies between SHALOM and the GIS cadastre database which are aimed to ensure that continuation is allowed only if the obligatory requirements have been fulfilled in SHALOM or in the GIS cadastral application.

6. TECHNOLOGY SOLUTIONS

SHALOM system is based on one of the leading ECM (Enterprise Content Management) products by EMC^2 called eRoom Documentum. eRoom is a virtual Project environment that allows different users to share information and interact. Each eRoom forms a place for a cadastral project and contains documents, schedule, tasks, checklists, notes, remarks etc., as would every real life Project. For each cadastral task, a customized template was built, composed from a series of individual cadastral tasks. While creating a new project the right template is used, thus creating a new eRoom with the relevant objects, data, users and tasks.

This allows each system user to view his/hers tasks on routine basis and handling many hundreds of projects simultaneously.

SHALOM is a central system (client-server) with distributed users, which logs in users via web browser from wherever they are. Retrieval of data can be performed in alphanumeric manner or in a spatial manner using the GIS interface. eRoom also possesses powerful documentation capabilities that ensures that each object and document is being indexed, and system tables keep record of data that is later used for retrieval or reports. Since all the data is centrally stored and backupped it can be retrieved regardless of the user´s physical location.

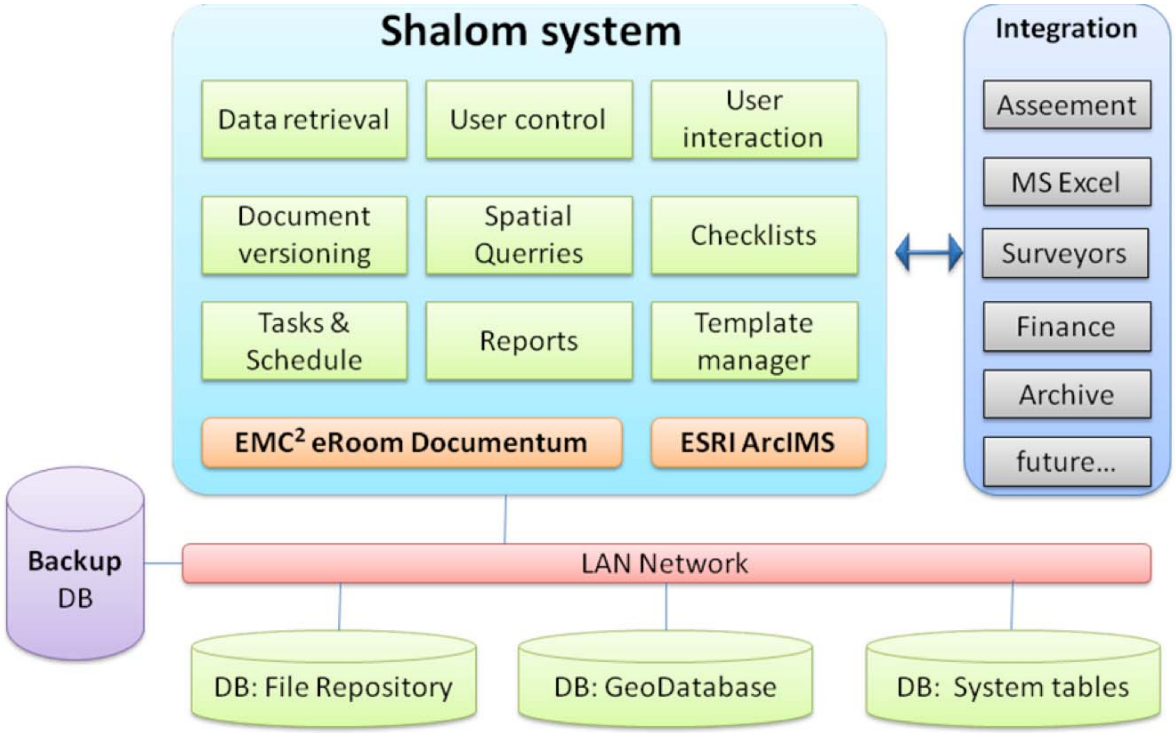
SHALOM uses eRoom´s comprehensive user management to determine the level of authorization for each user. Generally, all projects can be viewed by all users in Read Only mode and only the specifically authorized users are allowed to alter data. The system keeps traces of changes (auditing) and contributes to the accountability. All original documents handed in by the surveyor, for instance, are kept AS IS, and can be copied or managed using versions, if needed. Each task in the project is assigned to a specific user and can be viewed as a Gantt chart. This task can be anything from a manual operation to a detailed checklist. In order to simplify and automate data entry, surveyors hand in various data in an Excel file which contains general data about the surveyor, customer etc., and specific data about the project, including a list of checks which will later be performed by the SOI.

6.1. GIS Interface

A spatial query is done by the use of ESRI´s Internet Map Server (ArcIMS) which allows users to navigate and perform spatial queries, including many other functions as well as alphanumeric report creation. The GIS interface has been built as a GIS Portal and serves other units and processes in the SOI.

6.2. Design and Integration

SHALOM is a mostly a dot Net (.Net) based system and was designed in a Client Server configuration, using Service Oriented Architecture (SOA) to support integration with current and future legacy systems at the SOI. This approach supports current and future integration to systems which either contribute data to SHALOM or retrieve data from it. In this manner the responsibility for different data types was established and normalized.



6.3. Backup and DB

The system uses several repositories, mainly for storing documents and others such as Geo-Database (GDB) and system tables using Oracle and MS SQL Server. All repositories are regularly backupped by the organization backup server.

6.4. Coordination

A new GIS layer, called "Activity" shows a real time map of cadastral activity as polygons. Each polygon is linked to the corresponding eRoom, thus allowing users to view and coordinate resources and employees \ surveyors. The features in this layer lack cadastral accuracy and are designed to serve as reference layer only. The features are created upon project start and change their symbology according to their status.

6.5. Reports

The system offers several kinds of reports, in different environments, that can be exported to MS Excel for further analysis. Some reports reflect data in a single project while others provide data for the executive level and supporting management decision making.

7. THE SYSTEM STRUCTURE (MANAGEMENT TRACKS)

7.1 Sub Systems (Modules)

The System enables combining the abilities of the GIS with the Documentum system on its components. The mixture of the Work Flow mechanism with the environment of the Documentum enables defining processes and sub-processes for each cadastral course (module) defined in the system. The logic in the SHALOM system divides the whole system into sub-systems, and dismantling the processes carried out in each sub system.

Within the framework of the first development step of SHALOM, it will support the following modules of cadastral processes:

- Sub system for examination and approval of a batch of mutation plans in SOI.
- Sub system for checking a batch of mutation plans by authorized private surveyors and its final approval by SOI.
- Sub system for professional consulting with private surveyors in special problems, and documenting the decisions made.
- Sub system for managing the process of land settlement.
- Sub system for preparing, checking and approving of mutation plans examined by supervising surveyors.

In the following steps of SHALOM development for the SOI district surveyors' offices and other users in and out of SOI, it will support the additional following modules:

- Sub system for documentation of boundaries.
- Sub system for data improvement, corrections and changes of already approved cadastral products.
- Sub system for checking and approval of the geodetic control points involved in the specific cadastral product.
- Sub system for managing of 3D (multilayer) cadastral projects. (Shoshani et al., 2004.)
- Sub system for managing processes of discipline issues and enforcement of the survey regulations.

7.2 Front Desk

The front desk is the connection between SOI and the external partners. Each district surveyor office as well as the dedicated department in the main office will have a front desk for receiving the cadastral projects for examination and approval ("file opening"). The "file opening" includes working with dedicated checklists for the relevant module. The goal of inserting the front desk function is to improve the service to the customers and to minimize the friction between the customer and the project manager in SOI. SHALOM is intended to help the project manager to concentrate on his professional work instead of running after some missing components. The front desk is designed to prevent a situation of "file opening"

for projects that miss components. The front desk function decides about the type (module) of the project and is capable of helping and advising the customers. The staff of the front desk should have a wide knowledge of the cadastral processes, and should be highly aware and conscious of serving the public. Following the relevant "file opening" by the front desk, the file is transferred for treatment by the next new function called Planning and Control of Production (PCP). All the information coming to the front desk is transferred to an existing or new project or to another task (like professional consulting). The front desk is also responsible for all the activity connected with the external bodies, e.g. sending and receiving material which should be corrected as well as messages and information about the status and the progress of the projects.

7.3 Planning and Control of the Production (PCP)

After getting a project from the front desk, the PCP is routing it to the available and appropriate project manager. The PCP function is responsible for managing all the cadastral activity in SOI. The main duty of the PCP is to build the proper framework needed to manage the cadastral projects, allocating the required resources, and follow up the progress of the work according to time-table.

7.4 Project Manager and Checking Team

The project manager is responsible for carrying out all the tasks of his checking team from the beginning of the project up to its end with updating all the relevant information in the cadastral data base and in the archive.

7.5 Authorized Signing Person

Few professional persons will be authorized to examine and approve the professional decisions made in executing the projects. These persons can obviously cancel decisions of the project manager, and/or return it for the required changes.

7.6 Senior Manager

A senior manager is not directly involved in the process of detailed examination of the different activities; however he/she can get from SHALOM managing transversal reports that are not available to other users. A senior manager can also watch all the activity files and can make professional or management remarks whenever he finds need to do so.

8. THE PRACTICAL INTRODUTION OF THE SHALOM SYSTEM IN THE NORTHERN ISRAEL DISTRICT ("HAIFA PILOT PROJECT")

The "Beta" version of the "SHALOM" software system was implemented for the first time in the Northern Israel District Cadastre Office situated in the town Haifa.

The Northern District office completes the supervising and approval of some 250 mutation plans per year. The reason for choosing this district office as the "pioneer" for SHALOM implementation was the fact that a previous, in-house developed, sophisticated and user-friendly local management system has been used over the years. With this background it was quite clear that at Haifa district office the beta version of SHALOM will be rigorously tested and critically analyzed – which was very important in the very first stage of the practical use.

The main purpose of the "Haifa pilot project" was to operate and check the central component of the system: the "mutation plan track". 30 projects containing 53 plans have been fed and followed in the system during the first quarter of 2008. Some bugs have been identified, and a significant number of demands for changes / further improvements have been presented to the software developers. They considered them correctly and are dealing with the realization of most of them, and even decided to make some conceptual change in the software for ensuring a smoother operation of the system according to the user's demands.

A considerable work of development, test, interactive analysis and further improvement has to be completed in the following months, for bringing the system from its Beta version to its final stage.

9. SUMMARY

The development of an all-embracing cadastral production management system is near to its completion. The beta version was implemented and tested, significant improvements have been done and are being made.

The system brings new attitudes to the cadastral production. It makes it possible to manage and to execute in a more effective manner. The cadastral workflow is modernized and essentially standardized. It supports but also constrains the user to follow professional, legal and administrative rules and routines, while keeping a reasonable freedom for professional and management considerations. (There are significant points of similarity with the Swedish ArcCadastre system of the Lantmateriet.)

The next (and most complicated) stage of the project is the comprehensive, practical implementation of its improved (stable) version in the practical production. We (the enterprisers, system planners and developers) think that the system is clever, expedient and successful. But a really competent evaluation should be given by the users.

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BIOGRAPHICAL NOTES

Dr. Joseph Forrai was awarded M.Sc.(1974) and D.Sc.(1980) degrees at Technical University of Budapest, Hungary. Dr. Forrai was Lecturer and Senior Lecturer at TUBudapest, Tel Aviv University, Israel Institute of Technology (Technion) and Bar Ilan University (Tel Aviv) since 1976. Appointments at the Survey of Israel: Chief of Research Division (1987-1992); Head of Photogrammetry Department (1989-1993); Deputy Director General (1993-1994), Chief Scientist (1995-2003), Deputy Director General for cadastre (since 2003). Professional and research background (partial): crustal movement detection; photogrammetric data acquisition (national GIS topographic data base); permanent GPS station network; GPS support for geodynamics; improvement of national cadastral practice. Memberships of the Israeli Society of Photogrammetry and Remote Sensing (president between 1995-2001); Association of Licensed Surveyors in Israel (responsible for FIG relations); Israeli Cartographic Society.

Yohanan Gavish received his B.Sc. from the Technion – Israel Institute of Technology, Division of Geodetic Engineering in 1979. In 2001 he received his M.Sc. form the Technion, also in Geodetic Engineering. Since 1982 he has been with the Survey of Israel, where he was involved in cadastral measurements during the period 1983-1990. As a head of the GIS department since 1990, his main responsibility was the defining and building the Israel National Cadastral Database. In 2008 he was nominated as Deputy Director General of the Survey of Israel for Geo-information and Mapping.

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