TRANSITION FROM TWO-DIMENSIONAL LEGAL AND CADASTRAL REALITY TO A THREE-DIMENSIONAL ONE

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ABSTRACT

The problem of the intensive use of land and the growing demand for it in the central and northern parts of Israel has many aspects: social and political, economical and environmental. Other problems are more applicational and relate to engineering, planning, architecture and other topics. All these aspects have their judicial and technical context.

The Survey of Israel (SOI) is responsible for the technical aspects of rights to land registration in three dimensions. This responsibility consists of all the tasks relating to measurement, data processing, mapping, technical documentation and visualization for supporting spatial registration.

A two year long R&D plan proposed by SOI, and its rather complex interdisciplinary context is surveyed in the paper.

INTRODUCTION

Israel is a relatively small country. It's area is about 22 000 square kilometers (excluding West Bank and the Gaza-strip). The southern part of the country is a desert area, so some 95 percent of the population lives in the northern part of it. The general density of the population in the northern part of Israel (some 480 inhabitants per square kilometer) is higher then in Germany, Belgium, Japan or the Netherlands. The most dense population lives in Tel-Aviv district: 6660 inhabitants per square kilometer (*Central Bureau of Statistics, 1999*.)

The problem of the intensive use of land and the growing demand for it in the central and northern parts of Israel has many aspects: social and political, economical and environmental. Other problems are more applicational and relate to engineering, planning, architecture and other topics. This is the reason why discussions regarding land are in the focus of deep and essential debates within the Israeli society, either in the context of future use of agricultural areas (and the rights of the farmers to the land in various kinds of co-operative settlements), or with regard to the 'national' policy of land planning, zoning and building.

Israel's population rapidly increases as a result of two fundamental reasons: the relatively high birth rate and immigration. As a result of these factors, during 9 years of the past decade the population increased from 4 560 000 (at the beginning of 1990) to 6 041 000 (at the end of 1998). The expected trend is described in long-term development programs "Israel 2020" (*Mazor et al., 1993*), and "TAMA-35" (*State of Israel, 2000*). The number of inhabitants in Israel is predicted to reach 9 million in 2020, and 13 million in 2050, resulting in the total eradication of open space by that year. The proposed solution, enlarging and developing existing cities (like Nazareth, Haifa, Beer-Sheva and others) and their surroundings to so called "metropolises", has been confirmed by the government. This strategy of development will attract more and more inhabitants to the crowded urban areas, where land available for construction is limited and expensive even at the present.

For further urban development, the alternatives to the land surface are the space above the surface, the sub-surface and the shallow underwater areas along the sea - shore. The appearance of high buildings in the Israeli urban landscape, and the establishment of a number of artificial islands along the northern Mediterranean sea - coast prove the necessity and the economic merit of these two alternatives. The plans for an additional international airport next to Tel-Aviv shore are being seriously considered.

The third alternative, the underground development, has also been accelerated during the past years. However, the high cost of the construction and the lack of the registration of rights to underground property, often scare away the potential investors acting very carefully (*Lishar et al., 1996*).

The interest of the government in improving land use efficiency is clearly reflected in its resolution of 1999/144, declaring that "the Minister of Justice … is to submit proposed guidelines for implementing and amending legislation with the aim of facilitating more efficient land use, including subterranean space, and integrating several infrastructures and various applications in a single locality". The decision also decrees that "a solution

for ownership problems, registration of rights and surveying…" should be developed also for underground space. Another government resolution in mid 2000 is specifically dedicated to the necessity of practical solution of registration of rights in three dimensions. These resolutions resulted in an inter – ministry committee headed by the representative of the Ministry of Justice. An expert opinion was submitted to the committee (*Sandberg, 2000*), covering the legal aspects of the exploitation of the underground space in Israel, examining the necessity of additional legislation.

All these tasks have also their judicial context. In Israel, as in many western societies, there are legal arrangements regulating the way in which these problems are handled. There are different rules concerning planning and use of land (such as The law of Planning and Building, 1965), the procedures of land transactions (The Land Law, 1969), the acquisition and expropriation of land by the government and so on.

The Israeli land regime is unique in two remarkable characteristics: public ownership of about 93% of the land and the concept of central and governmental planning combined with free market attitudes towards any other property (*Alterman., 1999*). In this reality, it is small wonder that plans for almost any part of land, and especially in the more populated urban areas, are very complex and often confront both legal and political-social objections.

The existing cadastre in Israel is, of course, a two dimensional one (Doytsher et al., 2000). The transition to a three dimensional cadastral system demands a very careful, interdisciplinary procedure of research and development. More and more prominent persons of the governmental, public and private sectors realize, that for considerable improvement of underground land use efficiency, this transition is essential.

LEGAL BACKGROUND AND THE LEGAL CONTEXT

The Land Registration Office (Ministry of Justice) is the governmental unit which has the responsibility for registration of legal rights in real property. The scope of its activity is over the whole State of Israel and it operates through its regional offices. The basis for the legal right is The Land Law (1969). In the current legal state the right of ownership in a parcel spreads to the bottom of the earth, and to the sky, without preventing the passage in the sky (*Doytsher et al., 2001*).

In practice this legal concept has many exceptions. There are a number of laws that limit the owner right in the underground because of the existence of water, oil, minerals, antiquities, communication infrastructure and so on.

Because of historical reasons, Israel has a unique structure of land administration. As mentioned above, the government is the owner of about 93% of the land, which is leased to the public by various forms of short and long- term leasing. The Israel Land Administration is responsible for the communication with the lessees and for the marketing of land to the construction market for further development. This structure allows the government to maintain control of the construction market and adjust the supply of land to the changing needs and demands of the market.

The land settlement which began after the first world war covers about 95% of the area of the country. The rest is composed by the most problematic areas like old city centers, dense Arab villages, etc. A remarkable example is the old town of Acre, where the current land settlement procedure is facing the problem of property in strata.

In Acre city center ancient underground halls, roads, lanes and buildings are situated in the same vertical profile. Each of them belongs to a different owner. Yet, the appropriate techniques of registration have not been set.

The characteristic of the fast and massive development of Israel and the difficulties of adjusting both legal and registration reality are related to some other problems. One of them is the need to utilize public use of land, through a better and effective use of the underground space. This can be solved by combining public and private use of the same unit, especially in "mega-structures" (*State of Israel, 2001a*). Another evolving problem concerns the hazards of land pollution, which can be dealt with by the measure of "notice of warning". The existing legal cadastre, as one may say, is capable to deal with any complexity of registration. The right of ownership is the 'full' right. When using registration methods of secondary rights, such as leasing, notice of warning, notice of easement, etc., there is a way to 'mark' the existing and sometimes competing rights. These rights, in many cases, are only mentioned and not described in full.

As to structures under the surface, in many cases, the method of registration is using easement for the benefit of the state. The easement is registered after the legal proceedings and before the completion of the construction. Therefore, the information is not specified and, in many cases, is lacking the 'technical' or accurate and 'real' ("as made") details.

THE CARMEL TUNNELS – A CASE STUDY

The "Carmel Tunnels" is a transportation project aiming to solve the traffic problems in the busy city of Haifa, using tunnels to connect the entrances to the city from different directions. (See Figure No .1.) The importance of the project is obvious as Haifa serves as the major city in the North. Haifa has a busy commercial port, a small international airport, most of the governmental and public services and a very developed industry which attracts, every day, many workers from the neighboring cities. Thus, the project is due to have a vast economic effect and to improve the quality of life, both in the city (by reducing the number of vehicles passing through) and surroundings.

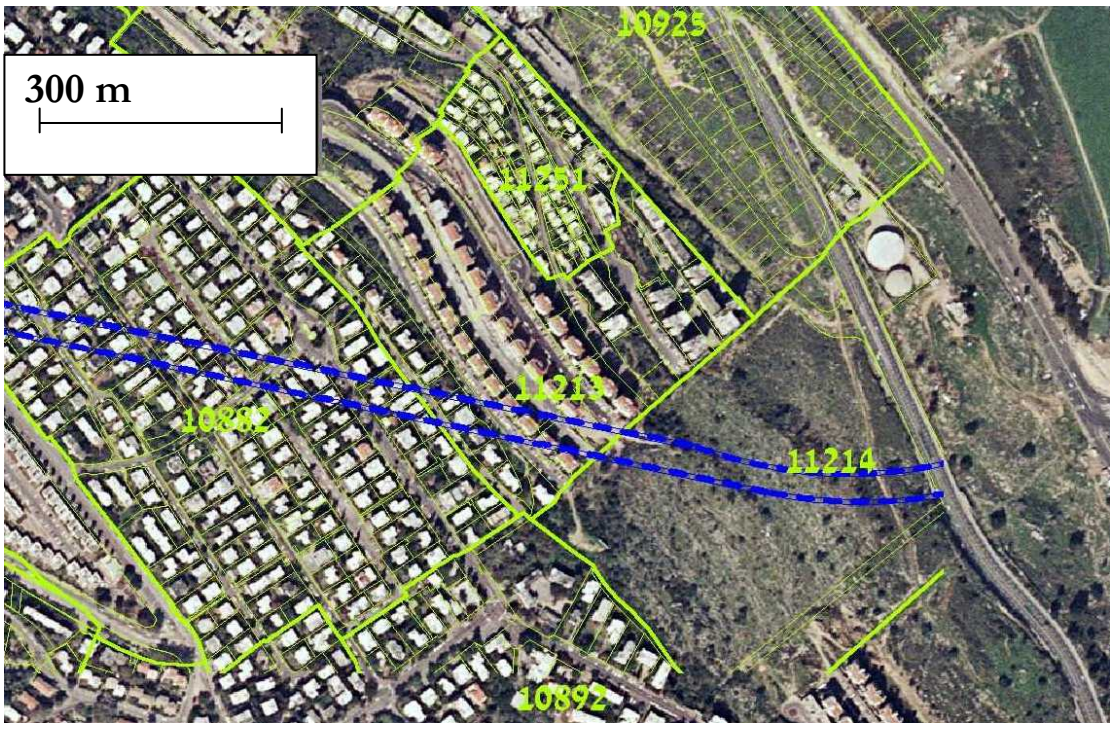

Figure 1: Orthophoto of a part of Haifa and the Carmel Tunnel layout (broken line), combined with blocks and parcels derived from the National GIS.

The project was initiated in 1993 as a B.O.T (build; operate; transfer) project and up to the time of writing this paper, the bureaucratic procedures are not over yet .On the contrary, the project was presented to the government during its recent discussion of the budget and the necessary structural changes in the Israeli economy (*State of Israel, 2001b*). Without covering the whole procedure concerning the Carmel Tunnels, we should mention the main problems that a project of that kind of magnitude raises: planning, proprietary, environmental and torts.

The registration tool used was a notice of easement, due to the state seizing and possession for a period of 99 years.

Planning proceedings are getting more and more complicated. More than 211 objections to the plan were submitted to the planning authority, attacking almost every detail of the proposed plan: aspects of the method chosen for the digging of the tunnels; its anticipated environmental influence, and the potential risk to the neighboring buildings (such as noise, dust, trembling, etc.) In order to make the proceedings coordinated and to make its hearing efficient an expert investigator was nominated to decide in all the objections.

Although the planning procedures have not been completed yet, the government had made expropriation orders (based on mandatory laws) and registered its right. These orders were the subject of a court judgment given on 22.11.2000 on the petition of the state of Israel (Ministry of Transportation) pleading to the court to order 97 citizens to "give underground rights of use and possession required for the excavation of tunnel". The order was given after a debate regarding the rules of expropriation for public use and their appropriate application in the circumstances of the case (*State of Israel v. Herzberg and Others, 2000*).

For the purpose of our paper it is very interesting to quote the (short) comment of the court with regard to the proprietary characteristic of the issue. After quoting the basic rule of the vertical expansion of the right of ownership the court states:

> *"…Thus the digging in the depth of the ground, under blocks and houses/dwellings, carries with it a damage to the right of owners. Naturally, the owners can not physically obey the order to give the possession regarding the depth of the ground, but, If the appealed order were not to be issued, they would have the right to protect their ownership and to prevent the contractor to enter the depth of the ground, to the land under their property."*
> *(The underline added. Free translation from Hebrew, by J.F. and G.K.)*

It is very interesting to notice that the court has granted the order although the description in the orders was lacking, by applying the detailed description in the proposed plan (which has not been confirmed yet). The order was limited and bordered to the proposed path of the tunnel; *"at least 30 m' under each building and 15 m' under each block"*.

It is also interesting to point out that the court's decision does include the possibility of 'real' damage to the owners property such as damage to the

building and to the further use of building rights above the ground surface. The court did not refer to the objections to the plan and the rights for compensation, questions which, as mentioned before, are to be handled by other proceedings.
There is news about the project almost every week. The most recent is (at the time of writing this paper) that the contractor's consortium of companies, which was chosen to carry out the project, is considering whether to use its contractual right to withdraw from it. Taking into concern the fact that the bidding procedures are long and complicated there is another risk of/ for further legal complication, litigation and additional delay. All of these and of course the compensation (if due) to the contractor means accumulated cost to the project and accumulated loss to the public.

No one can claim that the lack of 3d cadastre is the main reason for the enormous difficulties to execute this essential plan, as there are many other problems regarding excavating under so many existing houses (estimated number of 10 000 residents in the path of the tunnels). The fact is that we are dealing with "3D problems" in reality and even dealing with the delicate and complicated appraisal and proprietary problems through applying to courts, but without making a comprehensive and coherent legislative step.

THE SURVEY OF ISRAEL AND ITS ROLE IN THREE DIMENSIONAL CADASTRE

The Survey of Israel (SOI) is the governmental agency responsible for geodesy, topographic and cadastral mapping and the National Geographic Information System, as well as for licensing and instructing the geodetic and mapping professionals in Israel. These responsibilities were originally determined by the Survey Ordinance, published in 1929 during the British mandate in Palestine, and were applied to the surveying activities by the Survey of Palestine, the agency that preceded SOI. This document still serves as a valid law in the State of Israel. (The Survey Ordnance, 1929).

Based on the mandatory ordinance, the Israeli Minister of Construction and Housing, through SOI, periodically publishes surveying and mapping regulations. All surveying and mapping activities should be performed according to these regulations. They contain the main standards for surveying and mapping methods, measurements and data processing. The latest version of the regulations has been published in 1998 (*Forrai et al, 2001*).

According to the Survey Ordnance, the Survey of Israel is responsible for the whole cadastral surveying and mapping procedures in the country, including the changes in the existing cadastral status. Neither cadastral block

maps, nor mutation plans are judicially valid before the final approval of the Survey of Israel. This embracing cadastral responsibility of the SOI will undoubtedly be extended to the third dimension.

During the past decade, a topographic and cadastral National Geographic Information System has been developed in Israel (*Peled, 1995, Forrai et al., 1998*). The cadastral data base of the national GIS (NGIS), derived from cadastral block maps, is not judicially accepted for boundary re-establishment, but in practice it establishes the exclusive country-wide digital infrastructure of cadastre, and serves as an excellent tool for advanced land management and planning. The implementation of this digital GIS data as a legal digital cadastre is also under consideration (Steinberg, 2001). It is more then logical to assume that any practical three-dimensional cadastral solution should be integrated with the National GIS.

As in many cases, when new technology is going to be involved in professional practice, SOI shares its R&D tasks with the academic community. A number of problems (like literature review, relations between 3DCad and GIS, three dimensional topology, etc.) are already in various phases of research. The integrated framework, however, which will result in standards and regulations, should be carried out by medium-term, interdisciplinary R&D activity, related to a practical pilot project, as a relevant "case-study".

A PROPOSAL TO A 3DCAD R&D PROJECT

The existing legal cadastre in Israel is, a two dimensional graphical one. Consequently, all the cadastral regulations and standards are related to this reality (*Forrai et al, 2001*).

The main goal of the proposed project is the elaboration of regulations and standards regarding a digital, three-dimensional cadastral system, including registration of rights to properties in strata. During the project, we intend dealing with the following subjects:

- digital version of the existing 2D graphical cadastre
- complementing 2D cadastre with elevation data
- measurements and/or data processing and mapping in 3 dimensions
- analytical connection between subsurface-, surface- and above-surface units of property
- a model for global, 3DCad database relating to national GIS environment
- visualization of the 3DCad database
- documentation of the whole 3DCad procedure
- a proposal for registration procedure

From methodological point of view, the program is based on a pilot project. It will be completed in a planned area of a multi-layer and multipurpose transportation-, commercial- and residential center, where the three dimensional registration of the property rights is required in practice, in a brand new city named Modi'in (*Grinstein, 2001*). The pilot project will serve as a test case, and an experimental spatial registration will be carried out as an application output of the R&D project.

The project is planned to be carried out by leading experts in the following professional fields: cadastre, surveying, GIS, real property law, urban planning and underground engineering. Their activity will be guided and followed up by an inter-ministry steering committee, headed by the representative of SOI. The committee will be composed of the representatives of the Ministry of Justice, the Treasury, the Ministry of Infrastructure, Israel Land Administration, the Ministry of Construction and Housing and others. (See Fig.2.) The interdisciplinary manner of the planned activity aims to ensure optimal results and a better chance of practical application of 3D registration in the future.

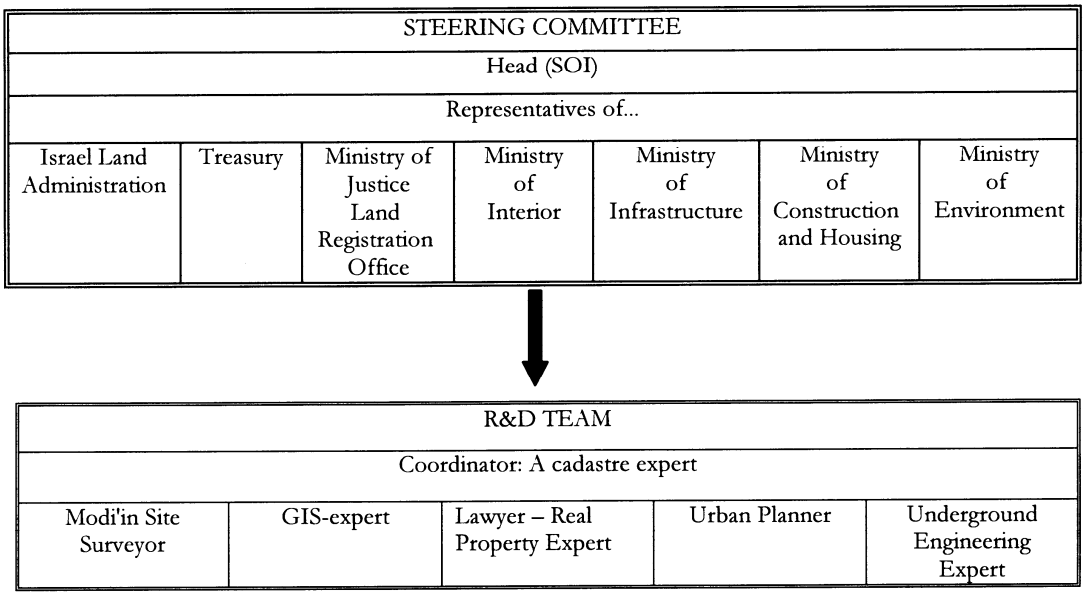

Figure 2: The steering committee and the R&D team of the project.

In Israel, the Ministry of Justice is responsible for rights to land registration. For this reason, the Land Registration Office (LRO) is a very important partner to SOI for the R&D project. As mentioned, SOI will develop the 3DCad facilities integrated with the cadastral database of the NGIS, and LRO should be connected to the GIS. Therefore, the development will be

carried out by coordinating the requirements of both organizations. As a part of the project, a proposal for GIS based, operational land registration technique will be prepared and passed on for consideration to the Ministry of Justice.

The 3DCad R&D plan is summarized in Table 1.

The assumed expenses of the R&D activity are composed of the experts salaries, who will be contracted, for about 10 000 working hours and the Modi'in pilot project costs. Our estimate is about 1 million US dollars cost over two year long period.

In the middle of 2001, the plan was presented to the Treasury for approval of its budget, and is under discussions at the time of writing this paper. No doubt that hard work of leading professional managers will be required to convince the Treasury. The main question of the Treasury is: what will be the total cost of introduction of a legal, three dimensional cadastre in Israel, and what are the expected incomes (private investments, taxes, etc.). Our opinion is, that the interdisciplinary steering committee and the participation of a Treasury representative in it will promote the achievement of a reliable estimate of cost/benefit ratio and other important economic parameters in national dimensions. However, as the Modi'in pilot project represents, a relatively "easy case" from the legal point of view, because the allocation of rights has not been defined yet and therefore no ownership rights will be influenced or restricted. It can serve as a model for future multi – purpose planning and registration. A gradual implementation of 3D cadastre in Israel might seem a solution to some of the legal, budgetary and administrative problems and yet will allow the use of both maximum technical and cadastral abilities.

The experts completing the program, will be supported by SOI, both with the existing geodetic, cadastral, GIS, etc. data and infrastructure, and human knowledge and experiment potential. A contracted GIS professional of LRO will also be involved in the development procedure.

TIME TABLE MONTHS / Disciplines	1-6	7-12
Cadastre expert	Standards for surveying and mapping, processing and managing of digital data in 2D and 3D, as preparation for Modi'in pilot project. **Product:** Initial 3DCad database	Completion of Modi'in pilot project (including surveying, data processing and mapping). Input of the data to the 3DCad database. **Product:** Real 3DCad data in 3DCad database
GIS expert	Integration of 3D data with NGIS Cadastral Database Establishment of 3DCad database **Product**: Initial 3DCad database	
Lawyer – real property expert	Study of the necessary changes in the existing surveying regulations with introducing the third dimension. **Product**: Proposal for changes of regulations	Study of problems which have arisen during Modi'in pilot project; Judicial/planning/engineering answers. **Product:** an improved version of all previous products.
Underground engineering expert	Study of engineering constraints, determination of standards. **Product:** An expert system, instructing the user according to the designation, status, etc. of the spatial land property.	
Urban planner	Study of planning constraints, determination of standards. **Product**: An expert system, instructing the user according to the designation, status, etc. of the spatial land property.	

TIME TABLE MONTHS / Disciplines	13-18	19-24
Cadastre expert	Adjustment between existing 2D and planned 3D cadastral data in Modi'in. Managing the data in the 3DCad database. Elaboration of the main principles of property registration in *strata*. **Products:** operational 3DCad database and proposals for its further improvement; initial proposal to spatial property registration.	Final revision of all previous standards; fixing principles and technical details (hardware, software, instructions, documentation, etc.) of the registration procedure. **Products:** final version of proposal of standards and instructions, both for 3DCad activity and registration procedure.
GIS expert	Improvement of the 3DCad database according to the above proposals. Visualization of the database content. **Products:** improved 3DCad database; operational module of visualization.	
Lawyer – real property expert	Support to elaboration of the principals of property registration procedure in *strata*, including documentation, information for costumers, etc. **Product**: continuous advising	Support to the final revision of previous standards and to the determination of the registration procedure **Product**: continuous advising
Underground engineering expert		
Urban planner		

Table 1: The 3DCad R&D plan.

SUMMARY
The three dimensional, efficient land use is a socio-economical and environmental necessity in Israel, where, especially in crowded urban areas, land available for further construction is limited and expensive. The free economy and the free market are able to give quick and flexible answers, but require rules and tools encouraging financial investments and guaranteeing a good chance for profit. One of these tools is the three dimensional cadastre system, including registration of property in *strata*.

Government resolutions guide the professionals to act in interdisciplinary teams, orienting them toward complex and coordinated solutions. Concerning the judicial and technology infrastructures existing in the country, the relevant professionals, with their knowledge and experience accumulated, are able to determine the operative tasks to be solved, and to complete them. Conservative ideas, bureaucracy, and the need to handle some other important problems (as the registration of some 600 000 flats which are registered in an 'unofficial' manner) may slow down the three dimensional cadastre procedure, but the strong economy and social needs of the private and public sectors will force its creation.

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