Modeling the Spatial and Legal Processes
in a Land Readjustment procedure in Greece

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Summary

The subject of the present paper titled "Modeling the Spatial and Legal Processes in a Land Readjustment procedure in Greece", is the modeling of the Land Readjustment processes which occur during the Urban Reconstruction. These processes concern the spatial transactions that are carried out in the real properties located in the study area and the changes in the real rights. The base for the development of the model is the techniques of object-oriented designing and specifically the use of a common language of modeling, known as Unified Language of Modeling (UML).

In the particular study, the processes that are executed during the implementation of a Land Readjustment procedure (Implementation Plan) in Greece are described as well as the way of regulation of real rights, the way that spatial transactions are realized and the role of expropriations as an intermediate phase.

Continuously, the three phases of the Implementation Plan as they take place in Greece are described as well as the processes that follow in each individual phase. Moreover, the spatial transactions that are realized in the study area and their results are mentioned and extensively described (for example, changes in the area and the shape of the real properties, changes in the land values, changes in the land use, changes in the way that legal rights applied in the real properties, etc).

Furthermore, the designing of the database that is used to record the data that are collected during the Land Readjustment was carried out using the Unified Modeling Language. The visualization of the database is ascribed by the static model and specifically by the static structure diagram, which allows the description of the spatial and descriptive entities and their inter-associations. Thereby, a completed model of the database of the Implementation Plan was resulted.

Finally, the conclusions which resulted from the conceptual and physical designing of the database of the Implementation Plan are formulated. Moreover, the direct benefits that emerge from the use of modern technologies (UML, XMI, GIS) and standards in the field of geosciences, are mentioned.

1. INTRODUCTION

One of the main problems in the urban development process is that existing property boundaries are in them a restriction as regards the optimum planning of an area. Moreover,

the cost for the equipment of the area with the basic urban infrastructure is one of the key issues that often public and local authorities are facing with.

Land Readjustment (LR) used in many countries around the world, including Germany, Japan, Taiwan, Korea, as an urban development technique which confronts in a very sufficient way the aforementioned issues.

Land Readjustment basically is a land reform system. Conceptually, it aims to take rural or unplanned urban land, usually irregularly subdivided, and re-allocate it in the required balance for public and private use according to town planning requirements (Yomralõoğlu, T., 1993). LR is a crucial land management tool in urban planning when suitable reformation of private land is necessary for residential purposes (Seele, W., 1992). It is a method by which the city government, other designated public bodies, even private associations can participate directly in the process of urbanisation and thereby share in its profits. The concept is a simple one. When there is a need to develop a suburban area, first, a site plan is prepared by the municipality. Then the area is subdivided into an appropriate pattern of streets, parks, schools, and sites for other uses. Within site blocks formed by the streets, new lots are allocated for private development. Public use areas are then determined by measuring the square meters in the planned streets, parks, and so forth and comparing it to the total area of the project. Each cadastral parcel is converted into building lots. After the project the city will be able to reorganise urban development, and at the same time, the private landholders will receive new lots which are as near to the same location as possible to their original land (*see* Fig. 1). (T.Yomralioglu - T. Tudes - B. Uzun - E. Eren, 1996).

Land Readjustment proved to be very sufficient – comparing to other conventional procedures such as the buying up of land, compulsory purchase, expropriation or gradual adjustment to a new plan for the area, at different phases of urbanisation, in the 20th century –a topic which has been widely and detailed investigated in the relevant literature. (Balla E., 2005).
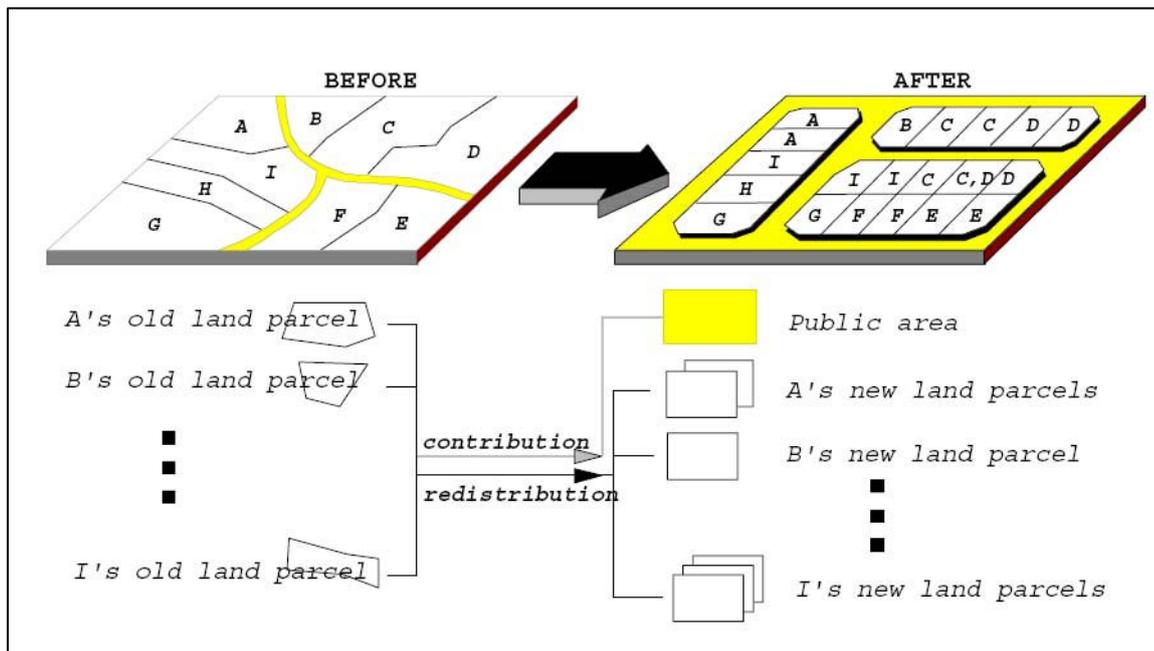
Figure 1. *Mechanism of Land Readjustment*

As it was mentioned the Land Readjustment (Implementation Plan) is a process that aims at intervention in the residential environment and the creation of attractive urban space.

This residential growth is achieved with the spatial changes that happen in the under study region. In each Extension or Reformation of region are realised various changes in environment space. These spatial changes, is possible to achieved or with conjunction of territorial parts or with exchange or with segmentation.

But spatial changes are not the only changes that could happen in the Implementation Plan. All these happen because exist certain laws and regulate these processes. Consequently the residential growth of region is not connected only with the territorial changes that are realised but also with the changes that are caused in the real rights with the action of application provided that these it is that connects the real estates with their owners.

2. SPATIAL AND REAL RIGHTS CHANGES IN LAND READJUSTMENT

Spatial Changes:

The term spatial change, means any change it can happen in somebody's parcel or it concerns change in the form, in the size or in the place of real property.

The most important spatial changes that happen in a region where is realised Land Readjustment are the following: (Tsigarda C., 2006).

1. The **abstraction of property because of street plan.** This procedure is the **removal of** a part of property for the creation of public spaces and facilities (roads, schools, green spaces or other community uses etc.) and it has as consequence the property it is became **smaller** than initial.

The **abstraction of property because of street plan** means land expropriation which is acted thanks to urban needs. It consists the administrative act which removes from the owner his property because the particular real property is occupied by public facilities, as these are determined by the city plan.

2. The **arrangement of** property which is realised in order to acquires the plot the minimal required front. As result of this action it is the **exchange of** spatial departments but probably and the **change of form** of the under arrangement plots.

The arrangement of plots, consists the exchange of spatial parts between their owners with a view in order that the settled plots acquire provision that would correspond more completely in the needs and the aim of their utilisation. It is incumbent upon when the settled spatial part, after the abstraction of property because of street plan, it hasn't the required front or depth. It is even imposed in the case where the settled plot has the appropriate area and dimensions but it has not the suitable form. If it is necessary, are allowed thanks to arrangement even the change of plots at the position, the form and their size, so each one plot acquires provision that corresponds more completely in the needs and the aim of utilisation of this and total of structured plots that is found in the same region and is conditioned by common provisions.

3. The **amalgamation of** property, with which is removed the property from the owner of real estate and is granted in the owner of other real estate. The amalgamation has

as consequence the **conjunction of** adjacent properties for the achievement of completeness.

The amalgamation is the transaction with which the ownership of real property, which after the abstraction of property because of street plan is became not building, because it is not complete or acquires form erratic or inadequate place, or is not fixable, is removed from his owner and is granted in the owner of other real property (neighbouring).   It is imposed, in three cases:

i.   When, afterwards the abstraction of property because of street plan, is created plot not complete because it remains in area (it is smaller).

ii.   When, afterwards the abstraction of property because of street plan, is created plot which is complete but not building because it has form erratic or does not have the suitable place (it is deprived front in communal space), etc.

iii.   When, afterwards the abstraction of property because of street plan, is created plot which has the required area but is deprived the required minimal dimensions of front or depth and thus is practically unfeasible its arrangement.

If the amalgamated plots are more from one, and of course they are adjoined, then they are amalgamated in or joined between them in order to shape one or more building plots. In these cases is allowed the amalgamation of not building plot in other more, after previously it is cut. The amalgamation of parcels is excluded if exist in them buildings.

The above changes it is possible they happen also in the revisions of urban planning (reformations) but also in the extensions of urban planning. Exists however a category of spatial changes that is able it happens only in the case of integration in the urban planning. And this category is:

4.   The **segmentation of** property, which is the **separation of** plot in more smaller plots. The segmentation of plot is allowed when the created smaller plots are all complete and building according to the being in effect urban provisions.

Real R7ights Changes:

Real right is the legal, direct and absolute, catholic or partial, power in thing or in foreigner right.

Then are reported most important forms of exercise of rights that they are: (Arvanitis A., 2000).

-   The **Ownership.** Usually it means the exclusive right of use parcel and the enjoyment of income from the utilization of land and the manufactures. Also it includes the right of the parcel's transfer in other person, mortgage and its renting.

-   The **Servitude** is the right of owner's parcel to use or to prohibit some form of use in one neighbouring parcel. The right is connected with parcel and it exists in force as long as it exists this.

-   The **Mortgage** is the right according to which the property is used as guarantee for the ensuring of money. If

the owner does not follow the terms of contract, then the lender has the right to cover by any chance losses of income with the acquisition of possession in the property.

-   The **Lease** gives in the lessee the right of parcel's use or part of it or of one bigger parcel for a limited time, according to the regulations that are in effect not only from the legislation but also from the contract with the lesser.

-   **Collective Rights.** Such rights are found frequent in systems where is dominated the collective possession of land but no exclusively in them.

-   The **Common or Community Rights** are important in a lot of countries, especially where the available land is abundant and its use, from a team covers an extensive region. In such cases the right of land's use and its resources, belongs in a team despite in the individuals of team.

The elaboration of Land Readjustment is realised with base the following main choices:

-   The real rights, which any person (natural or legal) could exercise in a real estate or a part of real estate, of course through a documental process (statement, submission of documents, control, objections, control of objections, possibility of resort in court, etc.) they are checked in their total for a region.

-   The real rights are connected with the real estates, specifically at the size and the place, via the unique number code of cadastral, having as result the correlation of rights with real property and persons.

-   The location and the size of real estates are defined with technical processes and specifically precisions, that are determined by technical specifications. These precisions lead to tolerances for the location of boundaries and the area of real estates.

The Land Readjustment is a cadastral process which includes three main parameters:

-   **The property's description**

-   **The owner and**

-   **The rights that are exercised in real estates**

Particularly it concerns the changes that became in these parameters, which have as aim the creation of an attractive urban environment.

The changes that happened in the real estates are possible to regard in the **abstraction of property** and accordingly in the creation of smaller parcel, in the **conjunction of adjacent properties** or even in the **change of location of real estate**, which is realised with the exchange of spatial parts because of the arrangement.

Also we should add the extensions of town planning where we have the property's segmentation, which is the partition of a plot in more parts.

The Land Readjustment is a process that caused not only changes in the already real estates, but it could create new real properties.

However changes do not exist only in the real estates but also in the rights that are exercised on them. This is expected
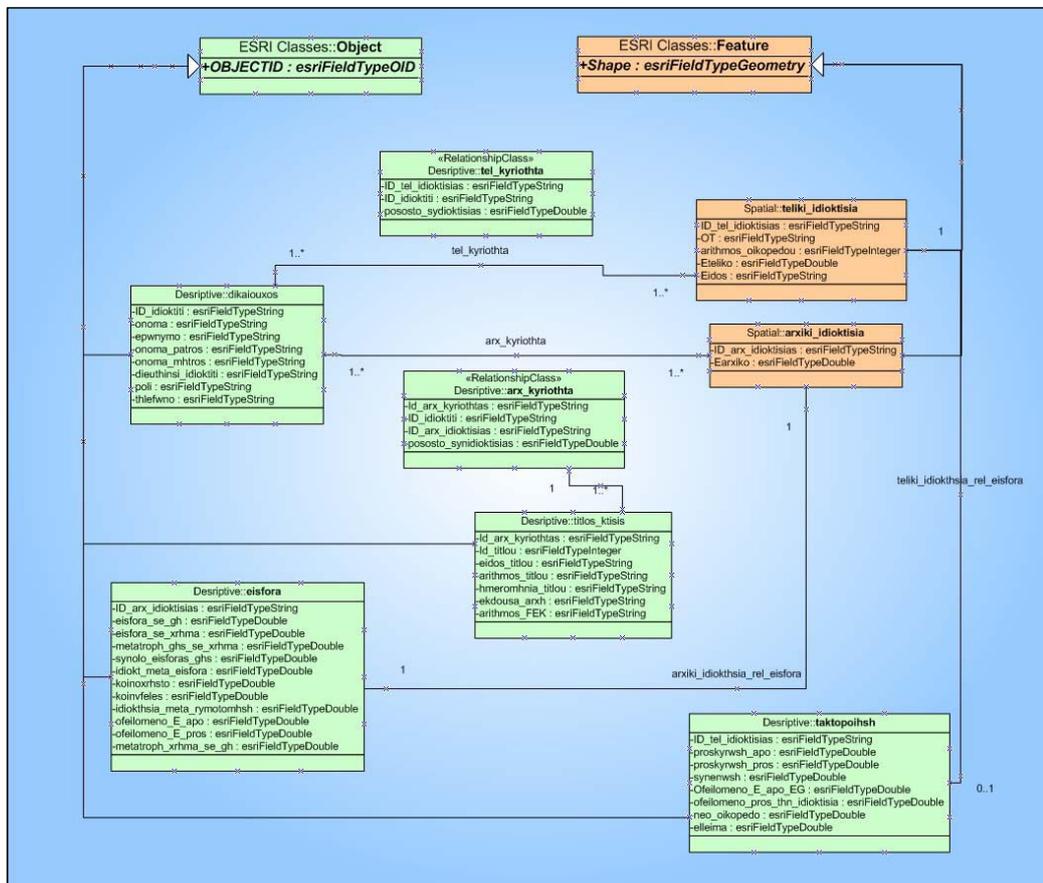
Figure 2. *Land Readjustment Data Model*

because **the real rights are connected with the real estates, specifically at the size and the location, via the unique number code of cadastral and that having as result the correlation of rights with real estates and persons.**

The changes which happened in real rights, related with two conditions:

- **The change of their application's place** and
- **The creation of new real rights** (provided that we have creation of new parcels).

3. DESIGNING THE LAND READJUSTMENT MODEL

Description and Analysis of the Land Readjustment data:

The data of Land Readjustment contain both spatial and descriptive information. The spatial data, initial and final properties, are topologically structured in polygons. The information related to the owners, the ownership titles, arrangement and contribution concerns the desciptive part of the information and is organized in tables.

- Initial Property (Spatial Data - Polygon)
- Final Property (Spatial Data - Polygon)

- Owner (Descriptive Data)
- Ownership Title (Descriptive Data)
- Arrangement (Descriptive Data)
- Contribution (Descriptive Data)

The representation in total of the classes and the relationships between them which correspond to the data of Implementation Plan using the appropriate mechanisms provided by the UML is presented in the diagram below.

Designing the Data Model:

The design of the data descriptive model for Land Readjustment has been done using as base, forms (templates) provided by ESRI that contain the objects necessary for the model construction which is then going to be reproduced and create the database in ArcGIS. These forms are publicly available for free on the Internet (*http://support.esri.com/ datamodels)* and the choice of the most appropriate one depends on the tool that is going to be used and its version. Specifically the model construction was based on Microsoft Visio 2003 thus the form used was ArcInfoUMLModel. For starters the form was inserted in the software package (File → Open → ArcInfoUMLModel) and then the model was created from the beginning.

The procedure mentioned above has been realized with

the use of the XMI standard. XMI is a standard for work distribution in XML format aiming to metadata exchange and system objects, reenforcing the systems' integration. It aids the object oriented analysis and design of the stereotypical behavior of model diagrams designed by the use of UML specifying an open information exchange model. This way it solves the interoperability problem between different applications providing a flexible system of standardized data exchange.

Using the XMI standard an attempt to exchange information embodied in the spatial data model of Land Readjustment and the spatial data collection, administration and processing software, ArcGIS by ESRI was made, leading to the creation of a database. For this to be possible the reconstruction of the model is demanded, by use of forms (templates) provided by ESRI in order for the model input to the software to be possible. This procedure allows the correlation of graphs representing spatial data and their relationships on the model with characteristics (Feature Classes) and also those that ascribe descriptive information (Object Classes) and the connections between them that ascribe the database structure of Land Readjustment in ArcGis. Basically from the initial model the database that is going to accommodate data collected during the Land Readjustment procedure is created. After that the user can input geographical data with great ease.

In further analysis the database implementation procedure modeled with UML consists of the steps below:
1. Model design using Unified Modeling Language.
2. Model extraction in XMI data files type.
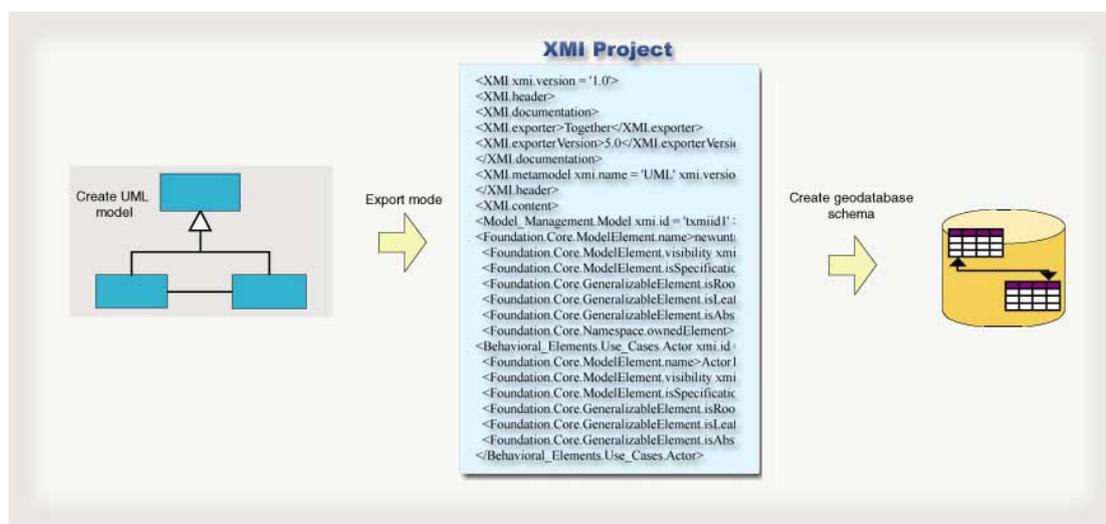3. Geodatabase schema creation in ArcGis.
4. Data input.

Figure 3. *The database implementation procedure modeled with UML (Sismanidis A.,2004)*

The format of the map produced after the data input in the various thematic layers and the proper configuration of the parameters mentioned above is represented in the figure below.
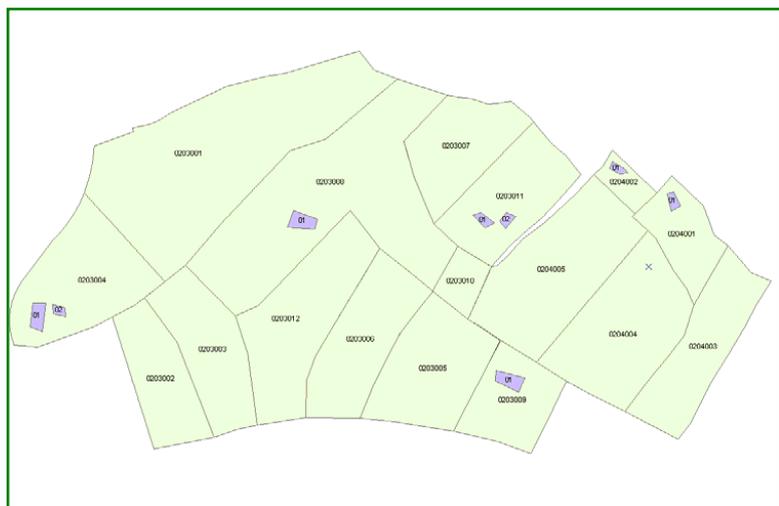

Figure 4.   *Initial properties map*

To continue the map of the final properties as they were shaped after the Land Readjustment application is presented.
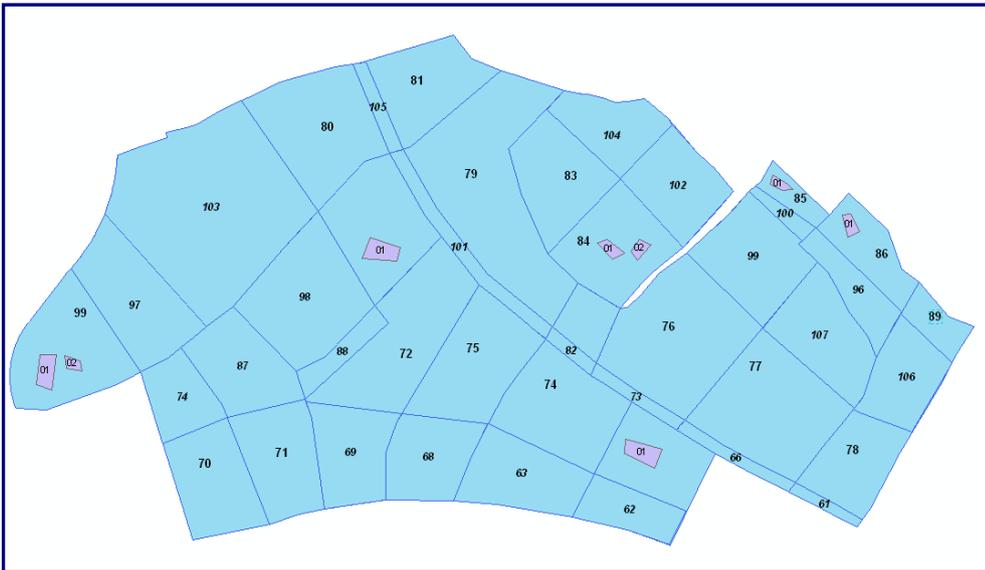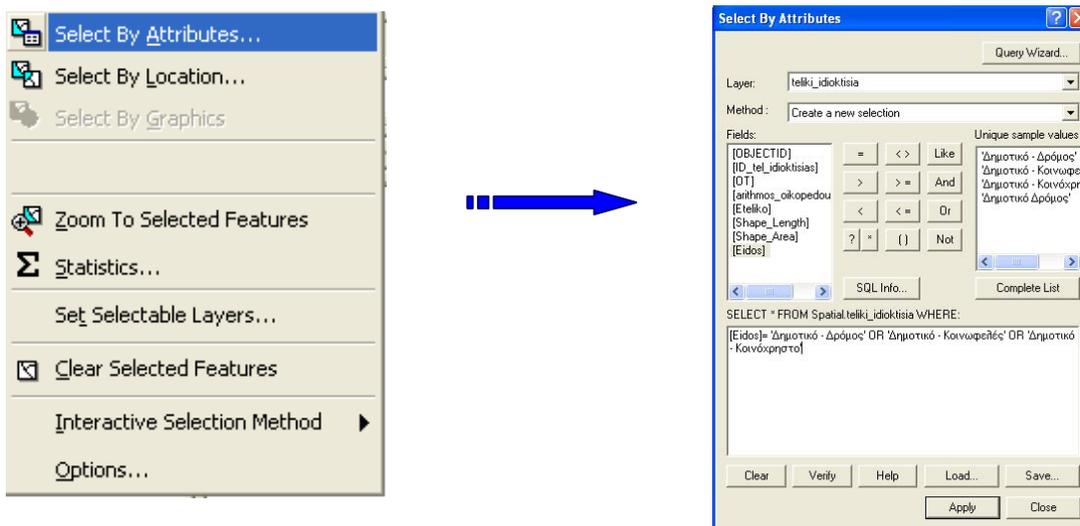

Figure 5. *Final properties map*

Municipal real estates that came up during the Land Readjustment procedure from the contribution of owners in land, are also considered final properties. The query below has been used to ascribe property sections that have been used for commonwealth constructions and installations.

QUERY FORM
SELECT FROM Spatial.teliki_idioktisia **WHERE**
[**Eidos**] = '*Dimotiko - Dromos*' OR '*Dimotiko - Koinofeles*' OR '*Dimotico - Koinoxristo*'
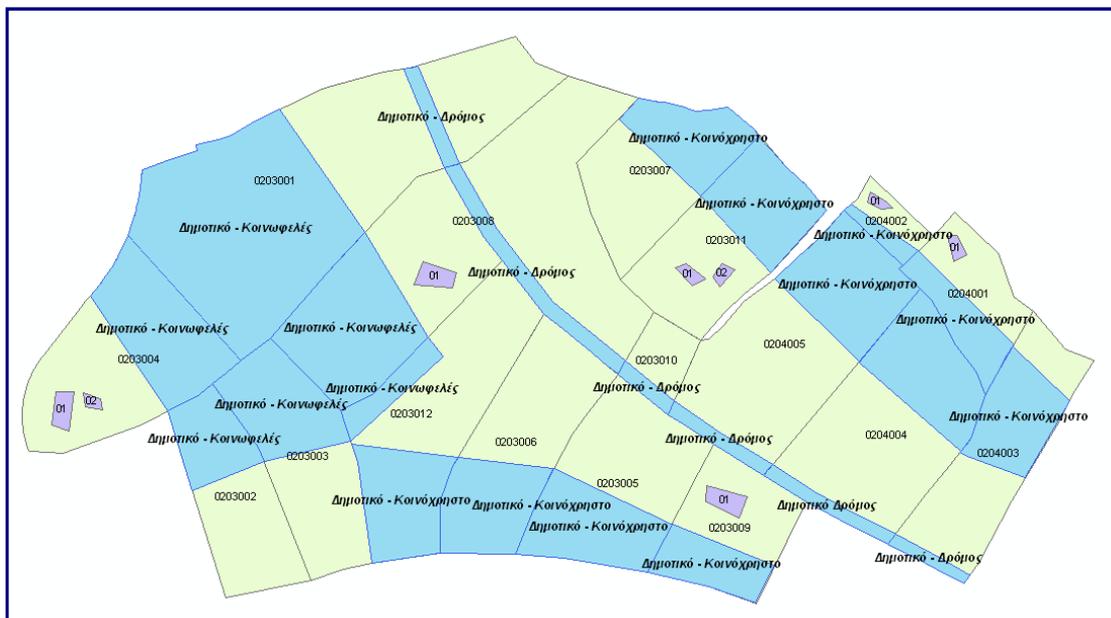
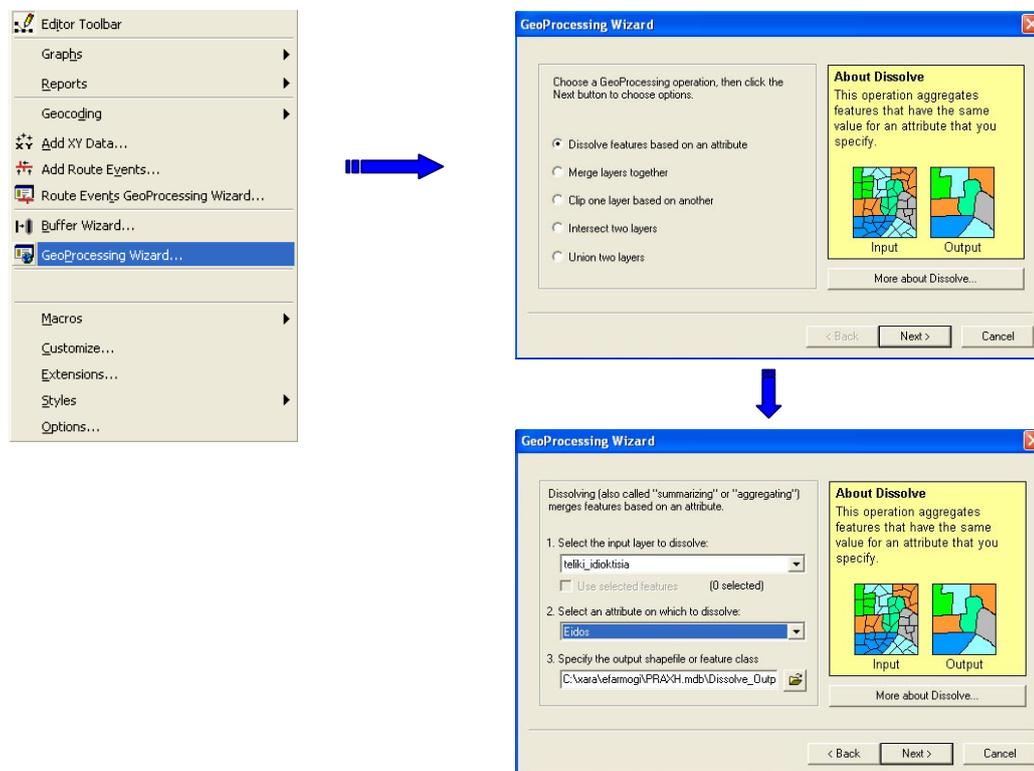Figure 6.   *Spatial Data Representation (Query)*

Figure 7.   *Aggregation query application*

With the use of the procedure presented in the figure above characteristics (features) of the final properties layer (teliki_id-ioktisia) are aggregated based on a field. As a result the total area of commonwealth and common use space from owners' contribution in land is calculated. **(Figure 8)**.
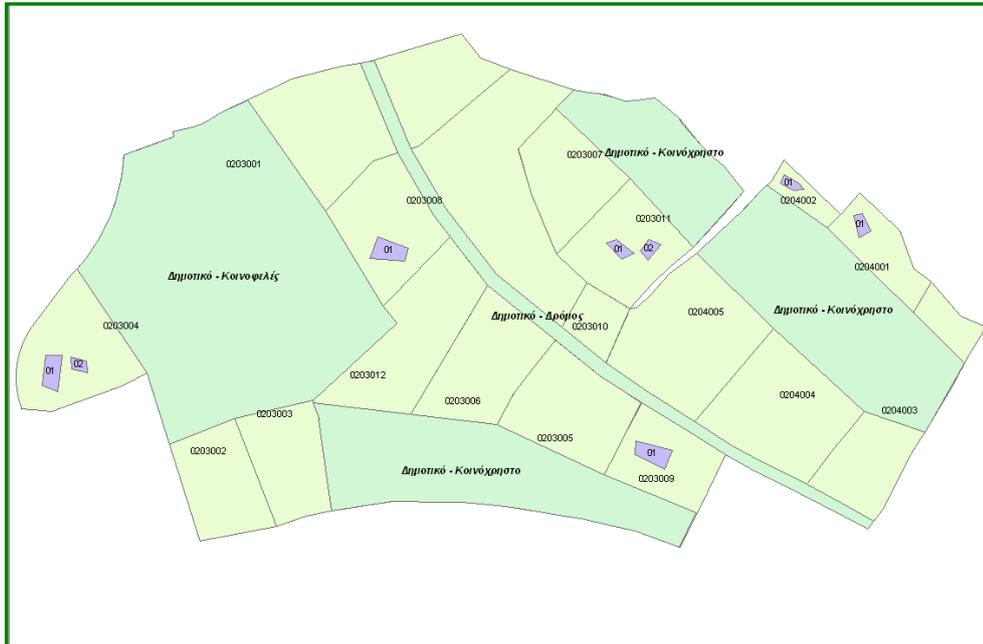
Figure 8. *Aggregation result*

4. CONCLUSIONS:

During the last few years object oriented logic continuously gains ground in modern applications and the development of the Unified Modeling Language (UML) has proved that it can stand as a capable tool for systems' modeling. It is the dominant diagram language in the design mostly of object oriented applications, giving the ability of visualization and development of complex systems and the definition and documentation of their requirements.

UML has been the powerful tool for modeling and developing the spatial and descriptive database of Land Readjustment, because it provided the basic symbolism for the diagrammatic representation of the its structure.

Designing the spatial data model for the Land Readjustment application using the Unified Modeling Language: (Sismanidis A., 2004).

- Improved the efficiency of work since it provided the appropriate tools for designing and representing the system's structure based upon internationally accepted standards.
- It comprised the basis for data exchange and also for the database contents, through its ability to cooperate with modern and widespread standards (XMI).

XMI specifies an open data exchange model thus making the exchange between different applications possible. Interoperability demands exchange of the model between users and applications without data loss.

Truly, during the data extraction process of the spatial model of Land Readjustment in the XMI format, a reusable data format came up which was then utilized for the production of the Land Readjustment database in a software package (ArcGIS) different from the one where the original model was designed (Ms.Visio). The standard was used as an open data exchange model, reinforcing work productivity and faster geodata exchange in an easier way and with lower cost.

Analyzing further the utilization of XMI architecture has:

- Drastically reduced the time consumed in distribution of the data contained in the spatial model of Land Readjustment designed using UML.
- Reduced the expenses of data exchange and transfer due to the reusability of the data (the database schema was produced automatically from the model).

Nevertheless, delays in the completion of the above procedure have been faced due to the incomplete support from companies for the tools they provide for XMI files input and output. Thus the finding of the appropriate applications was required in order for ArcGIS and Ms Visio packages to comply with the above file and data type. These tools are commonly known under the term add-ons and allow the input and output of files of the above type. It is though expected, due to the rapid increase of this standard's use in the last few years, the integration of such tools in the main software packages allowing the user to not resort in these procedures that usually bring problems and delays in work.

Finally, are presented the mainly issues of a Land Readjustment Procedure in Greece.

- Land Readjustment, in its current form, has been introduced in Greece, in 1979, as a modern instrument for the urban development of an area.
- The suspension of enforcement of 947/1979 law, and the enactment of 1337/1983 law from the first socialist gov-

ernment, was a determinant factor for the limited use of Land Readjustment in Greece.

- The 1983 Planning Law set as priority to incorporate illegally developed areas at the outskirts of existing urban regions, into the "Official Town Plan" following the provisions of Regulatory Building Conditions Zones.

Regarding the implementation of Land Readjustment in Greece, in the cases where Land Readjustment procedure has been followed, appeared a lot of problems which are relating mostly to the basic structural deficiencies of the planning system in the country, that is: (Arvanitis A., Balla E., 2005)

- Extreme time-delays in the procedures of elaboration, approval and implementation of plans
- Conflicting and scattered legal regulations and provisions considering the determination of land uses, the ownership status of public lands, forest areas etc.
- Fragmentation in competencies regarding different phases in the planning procedure
- Lack of experience and of a highly skilled technical staff in the key agencies such as public and local authorities
- And finally a confined political will of undertaking measures and policies which affect and limit the development rights of the landowners.

Land readjustment is a very elegant and economic instrument to realize urban development plans. This method of land exchange means no financial risk for the municipalities, because they do not have to purchase and to finance the original plots. Because land readjustment is just a plot exchange method, there is also no problem with privatization of the new plots with all those risks included. The land value increase from agricultural land to building land can be divided between landowner and municipality. The costs of urban development can be financed (at least partially). And if this instrument of sustainable urban development is implemented well, a partnership between landowner and municipality can be reached and guarantees a great benefit for both landowner and municipality. (Muller – Jokel R., 2004).

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