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Four Dimensional Cadastre Design

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ABSTRACT

Due to the need to know the vertical positions of the objects such as electric cables, natural gas pipelines, rain water network, drinking water network, sewer line, energy transmission line under and above the real estate, three dimensional cadastral studies have come to the fore. In addition, since the cadastre has a dynamic structure and is a living phenomenon, changes in both geometric and legal terms can occur continuously on the property. For this reason, it will be important to be able to monitor the changes that occur at different times on the real estate instantly and continuously. In time, to be able to systematically record transactions such as development plan implementation, land consolidation, cadastral renewal work, expropriation, renunciation for road, subdivision, amalgamation, acquisition from road, land use conversion, distraint, mortgage, to be able to integration of the immovable into TAKBIS together with the objects under and above the property and in order to monitor all these processes in four dimensions, a fourth dimension, which we call time, is needed in the cadastre. Thus, changes occurring in the cadastre will can be monitored instantly in a four-dimensional environment.

1. INTRODUCTION

The relationship between human and soil has a very dynamic structure and human has a limited time to live. Besides the spatial aspect of the rights and restrictions of real estate, the fourth dimension, the temporal aspect, is an important aspect of cadastral registration. Rights, responsibilities and restrictions have a temporal element. One of the reasons for the need for four-dimensional cadastral information is that a date record is required for a particular property. Time always plays an important role in cadastral systems (Van Oosterom et al., 2006).

Temporal Land Registry and Cadastre data are heavily needed in our country. Land Registry and Cadastre data are constantly changing over time as a result of applications such as subdivision, development plan implementation, sales, donations, mortgages (Alkan & Cömert, 2005).

Temporal cadastral data is an important component for land management, public and private sectors and has a dynamic structure. Therefore, the land registry and cadastre system plays an important role together in a country (Alkan & Polat, 2017).

Land Registry and Cadastre Information System (TAKBİS) project, initiated by the General Directorate of Land Registry and Cadastre, constitutes one of the transaction steps of Cadastre-2014. In addition, since the cadastre is a living phenomenon, the importance of the time factor, which is the fourth dimension, increases (Çay et al., 2007).

Visualizing changes over time requires specific techniques in a geographic query tool (Van Oosterom, 1997). Advanced visualization techniques to show data based on space and time can apply as a time dimension in the future (Van Oosterom et al., 2002).

Geographical data are constantly changing over time. Therefore, the need to monitor, analyze and query the time-dependent changes of these data has brought the temporal geographical information system to the agenda (Alkan, 2005).

Four dimensional cadastral schema is given in Figure 1. The four-dimensional cadastre concept is formed by adding the time dimension to the third

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dimension. In other words, there is no fourth dimension without a three-dimensional cadastre.

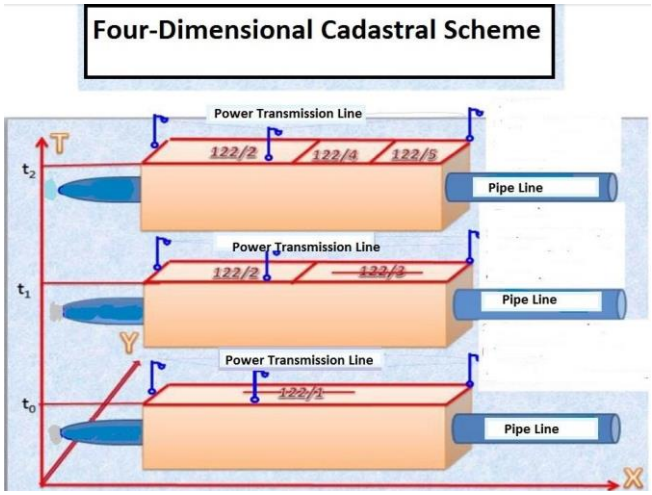

Figure 1. Four Dimensional Cadastre Schema

The importance and necessity of three- and four-dimensional cadastre in international platforms are carried out by FIG and emphasized in the 2014 and 2034 cadastral visions (Sürmeneli et al., 2018).

In the 3rd article of the Cadastre 2034 vision, the concept of "3D and 4D (3D + Time) Cadastre for land modeling, management, integration of property data and sustainability analysis" is discussed. In other words, the "Four Dimensional Cadastre" study takes its place among the targets of 2034.

In the 4th article of the Cadastre 2034 vision, the concept of "continuous updating of cadastral data and instant access to cadastral information" is also discussed. Here, the expression of instant updating of cadastral data means the fourth dimension of cadastre, the concept of time.

In our country, Land Registry and Cadastre Information System by the Land Registry and Cadastre General Directorate (TAKBIS), Land Registry Archive Information System (TARBİS), Spatial Property System (MEGSİS), Turkey's National Geographical Information System (TUCBS), Map Data Bank (HBB) and TUSAGA-ACTIVE Since the projects have been completed, an important step has been taken in reaching the 2034 vision of Cadastre (Döner & Bıyık, 2013).

TAKBİS 2020 vision studies are carried out in order to eliminate the deficiencies in TAKBİS. Thanks to this vision, data quality will be improved, temporal changes of spatial data will be monitored and a data infrastructure suitable for multidimensional cadastre will be established (Dursun et al., 2019).

In this study, four-dimensional cadastral design will be focused on as of today. Suggestions will be developed to eliminate the traditional problems of the cadastre and to enrich its content. In this study, with the vision of Cadastre 2014, the changes in the field of cadastre in the world and in our country will be examined, the missing situations will be determined and the necessary work to be done to reach the Cadastre 2034 vision will be discussed together with the four-dimensional cadastre.

The aim of this study is to create a system that will allow the changes in land registry and cadastre to be monitored instantly in four dimensions, together with the time dimension.

2. METHOD

In this study, the city map of the study area, parceling plan, science folders, land registers, implementary development plans, spatial data of illegal and licensed buildings, orthophoto map, drinking water, rain water, sewage and natural gas line network constitute the material part of the study.

The method used in this study; It is the four-dimensional modeling of the land by instantly and continuously entering the geometric and legal changes occurring in the study area into the database.

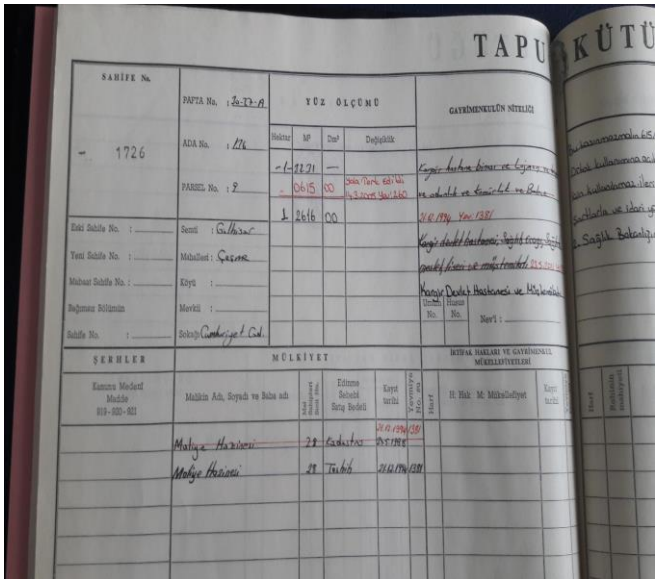

Figure 2. Land Registry of Immovables

An example of a land registry belonging to immovables show in Figure 2. In this study it is aimed to enter the information in the land registry records of the immovables that are within the scope of the study area, since the first facility cadastre, to the database and to monitor the changes that occur in the immovable properties instantly. Thus, the registration date and journal numbers of the changes occurring in the immovables, the rights and restrictions on the immovables will be monitored in four dimensions.

In Figure 3, the fourth dimension of the cadastre, the concept of time, is shown by entering the changes in the land registry chronologically into the database.

In Figure 4, the buildings forming the third dimension of the cadastre, objects such as natural gas, rain water, drinking water, sewage and energy transmission line located on or under the parcels will be combined with the time concept which is the fourth dimension of the cadastre. So a four dimensional cadastral design will be obtained.

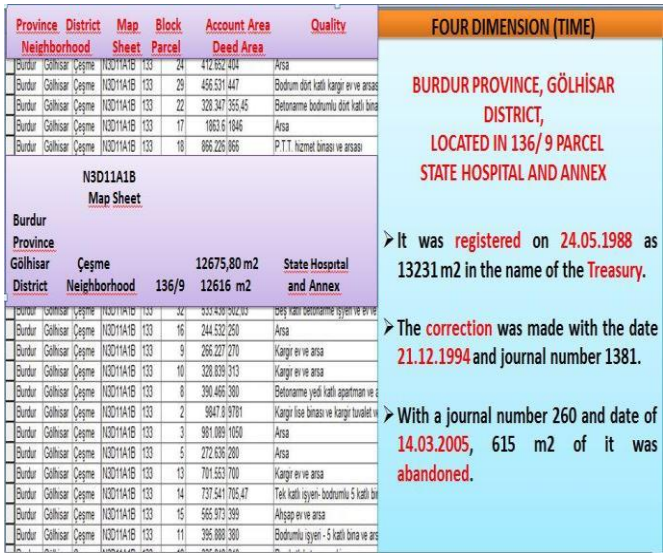

Figure 3. The concept of the fourth dimension

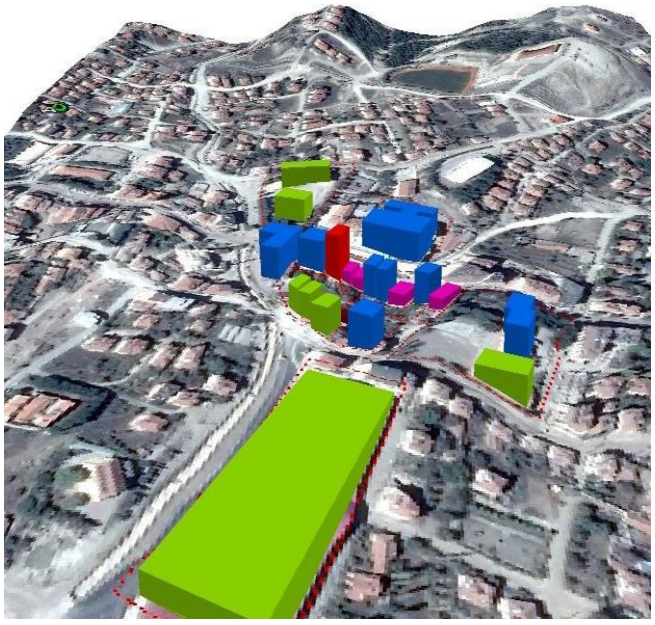

Figure 4. Three Dimensional View of Buildings

3. RESULTS

In Figure 4, the buildings are colored according to the number of floors. In addition to coloring according to the number of floors, it is possible to make classifications according to the license status, age and qualifications of the buildings. In this system, by adding new columns to the database, it can be shown what kind of changes the parcels in the study area are exposed to over time. By showing the processes such as development plan implementation, subdivision, amalgamation, renunciation for road, land use conversion, acqisition from road, expropriation, land consolidation in chronological order, the cadastre will gain a fourth dimension.

4. DISCUSSION

Public institutions and organizations that need to temporal data of immovable property in Turkey is shown in Figure 5. With the addition of the fourth dimension, the concept of time, to the cadastre, all documents related to the real estate will be recorded in four dimensions in digital environment, so document loss will be prevented to a great extent with duplicate processing. For example, in relation to a development plan implementation process made in the past, information such as when the implementation was registered, which municipal committee decisions were taken on which date, when the subdivision was arranged in which parcels, and which foot note were placed may be needed by public institutions and organizations. At the same time, the energy transmission lines on the parcel and the three-dimensional coordinates of the underground sewage, drinking water, rain water and natural gas networks may be needed.

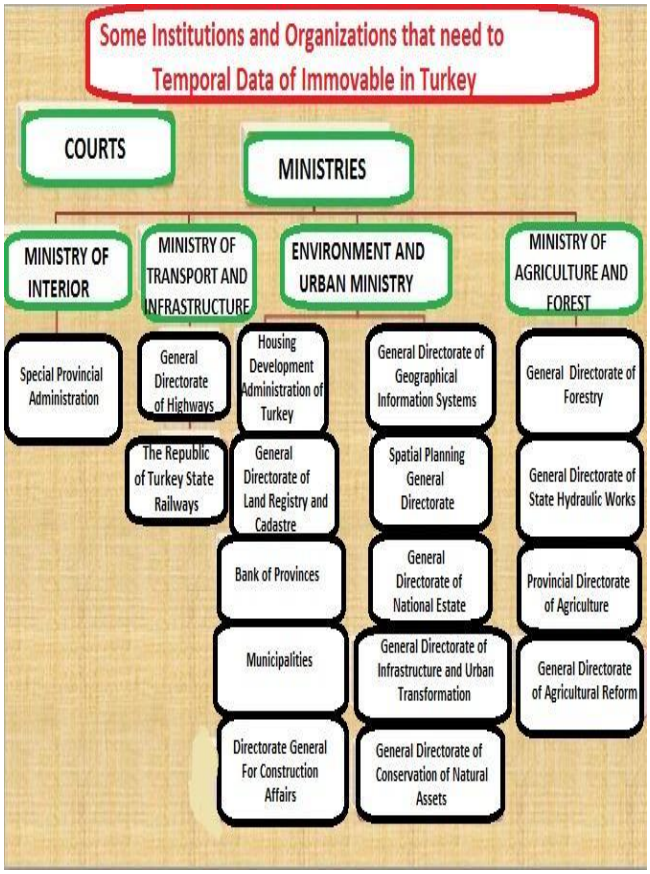

Figure 5. The institutions which need to temporal data in Turkey

5. CONCLUSION

After the parcels are processed on the three-dimensional digital land model, with the addition of buildings on it, all kinds of query and analysis operations will be made possible with the attribute information in the database.

Since time dimension will be used in four-dimensional cadastral studies, advanced technological devices will be needed. Three-dimensional photographs of the work area should be taken with high-resolution aerial cameras at certain periods and changes that occur over time should be easily monitored. Three-dimensional photographs taken with these high

resolution cameras should be analyzed with a quality software program designed for this purpose.

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