Problems and Solution Proposals in Integration of Cadastral Data into Geographical Information System (GIS) in Turkey

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1. INTRODUCTION

Being one of the outcomes of developing information technologies the Information Systems can be briefly defined as a tool that can be used in performing specified goals. The benefits of information system can be summarized as to be the more effective usage of spatial and non-spatial information that is included into the system to fulfill the specified goal for planning, service, management, control etc. subjects.

Founding and applying Geographical Information System are the most popular working areas nowadays, in Turkey. Projects that are started by different institutions are developed rapidly and they are described as GIS and Urban Information System (UIS) like E-Goverment, MERNIS (Central Population Information System) project and TAKBIS (Turkish Land Registary and Cadastre Information System) project, etc.

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As defined by FIG (International Federation of Surveyors), the cadastre should be the base of all planning and projecting studies. In other words, the main base of Geographical Information Systems (system based on position) that were planned to be formed should be the cadastral data. It is evident that the inclusion of a land whose owner is not known will not overlap with the goals of Information System.

The integration of property data into the system is the biggest problem of the system that will be formed. Because the cadastral maps showing the geometrical position of property data were produced with different laws and regulations from past to today and they are still being used. In the study, benefiting from digitizing process in transferring cadastral data into the system was taken as the basic principle, however the possible problems to be met were determined and their solution suggestions were given.

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2. A GENERAL OVERVIEW TO CADASTRAL STUDIES AND PRODUCED MAPS IN TURKEY

2.1 Cadastral Studies in Turkey

General Directorate of Turkish Land Registry and Cadastre performs the cadastral survey services in Turkey and fulfills its services as Central and Rural Organizations. The rural organization involves 22 Regional Directorates, 1003 Directorates of Land Registry and 325 Cadastre Directorates. The cadastral studies have been completed in 98 % ratio in urban areas and 65 % ratio in rural areas. The improvement studies are also in 15 % level. The condition of cadastral studies throughout the country is summarized in Table 1.

	PRESENT	FINISHED	EXPLANATION
NUMBER OF TOTAL CITY	81	79	
NUMBER OF TOTAL TOWN	950	794	127 CENTRAL TOWN

Table1. Present Condition of Cadastral Studies in Turkey

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The cadastral studies in Turkey are all property cadastre. The enacted and applied laws for cadastral studies from Ottoman time until today have determined the expectations and changed goals. The goal variations in cadastral studies in our country are represented in (Figure 1).

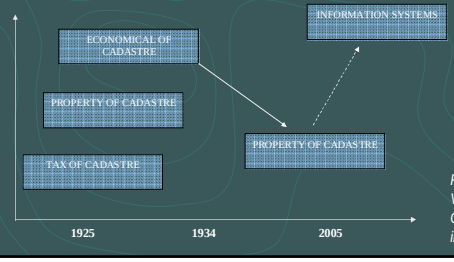

Figure 1. Goal Variations in Cadastral Studies in Turkey

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2.2 Maps Produced in Turkey and Their Characteristics

Maps produced as the outcomes of cadastral studies performed from past till today in Turkey can be classified as in Figure 2.

Figure 2. Classifications of Cadastral Maps According to Production Techniques

Number and base species of maps which are seen from the figure can be sumerized like this:

According to producing methods ;

Produced with photogrammetric method	42374
Produced with prismatic method	45389
Produced with polar method	53318
Produced with digital method	12916
Produced with graphical method	110710
TOTAL	264707

According to base species ;

Astrolon	65684
Diazo	444
Tracing Paper	632
Film	81012
Oilcloth	116935
TOTAL	264707

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3. INTEGRATION OF CADASTRAL DATA INTO THE SYSTEM

Transferring data into system in other words, database formation process is the most important process in GIS studies. This process takes more time and reaches the 65-70% of system cost. Cadastral data explains the digital and attribute information belonging to the earth. Spatial data can be included into the system with classical and photogrammetric measurements or by the help of the satellite views or digitizing processes from existing maps. In this study, digitizing process is taken into consideration.

Property data should be accurately transferred into numerical format and integrated into the system for GIS systems. In Turkey, cadastral maps produced with various methods are still being used (Examples of spatial maps that produced for urban and rural areas are shown in Figure 3). In the maps produced with various methods, the determination process of geometrical conditions of real estates varies due to applied legal regulations, measurement devices used in measuring, method and technology used in calculation and drawing. Therefore, it is known that produced maps have technical errors besides differences in point position accuracy.

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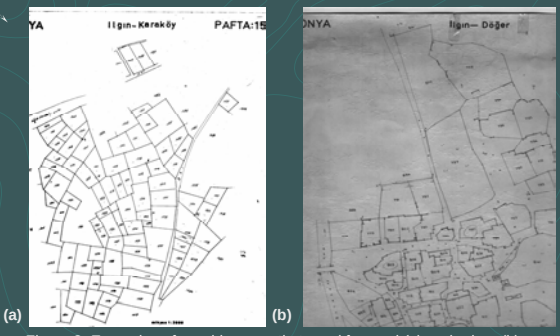

Figure 3. Examples of graphic maps that used for rural (a) and urban (b) areas

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As it is observed from Figure 4, the integration process of cadastral data into the system can be sorted as error investigation of cadastral maps, digitizing process and providing coordinate accordance. During digitizing of cadastral maps, the determination and correction of technical errors will affect the accuracy of digitizing process. Providing coordinate accordance and transforming into national coordinate system after digitizing process is necessary for integration.

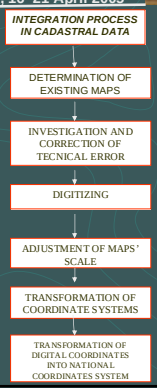

Figure 4. Integration Process of Cadastral Data into the System

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3.1 Presence Investigation and Elimination of Technical Errors

Cadastral studies are carried out with classical and photogrammetrical measurement methods. The classical method process is formed from bounding and measurement stages. The technical errors that can appear during and after measurement can be classified in three groups;

1.Measurement Errors
- Prismatic measurement errors,
- Tacheometric measurement errors,
- Digital measurement errors,

2.Drawing Errors

3.Calculation Errors

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Measurement errors are caused from devices (for ex: prism, tacheometry electronic telemeter, etc.) that will be used in the method. In prismatic method, measurement sketches should be controlled in order to determine the measurement errors. Side controls should be made by prismatic measurement method applied on the lines formed between polygon points.

The drawing errors are caused from incomplete or wrong points during the drawing of measurement values into the sheet. They are being corrected according to 41st clause.

The calculation errors are generally met in area calculations made by planimeter. There occur errors due to carelessness in area calculations that are made digitally or with Thomson Formulas. The elimination of this type of errors is made with 1458 and 1994/5 numbered regulations.

3.2 Digitizing Process

Information system functions are seen in data collection, processing and presentation manners. Data should be integrated into the system digitally.

3.3 Providing Coordinate Accordance

Present cadastral maps are produced in various scales with various coordinate systems. Providing scale and coordinate accordance between maps is extremely important. The coordinate values obtained by digitizing process are local coordinate values determined on digitizer. During digitizing process, although partial transformation is made with the help of grid lines of the sheet, the integration process will be completed after connecting all the spatial data that is collected in the database to the national system then the spatial data will become meaningful.

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4. PROBLEMS DURING INTEGRATION PROCESS AND SOLUTION SUGGESTIONS

The determination of problems met during the integration process of cadastral data into the system and investigation results directed towards solutions are given in the following;

- In order to be successful in Information System studies in Turkey, present conditions of cadastral studies and problem resources in cadastre should be improved before all else by making investigations.
- Especially for permanent and reliable solutions of technical problems, existing network should be improved and the obligation of connection to TUTGA Network (Turkish National Fundamental GPS Network) should be provided. The transformation parameters that will provide transformation between ED-50 (Europe Datum 1950) and TUTGA-99 with sufficient accuracy should be obtained.

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- The digitizing process should be accelerated throughout the country for the integration process of Information System, since huge amount of cadastral data is not in digital format in Turkey.
- During digitizing process, it should be decided whether cadastral data would be transferred into the system according to temporary coordinate data or national coordinate system that will be obtained by making land investigation with the help of these data.
- The regulation should be reviewed since performing digitizing process according to existing laws is far from being practical.
- There should be made legal regulations to provide easiness to applicants while regulating the technical errors that will be met during digitizing process of cadastral data.
- The truly determination of technical error regulations of property position carries the mean of eliminating wrong presentation caused from administration (Cadastre Law 41st clause) and since this contradicts with clause 645 of Civil Code, it should be reviewed.

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- The error limit of The Standards of Producing Large Scale Maps should be re-determined after reviewing the coordinate and position tolerances given to the contractor and position error caused from prismatic measurement.
- Map production precision should be 0.2 mm. according to The Standards of Producing Large Scale Maps. Changing this precision as 0.5 mm by thinking map production techniques will contribute to perform the processes faster.
- The point position error of ±10cm determined in The Standards of Producing Large Scale Maps is found to be satisfied only in the maps produced with digital method.

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- The calculations should be controlled in the 2nd coordinate system due to the precision expected from the study, since there can occur errors during the transformation of local coordinate values in various systems into another system.
- Helmert coordinate transformation is determined to be more appropriate for not large areas in Turkey in making transformation between coordinate systems of cadastral studies.
- The coordinate transformation with single parameter is found to be unreliable for transformations of coordinate systems in large areas like urban areas, since error ratio increases when going away from the center of gravity of common points and it is concluded that different parameters should be used in different regions.
- The usage of Affin transformation method will be useful for the transformation of coordinate values obtained from digitizer table or scanners into local coordinate values.

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5.CONCLUSION

The cadastral studies in Turkey are continuing and the completion period of them cannot be indicated definitely. In order to complete the cadastral studies, the usage of Digital Photogrammetry and GPS (Global Positioning System) measurements in detail measurement will accelerate the studies especially in rural areas. It is known that cadastral data does not have the same standards since they were obtained from the maps produced with different techniques and methods in the regions where cadastral surveys were completed.

Well perception of existing condition of cadastral data group necessary to be integrated into the system, determination and elimination of possible errors and providing coordinate accordance are extremely important in the formation studies of Information Systems. New legal regulations are required to accelerate the digitizing studies and elimination of technical errors.

Without eliminating problems, the National or Urban Geographical Information Systems will not reach its goals as it is planned to be established.

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