Opportunities and Constraints to Develop Geographic Data Models for Land Administration in Turkey

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Abstract

Geographic Data supports decision making in various application areas from land administration and planning to environment and agriculture. Developing Geo-ICT technologies have resulted in increasing the use of digital geographic data. While early Geographic Information Systems (GIS) were largely designed to serve specific projects or user communities, Spatial Data Infrastructure (SDI) encompasses policies, technologies, human resources for the effective collection, management, access of GI to stimulate better governance, and to foster environmental sustainability by reducing duplication and facilitating integration at different administrative levels and across different sectors. To make a land administration system socially credible and functional, land-related information should be registered and structured at a detailed spatial level, such as the parcel and address level. In Turkey, there is not yet an integrated structure to manage key registers -parcel, address, building, and citizenship data in a harmonized way and no standardized approach to cope with application-driven requirements of public institutions. For example; the Interior Ministry is in the process to combine the databases of National Address Database (UAVT) and National Citizenship System (MERNIS). And, also Building Following System is being built to work with these systems under responsibility of municipalities. Land Registry and Cadastre Information System (TAKBİS) are in the process to be built in all cadastre directorates of Turkey. In addition to this, GIS projects executed in local governments, cadastre directorates, municipalities, and public institutions were not designed to enable data interoperability because they use different conceptual models and feature catalogs. In this study, the importance and use of registers in a harmonized way is examined. Standardization needs are determined as for example in the domain model for Land Administration. Legal status and current projects for key registers of Turkey are analyzed. Opportunities and constraints to develop geographic data models are determined and explained with case studies.

Keywords: Key Registers, Land Administration

1. INTRODUCTION

Using geographic information corporately provides noteworthy benefits to environmental, social, and economic context for sustainable management of urban areas under responsibility of local governments and municipalities. The lack of interoperable geographic information hampers cooperation among local governments and decision making at other levels. The limited availability of the data are the result from barriers such as organizational, legal, technology issues, and differences in data content such as data models and specifications (Craglia, 2004, Ting, 2003, Annoni, 2002, EUROSTAT, 2008). While GIS is largely designed to serve specific projects or user communities, the focus is now increasingly shifting to the challenges associated with integrating these systems into a society perspective (Georgiadau, 2003). As a result of these expectations beyond GIS, Geographic Information or Spatial Data Infrastructure (GII/SDI) encompasses policies, technologies, standards for the effective collection, management, and access of geographic data to stimulate better governance, and to foster environmental sustainability by reducing duplication and

facilitating integration at different administrative levels (INSPIRE, 2007, Nebert, 2004). This also enables maintained links between geographic data and other key registers, for example; addresses, persons, companies, buildings, land rights, etc.

According to the Cookbook of Global SDI Association, the development of consistent reusable geo-data themes is recognized as a common ingredient and beginning phase in the building of GII (Nebert, 2004). Open Geospatial Consortium (OGC) and International Standardization Organization/Technical Committee 211 (ISO/TC211) Geo-Information/Geomatics have developed a variety of standards in this area. The Infrastructure for Spatial Information in Europe (INSPIRE) Directive was agreed to produce harmonized models of 34 different data themes such as administrative unit, address, and various topographic themes (transportation, hydrography, height, buildings) to deliver for 27 countries of the European Union (EU). US Department of Homeland Security (DHS) Geospatial Data Model covers quite a broad number of data themes like these. Also, many countries are in the process to be able to manage geographic data corporately all over the world (Scarponcini, etc., 2008). However it is impossible to develop a standardized geographic information model that can be example for local governments of different countries because each country has its own administrative structure. What is possible is to create a generic model, which is then used as a basis and can be refined to serve the local needs. This generic model will then also enable the meaningful communication.

The UN Land Administration Guidelines (UN/ECE, 2006) describe land administration as the "process of determining, recording and disseminating information on ownership, value and use of land when implementing land management policies". The cadastral registration (land administration) contains cadastral data as geographic information and land ownership data as administrative information. The cadastral registration has important relationships with other registrations in the GII. These registrations are both geographic information such as topography, buildings, numbering and administrative information such as persons, addresses, companies. In order to obtain an unambiguous definition of the content of a cadastral registration, Land Administration Domain Model (LADM) presented to ISO TC211 (2008) covers registration and cadastre in a broad sense, the "multipurpose cadastre" (Kaufmann and Steudler 1998). It serves at least two important goals: (1) to avoid reinventing and reimplementing the same functionality, but provide an extensible basis for efficient and effective cadastral system development based on a model-driven architecture (MDA); and (2) enable involved parties, both within one country and between different countries, to communicate based on the shared ontology implied by the model. The second goal is important internationally and within one country because as one combines and exchanges information from several different registrations in the GII (Groothedde, et al, 2008, ISOTC211, 2008).

In this study, the development of key registers in Turkey such as population registers, addresses, cadastre, and topographic maps were explained in section 2. And, the use and importance were examined towards building GII. Management possibility of these registers was discussed in view of support urban land administration towards LADM vision in section 3 and concluded in Section 4.

2.   KEY REGISTERS IN TURKEY

Various projects related to land administration started in Turkey as a part of e-transformation Turkey project. The most important ones are explained in this sub-

sections; Central Population Management System in Section 2.1., Address Registration System in Section 2.2., Land Registry and Cadastral Information System in Section 2.3., and maps to manage key registers in Section 2.4.

2.1. Population Register - Central Population Management System (MERNIS)

The population registers are managed by 923 Population Administration Offices under responsibility of General Directorate of Population and Citizenship of Interior Ministry of Turkey. These offices are situated in counties. The idea to build "Central Population Management System (abbreviated MERNIS in Turkish)" began in 1972 and put into practice in 1997 after the World Bank's approval work. Once computer infrastructure and personnel education of these offices were completed in 1997, all identification information was transferred to electronic environment. Data entrance for 122.145.860 people (living and dead) was completed at the end of 1999. In this way, a Turkish Republic Identification Number (ID) was given to every Turkish Republic Citizen in 2000 that can be confirmed on the web nationally. It has 11 digits which does not include any information. The last two digits are used for conforming the accuracy. MERNIS records contain facts such as the "Name, Surname, Mother's and Father's Name, Place of Birth and Information on Civil Status Events" are related to the identity of the person using the Turkish Republic ID. In this way, giving a Turkish Republic ID number;
• Making the citizens unique,
• Solving the problems caused by the identical names used by various institutions differently,
• determining the identification quickly,
• controlling every process with a unique number from the birth,
• Getting and sending information between the public institutions and making the service faster for the citizens

MERNIS, one of the pioneering e-government projects, permits immediate updates and enables the changes of the identification information in a secured way. This project makes public work faster and has ended usage of different numbers and definitions by different institutions.

"The Identification Information Sharing System (abbreviated KPS in Turkish)" project as extension part of MERNIS opened the identification information to other public institutions in 2005 by fast and efficient services. An agreement must first be concluded in order for the agencies to benefit from KPS. KPS prevents unnecessary paperwork and enables to manage citizenship information with unique identification between public institutions. Municipalities, provincial public administrations, general, regional, and provincial directorate of public institutions, etc. can adapt their e-government applications to KPS based on XML web services in order to view updated citizenship information and to update their own databases automatically (or to built distributed information systems refereeing to each other registers).

2.2. Addresses- Address Registration System (AKS)

According to the law about "Naming Streets and Numbering Buildings" (accepted in 1927) it became compulsory to number buildings and name streets. To do numbering process standardized, first "Numbering Regulation" was accepted in 1963 explaining how these streets are named, how buildings are numbered, how numbers and names are showed on a signboard, who is responsible and the authority for this process. Local governments carried out numbering and address processes according to these regulations.

Examining address information on some Urban GIS applications with Trabzon and Pelitli Municipality cases as seen on Figure 1 (Yıldırım, 2003, Aydinoglu et al, 2007):

- Numbering regulations have not been applied in the cities completely. There are different approaches unlike regulations and laws.
- There are repeated street names and wrongly numbered buildings.
- Signboards were not updated or managed regularly.
- Citizens and public institutions are not aware of, and therefore can not follow, address related changes executed by responsible local authority.
- Public Institutions have used different address definitions on their notifications. That is, the same address is explained with different components without a standardized format.
- Changes on numbering and address information result in the uncertainty of the address.

Figure 1: Interface of Web based Numbering Updating System of Trabzon Municipality (left) and Address Management Interface of Pelitli Municipality (right)
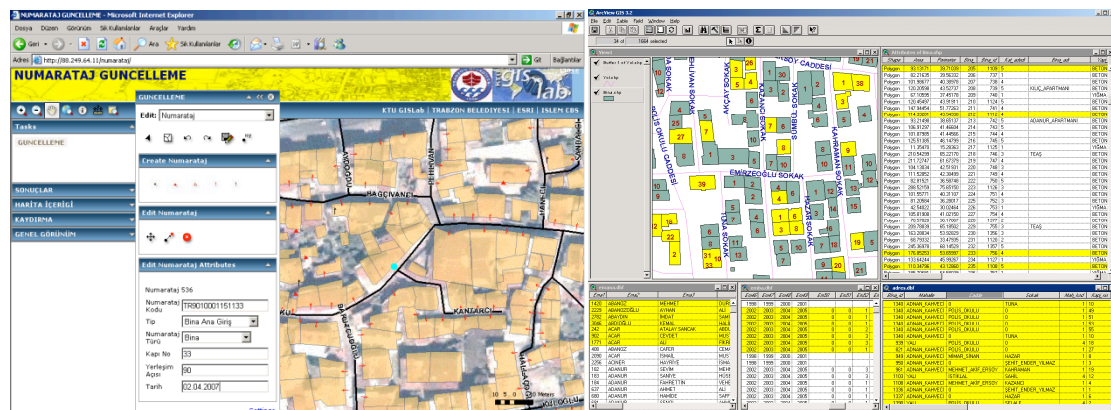
Basic cause of these problems are that there were lack of experts and trained personnel about numbering in local governments, deficiencies on control mechanism of Turkey Statistics Institute (TUIK). There was no a centralized address management platform and database to control changes and failures. Also, numbering works were not related to any map or GIS application for confirmation. Turkey Informatics Conference (TBD, 2007) declared that repetitive use of the addresses costs 52 million $ for the country's economy. The main reason of this is that a citizen's address was registered at least at 10 governmental points. Records were not stored accurate and up-to-date. The wrong addresses were declared and address components were changed frequently.

According to the survey executed by TURKSTAT to 3066 out of 3228 municipalities of Turkey in 2005, 18 % (543) of the municipalities have numbering unit and 4 % (126) of which work on Urban GIS (TURKSTAT, 2007). Most municipalities in especially big provinces are trying to build Urban GIS and e-municipality applications.

After "The Civil Services Law" put into practice in 2006, "Numbering and National Address Database Regulation" started the processes on the creation of address information, registering in the databases. Although there are some conflicts in view of using information technologies and applicable methods, this regulation can be accepted as an important opportunity to manage authentic registers corporately.

Besides old regulation, this regulation's main innovations can be explained with following properties:

- Square, Avenue, Main Street / Road, Street, and Cluster Homes get a identification number (abbreviated as TN in Turkish) beside name. Any name must be unique in any province. And, a number of any address component should be unique within a district or village. This gives opportunities to manage address data in the databases in spite of the difficulty of using address data in various applications.
- Local Governments are responsible for registering the addresses to the database; municipalities in their responsibility areas, provincial public administration in the villages.
- Building Construction Permits, Building Use Permits, Burned and Destroyed Buildings are registered to the databases for reconstruction areas.

National Address Database (abbreviated as UAVT in Turkish) was initiated by TURKSTAT on the scope of e-transformation Turkey project. Surveys were executed in all Turkey to get address information of domiciled people. Then, this database's management was transferred to General Directorate of Population and Citizenship as seen on the example finding street, building, and addresses hierarchically of Figure 2. MERNIS includes identification information for all citizens to follow public services. But, this system does not have domicile information defining address of any citizen. Citizenship oriented services could not be carried out regularly because public institutions do not have real domicile defitions. Therefore, the process to match MERNIS and UAVT databases was started by using Turkey Republic ID number. And then, UAVT was matched with foreign people living in Turkey. The databases were cross checked and eliminated to prevent duplications. In this way, Address based Population Registration System (abbreviated as AKS in Turkish) was built and presented to related authorities and public institutions in 2007. As seen on Figure 3, some governmental services can be managed by local governments on this integrated AKS system. While administrative unit, street, building, and address changes can be controlled on UAVT, citizen identification and related changes can be managed on MERNIS.

Figure 2: Finding Street and Building (left), and address (right) with web based UAVT interface

AKS includes address information and domicile information of citizens having Turkey Republic ID number. However the regulations do not include sufficient instruction to manage building, address data in information systems. Municipalities

are in the process to build Urban GIS applications. But, how interoperability of data sets is provided has not been standardized for AKS, Urban GIS applications, and other databases.

Figure 3: General processes on Address based Population Registration System
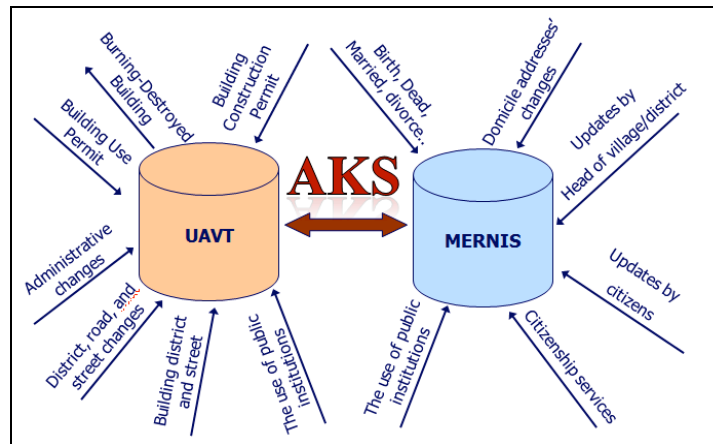
2.3. Cadastre- Land Registry and Cadastral Information System (TAKBIS)

Modern cadastral works were started by applying "Land Registry and Cadastre Law" in 1934. In 1987, after some processes, land related laws were combined and only one "Cadastral Law" numbered 3402 was put into force for the both area of City and Village. Cadastral works have been executed by using this law. In Turkey, Cadastre processes are carried out by the General Directorate of Land Registry and Cadastre (abbreviated TKGM in Turkish) that has central, regional and local branches whole the country. Cadastre is compulsory and based on legal system. Land taxation is also one of the purposes in the system. The purpose of the cadastre in Turkey is to keep public registers for real estates, to make and update cadastral registers and maps, to assist land related projects, and to make large scale topographical base map of the Turkey. From this context, the cadastre also has multipurpose role, especially providing information for local land planning and development activities too.

The main unit is a land parcel and a registration book linked to land parcel. Cadastral working area divided by blocks bounded by natural or artificial borders such as road, way, highway, railway, lake, sea. It is a parcel registrations system based on boundary surveying process on the field. All legal rights related to a parcel, including landowners information, are registered on the registration book under the given index, cadastral block, and parcel ID. In addition, owners of condominiums are defined in another related registration book.

Cadastral maps consist of graphical features (parcels boundaries, polygons, landmarks, etc.), parcel ID, coordinate tics, text for some features (street names, etc.) and sheet related information (geographical grid index, approving the sheet, etc.) as seen on the example of Figure 4. All cadastral measurements have been digitally collected with (X, Y) coordinates since 1987. There are also great efforts to digitize land registry and cadastral information since year 2000.

A project to create the Land Registry and Cadastral Information System (abbreviated as TAKBIS in Turkish), began for developing a National System. The goals of TAKBIS are:

- Providing reliable land information required for land and land-related activities and decision makers.
- Planning, conducting, and managing the activities of the TKGM more properly more quickly, more reliably and more effectively.
- Regulating such activities in accordance to the principles of GIS and LIS, in frame of standards of OGC.
- Transferring land register records and cadastral maps to a digital environment and to a database, modeled and created according to the requirements of TAKBIS.
- Maintaining information updated and re-evaluating them within the scope of information technologies and offering them to the use of central and provincial units of the TKGM and other public organizations.
- Providing a possibility to transform land registry and cadastral information into a Multipurpose Land Information Systems, through the use of such information by relevant organizations.

Figure 4: Analog (up) and Digital (bottom) Cadastre Map Examples from Turkey
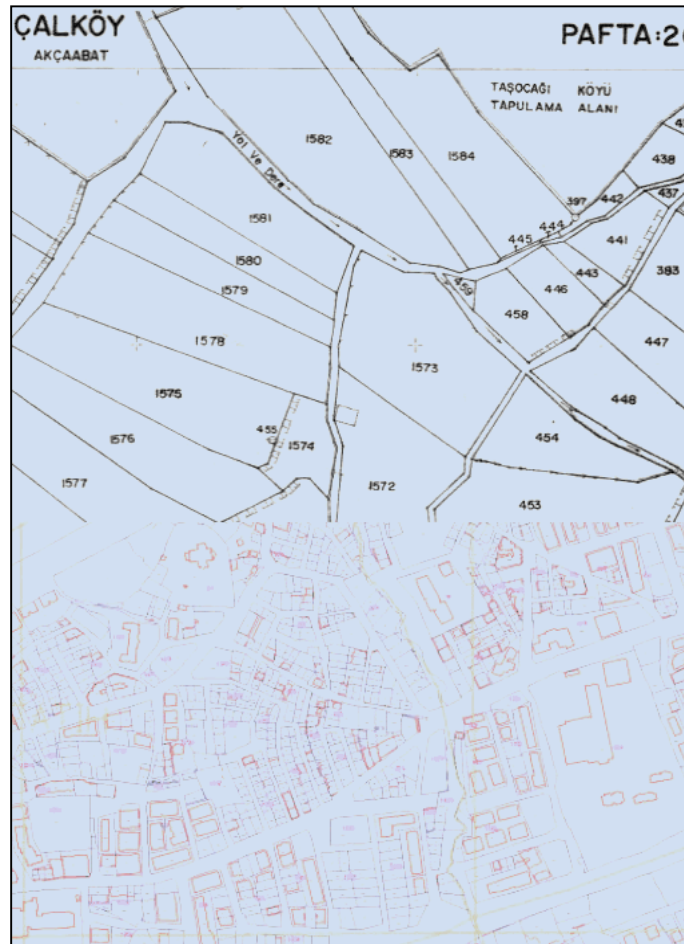

It is supposed that TAKBIS controlled by TKGM encourages land administration activities in about 50 different sectors such as local government, transportation, justice, forestry, agriculture, and energy. The project is still under development, and consists of three steps: analysis, design, and application development. Integrating cadastre information with land registry information is the most important part of TAKBIS. Integrating problems are (Mataraci, 2007):
- Updating difficulties on digital and non-digital cadastral data.
- Conflicts between cadastre and land registry districts.

- The differences between responsibility areas of land registry and cadastre directorates.
- Cadastre parcels not registered in land registry
- Systematic problems for transferring cadastre and land registry information to digital environment.
- When cadastral data are combined digitally, some geometric and topologic problems appeared. For example in a county of Ankara; parcel errors over the limit (Figure 5.1), the space between parcels (Figure 5.2), and duplicated parcels (Figure 5.3)

Figure 5: Combining problems of cadastral data with a case from a county of Ankara
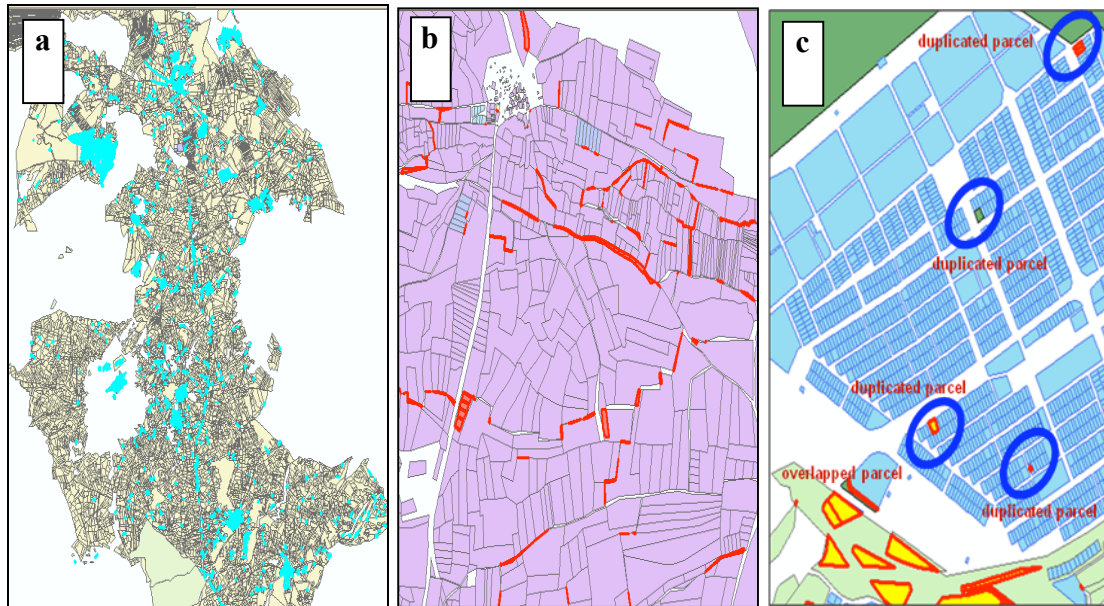
2.4. Maps to manage key registers

Standard Topographic Maps (STM), smaller than 1:5000, are produced by General Command of Mapping (abbreviated HGK in Turkish). Large Scale Maps, 1:5000 and larger, are produced by TKGM and State Provincial Bank. Other public institutions and municipalities have produced maps and GIS projects serving their needs. There is no any geo-information standard and topographic map accepted as authentic register or used with other key registers. Large Scale Maps are produced depending on Large Scale Map and Map Information Production Regulation (abbreviated as BÖHHBUY in Turkish) that was revised and enclosed with feature / attribute catalog in 2006. The usability of BÖHHBUY specifications on GIS applications and key register management is examined with followings:

- Features are defined with basic attributes and map symbology to produce large scale topographic map. These include land cover, plantation, railroad, road, hydrographic, administrative areas, building, and like these.
- It includes features and properties for large scale topographic map and basic GIS applications.
- Geo information standards are not defined to support various GIS applications and decision making processes, to harmonize with TAKBIS, AKS, and other Urban GIS applications (Aydinoglu, et al, 2007, Emem and Batuk, 2007).

Inter-Ministerial Map Progress Coordination and Planning Commission Report (BHIKPK, 2008) and Action-36 action to build National SDI (TKGM, 2006) emphasized that geographic data specifications should be developed to carry out

geographic information needs of (local) governments. Geographic data specifications and exchange formats should be produced to enable data sharing on the web.

Some geographic information standards have been produced by governments, such as Turkey Disaster Management System Catalog (TABIS). However local governments need high resolution and large scale geographic data and maps for the applications like zoning plan, real property management, and infrastructure. Urban GIS applications of local governments were developed, depending on GIS software companies. Therefore geographic data is not interoperable because public institutions use different conceptual model and feature catalogs. GIS projects executed in local governments, TKGM, and public institutions were not designed to enable data interoperability (TKGM, 2004, 2006, Aydinoglu, etc., 2007).

The key register issues are explained with a case study - Urban GIS application of Trabzon Municipality. In this project, the data coming from different sources is combined on GIS environment, especially cadastre data from cadastre directorate of Trabzon, land registry data from land registry directorate of Trabzon-Merkez county, road and building data from BÖHHBUY based large scale map, and address numbering data from numbering service of Trabzon Municipality. It was pointed out that:

- There are differences between Districts' boundaries presenting the lowest level administrative unit. For example, cadastral districts have not been updated since completion of cadastral works by cadastre directorate. In this way, the boundaries of districts were updated and harmonized with municipal boundaries as to zoning plans, cadastral maps, and current large scale maps.
- Building data on current large scale maps and cadastral maps have not been updated regularly. When building data on the maps was compared with "building use permit" documents of Trabzon Municipality, it was determined that about 25% buildings have not been presented on the maps spatially.
- There are 1300 streets, 125 roads, 3 boulevards, 3 squares in the responsibility areas of Trabzon municipality. But 192 streets with their names were changed as to new "Numbering and National Address Regulation"
- When geographic data was harmonized as seen on the example of Figure 6; road, building, cadastre, zoning plans, and numbering data of Hızırbey District of Trabzon Municipality cannot be combined as an abstraction of real world.

Figure 6: Harmonizing Road, Block, Parcel, Building, Numbering data of Hızırbey district
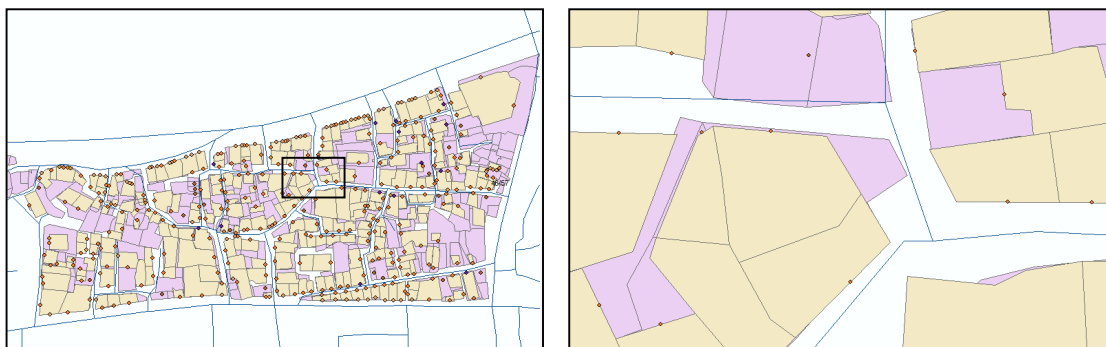
- Beside these, there is incompatibility and discrepancies between cadastre, land registry, building, and reconstruction plan. The main reason is that all legal documents of key registers are registered in different databases without a relationship with geographic data and maps. Harmonization and interoperability of these key registers have not been defined in any common specification

technically. In this way, local governments are trying to solve these problems with different approaches in their Urban GIS and land administration applications.

3. DISCUSSION

In Turkey, MERNIS as population register pioneered e-government applications. AKS as address register encourages the use of geographic information in land administration activities providing services to the citizens. However, local governments couldn't adapt their numbering works completely to "Numbering and Address Database Regulation" because it is impossible to renew street names with Identification Number and building number in short time. However, AKS needs time for the adaptation process within local governments. As seen on Urban GIS cases, many conflicts have been determined between the address registers and the real world. Therefore, address should be geographically referenced in mapping and GIS applications to confirm accuracy and to support other land administration and e-government applications. Address and domicile information defined spatially can provide significant contributions and revenue to local governments for some services such as notification documents: phone, electricity, natural gas, water, advertising, etc. In addition to this, domicile information can be an important requirement on the collection of property taxes and access to land owners.

TKGM as a cadastre and land registry agency can pioneer land administration activities with TAKBIS project that aims to make land related activities more effectively on digital environment. But, harmonizing the data coming from different directorates has difficulty. Most land ownership registrations have not been defined with Turkey Republic ID of person and domicile information because AKS and MERNIS are new developed databases. This hampers land administration processes to interact with other e-government applications such as MERNIS, AKS, Judicial Network (abbreviated as UYAP in Turkish), Internet Tax Office (abbreviated as VEDOP in Turkish), National Police Network (abbreviated as POLNET in Turkish), and etc.

Topographic maps and geographic data sets are not produced to manage authentic registers spatially. Cadastral maps produced by TKGM include cadastral block and parcel information updated. Building information is controlled in reconstruction directorate of the municipalities and generally not maintained and updated in the maps spatially. But there is no a standardized geographic data model to manage authentic registers spatially at required data use level. Almost all large scale maps and related information are produced based on BÖHHBUY regulation and data catalog attached in 2006. In this way, there is no approach to manage key registers and to harmonize geographic information coming from different sources. Local governments are trying to develop Urban GIS and land administration applications based on their vision and expectations.

4. CONCLUSION

Similar to LADM vision, land administration should be carried out in corporate way within the GII framework. That is, authentic registers such as address, building, population register, land ownership, and others should be harmonized to support e-government applications that provide noteworthy benefits to citizens, business, and governments. In Turkey, collecting geographic information from different sources has some difficulties. Currently, there is no a standardized data model and public institutions use the data with different semantics. Therefore, the integration of geographic information through interoperable systems is the central role of key

registers' management supporting urban land administration. Realizing the GII, nevertheless, provides information from different sources for effective delivery of government services and plays a crucial role for e-government that supports the information flow between government, citizens, and the private sector. In this way, a harmonized geographic information model should be developed for urban governance of Turkey. The model should solve application-driven geographic data needs of local governments and support decision making processes through regional and national levels. If this approach is examined as a next vision, using and sharing geographic information will support urban governance as a part of e-municipality and land administration activities.

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