Geo-data Management Issues for Urban Land Administration in Turkey

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SUMMARY

Geographic (geo- prefix) data supports decision making in various application areas from land administration and planning to infrastructure and taxation in urban areas. Geo-Data Infrastructure encompasses policies, technologies, human resources for the effective collection, management, access of geo-data 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 urban land administration socially credible and functional, land-related information should be registered and structured at a detailed level, such as the parcel and address level. In Turkey, a standardized geo-data structure has not been developed yet to manage key registers land ownership, building, address, infrastructure, citizenship data, etc.- in view of user requirements. For example; the Interior Ministry is in the process to combine the databases of National Address Database (UAVT) and National Citizenship System (MERNIS). Building Following System is being built under responsibility of municipalities. Land Registry and Cadastre Information System (TAKBIS) are in the process to be built in all cadastre directorates of Turkey. GIS projects, such as Urban GIS, planning, and infrastructure, have been executed in local governments, municipalities, and public institutions without coordination. Although various public institutions need these data in their applications, these systems have not been designed to enable data interoperability because they use different conceptual models and feature catalogs. In this study, standardization needs and key register related GIS projects were examined and analyzed. According to Turkey National GIS actions and Infrastructure for Spatial Information in Europe (INSPIRE) directives, a domain geo-database model were developed to solve application driven geo-data needs of local governments and support decision making processes through regional and national levels. Generic Conceptual Model components were defined that explains rules to harmonize geo-data. Application schemas were produced for data themes such as Administrative Unit, Address, Cadastre/Building, Land Cover/Use, and etc. with Unified Modeling Language (UML) enabling semantic interoperability in a Model Driven Approach (MDA). This interchangeable data in the model explains objects with properties and relations semantically. According to the model, urban GIS applications using geo-data corporately were developed for Trabzon Municipality.

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1. INTRODUCTION

Land administration facilities the implementation of land use policies supporting economic development, environmental management, and social stability in both developed and developing countries (Williamson, 2001). The UN Land Administration Guidelines (UNECE, 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 and land ownership data has important relationships with other key registers such as buildings, numbering, citizens, addresses, companies, and so on. To use these information corporately, Agenda 21 (UN, 1992) and the Aarhus Declaration (UNECE, 2001) refer to the need to build appropriate databases and exchange of information in order to create the conditions necessary for sustainable development in all regions of the world.

High-quality and large scaled geo-data is needed for urban areas. The deficiency of up-to-date geo-data hampers sharing data among local governments and public institutions. Managing geo-data interoperable enables effective delivery of government services. In this way, beyond GIS, Geo-data Infrastructure (GDI) that encompasses policies, technologies, and standards for the effective collection, management of geo-data encourages better governance and fosters environmental sustainability by reducing duplication and facilitating integration at different administrative levels (Mc Laughin and Nichols, 1992; Nebert, 2004; INSPIRE, 2007). In this way, GDI has importance to support information flow between public institutions, private sector, and citizens.

Urban land administration is required more information than provided from one single data set that is well-maintained links between cadastral data sets and other key registers. An effective GDI, therefore, is necessary for integration and multiple use of geo-information (Groothedde et al., 2008). According to GSDI Cookbook (Nebert, 2009), the development of consistent reusable geo-data themes is recognized as a common ingredient and beginning phase in the building of GDI. In this context, Land Administration Domain Model (LADM) presented to ISOTC211 covers registration and cadastre in a broad sense, the "multipurpose cadastre" to achieve standardization following conceptual framework of Cadastre 2014 (Kaufmann, Steudler, 1998). One of the aims of LADM is to combine and exchange information from several different registers in the GDI (ISOTC211, 2008).

In this study, current situation about cadastral and other key registers was determined for urban land administration of Turkey. Constraints were examined to manage geo-data effectively. And then, a harmonized geo-data model was developed and examined for urban land administration.

2. CURRENT SITUATION FOR URBAN LAND ADMINISTRATION

Turkey is managed centrally with republican parliamentary democracy. There are three basic local administration systems; province, county, and village. 81 provinces of Turkey include counties with civil authorities. Each county and its residential areas with population more than 2000 have municipalities. The local infrastructure and services are provided by the Provincial Public Administrations for the areas outside the municipalities.

Land administration activities are generally managed by Land Registry and Cadastre Directorate (abbreviated as TKGM in Turkish) in Turkey. Municipalities develop Urban GIS applications and produce key-register data. With e-transformation Turkey project, Turkey has speeded up efforts to transform the country into an information society. After 2003, actions about building National GIS, similar to GDI vision, have been triggered and continued as a part of e-Transformation Turkey Project. In this context, Interior Ministry of Turkey is in the process to combine the databases of National Address Database (UAVT) and National Citizenship System (MERNIS). And, Building Following System is being built to work with these systems under responsibility of municipalities. Various Urban GIS applications were developed by local governments. Beside these, there are many national information systems such as taxation, security, justice, and the like. In this section, the most important registers such as land registry and cadastre, address, and population registers are discussed to manage the registers spatially.

2.1 Land Registry and Cadastre

All cadastral works were executed according to 3402 numbered Cadastral Law. These processes are carried out by the General Directorate of TKGM 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 this system. The cadastre also has multipurpose role, especially providing information for local land planning and development activities. The main unit is a land parcel and a registration book linked to land parcel. Cadastral working areas are divided by blocks and natural or artificial borders such as road, highway, railway, lake, and sea. It is a parcel registration system based on boundary surveying processes on the field. All legal rights related to a parcel, including land owner 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.

A project to develop the Land Registry and Cadastral Information System (abbreviated as TAKBIS in Turkish) was started as an integral part of National Information Systems. The goals of TAKBIS are to provide reliable land information required for land administration activities and decision makers. 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.

2.2 Population Register

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. Digital 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. MERNIS records containing "Name, Surname, Mother's and Father's Name, Place of Birth, and Information on Civil Status" are related to Turkish Republic ID of the person. In this way, giving a Turkish Republic ID number is to make the citizens unique, to solve the problems caused by using different identical names on public institutions, and to process information between the public services faster. MERNIS 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 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. 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 can adapt their e-government applications to KPS based on XML web services.

2.3 Address

According to the law Naming Streets and Numbering Buildings (accepted in 1927), numbering became compulsory in Turkey. "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, and which authority is responsible for this process. Local governments carried out numbering and address processes according to these regulations.

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 10 governmental points at least. Records were not stored accurate and up-to-date. The wrong addresses were declared and address components were changed frequently. After The Civil Services Law was put into practice in 2006, Numbering and National Address Database Regulation started the processes on the creation of address information in the databases. National Address Database (abbreviated as UAVT in Turkish) was initiated by TURKSTAT on the scope of e-transformation Turkey project. The process to match MERNIS and UAVT databases was started by using Turkey Republic ID number. And then, the databases were cross checked. Address based Population Registration System (abbreviated as AKS in Turkish) was presented to related public institutions in 2007. AKS includes address and residence information of citizens having Turkey Republic ID number. This system aims to manage various functions relating to address, building, and citizens as seen on Figure 1.

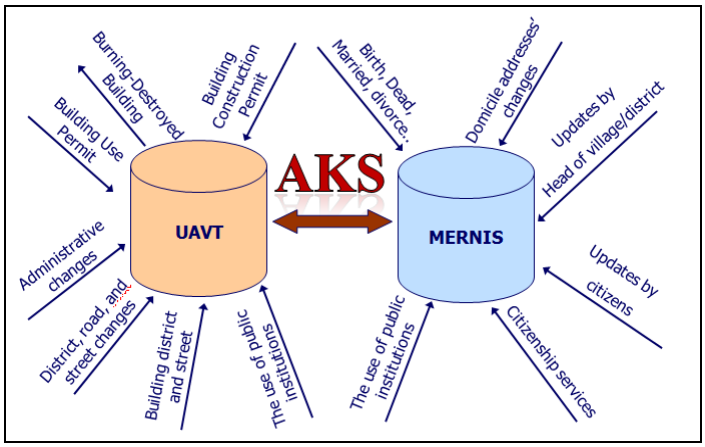

Figure 1. AKS for address based census registration

2.4 Urban GIS applications and 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 in accordance with the Large Scaled Map Production Regulation (BÖHHBUY). 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 key-register or used with other key-registers. According to the Turkey State Planning Organization (SPO, 2006), there is a lack of coordination between the public institutions that produce and use geo-data. In addition, there are technical difficulties, a lack of data standards and specific policies governing GIS projects. These impede the sharing of data and the management of the GIS projects.

According to the Municipality Law (No. 5393) (Official Gazette, 2006) and the Metropolitan Municipality Law (No. 5216) (Official Gazette, 2004), municipalities must build GIS and Urban GIS applications. A survey, executed by TURKSTAT to 3066 out of 3228 municipalities of Turkey in 2005, pointed out that 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. Local governments need large scaled geo-data and maps for applications such as zoning plans, real property management, and infrastructure development.

3. CONSTRAINTS TO USE GEO-DATA CORPORATELY

Integrating cadastral information with land registry information is the most important part of land administration. When integrating land ownership and cadastral data on TAKBIS (Mataraci et.al., 2009), updating difficulties, conflicts, and some systematic problems appeared for transferring data.

Examining address information on some Urban GIS applications (Aydinoglu et al, 2007), numbering regulations have not been applied completely in the cities. There are different approaches and applications unlike regulations and laws. Although UAVT database was developed to manage address and citizenship data corporately, address works were not related to any map or numbering application in local governments. Although numbering and national address database regulation triggered managing address data on e-government applications, the regulations do not include sufficient instruction to manage building and address data in, Urban GIS applications.

The usability of BÖHHBUY specifications is impossible on GIS applications and key-register management. Geo-information standards have not been defined to support various GIS applications and decision making processes. Geo-data is not interoperable because public institutions use different conceptual model and feature catalogs. GIS applications on public institutions were not designed to enable data interoperability between TAKBIS, AKS, and other Urban GIS projects. Harmonization and interoperability of these key registers have not been determined in any common specification technically (Aydinoglu, 2009, Emem and Batuk, 2007).

4. DEVELOPING A GEO-DATABASE MODEL

A harmonized geo-data model for Turkey was designed to enable multiple use of geo-data as a new approach. The name of this model is UVDM meaning that National Geo-Data Exchange Model. General properties of this model (Aydinoglu, 2009);

- A base data model as a starting point to produce sector data models including cadastre, water, transportation, and etc.
- Meeting application-driven geo-data needs.
- A semantic model because a harmonized model provides a common domain of interaction and the related information.
- An object-relational data model that enables users to store objects and their associated attribute data in a single geo-database system.
- Compliant with ISO190XX Geographic information / Geomatics standards
- Compliant with the INSPIRE expectations that European countries follow to build European SDI.
- Following Turkey National GIS Actions.
- Geo-data should be maintained at province level, larger than 1:5000 scale and 50 cm resolution, where the data is managed effectively, and then re-using at different levels with generalization.
- Each Spatial Object is defined with an unique “Spatial Object Identifier” nationally. These identifiers can be used to ensure interoperability among databases.
- Object Versioning defines temporal changes of Spatial Objects.
- Designed with UML (ISO 19103) in a Model Driven Approach (MDA).
- GML Application Schema can be derived from UML Application Schema for data exchange.

UVDM Conceptual Model specifies the components to determine application schemas of data themes and to harmonize spatial data and to produce application schemas of spatial data themes such as Administrative Unit, Topography, and Address. Conceptual Model components are divided into two sections, Scope/Application Area and Technical Components.

- Scope / Application Area Components include; Standard Hierarchy, Scale-Resolution and Applications, Generalization Approach, Building Province Level SDI in Turkey, Horizontal/Vertical Relationship, and so on.
- Technical Components include; Principles, Reference Model, Application Schema Rules, Spatial Object Identifier, Spatial Object Versioning, Metadata, Quality, Multiple Representation and Cartography, and so on.

UVDM includes 16 data themes such as Address (AD), Land Ownership/Cadastre (MB), Administrative Unit (IB), Transportation (UL), Hydrography (HI), Land Surface (AR), Topography (TO), Geodetic (JD), and the like. UML application schemas of data themes include feature types with properties, geometry, attributes, relations, functions, and etc. Example UVDM data themes with UVDM:MB in detail can be seen on Figure 2.

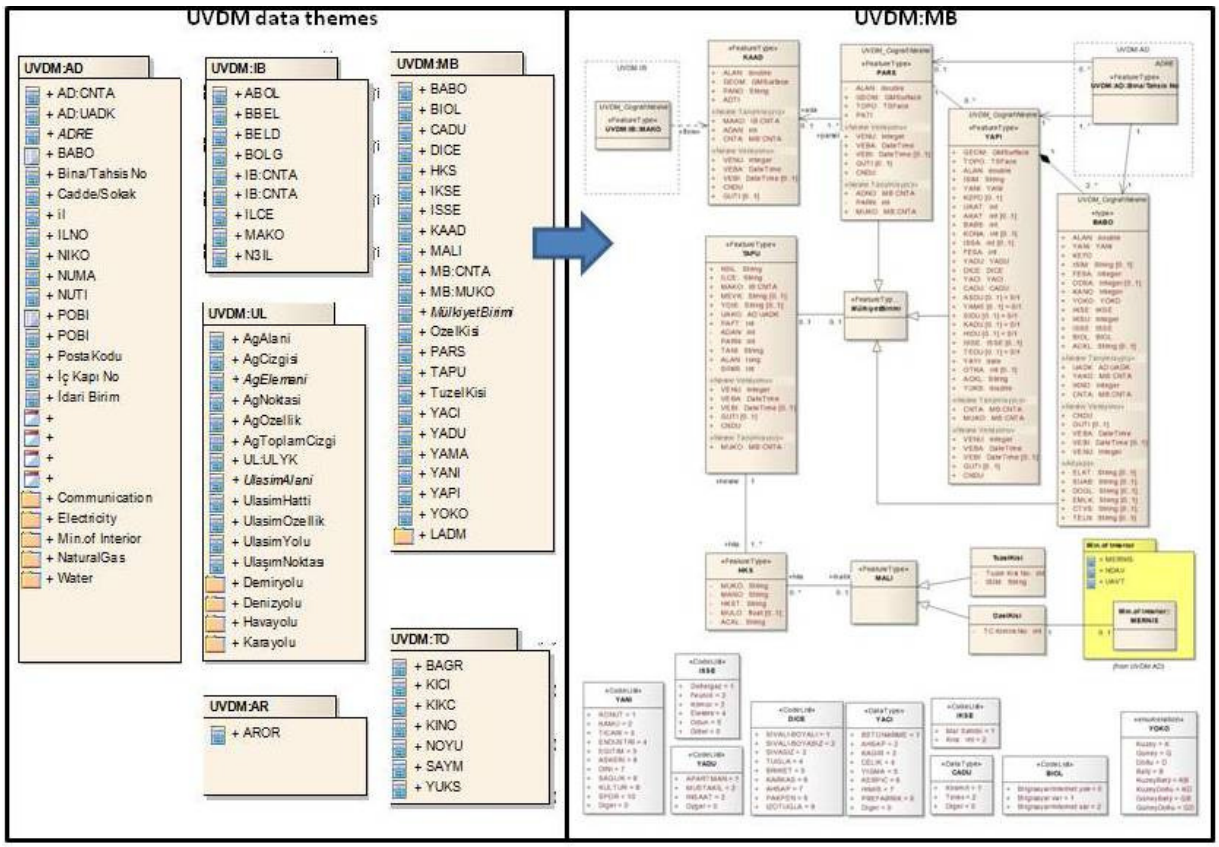

Figure 2. Some UVDM data themes and UVDM:MB Application Schema

Key registers can be managed interoperable. As seen on Figure 3; AD, MB, IB, and UL data themes can be linked with common object identification framework (abbreviated CNTA in

Turkish). For example, administrative unit codes used in public institutions were combined in respect of country's administrative hierarchy. When address code of UVDM:AD model is used, data harmonization and exchange on various databases will be possible. Address information for a person can be obtained easily with identity number. Urban GIS applications of local governments are harmonized to UAVT and MERNIS database from local to national level.

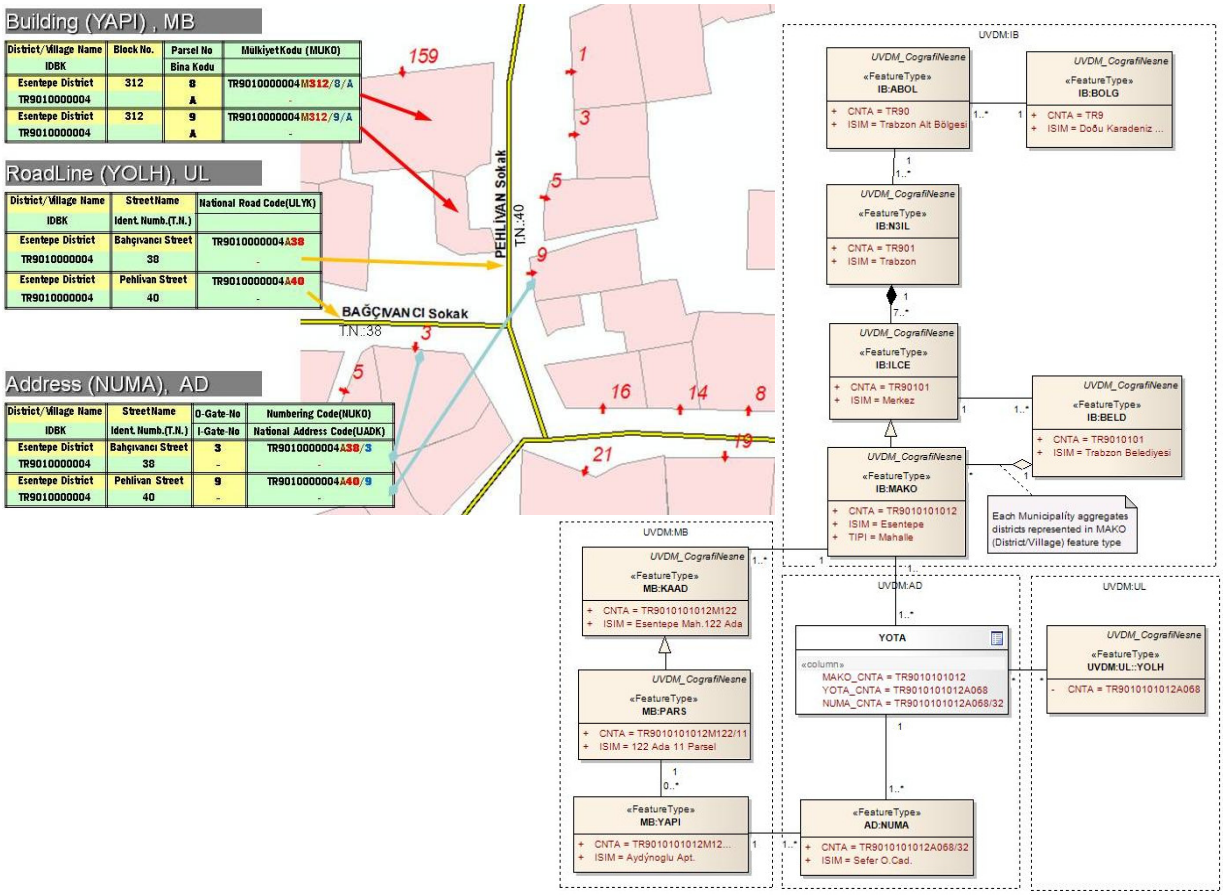

Figure 3. Managing AD, MB, AD, and UL data themes corporately

5. CONCLUSION

TKGM as a cadastre and land registry agency pioneers 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. MERNIS as population register pioneered e-government applications. AKS as address register encourages the use of geo-information in public services, but local governments have not developed Urban GIS and numbering applications compliant with AKS. Topographic maps and geo-data sets are not produced to manage key registers spatially with a standardized geo-data model. This hampers land administration processes to interact with other e-government applications such as MERNIS, AKS, Judicial Network, Internet Tax Office, National Police Network, and etc. If AKS is defined spatially, it provides significant contributions and

revenue to local governments for some services such as phone, electricity, natural gas, water, advertising, and collection of property taxes and access to land owners.

Therefore, similar to LADM vision, land administration should be carried out in corporate way within the GII framework. A Harmonized Geo-data Model can provide an effective approach on geo-data interoperability. This common approach enables the balance of heterogeneity towards the building a GDI from local to national level. That is, key registers such as address, building, population register, land ownership, and others should be harmonized to support e-government applications.

REFERENCES

Aydinoglu, A.C., 2009. Developing National Geo-data Exchange Model for Turkey, PhD Thesis, KTU Applied Science Institute, Trabzon.

Aydinoglu, A.C, Yildirim, V., and Ozendi, M., 2007, Spatial Modeling of Administrative Unit for National based Address Information System, HKMO 11. Turkey Surveyors Technical and Scientific Congress, Ankara.

Groothedde, A., Lemmen, C., Molen, P.V., and Oosterom, P.V., 2008, A Standardized Land Administration Domain Model as Part of the Spatial Information Infrastructure, in: Creating Spatial Information Infrastructures towards the spatial semantic web, P.V.Oosterom, S. Zlatanova (Eds.), Taylor&Francis Book, London, Newyork.

ISOTC211, 2008. ISO/WD 19152- Geographic Information- Land Administration Domain Model, 31.10.2008, ISO.

INSPIRE- Infrastructure for Spatial Information in Europe, 2007, A Directive of The European Parliament and of The Council Establishing An Infrastructure For Spatial Information in The Community (INSPIRE Directive). EC, Brussels.

Mataracı, O., Aydinoglu, A. C., Yomralioglu, T., İnan, H.İ., 2009, Turkey National LIS Actions towards Building SDI. Eleventh International Conference of the GSDI Association and the Third INSPIRE Conference, Roterdam.

Mc Laughin, Nichols, S., 2004, Building the national spatial data infrastructure. Invited article in Computing Canada, p. 24.

Nebert, D.D., 2009. The SDI Cookbook: Developing Spatial Data Infrastructures V.3. Global Spatial Data Infrastructure Association.

Emem, O., Batuk, O., 2007. Examining Web Services and OGC Use on Modern GIS approaches and National SDI. TMMOB National GIS Congress, Trabzon.

Official Gazette of Rep. of Turkey, 2006. Municipality Law 2006: No.5393.

Official Gazette of Rep. of Turkey, 2004. Metropolitan Municipality Law 2004: No.5216.

SPO- State Plannıng Organızatıon Of Turkey, 2006. Ninth Development Plan (2007-2013), Ankara.

TBD- Turkish Informatics Society, 2007, Final Report of Informatics Development. XVIII. Turkey Informatics Conference, Ankara.

TURKSTAT- Turkey Statistics Institute, 2007. Municipality, Numbering and Urban Information System Survey, Ankara.

UN-United Nation, 1992, Agenda 21: the Rio Declaration on Environment and Development, and the Statement of principles for the Sustainable Management of Forests. United Nations Conference on Environment and Development (UNCED), Rio de Janerio.

UNECE- United Nations Economic Commission for Europe, 2001. Aarhus Convention: The Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters. Danish City of Aarhus.

UNECE, 2006. Land Administration Guidelines, Geneva, Swirzerland.

Williamson, I.P., 2001, Land administration “best practice” providing the infrastructure for land policy implementation, Land Use Policy Vol. 18(4), p. 297-207.

BIOGRAPHICAL NOTES

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