Trends and Expectations Towards to Three-Dimensional Property System in Turkey

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Key words: 3D Property, Condominium Unit, Land Share, BIM

SUMMARY

It is not sufficient for today's needs to measure and record the immovables two-dimensionally. Because the differentiating human needs of the 21st century are observed in great engineering and architectural projects and they require the transition to a three-dimensional property system. The cadastre register system is based on geometrically defined two-dimensional parcels and condominium units on these parcels in Turkey. However, this register system remains incapable in i) keeping the current three-dimensional records of truely three-dimensional constructions, underground and above ground facilities and residential units ii) solving the problems regarding the use of the third dimension iii) following the temporal changes and lighting the way for the representation of real world. In our country, there is no compulsory system or model that could represent the immovables in three dimensions yet. However, the need for creating such a visual modeling pushes the public institutions toward conducting various studies. General Directorate of Land Registry and Cadastre, General Directorate of Geographical Information Systems and universities are among the public institutions showing the effort on this matter. Even though the projects being conducted by these institutions regarding the e-government and geographical data models at national level provide some conveniences for the 3D cadastre and visualization, they still remain insufficient for a full 3D modeling and analysis. The objective of this study is evaluating the present condition of Turkey in the 3D cadastre and 3D registration, and revealing the prospective tendencies and expectations and showing that Building Information Modeling (BIM) can be used for solving the problems regarding with the vertical landownership (condominium). In order to do it, we investigate whether or not the laws and regulations are ready for the transition to the 3D registration, 3D cadastre and BIM, analyze the projects and e-government applications of public institutions regarding the spatial data and evaluate the outcomes of these projects. This study shows that 3D property should be evaluated as an important component of the goal of reaching sustainable cities today. Besides, it is shown that surveyors have an important role in terms of solving condominium problems by using BIMs.

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1. INTRODUCTION

Multi dimensional developments in urban areas put enormous pressure on existing land administration systems that are equipped with cadastres that represent 2D spatial objects (Aien, 2013). This kind of pressure on land in urban areas and especially their business centres has led to overlapping and interlocking constructions (Stoter and Oosterom, 2007).

Traditional two-dimensional cadastral technology has proven to be deficient in the management of these newly conceived urban spaces; thus, the 3D cadastre is emerging as an effective means to support the administration of space in three dimensions (Guo et al., 2013). Besides, most cadastral data models is inefficient communication of the spatial dimension of 3D Right Restriction Responsibility. In these data models 2D land parcels usually provide the basic spatial units to map ownership boundaries (Kalantari et al., 2008).

In Turkey, existing land titling and property (cadastral) systems have developed around the concept of a two dimensional mapping system. The content about land registry and cadastre data in Turkey is being developed based on the Land Registry and Cadastre Information System (in Turkish TAKBIS) which is parcel based Land Administration System, with some deficiencies regarding managing geographic data (Aydınoğlu and Inan, 2014).

Because of the geographic information requirement and data sharing needs started to increase, Turkey National GIS (TRGIS) as an e-government project aiming at establishing Turkey National Spatial Data Infrastructure that enables effective geo-data management, was triggered and first legislation was published in March 2015. However not put into practice yet because of the legislative conflict for interministrial coordination (Aydınoglu and Yomralioglu, 2015; Aydınoğlu and Inan, 2014).

Another e-government project is Spatial Property System (in Turkish MEGSIS) which an open-source application developed by Land Registry and Cadaster General Directorate (LRCGD), where cadaster data are collected by the center system from local users in the cadaster offices in digital .cad format and are harmonized with land registry data in order to be submitted to stakeholder institution, organization, municipalities and citizens by e-government link (URL-1). Graphical and attribute data of the spatial legal obects have been integrated with the percentage of 97% in 2015 and released to the government institutions in the international standards (OGC) (Seymen et al., 2015).

Even though the projects being conducted by these institutions regarding the e-government and geographical data infrastructures at national level, provide some conveniences for the 3D cadastre,

3D property and visualization, they still remain insufficient for a full 3D modelling and analysis of the physical objects (such as buildings and condominium units).

The objective of this study is evaluating the present condition of Turkey in the 3D property/registration, and revealing the prospective tendencies and expectations and showing that Building Information Modeling (BIM) can be used for solving the problems regarding with the vertical landownership (condominium). In order to do it, we investigate whether or not the laws and regulations are ready for the transition to the 3D registration, 3D property and BIM, analyze the projects and e-government applications of public institutions regarding the spatial data and evaluate the outcomes of these projects.

This study shows that 3D property should be evaluated as an important component of the goal of reaching sustainable cities today. Besides, it is shown that surveyors have an important role in terms of solving condominium problems by using BIMs.

2. CURRENT E-GOVERNMENT PROJECTS RELATED TO LAND ADMINISTRATION SYSTEM

The cadastral system defines and records the location and extent of property rights, restrictions and responsibilities. It includes a geometric description of land and real property boundaries linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements (ICSM, 2014). In Turkish case, lands and real properties are restricted and registered with respect to their x and y co-ordinates by the Land Registry and Cadaster General Directorate. Even if the topographical data has been added by the Cadastre Law (numbered 3402), cadastral maps have not included third dimension data yet (Demir et al., 2008).

All of the legal datas and of the immovable properties are holded by Land Registry and Cadaster General Directorate which is the most confident governmental institution. Currently, graphical and 2D parcel based maps are produced by Cadastre offices, attribute datas (such as owner, parcel number, size, easements, condominium informations etc.) are collected and registered to the book of real estate registers. There is a need for a new approach in order to adapt emerging information technologies and establish the Spatial Data Infrastructure which is the aim of Cadastre Law (no. 3402). So, it is very curicial adapting international standarts to create information systems that can easily exchange “geospatial” information and instructions with other information systems. Accordingly, the current land administration system has been developed for an advanced data sharing and interoperability.

Land Registry and Cadastre Information System (TAKBIS)

The purpose of TAKBIS is to establish an infrastructure of data processing technologies aimed at presenting to relevant person in an environment where the all data of land registry (ownership data) and cadastral (geometry) data integrated with each other and to provide integration with the relevant party out of the institution in an electronic environment (TurkeyTAKBIS). In this project, software development and applications were performed for the automation of services served by central and

local bodies of General Directorate of Land Registry and Cadastre (TKGM). But, the project has some deficiencies regarding managing geographic data because of the inclination of preserving traditional data management, poor quality of geographic data, and problems about temporal changes. (Aydınoglu and Inan, 2014). The system is build on central architecture. Land registry data management is carried out by SQL/Server and cadastre data management is carried out by ArcSDE on SQL/Server Database Management System. There are four separate data sets; property, administrative boundary, project area and construction and nine feature class which are related to cadastre in geodatabase (Fig. 1) (Bank ve Mataracı, 2004). However, the system which is capable of forming a confidental geometry for the land management applications, there is no geometric definition regarding with the management and representation of 3D physical objects like buildings or condominium units.

Data Sets	Feature Classes	Geometry
Administrative Boundary	Province	Polygon
	County	Polygon
Property	Village/Quarter boundary	Polygone
	Block	Polygone
	Parcel	Polygone
	Parcel Corner Point	Point
	Parcel Segment	Line
	Servitude	Polygon
	Ground Corner Points	Point
Project Area	Working Area	Polygon
Construction	Building	Polygon
	Numbering	Point

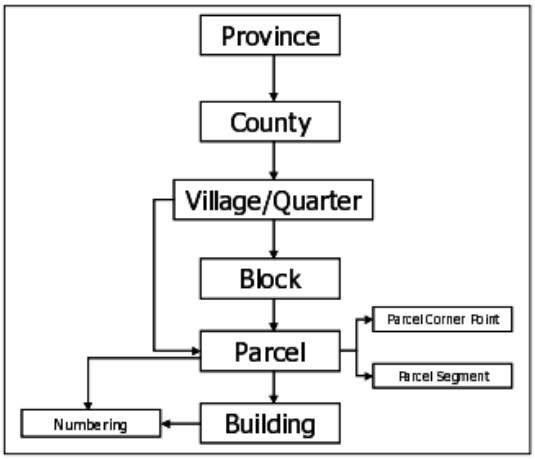

Fig. 1. Data sets, feature classes, and relationships among them (Bank and Mataraci, 2004).

Turkey National GIS (TUCBS)

In Turkey, there have been a growing interest for the development of national GIS infrastructure. This process has been accelerated with the establishment of the General Directorate of Geographic Information Systems in 2011. The most important point of the process is Turkey National GIS (TRGIS) which is an e-government project aiming at establishing the infrastructure for Geographical Information System in accordance with technological developments at the national level and INSPIRE Directive, creating a web portal for public institutions and organizations to provide on a common infrastructure the geographic information they are responsible for, creating content standards so that geographic data can meet the needs of all user institutions and identification of data interchange standards. Some basic geographic information sharing standards are determined for the system;

- Identification for the geometric characteristics of the geographic objects; ISO 19107 (ISO/TC211, 2005d) spatial schema and ISO 19123 (ISO/TC211, 2003) layer geometry and functions schema has been used.
- Point, curve and surface objects have been determined as basic geometry objects (URL-2).
- Conceptual model components which is compatible with ISO/TC211and can be implemented to the INSPIRE process have been determined. Accordingly; 5 basic geo-data

theme have been developed (BI-Building, AD-Address, TK-Land Registry/Cadastre, IB-Administrative Unit and UL-Transportation). Application schemas and standards, accoring to the user needs at the national level, were completed and approved in 2012 (Yomralıoglu and Aydınoglu, 2014).

- Geo-data models were developed for these themes. One of them is building feature type. According to the TUCBS.BI data theme;
    - Building information is represented in the surface geometry. Building data theme contains INSPIRE extended 2D building features. It is related with Urban GIS feature class which represent 3D data in the GIS and meets the needs in national level (URL-3).

Spatial Property System (MEGSIS)

It is an open-source application developed by Land Registry and Cadaster General Directorate, where cadaster data are collected by the center system from local users in the cadaster offices in digital .cad format and are harmonized with land registry data in order to be submitted to stakeholder institution, organization, municipalities and citizens by e-government link (URL-4). Studies held under Spatial Property System (MEGSIS) are collected under four main topics. i) Web-based application software ii) International standard map services iii) E-Government Services iv) Orthophoto Services. Spatial informations in the system are serviced to the institutions and organizations in the international standards (such as OGC Web Services).

Citizens can freely visit the website (parselsorgu.tkgm.gov.tr) and query parcel number/size, attribute informations, title deed informations, geographic co-ordinates and panoramic view of any immovable property.

According to Atasoy et al., (2015), the structure composes a small part of the land administartion system infrastructure. So, it should be developed and diffused to the national base. At this stage, it is identified that collected datas are used in a wide area and data quality is not in the desired level and data model should be updated. (Seymen et al., 2015)

Development of the Urban Information System (UIS) Standards

Aim of the project: Development of the UIS spatial data standards and guidelines for the realization of UIS applications. Composing a common platform for the local governments across the country.

Content: The project has been realized in the extent of nine work package. These are; legislation analysis, institutional analysis, data/user requirement analysis, international standards analysis, conceptual data model design, determination of the spatial data standards, developing UIS data exchange format, documentation/ dissemination, administrative and finacial modelling and preparation of the draft legislation.

Current Standards: ISO/TC211 ve OGC are the basic standards for the geo-data management and application schema and feature catalogue specified in an INSPIRE data specification are used. INSPIRE Buildings data specification is used because of providing detailed building features. City furniture, topography and transportaion objects, specified in cityGML, are modelled within the UIS project (URL-5).

Current situation: UIS standards have been tested with pilot implementations.

3D Topography and Urban Data Modelling Research and Development Project

Aim of the project: Development of the 3D city data model and sample analysis tools in order to contribute of the improvement of urban analysis, planning, design and decision-making process. The project is composed of the following components;
1. Determination of CityGML based data collection and preparation standards that cover 3D geometry, semantics and topology for large-scale map production.
2. Preparation of the tools which supports CityGML based national standards and capable of; visualization, data processing, modeling, data presentation, data optimization, data conversion and geospatial analysis.
3. Preparation of a 3D model library for easy mapping of the 3D entities (such as city furniture, traffic lights, vegetation and electricity poles).
4. Realization of a pilot project in order to test the defined standards and to conduct the use cases.
5. Organizing technical meetings, workshops and performing dissemination activities.
Project deliverables: Data preparation module, visualisation module, quality control module, analysis module, energy efficiency module, urban regeneration and planning module, geological layer and visualization and analysis of mine galleries module, 3D model library and 3D city Model. Some of these modules have been completed such as energy efficiency module and 3D model library and some of them are still in progess (URL-6).

3. 3D PROPERTY IN TURKISH LEGISLATION

Article 718 of the Turkish Civil Law stated that; land ownerhip extends downwards to the centre of the earth and upwards infinitely into the sky in the extent of providing benefit.

Article 998 of the Law stated that; (1)Land parcel, (2)independent and permanent rights and (3) condominium unit that subject to Condominium Ownership are registered as an immovable property to the land registry.

Condominium Ownership Law (numbered 634) designs some rules regarding with determination of the condominium unit ownership which is the part of a constructed/ constructing building. The law consist of fundemental rules and basic definitions that have to be considered. Such as (i) types of the condominiums (apartment, office, shop, cellar, warehouse etc.) (ii) determinants for the land share (iii) usage of the common spaces (iv) management of the building, etc.

According to the Large Scaled Map Production Regulation (BÖHYY); 3D cartesian coordinates (x,y,z) of the large scaled spatial informations and location informations on the map should be collected in the national data exchange format that will be a basis for GIS. Besides, these informations should be visualized with information technology and cartographic techniques.

According to the General Directorate of Land Registry and Cadastre Circular Letter (numbered 2011/3); architectural project, construction project and layout plan are the baseline documents for the title deeds of the buildings which subject to condominium ownership.

General Directorate of Land Registry and Cadastre Circular Letter (numbered 2010/4) defines the condominium unit plan (Fig. 2b). This plan shows the location of each condominium unit according to the architectural project, layout plan and construction permit. The plan which is the digital and graphical is approved by the municipality or governorship and is an official document for establishing condominium ownership.

According to the Regulation for Title Deed Plans (Official Gazette, no: 26980); Layout plan and condominium unit plan are based on the principal of establishing condominium ownership. These plans are designed in digital and graphical and includes; (1) locations and numbers of the condominium units (2) locations of the buildings, annexes and technical infrastructures (Fig.2a and 2b).

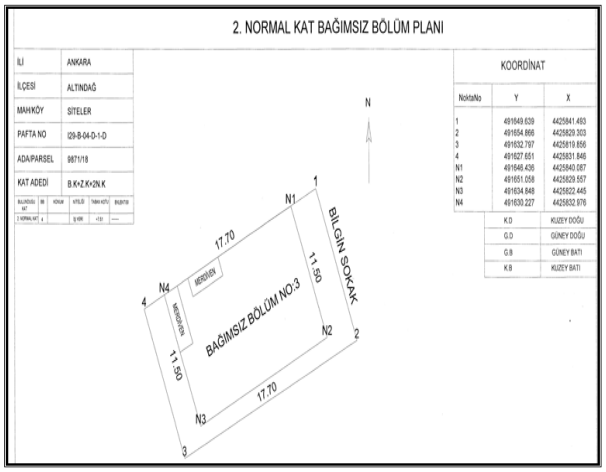

Fig. 2a. Condominium unit plan

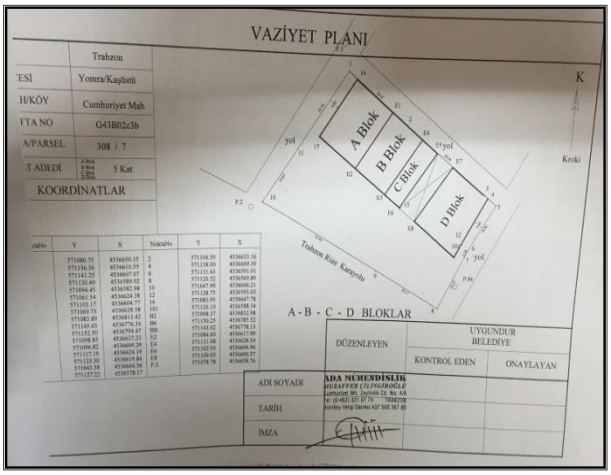

Fig. 2b. Layout plan

Acoording to the most of the jurisdictional decisions it is stated that *vertical cadastral sheet* of the buildings (condominium units) are architectural projects.

3.1 The Process of the Development of Condominium Ownership

Establishing the condominium ownership is the most basic step for the condominium units (3D physical objects). In this way, these units are registered and legal security is provided.
These are the main steps for the development of condominium ownership;

1. Preparing the architectural, static, electrical and mechanic projects (by Architect and engineers)
1. Construction permit (from municipality or governorship)
2. Completing the construction
3. Occupancy permit (from municipality or governorship)
4. Establishing the condominium ownership the documents below;
   - Measurements of the condominium unit, annexes and common spaces
   - Land shares of the condominium unit

- Number of the apartment, office, shop, cellar or warehouse which are in the same building
- Building management plan
- Architectural project
- Occupancy permit document
- Layout plan
- Condominium unit plan

6.Cadastral approval

7. Registration of the condominium unit in the Registry office.

The condominium is based on the principal of establishing co-ownership on buildings and building parts with determining the land share. So, the land share of the each condominium unit should be determined by means of containing the value differentiation between the condominium units (634 sayılı KMK, md.3). Namely, valuation of the condominium unit is very important and play a crucial role in the entire process from construction to demolition of the building.

The problem is that: architectural projects are prepared when the building is not physically on the land surface and projects prepared in design phase don't include valuation determinants and are not meaningful for cadastral/registry purposes. Besides, it is not easy to show their value on a 2D architectural project (in the digital cad format). However in the project phase land shares are determined over the project documents lacking of scientific determinats (addressed in Law no.634). These are the main documents of the architectural project regarding with condominium unit and land share;

- Layout plan
- Share chart (including land share of each condominium)
- Application project
- Numbers of the each condominium unit

Current situation, area based and equal rate based methods have been used for the determination of the land share. As a result of that, there have been different land shares which are belonging to the same condominium unit (as seen in Table 1).

Table 1. Determination of the land shares with different methods

Condominium number	Floor Area (m^2)	Unit value ($)	Land share (based on area)	Land share (based on equal rate)	Land share (based on value)
1	120	100.000	12/70	1/5	10/60
2	120	100.000	12/70	1/5	10/60
3	140	120.000	14/70	1/5	12/60
4	150	130.000	15/70	1/5	13/60
5	170	150.000	17/70	1/5	15/60
Total	700	600.000	1	1	1

So, this kind of incorrect and unscientific appreciations lead to important immovable property conflicts (especially in the context of condominium). Whereas, land share should be determined value based (as stated in Law no. 634) and even if the building is not physically on the land surface, valuation should performed with the real measurements and datas from the 3D virtual building model. This kind of a valuation system is not supported by the current land administration system. Besides, according to Cete and Yomralioglu (2013); real estate valuation is one of the most problematic domains within the Turkish Land Administration System and real estate valuation system should be restructured in a holistic manner with land registry and cadastre components.

3.2 Determination of the Land Share with BIM Process

Building Information Modelling (BIM) is a digital representaion of the physical and founctional charecteristics of a facility/building/ structure (URL-7).

BIM is not just a 3D drawing tool but a new way of holistically managing the information related to construction projects, from planning to design, construction and operations. BIM, is a data-rich, object-oriented, intelligent and parametric digital representation of the facility, from which views and data appropriate to various users' needs can be extracted and analysed to generate information that can be used to make decision and improve the process of delivering the facility.

BIM enables better control of the construction process and enhances cross-disciplinary collaboration, problem solving, decision-making support, productivity management and risk management. BIM can also help with localised engineering solutions such as clash analysis, shadow analysis, cost analysis, design scheme options, etc. (URL-8).

There are limited studies regarding with using BIMs for the management of immovable properties in Turkey. According to the Isikdag et al., (2015), the highly detailed Building Information Models (BIMs) provide opportunities for model-driven valuation for the new construction projects. In many countries a lot of properties are apartments and it is not easy to show their value on a 2D map (and adding a table to a complex building is not giving clear insights) and it could be an option to use a 3D building and/or cadastral models for this.

3D BIM models can provide important approaches for the valuation problems in the determination of the land share. A model could be used for the following purposes:

1. The building which is not actually built in the physical land surface can be generated as a 3D virtual building model.
2. The factors needed for the land share determination should be visualized. Such as; floor area, level of floor, landscape, sunshine duration, construction cost etc.
3. Determinants for the valuation of the condominium unit can be analysed on the model easily.
4. Differences of each condominium unit compared to others become prominat (superior or missing features).
5. Condominium unit energy performance (solar, shadow, wind, etc.) can be considered with the support of environmental analysis function of the BIM softwares.

So, building elements with actual dimensions and details can be generated in the detailed design phase. 3D building serves as a real building and improves understanding of the expected end-result through visualization and virtual prototype. The decision-making process is accelerated and land shares are determined in a scientific manner (as stated in Condominium Ownership Law no.634).

CONCLUSION

The geospatial data is the most important component of the Land Administration Sytem in Turkey. The e-government projects of public institutions have been accelerated for fifteen years. TKGM and GDGIS are responsible for managing this spatial data and they have put into practice many e-government projects regarding with;

- land registry (ownership data) and cadastral (geometry) data integration,
- establishing the infrastructure for Geographical Information System
- creating a web portal for public institutions and organizations
- creating content standards so that geographic data can meet the needs of all user institutions identification of data interchange standards
- collecting the cadaster data by the center system from local users in the cadaster offices in digital .cad format and harmonizing with land registry data. And serving to the institutions, organizations and citizens in the international standards (such as OGC, ISO, INSPIRE).

When we look back at all of those stages, it can be concluded that 3D buildings have been evaluated in the concept of Urban Information Systems and used for an underlay for municipal requirements (such as; energy simulation, urban design, urban regeneration scenarios, flooding analysis,virtual tours, etc.) by the CityGML based national standards.

However the management of the 3D buildings and its components (like condominium unit) have not been considered in highly detailed level.

In the study we have considered the important problem regarding the condominium unit valuations. We find out that BIM can be used for solving the problems regarding with the vertical landownership (condominium ownership). Despite the fact that BIM world seems far away from the geospatial world, its functionality and detailed models containing geometric, topology and semantic information can be provide usefull informations for the surveyors in the management of 3D physical objects (buildings and condominium units).

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BIOGRAPHICAL NOTES

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