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## Urban information systems in Turkey

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**Geographical information system (GIS) projects were initiated during the 1980s in Turkey. The numbers of those projects increased both in public and private sectors during the 1990s, encouraged by the rapid developments in technology. One of the types of institutions most eager to use GIS technology is municipalities in the country. The administrators of the municipalities consider that effective management of the large amount of data in cities to access correct, up-to-date and comprehensive data is only possible with the use of information technologies. This idea has led them to establish urban information systems (UISs). However, they face technical, organisational and legal issues in their efforts. There is therefore a need for solutions to make UISs effective. In this context, this paper presents an overview of the UIS projects which have been implemented in Turkey. The issues faced during those projects are discussed, along with recommendations for solving those issues.**

### 1. INTRODUCTION

Geographic information systems (GISs) were developed in the 1950s and 1960s internationally.<sup>1</sup> However, use of those systems in Turkey was not initiated until the late 1980s.<sup>2</sup> The numbers of GIS projects, especially those implemented by different government authorities, have increased gradually. While some of them are national or regional, most are local projects. The most comprehensive national project that has been developed in the field of GIS is Turkish land registry and cadastre information system (Takbis), which is carried out by the General Directorate of Land Registry and Cadastre covering the whole country. The Marmara earthquake region land information system (Merlis) is an example of such a project. It was developed after an earthquake in 1999 in the Marmara region of Turkey, to improve the situation in the region and to develop an earthquake response system.

Local GIS projects are generally carried out by governorships and mostly by municipalities. Some Turkish governorships are establishing GIS units in their units to organise spatial information and to have up-to-date data in the province level, for example Sakarya, Kocaeli, Bursa, Ankara, Istanbul, Amasya and Trabzon.<sup>2</sup>

Other local authorities which regularly use GIS in Turkey are municipalities. They are leading institutions charged with providing services to the urban population. Their main

responsibilities are urban planning, building permission, tax collection, transportation, infrastructure and mapping.<sup>3</sup> Most of the population lives in urban areas and the number of migrants from urban to rural increases daily. According to the statistics, the volume of the data regarding urban areas increases by a factor of two every year.<sup>4</sup> Use of computerised systems is essential for the municipalities to carry out complex tasks and manage the huge amount of data effectively. Many Turkish municipalities are therefore trying to establish and use urban information systems (UISs) as an efficient tool for collecting, storing, manipulating and displaying spatial data.<sup>2,5</sup>

The municipalities are also facing a lot of technical, organisational and legal issues while establishing UISs. There is therefore a need to develop solutions for those issues to make UISs work well. In this context, the paper starts with an overview of the UIS projects conducted so far in Turkey. The issues experienced in these projects are then defined. Finally, recommendations for solving these issues are discussed.

### 2. UIS PROJECTS IN TURKEY

The main purpose of the UIS projects implemented in the late 1980s and in the 1990s was to digitise municipal records and automate municipality works in Turkey. The comprehensive UIS projects began in the municipalities at the start of this century. According to the research carried out in 2004, the main aims of Turkish UIS projects are providing decision support systems for city administrators (75%), managing urban services (67%), defining real estate inventory (67%) and applying plan and mapping applications (64%) (Figure 1).<sup>6</sup>

There was no responsible authority defined by law to implement UIS projects until 2004. Before then, the duty for 'establishing the geographical and urban information systems' was given to the municipalities by the Law on Metropolitan Municipalities.<sup>7</sup> Since then, the number of UIS municipality projects have increased. According to a survey carried out by the Turkish Statistical Institute (TSI) in 2005, 3066 of 3288 municipalities were examined. It was found that only 126 city, township and town municipalities have UIS projects, that is only 4% of municipalities have UIS projects.<sup>8</sup> Municipalities with established UIS projects include Trabzon, Samsun, Konya, Sakarya, Kocaeli, Afyon, Bursa, Izmir, Aydin, Eskisehir and some townships of Istanbul (Bahcesehir, Bahcelievler, Bakirkoy, Kadikoy and Fatih) (Figure 2).<sup>9</sup>

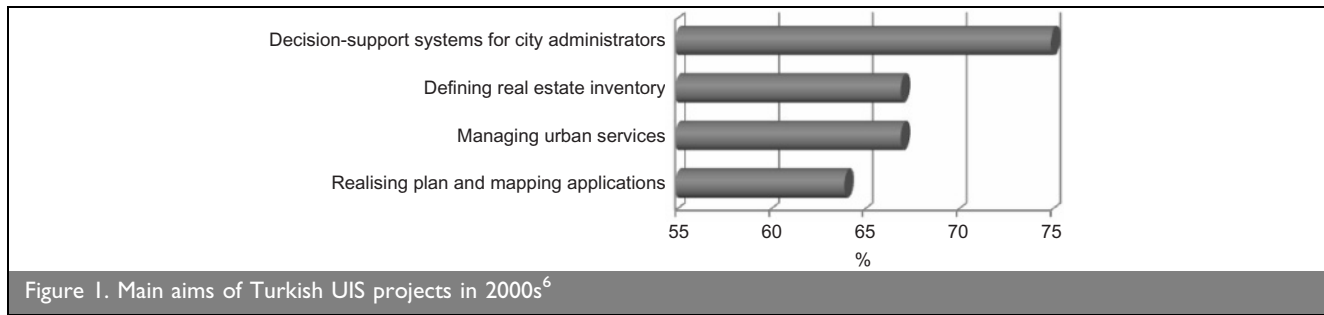


Figure 1. Main aims of Turkish UIS projects in 2000s<sup>6</sup>

The project carried out in the province of Sakarya is one of the best-known UIS applications in Turkey. In 2000, Sakarya Governorship established the Centre of Geographical Information Systems and digitised all graphical and non-graphical data of the entire province. The base maps have been made available in small scale for planning and in large scale for management and decision support. The system was designed such that all municipalities and public organisations in the province can access the system and update the relevant data. It prevents duplication in data production, which is also a big problem in many Turkish provinces. Data are shared via intranet, extranet and internet.<sup>10</sup> Another successful implementation of UIS was carried out in Kadikoy Municipality in Istanbul. The project KADGIS (Kadikoy GIS) was initiated in 2001 and put into practice in 2002. The purpose of KADGIS is to provide services quickly, economically and more effectively, prevent illegal constructions, efficiently manage traffic, increase the income of the municipality with effective tax collection, manage disasters and provide services such as electronic tracking of a parcel.<sup>6</sup>

Istanbul, the most populated city of Turkey (population 12 million), also has sub-projects that could be a base for future UIS projects. Two examples of such projects are producing 1:25 000 and 1:100 000 environmental master plans and surveying and restoring the historical peninsula containing the Fatih and Eminonu townships of Istanbul. In the former project, land use rights, development restrictions, protected areas and participation and coordination mechanisms were defined by environmental master plans. In the latter project, the historical places

information system was built using three-dimensional (3D) models of the environment produced via terrestrial laser scanners. Using this data, Fatih and Eminonu municipalities are conducting UIS projects.

Data used in UIS projects in Turkey include: existing maps; cadastral maps and land records; development plans; satellite images; numerating and address data; residents' information; buildings (number of storeys and construction characteristics of buildings); technical infrastructure maps; urban services data (drinking water and natural gas); and real estate and garbage taxes data.

### 3. UIS PROJECT ISSUES

There are important issues faced in UIS projects of Turkish municipalities. Those can be classified as technical, organisational and legal issues.

#### 3.1. Technical issues

As in all other GIS projects, the most time-consuming and costly part of a UIS project is data collection. Since there is no National Spatial Data Infrastructure in the country, the municipalities collect, process and analyse the data themselves needed in the UIS projects or they attempt to obtain data, if it exists, via signing protocols with relevant authorities. Therefore, the biggest part of technical issues faced in the projects is experienced during preparation of data needed in the system. In this context, the issues of Turkish UIS projects are summarised below.



Figure 2. Turkish cities with UIS projects

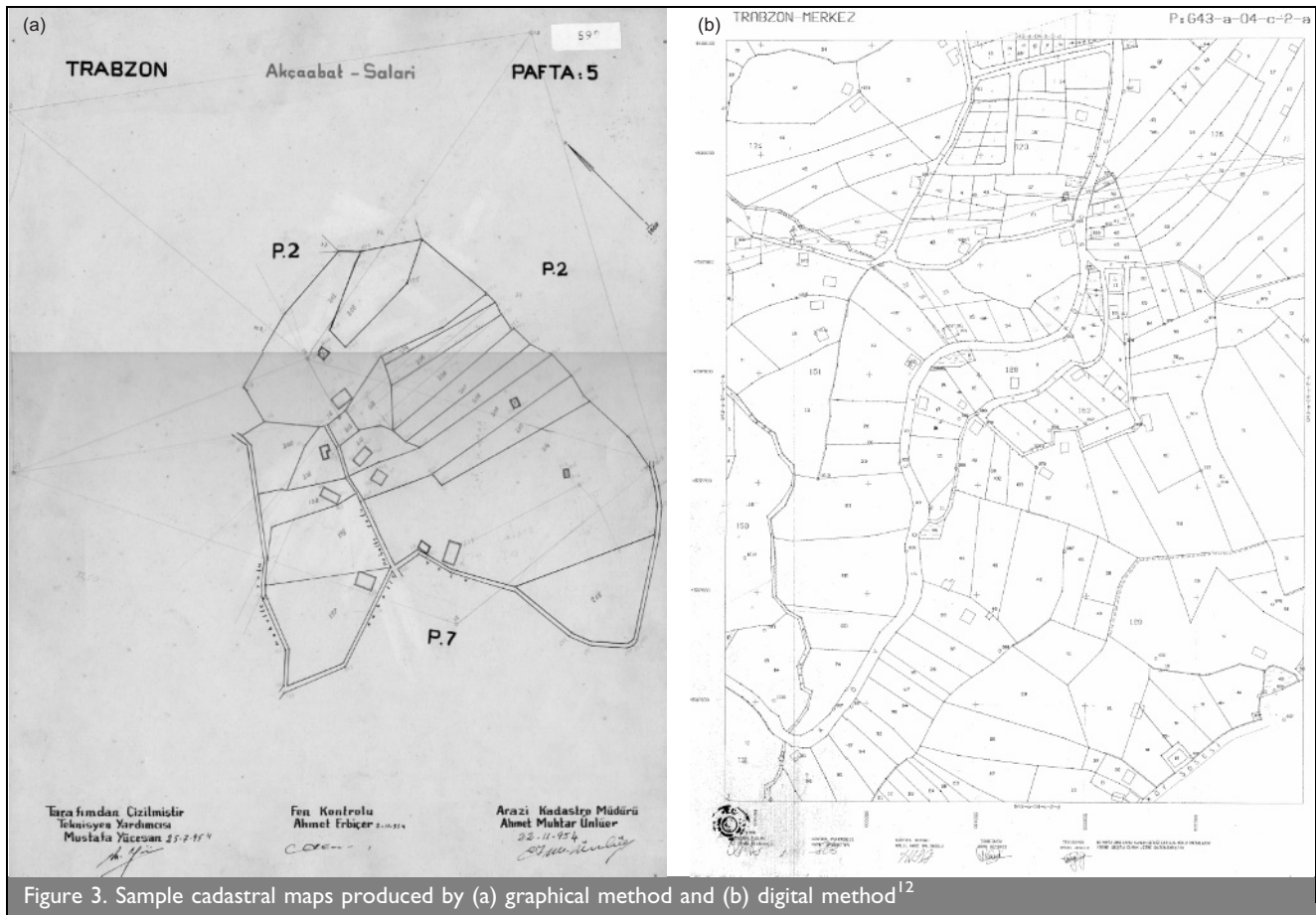


Figure 3. Sample cadastral maps produced by (a) graphical method and (b) digital method<sup>12</sup>

3.1.1. *Large-scale topographical maps.* Large-scale topographical maps (LSTM) contain important features required in UISs such as topography, buildings and roads. For this reason, they are one of the main graphical bases of the systems. In Turkish municipalities, LSTM are mostly either non-existent or not up to date. UIS projects therefore begin with building or updating those maps. However, it is a costly and time-consuming process, discouraging city administrators.

3.1.2. *Cadastral maps.* Defining property structure at a location, cadastral maps are one of the most important base maps in UIS projects in Turkey. However, those maps cause problems in UIS projects. Cadastre works began in 1925, and 83.9% of the works had been completed by 2007. In other words, 16.1% of the area still needs cadastral maps.<sup>11</sup> In addition, almost half of the existing cadastral maps cannot be used in UIS projects as they were produced using different survey methods and coordinate systems and in different scales (Figure 3). Cadastral maps therefore require to be updated.<sup>12</sup>

One of the most important issues to be tackled at the start of a UIS project is producing or obtaining cadastral maps in digital format. In cities which do not have approved digital cadastre maps, municipalities are trying to persuade the cadastre directorates to digitise cadastral maps. This is a difficult task that takes time and has to be approved by municipalities before the project begins.

3.1.3. *Utility maps.* Utility maps showing electricity and telephone lines, water and gas pipes and the sewage system are

becoming important in Turkey.<sup>13</sup> There is a need for both graphical and non-graphical data on these complex infrastructures to manage them effectively (Figure 4). In this

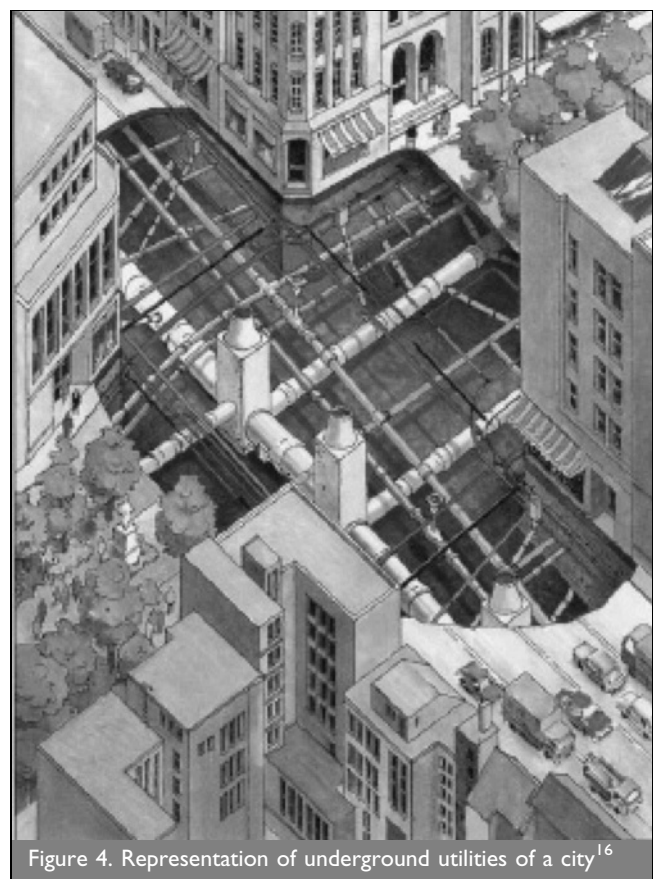


Figure 4. Representation of underground utilities of a city<sup>16</sup>



context, technical infrastructure maps are one of the main bases needed in UIS projects.

Turkish UIS projects also have important problems in data acquisition. In most municipalities, there is no graphical or non-graphical data on these utilities. Some municipalities have that information; however, they do not have the required standards.<sup>14</sup> In particular, the locations of underground utilities are only known approximately by the older staff of municipalities. Digging and surveying projects are therefore needed to create maps of those infrastructures. The current set-up makes it difficult to include utilities in UIS databases.<sup>15</sup>

**3.1.4. Common reference system.** UIS database is composed of the graphical layers and of relevant textual data. The layers have a common reference system which allows overlays. However, the graphical bases used in UIS projects have been produced in different times with different coordinate systems. The most common reference systems used in those bases are local coordinate systems. Therefore, transformation of the reference system of the existing maps into a common reference system is needed. However, the transformed maps, in most cases, do not have required accuracies.

**3.1.5. Address.** According to the Law on Numerating Buildings and Naming Roads (1927), all buildings have to be numbered and all roads have to be named or numbered.<sup>17</sup> The same law makes municipalities responsible for those works. Appropriateness of existing road names and building numbers has vital importance in UISs, since address information systems, which are sub-component of UISs, are based on those data (Figure 5).<sup>18</sup>

The survey carried out by the TSI proves that municipalities do not pay sufficient attention to numbering work in Turkey. Of

3066 municipalities, 543 (18%) have a numbering department in their municipal organisation. Numbering information is updated in only 104 municipalities, and is stored in the computer environment in only 17 municipalities.<sup>8</sup>

The most common problems faced by Turkish local authorities in UIS projects regarding address are nameless roads (especially in new settlement and urban areas), uncertainty on starting and ending points of roads, unnumbered buildings, repeated road names in the same city and a lack of numerical information about buildings on existing maps.<sup>4,18</sup>

However, there have also been some improvements on the Turkish address system recently. TSI initiated a project to standardise addresses, covering the whole country. Municipalities and special administrations of provinces numbered all buildings in accordance with address and numerating regulations and then recorded those addresses on the national address database developed by TSI. An address information system has therefore been developed to provide standard addresses, sustain address information in an electronic environment in a central database, keep the database up to date and establish a relationship between citizens and address databases.<sup>19</sup>

**3.1.6. Deficiencies in municipal records.** Accrual and collection information on water and natural gas service fees, real estate, environmental cleanup and advertisement taxes are recorded in the municipalities. Those data are stored in UIS databases. However, it is seen that the relevant data are not recorded regularly in some municipalities. For example, in most cases, the information regarding consumers (i.e. address, name etc.) is recorded as being missing, especially in middle- and small-scale municipalities. This impedes effective supervision of payments in UIS projects.



Figure 5. Sample numerating map produced in an UIS project in Turkey<sup>24</sup>

3.1.7. *Lack of research and planning.* Evaluating current UIS applications is important and should be carried out at the beginning of the projects. In Turkish UIS projects, the source of many problems is ignoring those important tasks. Many municipalities start the projects without sufficient research, which leads to inappropriate or disordered work. For example, the most common problem experienced in this context is the purchase of unnecessary hardware and software systems or buying necessary systems at an inappropriate stage of the project. These systems may become useless or inefficient for the project. As a result, the funding of the projects is not used appropriately.<sup>20</sup>

Another important issue is the application of effective project planning. It makes expectations, stages, their durations and costs and some results much clearer. Since the important tasks mentioned above are disregarded, many projects cannot be completed or sustained successfully in Turkey.

3.1.8. *Updating.* Another problem experienced in Turkish UIS projects is updating. In some municipalities, the UISs are becoming unusable right after they have been established. This is because the created systems built, with huge efforts and costs, are not updated dynamically or within a specific period of time. The data therefore do not reflect the existing situation in the field. A lack of educated personnel, inappropriate institutional structure and software systems bought as a package are seen as the biggest issues when updating systems which have vital importance for UISs.<sup>21-23</sup>

### 3.2. Organisational issues

Organisational issues in UIS projects can be classified under four main titles, as follows.

3.2.1. *Support of city administrators.* Obtaining the support of city administrators is the first requirement in UIS projects. As the first step, the administrators should be convinced that the system is necessary and useful. In some cases this is a difficult task, as some administrators have innovative ideas while others are more conservative. Conservative administrators are one of the biggest obstacles of UIS projects.<sup>4</sup>

3.2.2. *Institutional structure.* Municipalities have different organisational structures in Turkey, and this makes defining a model for UIS projects very difficult. It seems that changing current institutional structures is not possible in the near future.<sup>22</sup>

3.2.3. *Financial issues.* Most of the Turkish municipalities are having difficulties in finding funds to establish UISs. Funding is very important, especially during the data acquisition period. Experience shows that successful UISs recoup the money spent during the project (Figure 6). In this context, the issue is to find financial support at the beginning. If UISs are initiated without enough money, the project most likely fails and all efforts and investments are wasted.<sup>4</sup>

3.2.4. *Educated personnel.* UISs are sustained by educated and experienced personnel. Educated personnel are also crucial for solving hardware, software, network and database management issues.<sup>25</sup> However, the number of qualified people working in the field of information technology is limited in Turkey. In

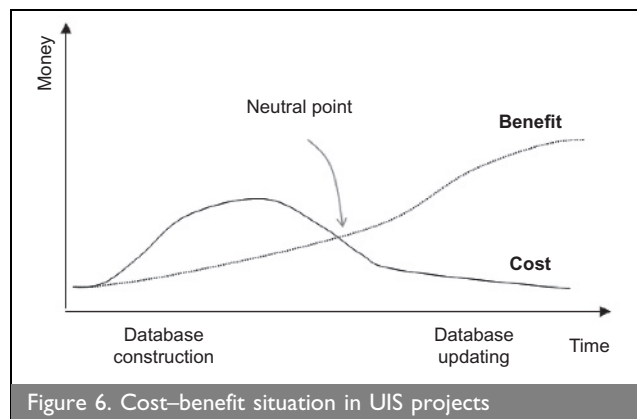


Figure 6. Cost-benefit situation in UIS projects

addition, municipalities are having difficulties hiring these people due to their limited budgets.<sup>20</sup>

### 3.3. Legal issues

Legal issues in UIS projects can be classified as one of two main issues.

3.3.1. *Regulation gap.* The UIS projects, carried out in different municipalities by counselling of an expert or agency, do not have a standard structure in Turkey. Projects therefore have remarkable differences in methods, data types and standards.<sup>20</sup> The systems built by municipalities for some specific tasks such as supervision of taxation and construction are referred to as UISs, which leads to misunderstanding in the application of UISs.<sup>26</sup> The main cause of this situation, of course, is the current regulation gap for UIS projects. As long as some regulations are not enacted, those misunderstandings and applications will remain.

3.3.2. *Data privacy.* UISs use land registry data which define property information of the real estates in the municipal area. According to Turkish civil law: 'Land registry is open to public. Anybody who proves his concern can demand to see or get the relevant pages and documents in the land registry.'<sup>27</sup> Accordingly, privacy of property data has to be taken into consideration in UISs to sustain the projects legally. However, that approach makes distribution of data on the web difficult and prevents some online services.

## 4. RECOMMENDATIONS FOR SOLVING ISSUES

In the informatics age, UISs are important and indispensable decision-support systems for local authorities. City administrators who realise this fact want to construct UISs in their municipalities. Meeting those demands effectively is only possible with effective solutions to the issues discussed.<sup>21</sup> General recommendations, to make Turkish UIS projects more effective, are summarised below.<sup>21</sup>

- An UIS regulation defining the framework of UIS applications should be prepared and put into practice as soon as possible to prevent differences in Turkish UIS projects.
- Organisational structures of the municipalities should be re-engineered according to informatics age. This will also facilitate constructing and sustaining UISs.
- After the required infrastructure is prepared, municipalities should be encouraged and supported both financially and technically.

- (d) UIS projects should be carried out by trained experts and with a project plan.
- (e) Lack of utility maps should be corrected and 3D positions of the infrastructures should be surveyed and mapped with relevant accuracy in all new technical infrastructure projects.
- (f) Special attention should be paid to the UIS education in the surveying engineering departments of the universities to meet the educated personnel needs.
- (g) The regulations on access to property data should be revised to respond the requirements of the informatics age.<sup>28</sup>
- (h) User-friendly interfaces should be developed for UISs to make them easy to understand and use.<sup>3</sup>
- (i) The policies and designs for updating UISs should be determined at the beginning of the projects. This makes the systems sustainable.
- (j) Pilot projects should be carried out at the beginning of the projects to demonstrate advantages of UISs to city administrators.
- (k) The municipal departments responsible for each dataset should be clearly defined, and duplication in data acquisition should be prevented via improvement of data sharing among the municipality units.

## 5. CONCLUSIONS

UISs are one of the most common GIS applications in Turkey. The number of initiatives to develop UIS projects has been increasing in municipalities since the early 1990s. The main reasons for that increase are the growing awareness of city administrators about the importance of UISs to respond to increasing service demands of population, fulfilling the duty charged with the law, making available up-to-date urban data especially for the purpose of decision support, carrying out municipal responsibilities properly and supervising accrual and collection of local taxes. The duty of establishing the geographical and urban information systems in municipalities given by the Law on Metropolitan Municipalities in 2004 has triggered the municipalities to create UISs. It seems that those projects are going to become more widespread in the future. However, there are still a lot of issues faced in UIS projects. There is therefore an urgent need for solving current issues of UISs to make them more effective and useful. The recommendations discussed here should be implemented as soon as possible.

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