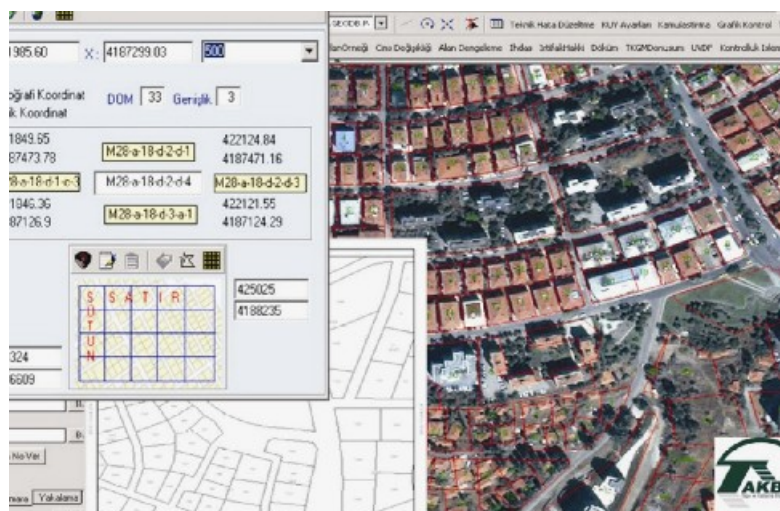


# Developing Infrastructure Potential in Turkey with GI From the Ground and from Space

In Turkey, the earliest GIS projects were initiated in 1986 by the General Command of Mapping (GCM) to produce digital maps for military aims. A National GIS Symposium has been held in Turkey since 1994. Many local authorities have followed GI related projects since that time with a view to increasing the adoption spatial technologies within the public services. However, the private sector has been focused more upon individual spatial information system projects, which stimulate private investments. After the Izmit Earthquake in 1999, many Turkish GIS projects became involved in risk analysis related activities. This has resulted in a rapidly expanded GI industry within Turkey that faces numerous issues surrounding standardization and lack of a formal GIS institution.

Location:	Convergence of three continents
Area:	814,578 square kilometers
Population:	68 million - 66% in cities and towns
Provinces:	81 administrative provinces
Regions:	7
Population relative to Europe:	second largest

By Tahsin Yomralioglu



**Figure 1** – An interface example of TAKBIS project. Aerial photograph and cadastral map is integrated, and manipulations of map sheets are also provided.

## Current Status and Issues

The importance of GIS has been realized by many government and non-government agencies within Turkey. Since the late 1990's, many GIS related developments have occurred across the country. Initially a few public projects originated from the General Command of Mapping, which is responsible for producing digital maps for military services. Additionally, some universities have been exploring through research related activity at the graduate level and numerous GIS projects have been completed since the first national

symposium. As GIS has grown in popularity within Turkey, the country is experiencing difficulties that are related to the establishment of a National Spatial Infrastructure. These difficulties include are attributable to the fact that there is no standardized GIS terminology, feature and attribute coding, and data exchanges at national level within the country. As a result, complexity and misuse of spatial data still exist. There is also a considerable distinction between the public and private sectors in terms of qualitative and quantitative use of GIS technology.

## GIS in Public Sector

The public sector acts as an engine for GIS activities in Turkey. The military was the first and continues to be the largest

user of GIS, while the Turkish land registration system is also required to collect and manipulate cadastral information. However, more data is required to fully develop and realize the benefits of a national spatial infrastructure on a national government level – across many departments and users. To meet this need, a national spatial data structure was requested from users in the public and private sector. On the local level, municipalities urgently need spatially based information, in order to make better investments and promote planning activities. The requirements for each sector revolve around similar types of spatial information as well as sector specific information. Consequently, GIS activities in Turkey can be seen under public, private and educational sectors as mentioned below.

## Land Registry and Cadastral Information System Project (TAKBIS)

In Turkey, cadastre is a compulsory task. In 2000, a project, called TAKBIS, began for developing a National Land Registry and Cadastre Information System. The goal of TAKBIS is to establish a country-wide land information system (LIS) through the use of GIS and to develop several GI-based applications, using software required by the end-users (see Figure 1). The initial project investment was estimated 150 million USD. In the first phase of the project, which included a pilot project area in Ankara, involved 360,000 land units with over 1 million land ownership documents. These have been integrated with spatial

information systems, taking a year to complete. The project is still under development, and consists of three steps: analysis, design, and application development. The main purposes of TAKBIS are:

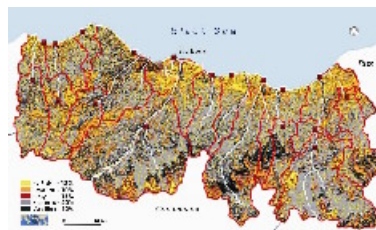
- to provide reliable land information required for land and land-related activities and decision makers
- to regulate such activities in accordance to the principles of GIS/LIS in frame of standards of OpenGIS Consortium
- to maintain information updated and re-evaluating them within the scope of information technologies
- to provide spatial data for use in central and provincial public organizations

### GIS in National Security

The (GCM) is the national organization of Turkey which is responsible to produce both printed and digital maps at medium and small scales, required by both military and civil organizations in Turkey. Within the (GCM), GIS related activities began in 1986 and consist of mainly two distinct projects, one at 1:25.000 and the other at 1:250.000, using scanning, digitization, editing and tagging processes. In 1990, a GIS project named the "National GIS project" was conducted in accordance with NATO Data Standards. The (GCM) also developed a GIS software named 'Digital Map Aided Military Applications' in order to save money, personnel and time. The software enables all map users in the military to perform military applications easily, using digital maps distributed on CD in a simple PC environment without any computer knowledge

### GIS in Local Governments

In Turkey, there are both provincial governments and municipal levels using GIS. At the province level, in order to organize spatial information for the whole province with up to date information, these agencies are establishing GIS sections within the organization. This includes data pertaining to the provinces topography, administrative structure and other thematic data as well as providing them with the opportunity to manage other provincial activities such as



**Figure 2** – A map of potential landslide hazard areas of Trabzon province. GISLab, 2003.

hazard, healthy, security, population, communication and road network works (Figure 2).

The governments of Sakarya, Kocaeli, Bursa, Amasya, and Trabzon are examples of expanding GIS use in the provinces. Municipalities are also growing users of GIS and activity has been increasing. The goals of municipalities using GIS include:

- infrastructure planning
- prevention of illegal building construction
- improved urban traffic management
- easy and practical use of deed and cadastre information
- increase the revenues of the government with property and local taxes

- monitoring the city development and construction information

Several demographic analysis and population forecast techniques are being implemented and prepared; building on earlier GIS projects with the use Urban Information Systems implemented in the mid-1990s. Some metropolitan municipalities such as Bursa, Istanbul, Ankara and Izmir are more practical in nature, including those in use at the Bursa Metropolitan Police Station which applies GIS integrated with GPS for vehicle tracing. In this case, maps for criminal analysis activity are produced (see Figure 3). However, standardized data for information system use remains incomplete and largely non-existent at the local level.

### GIS in Private Sector

The private sector has a very important role in the dynamic Turkish economy. In the GIS industry, private sector drives the public sector with respect to adoption and use of GIS. New developments in the IT area are promoted from private industry, and diffuse to public use more quickly. This sector is also well diversified, offering not only hardware and software requirements but also data capture, digitization, and the establishment of many

infrastructure information technologies. Similar to other parts of the world, where information on rates of return and GI value to the economy is difficult to acquire and determine, a similar situation regarding the 'GI Marketplace' in Turkey, also exists. Some individual GIS companies do operate services for public organizations. Most GI projects that are requested by municipalities in order to determine needs and establish urban information systems within their jurisdictions. This approach is increasing very rapidly through the use of expanded Internet availability and use, providing quick and easy access and distribution of spatial information. This is resulting in a growing number of Web-based GIS applications, while at the same time enhancing awareness with respect to Internet mapping concepts at the local municipality level. Most people in Turkey speak the Turkish language therefore technologies that recognize and include Turkish language capability are more predominately used. This also applies to research and development agencies.

### GIS in Education

Several Turkish universities are involved in teaching curricula through the use of GIS. As more universities have expressed interest in these technologies and students have demanded them, a growing number of master thesis projects have been completed more recently. Academics within universities have also embraced GIS into research related activities and this has again resulted in greater diffusion of GIS into the economy. Surveying Engineering Departments are the primary users of these products, although several other disciplines are now involved with the technologies including; geography, geology, urban planning, civil engineering, computer science, biology, forest sciences and so on. Courses usually consist of tutorials, readings, projects, and discussions concerned with how GIS can be used to integrate spatial data compiled from varied sources for a wide range of purposes. Graduates of these institutions learn how to create digital



**Figure 3** – GIS&GPS integration is adapted to police department of Bursa Metropolitan.



geographic databases, geo-register scanned base maps, digitize vector features, enter and manage attribute data and compile metadata. Generally, the use and application of GI technologies is greater at the graduate level than at the undergraduate level. Consequently, there are several research projects have been carried out by universities through the creation of special GIS research facilities. The Turkish Chamber of Surveying Engineers is also a voluntary committee that organizes and promotes countrywide activities like workshops, conferences, publications and lobbying for a standardized spatial data infrastructure.

### Remote Sensing in Turkey

'BILSAT-1' is the first a surveillance satellite Turkey launched on September 27, 2003 from Plesetsk in north eastern Russia. The BILSAT-1 satellite, built at a cost of \$14 million, orbits the Earth at an altitude of 686 kilometres,



**Figure 4** – The first image of BILSAT. Gulf of Iskenderun, 2003.



**Figure 5** - A mosaic of Landsat 7 ETM images of Turkey, 2000.

collecting data to be used for environmental, agricultural purposes, the management of natural catastrophes and urbanisation issues. Images have 27.3m multi-spectral and 13.6m panchromatic resolutions. The equipment package for the satellite was designed by a consortium of Turkish and British engineers and conducted with Surrey Satellite Technology Limited (SSTL) of Surrey University, UK. The image processing on the satellite captures a 4-band multi-spectral image with a size of 2048x2048 in 8-bit pixel format. These images are then compressed simultaneously with the new industry standard JPEG2000 algorithm and forwarded to SSDR of BILSAT-1 for storage upon downlink transmission. This represents the first space system entirely designed, manufactured and tested in Turkey (see Figure 4).

### Land Cover of Turkey by Remote Sensing

A new project has been designed and implemented by the State Institute of Statistics (SIS) to determine land cover types using remote sensing techniques. DIE has exclusive responsibility for producing and disseminating official statistics in Turkey. Agricultural census are produced every ten years, while agricultural production statistics based on data collected yearly, are available from the regional offices of the Ministry of Agriculture – this figures are often not reliable. Discrepancies between the yearly grain production figures of the Ministry of Agriculture and results from the Agricultural Census, State Planning Organization (SPO) has resulted in SIS investigations and the publishing of the "Estimation of Grain Production by Remote Sensing Project." For this purpose, Landsat MSS images were processed (see Figure 5). Four classes were determined by visual interpretation of the whole country as follows:

- Agricultural Areas (35% - 27,294,086 ha)
- Natural Vegetation Cover (28% - 22,281,104 ha)
- Water Bodies (1% - 1,079,650 ha)
- Non-agricultural Areas (36% - 27,374,270 ha)

General Directorate of Mineral Research and Exploration (MTA) is another large public institution and is responsible for mineral related activity in Turkey. In recent years, MTA has also carried out some projects based on remote sensing and using GIS. It has produced a 'Geological Map of Turkey' which was digitized in 1998 and since that time the remote sensing and spatial analysis group within that organization have expanded and consolidated to provide other Turkish geological information). This has been largely the result of natural disasters, such as the destruction caused by the earthquake in August of 1999. Since that time, the area has been focused upon in order to monitor and manage the level of impact caused from dangerous earthquake activity. Much spatial analysis and related work pertain to this region at both the local and regional levels.

### Conclusions

Turkey has realized that GIS is one of the main tools for public management and to know the resources of the country in order to having an ordinary development. Therefore, in both public and private sector have spending too much effort to get benefits from GIS. Public sector puts a couple of serious GIS related projects in country-wide to implement, while private sector proving IT to them. But still unorganized developments on spatial information use are occurring. In data exchange and standardization issues, for example, are still exist. Developed projects and produced spatial data could not be integrated for future use. In some cases data may not be available and to collect it is very expensive. Sometimes it may be available but at this time a limited use can occur because of confidential information. Even many uncertainties are present, use of GIS is going up very rapidly so that Turkey has a great potential for GIS industry.

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