ISTANBUL DISASTER INFORMATION SYSTEM

H. Can Ünen, Muhammed Şahin, Ergin Tarı, M. Zeki Coşkun,
Himmet Karaman, Turan Erden

Istanbul Technical University

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Abstract

Natural hazards, especially earthquakes have been threatening Turkey, and will continue to threaten in the future. The 1999 earthquakes in Turkey caused 20,000 casualties, injuries, 30,000 building damages. According to the results of many earth science researches, Istanbul is waiting for her earthquake in the near future. Thus, Turkish Ministry of Internal Affairs and Istanbul Technical University initiated a project on May 2001, called Turkey Disaster Information System (TABIS) Standards, to prepare GIS standards based on disaster management and these standards are declared to the central and local governors by the Turkish Ministry of Internal Affairs.

Aim of the study is to apply the proposed GIS-based information and management support system standards model for a selected pilot region in Istanbul in order to set an example for the succeeding applications in the country to be implemented in the future. The system, using modern satellite technologies and information systems, will be used especially for planning and applying emergency preparations, disaster management and loss assessment activities in case of a disaster and will also function as a decision support system for central or local authorities (ministries, governorships, municipalities, etc.) at other times. As a result of the study, an information system model is planned to be built that will support the authorities on their decisions by assisting the harmony and coordination in disaster planning between Istanbul, local municipalities and neighboring cities and by improving the TABIS standards.

So far, data source organizations for the collection of data are determined and preliminary design of the system is done in the project. After the inspection and integration of the data gathered from different sources, the emergency management tools to be used in the system will be determined.

With the establishment of the system, the impact to the national economy of Turkey will be minimized because of a disaster and the recovery operations after the disaster that will take place in a metropolitan city like Istanbul.

INTRODUCTION

If we look at Turkey in general or Istanbul in particular, Geographic Information Systems (GIS) have started being widely used as a popular technology for urban administration and planning purposes. However, a system with a data structure and standardization that would completely provide any need of a city has never been perfected yet. This study is an example for a disaster management system, which its likes have not yet been established for Turkey. And the project is supported by Turkish Prime Ministry State Planning Organization and Istanbul Metropolitan Municipality.

Aim of the study is to apply the proposed GIS-based information and management support system standards model for a selected pilot region in Istanbul in order to set an example for the succeeding applications in the country to be implemented in the future. The system, using modern satellite technologies and information systems, will be used especially for planning and applying emergency preparations, disaster management and loss assessment activities in case of a disaster and will also function as a decision support system for central or local authorities (ministries, governorships, municipalities, etc.) at other times. As a result of the study, an information system model is planned to be built that will support the authorities on their decisions by assisting the harmony and coordination in disaster planning between Istanbul, local municipalities and neighboring cities and by improving the TABIS standards.

Turkey Disaster Information System (TABiS) was developed in the scope of "Development of a National Database Using Geographical Information Systems (GIS) and Remote Sensing System and Standards for a Disaster Management Decision Support System" in the Istanbul Technical University (Karaman H., et al, 2002).

For Turkey and especially for Istanbul there are no GIS which have standardization and the data structure that provides all the required processes for a city even though the popular technology of GIS is used widely for the city management and planning (Şahin et.al., 2006).

SYSTEM FEATURES

System will provide planning and preparedness for disasters and will help to orientate the response and logistic support faster and more accurate than before. After a disaster, system will act as a decision support unit for the mitigation efforts. The system will inform the decision makers about:

- What kind of and how much help is needed from where,
- From where can this help be provided in the shortest time,
- Which specifications are needed for the staff to be charged.

Optimization and planning of the response will reduce the disaster loss and response and recovery costs. Thus, the system will minimize the economic catastrophe likely to follow the disaster for Istanbul. Also, announcement of the emergency plans to public will minimize the panic state during and after the disaster. This will also enable the participation with public. The system will provide current, correct, standardized and consistent data for its users and prevent the complexity of transmitting of unnecessary information.

Steps proposed at starting phases related to the study were: Configuration of the spatial and non-spatial data related to emergency management, formation of the principles of the institutional structure to keep the system up-to-date, formation of the system and determination of the hardware and software to be used, acquisition of different types of data according to the prescribed scales, determination of the integration of the data coming from different sources, determination of the presentation formats, formation of access and distribution of the data. As can be seen, the study requires a multi-dimensional expertise, generating solutions for the tasks in multiple phases (Şahin et.al, 2006).

All actions in the scope of the study are carried out with cooperation between Istanbul Metropolitan Municipality (IMM) and Istanbul Technical University (ITU).

ESTABLISHED TASKS

- Project budget was arranged in order to fulfill long-term requests and purchasing of equipments and services for the year 2006 have been made and documented.
- Determination of spatial data and data sources was made. Data formats and spatial references were also determined.

- A detailed draft of tasks to be done during the project was prepared. Main features of this draft are: carrying out system analysis, obtaining necessary equipments, obtaining necessary basic software, carrying out system design work, data transformations, data production, development of application software, testing of the system and putting into practice.
- Project headquarters were formed in a room assigned by the Deanship of the Faculty of Civil Engineering in accordance with the academic committee of the Department of Geodesy and Photogrammetry Engineering (Figure 1).

Figure 1: Project Headquarters.

- Acquisition of a portion of the data from IMM or other relevant organizations is established. Gathered data can be listed as follows:
    - 1/5000 scaled base maps produced in 2005.
    - 1/1000 scaled digital maps from 1996.
    - Satellite imagery covering Istanbul.
    - Digital geometric data related to transportation.
    - Spatial topographic data and attributes being served in Istanbul Guide on the IMM website.

DATABASE DESIGN PROCESS

The primary objective while bringing TABIS to life, is the database design. The design process involves logical and physical design respectively. In the logical design phase, data types for the physical design phase and the spatial representation of the data (point, line, polygon) are determined along with their attributes. In the physical design phase, data sets, feature classes and tables to store the data defined in the logical design phase are built and relations between relevant data are defined. TABIS Object Catalogue (TABIS-OC), which is a standard data model for a GIS based management information system, is specified for the planning of preparations and rapid loss assessment in case of a disaster. This catalogue defines the features to be evaluated in the system.

TABIS-OC ,an object oriented database model, and IMM-DB (Istanbul Metropolitan Municipality Database), a relational database of IMM implemented for test purposes are compared in detail. IMM-DB is currently being used especially in applications that local governments need and contains data models used in projects in national scale and is developed by the integration of several private sector projects. It is decided that these two database models will be compared for the enrichment of the system to ensure that the system will be used easily by the local government.

MODELS USED FOR THE DATABASE DESIGN PHASE

With the establishment of the project for setting the standards of a remote sensing and GIS based, disaster management focused decision support system, it is aimed to define the mandatory data to be present in an information system and how these data should be structured. TABIS-OC has a basic geodatabase structure oriented to all specialties. Object models, object definitions, attribute definitions and attributes that the catalogue contains is similar to a structure of a topographic map. Digital maps can be prepared from the database by applying some generalizations on the data. TABIS-OC consists of two main components built parallel to the digital spatial and the hazard models (Figure 2). First component, Basic Topographic Object Areas, covers the modeling of actual objects characterizing the geometry of the related region. The second component, Disaster Management Object Areas, contains discretely referenced object models to be included in a geographical information system for disaster management purposes.

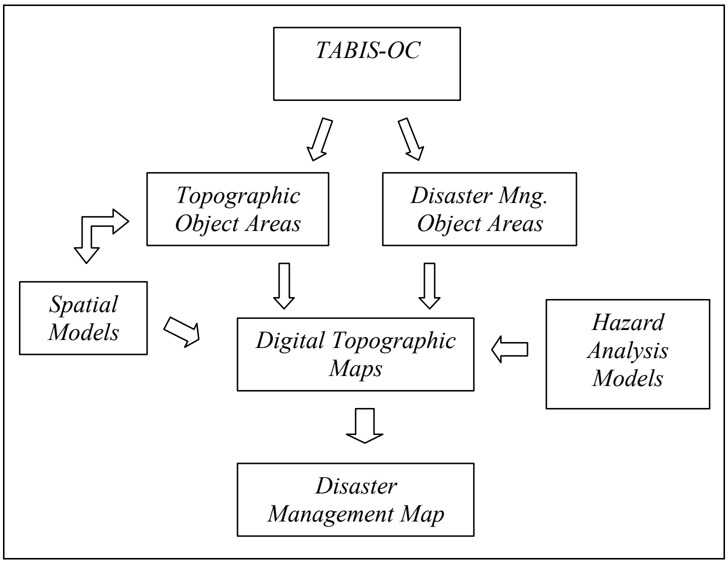

Figure 2: TABIS-OC

IMM-DB, is in a geodatabase structure, where geodatabase is a data model providing data storage and management on standard relational database tables. Two different architectures can be present in geodatabases: personal geodatabases or multi user databases. Multi user geodatabases are large and dynamic databases allowing more than one user to work simultaneously. A geodatabase stores spatial data in components as conceptual models determined by their similarities in utilization. These components are classified as feature dataset, feature class and table (Figure 3). Table is the component storing attributes related to a vector data. Feature classes store vector data in relevant geometries in a layer structure. These layers can be stored in a feature dataset or directly in the geodatabase. A feature dataset contains feature classes that can be presented together due to topology or content of the subject.

IMM-DB contains initially unused feature datasets, but this situation reduces the need to update the conceptual model in the future. In other words, the necessity of the geographic information system built in the scope of a project does not diminish after the completion of a project.

IMM-DB is in a structure that it can meet any content expansion due to integration of several projects, along with the datasets developed during the projects that it was used. Thus, the model consists of administrative area, ownership, residential area, urban service, infrastructure, transportation, numeracy, vegetation cover, recreational area, hydrography, topography, geology, geophysics, geodesy, project area, protection zone and zoning datasets.

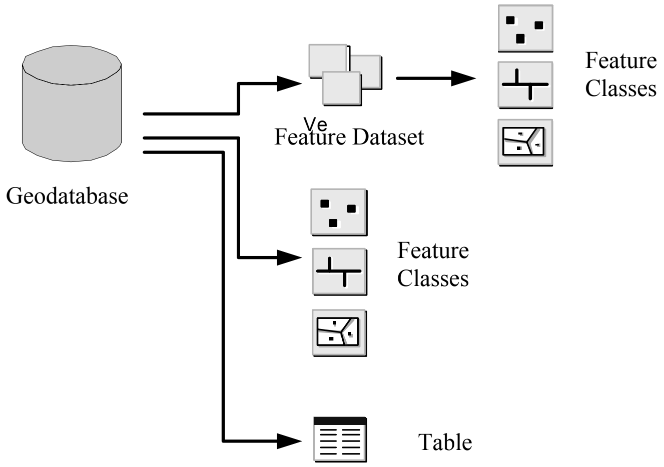

Figure 3: IMM-DB

ANALYSIS AND COMPARISON OF DATABASE MODELS

The database to be developed in the scope of the project will be built on TABIS-OC containing all of the objects needed in the system. The object models, object definitions and attributes included in this structure completely fulfills the needs of a topographic information system. Object areas are divided into two as basic topographic object areas and disaster management object areas. The components of the object catalogue are resolved during the logical design phase of the database.

While displaying the structure of TABIS-OC, object areas were classified along with their sub-groups and arranged in a more understandable form. Also, all object types are arranged in this form in order to be organized during the database development.

The database model to be used in the project, will be developed by the contribution of IMM-DB on adding models needed by the local authorities and on obtaining compatibility. As mentioned, IMM-DB database structure consists of a data model that divides the spatial data into components according to their usage patterns. Feature datasets that are designed and updated throughout multiple projects enriches the database structure. At the first phase of the study carried out, IMM-DB has been discussed on every aspect and its conceptual model was revealed up to its attribute data. While working on IMM-DB, compilation of the data classes contained were shaped into a more understandable figure.

At the second phase of the study after considering the data models of TABIS-OC and IMM-DB, these structures were compared in detail and the features that exist in TABIS-OC but not in IMM-DB were listed. So, the match-table prepared this way would lead to a complete model at the database design phase. TABIS-OC and IMM-DB, although looking similar due to their contents, have structural differences. For example, in TABIS-OC, each spatial object is defined as different objects. Whereas in geodatabase structure they are defined as subtypes of the feature classes they belong to.

CONCLUSION

From the study, advantages and disadvantages of each carefully examined database structures according to each other have been stated. In further stages, a stronger database structure is foreseen to be established based on the gatherings from this study.

By the completion of the project, every kind of national information system studies will be constituted according to defined standards and will be able to relate the national information systems to the system that is planned to be developed. The aim is to unite all independent studies and to enable the exchange and management of the valuable data for disaster management.

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AUTHOR BIOGRAPHIES

Muhammed Şahin

He is a professor of Surveying in the Faculty of Civil Engineering, Istanbul Technical University. He has been the head of Surveying Technique Division since September 2004. He was born in Pazar, a town of Rize where he finished his primary, secondary and high schools. He graduated from the Department of Geodesy & Photogrammetry, Istanbul Technical University in 1987. He received MSc & PhD from University College London and University of Newcastle Upon Tyne, UK, respectively. He become an assistant professor in 1994, an associate professor in 1996 and professor in 2002. His research interests include satellite positioning techniques, monitoring of earth crust using GPS, emergency management, disaster information systems, GIS based on emergency management.

Himmet Karaman

He is a geodesy and photogrammetry engineer and has his Master of Science degree on 2003 from ITU Science and Technology Institute on database systems on disaster management. He is a PhD candidate since 2004. He is a research assistant in Istanbul Technical University, Civil Engineering Faculty, Surveying Technique Division, since 2001.

Ergin Tari

He is a professor in the Faculty of Civil Engineering, Istanbul Technical University. He graduated from the Department of Geodesy & Photogrammetry, Istanbul Technical University in 1988. He received MSc & PhD from Istanbul Technical University. Between 1998 and 1999, he was a Visiting Scientist at Department of Earth, Atmospheric and Planetary Sciences of Massachusetts Institute of Technology with GPS and Geodynamics Group in Earth Resource Laboratory. He become an assistant professor in 1998, an associate professor in 2000 and professor in 2006. His research interests include engineering surveys, deformation measurements, surveying, GPS measurement, planning, evaluation and deformation, GIS based on disaster management.

Mehmet Zeki Coşkun

He was born In Malatya in 1964. He is graduated from ITU-Geodesy and Photogrammetry Engineering Department, then took his MsC degree in 1992, and took PhD degree in 1998. He has been an assistant professor in Surveying Techniques Division since 2000. He is interested in GPS, GIS, Mobile GIS, Emergency Planning, and software development.

Hüseyin Can Ünen

He is a research assistant in Istanbul Technical University (ITU), Geodesy & Photogrammetry Department, Surveying Techniques Division since November 2005. He graduated from Middle East Technical University (METU), Civil Engineering Department in June 2004 and have been carrying out his Ms.D study in ITU Informatics Institute, Satellite Communications & Remote Sensing Program since 2004. His area of study is GIS applications in emergency management

Turan Erden

He was born in Tekirdağ in 1977. He graduated from ITU Geodesy & Photogrammetry Engineering in 1998, and then took MsC degree in 2001. He has been working as a research assistant in Surveying Technique Division in Geodesy & Photogrammetry Department since 1999. He is a doctorate student now. He is interested in GIS, Emergency Planning and related subjects.