The Design, Development and Implementation of the Turkish Land Registry and Cadastre Information System

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Key words: cadastre, land registration, LIS, renovation.

ABSTRACT

In a parcel-based land information system or cadastre, the data are organized around the cadastral parcel. Different countries interpret the term of cadastre in different ways. The common understanding is that a cadastre is a form of land information system (LIS). The juridical cadastre system is used in Turkey.

Turkey is concentrating an establishing a Land Registry and Cadastral Information System. The project is presented in September 2000. The general objective of the project is to establish the Turkish Land Information System through out the country (TAKBIS). The pilot area of the project is the city center of Ankara and its vicinity. Marmara Earthquake Region will be the first implementation region that covers an area of 36.000 km² and is an intensive settlement and industrial region.

The scope of the project, project phases, related projects and Marmara Earthquake Region Land Information System are given in that paper.

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1   INTRODUCTION

In this decade, "**information**", has become the most important economic and strategic resource. The information produced or acquired by automating the managerial and functional activities of the institutions having a multi–layer hierarchic structure and an organization spread throughout the country, by means of an Integrated Information System logic may be made :

- visible
- sharable
- accessable
- producible.

As long as information is visible and sharable, it will provide an economic benefit and it will enable to produce strategic conclusions. Sharing the information located on a piece of paper requires many bureaucratic formalities which are fatiguing, time–consuming, paper and labor–intensive. In addition, such information may be lost or changed between hierarchic layers. In the age of information, availability of information in somewhere is not important, rather, offering it to the users in time, accurately and currently, according to the need–to know principle.

2   TURKISH LAND REGISTRY AND CADASTRE SYSTEM

In a parcel-based land information system or cadastre, the data are organized around the cadastral parcel. The principal function of a cadastre is the provision of data concerning such matters as land ownership, value and use. It may, for example, provide the information component of land registration. This is the process whereby various rights in defined units of land are officially recorded. The information in a cadastre is collected, sorted, referenced and retrieved primarily at the land parcel level. Other referencing systems, such as coordinates, may then be added to facilitate data manipulations and exchange of information with other systems.

Different countries interpret the term of cadastre in different ways. The common understanding is that a cadastre is a form of land information system (LIS).

Cadastral works in Turkey started in 1925 and organized by the cadastre law. The scope of cadastral activities in Turkey; establishment of cadastre as an adjudication, demarcation, survey and description, renovation and updating-post cadastre activities such as applications, subdivision, amalgamation etc.

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As an applied cadastre system in Turkey, the juridical cadastre has as a rule two parts. The first is a written record or registry containing information about each parcel , such as the name of the owner and rights which appertain to the land; the second is cross-referenced to the first and contains a detailed description of the parcel, in form of either maps or survey measurements. Components of juridical cadastre: adjudication, which is the official determination of rights in land; demarcation, which is the marking of the limits of each parcel on the ground; survey, which entails measurement and mapping; a description , which entails entering relevant information into the official recording system such as in registries.

Establishment of cadastre is mostly completed in Turkey. As it is explained above, the aim of maintained cadastral works in the country is to determine both the legal and geometric position of all the real property. In this way, the modern land registration which is anticipated in Turkish Civil Code will be founded.

Land and Cadastre works are carried out by Directorate General of the Land and Cadastre (TKGM) which has 155 years background is responsible for;

- To make any type of contracts and registries related to real properties.
- To follow changing onto registries, to control, to protect and to maintain property the land registries which are under the responsibility of the state.
- To indicate the real properties onto plans by establishing national cadastre.
- To determine and to follow applications of principle which are coordinating and developing land and cadaster and mapping services related with land and cadaster.

There are certain problems reflecting the general situation in the country. These are as follows: Insufficient amount and quality of software and hardware; Insufficient standards; Insufficient number of experienced staff; Budget limitations; Legislative limitations. In addition to these; there is no connection of old maps to the national geodetic network, there is no uniformity of map scales, the boundary points are not marked, there is no standard for large scale map series.

The General Directorate of Land and Cadastre (GDLRC) has planned to establish a Land and Cadastre Information System (TAKBIS) to improve land registration and cadastre data and operations. This Project shall result in implementation of a Land Information System to improve operations of the land registration and cadastre offices, and to supply appropriate land related information to all its users, both private and public, municipalities in particular.

3   LAND REGISTRY AND CADASTRE INFORMATION SYSTEM

3.1   Objectives of the Project

The main objective of TAKBİS project is to create a **"Land Registry and Cadastre Information System"** throughout the country. Within this point, the other goals of the project are to analyze land and cadastre services throughout the country within the frame of a GIS/LIS philosophy and to determine the problems; to find out solutions; to perform land

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registry and cadastre services in this way electronically, to determine technically the relations of local administrations and relevant institutions with land registry and cadastral survey ; and to offer correct, reliable and up–to– date information in the concept of land information system to local administrations and relevant institutions.

The objectives of the TAKBİS project are summarized as follows:

- To provide accurate, valid and reliable land information required for land and land–related activities and decision makers, to keep land registry and cadastral survey maps updated, to transmit all the data to the database, to keep updated data in a computer digitally, to re–assess such data under the information and communication systems technology and to offer them for use.

- To transform land registry and cadastral survey works and information into a multi – purpose land information system by the participation of external users as well and to keep such data in a secure medium and to provide access to them in a secure way.

- To plan, manage and activate the services by the GDLRC in a better, quicker, more reliable and more effective way, to ensure that the data given to other institutions and organizations are used more broadly.

3.2   Scope of the Project

The TAKBİS covers the analysis of the activities carried out in the GDLRC, in Regional Directorates, in local Land Registry and, in local Cadastre Directorates; the data flow with the other relevant institutions; the design of the TAKBİS model to be developed; the development of the application software within the concept of ICT technologies in accordance with the designed system; testing of the developed application software; the preparation of a proper data dictionary, other relevant technical and training documentation; the spread of the developed TAKBİS in the Regional Directorates, local cadastre and land registry directorates according to the priorities to be established by the Administration during Stage III of the project; to take measures for internal and external security of data; to transfer land registry and cadastre survey data available in application areas to the ownership system; the acceptance of the system following the tests to be conducted at stages I and II; the preparation of the reports, training documentation and user manuals concerning the management and use of the system and the training of the personnel.

During stages I and II, the data concerning 2068 maps of Çankaya Cadastral Directorate and Gölbaşı Cadastral Branch, about 943.000 owners of Çankaya Land Registries I, II, III, IV, V and Gölbaşı Land and about 288.000 major properties will be digitalized, their topologies will be established, developed and transferred to the system. Stage I of the project will be completed within 15 months and stage II in 10 months.

3.3   TAKBİS is an Integrated System

Land Registry and Cadastre Information System (LRCIS is called TAKBİS) is an integrated

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system that will;

- standardize the procedures related with land registration and cadastral survey techniques of the General Directorate of Land Registry and Cadastre (GDLRC)
- ensure that GDLRC (including Branches) will carry out the procedures in accordance with the regulations and in a computer medium
- minimize or eliminate any risks related with the procedures carried out by officials, by means of control and warning mechanisms to be included in the application software to be developed
- provide the relevant official with the support of the last regulations concerning the procedure carried out through his/her screen and that will provide a possibility of "Computer – Supported Training" through his/her monitor by providing explanatory information about the procedure carried out
- form an integrated structure by the transmission of the produced data to the system to be set up at the General Directorate and thus, that will enable the citizens to carry out sales and similar procedures in any place in Turkey
- enable the top hierarchy to monitor the performance of the directorates and of the personnel in the directorates
- produce Decision Support functions and reports for the Regional Directorates and the General Directorate's central units by use of such centrally generated information
- produce instant statistical conclusions, in strategic matters related with properties for any public organization
- conduct financial guilt investigations and asset interrogations centrally and thus, that will release the Directorates from such workload
- the citizens to see the last information about their owned properties and to obtain information and documentation related with loan registry and cadastral survey procedures before an application by use of **"Citizens Information System"** to be developed, from their homes, their workplaces and internet cafes
- accomplish all such procedures in the logic of **"Geographic Information System / Land Information System".**
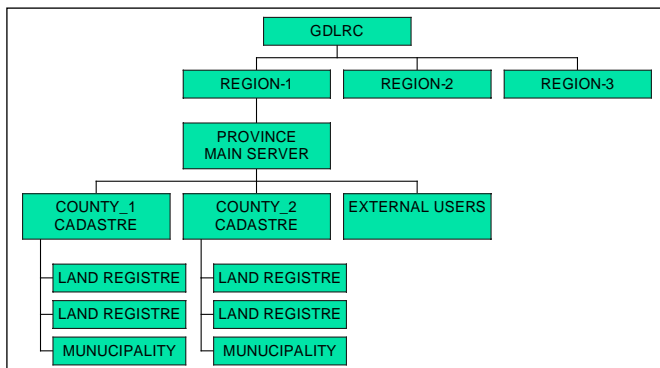
TAKBİS is not a system where only the automation of its internal activities is intended. There are many institutions that will use TAKBİS data as a base and will carry out the works under their own responsibilities in a digital medium. TAKBİS is a vital project for the strategy and security of the country.

It is evaluated that the Land Information System in Turkey will be transformed in a short time into a Multi – purpose Land Information System by the use of TAKBİS data by external users. In case that the Farmer Record System, Marmara Earthquake Region Land Information System which are projected to be realized entirely, it will be an important proof that the public has an intention to transit to this system.

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4 SYSTEM DESIGN AND ARCHITECTURE

4.1 TAKBİS Hierachy and Network

TAKBİS network will be established by the interconnection of various independent wide area networks (GDLRC, Regional Directories, Cadastral Directorates and Land Offices). Fig. 1:

Main server will be installed in GDLRC that will be Center, local servers will be connected to the main server will be installed in the Regional Directories and Cadastral Directorates. Land Registry Office's and end user PC's at Municipalities will be connected to the local servers. Database hierarchy is given at Figure 1.

In principle, Land Registry and Cadastre Offices will be linked to each other via WAN-Wide Area Network. If the Land Registry and Cadastre Offices are in separate locations, the systems in these two buildings will be connected with leased lines. The Wide Area Network (WAN) must be based on Ethernet Switch/Hub, and at the speed of 10/100 Mbit/sec. Based on speed, distance considerations, and capability to support future developments, fiber based cabling, although costly, must be preferred for connections between Cadastre and Land Registry Offices.
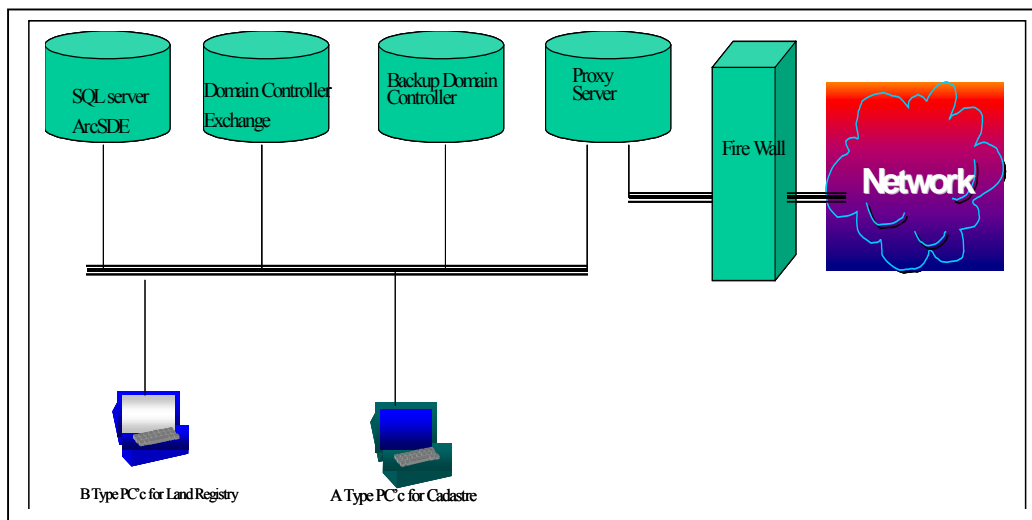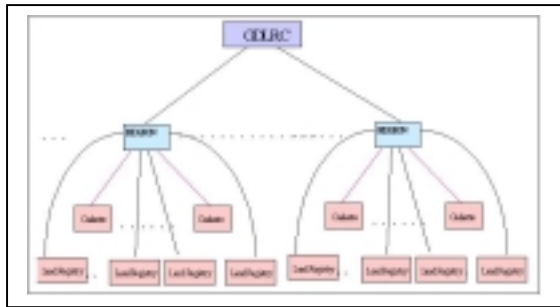

Figure 2: Main servers and Ethernet connection

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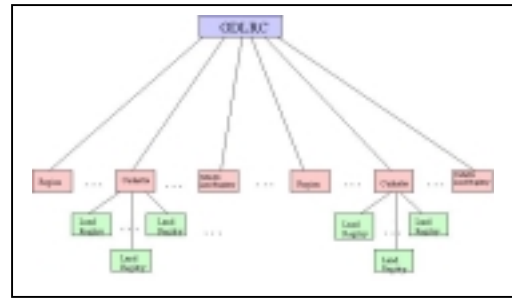Washington, D.C. USA, April 19-26 2002

4.2 TAKBİS Architecture

There are two alternative ways for TAKBİS architecture. One of them is central–distributed system, the other is locally distributed system. In the central–distributed system, GDLRC servers will be used by TAKBİS local servers. In this way there will be reduced cost for some hardware and software (SQL Server, ArcSDE, Domain Controller, Proxy, Fire wall). All these servers will be installed at GDLRC.

Figure 3: (a) Distributed architecture   (b) Central architecture

In the pilot project phase, central database architecture will be used. In this system, all Land Registry (5 unit), Cadastre Office Gölbaşı branch of it and Regional Directorate will be directly connected to the GDLRC. Depending on the performance testing results it will be changed distributed database architecture.

4.3 Accessing TAKBİS Data from the External Users

TAKBİS will be established as an Open system. There will be a lot of alternative ways in order to the connection and using TAKBİS data for the external users (Figure 4). External users will be connected to the servers to use GIS system for read only or viewing. The external users will not have the authority to update, add or delete data on the main server. Municipalities will be the main external users in the TAKBİS System.
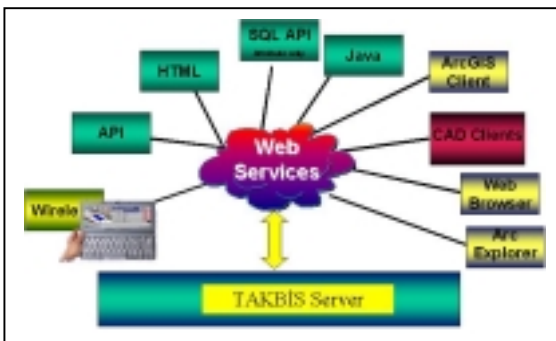

Figure 4: a) Serving TAKBİS data   b) Data viewing and searching via internet

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5   SOFTWARE DEVELOPMENTS

5.1   General Directorate Functions Software

Automation requirements of the central units will also be accomplished within the scope of TAKBİS. As the central building of the GDLRC is the center where all the data created under the TAKBİS project would come together, it will be in a position that enables to interrogate all the verbal and graphic information related with all the properties (estimated 33 million parcel data) in Turkey. For this reason, the following systems will be developed, related with the procedures carried out under the responsibility of the central units.

There will be a capability to interrogate by use of any information related with any property or any owner in any part of Turkey. This software will be placed in the system under the heading of "Property and Owner Interrogation". Also, "Assets" investigations will be carried out from this center instantly.

Interrogation and reporting programs where various information such as workload evaluation related with the procedures carried out by the Land Registries and Cadastre Offices will be available.

Also, the applications such as monitoring personnel, materials, budget, papers and statistical evaluations not included in the general interrogation activities will be developed for decision makers.

Any new land registry and cadastral survey procedures which may be arisen from any regulations amendment (including explanations–statements, taxes–duties) will be identified from the center (Disposition Department) by means of the "Work Management System" to be developed within the scope of the General Directorate's software and such a change will be reflected instantly to all the Land Registries and Cadastral Offices/Branches, in the new status. This design decision conforms to the present status of the institution and requires a comprehensive engineering work.

5.2   Land Registry Application Software

The land registry application software to be developed for the daily procedures of the Land Registry is designed in full compliance with the present land registry regulations. Each procedure will be controlled by a background – edited mechanism, the error risk of the official will be minimized, the system will warn the user is case of error and will ensure that procedures are carried out correctly. In addition, the official will see the present updated regulations by means of User Support Service functions and such an official will know the legal basis of the procedure carried out.

The basic functions of the Land Registry Application Software are sales, donation, exchange, lifelong care contracts, division (share), transfer of immovable property through inheritance, mortgage, establishment of individual apartment ownership, ownership, separation,

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correction, executive sales, restrictions placed on immovable property, right of usage.

5.3   Cadastre Application Software

The cadastre application software to be developed for the daily procedures of the local Cadastre Directorates are designed fully in compliance with the applicable regulations. Every procedure will be controlled by a background–edited mechanism, the error risk of the official will be minimized, the system shall warn the user in case of improper procedures and it will enable the procedures to be carried out correctly. In addition, as in the Land Registry, the official will see updated regulations by means of "User Support Service" functions and the official will know the legal basis of the procedure carried out.

The facility cadastral survey conducted by the local Cadastre Directorates, renewal, procedures subject to request, registration and control and other cadastral survey activities and project monitoring–intended application software will be available in the Cadastre Directorates.

The functions to be developed for the Cadastral Survey Directorates will be as follows: data entry, query, graphic and non-graphic data editing, parcel subdivision and amalgamation, statistical analysis, data presentation, displaying functions; conversion process, mapping, completion service, first cadastre activities, renovation activities, generating of technical documents; Generating of application sketch, generating of measurement sketch, generating of notice, generating of general boundary sketch, generating of block separation sketch, generating of plan copy, generating of block/parcel report, generating the posting announcement, project output process. Control activities; leaving for road and saving from road process, application of parcel planning, expropriation process, project monitoring software.

5.4   Project Monitoring Software

The procedures of project tracking, evaluation and execution will be able to be followed up by the project monitoring software according to the data produced by the Cadastre Directorates and in addition, TAKBİS works will be thought as a project and all its stages will be able to be monitored dynamically. The modules of the project monitoring software are defined as follows: Application Follow up Module, Local Cadastre Directorate Duty Distribution and Follow up Module, Work Follow up and Statistics Module

5.5   Office Automation Software

Another application software to be developed within the scope of TAKBİS is the office automation software. This office software will automate the following activities; Papers archive, material and hardware monitoring works; Fixture monitoring works; Official – worker payroll program, personnel services monitoring and similar administrative works; Revolving Fund monitoring works; Allocation monitoring works.

Although it is seen as a simple application, a Management Information System sub –

structure will be formed by the office automation software, by means of determining and planning all the sources of the institution, by monitoring applications related with them and by creating decision support – purposed information.

5.6   User Support Services

User support services will be developed in order to provide TAKBİS users with regulations support, to request pinions from superior authorities in case of hesitation in the procedures, to produce formatted letter / message in the system and to distribute the same to relevant units, to transmit TAKBİS – related Views, complaints and comments of the users to the TAKBİS manager at the center and to enable the TAKBİS branch to carry out on – line announcements to the users. This service will accomplish the following systems : Regulations Information System, Opinion Formation System, Report and Correspondence, System, Users Complaints, Comments and Announcement System.

5.7   Citizen Information System

A web – based program will be developed under TAKBİS for the citizens to obtain information previously, related with the procedures to be carried out in the Land Registry and Cadastre Directorates and to be guided about such procedures. They will be able to see any explanations related with land registry and cadastral survey procedures, address and telephone information about Land Registry and Cadastre Survey Directorates, and especially the last status of their own properties, by a simple interrogation, through internet, from anywhere (home, workplace, internet cafes).

5.8   Digital Geographic Information Standards

Terminology Standard, Data Modal Standard, Classification Standard (Feature and Attribute Coding Catalog), Data Glossary Standard, Meta Data Standard, Data Exchange Format Standard are prepared as a digital geographic information standards within the scope of the project. Some of them are produced or used as a same the standards developed by General Command of Mapping.

6   RELATED PROJECTS WITH TAKBİS

6.1   National Information System

Land and cadastral data to be produced within the scope of TAKBİS will form the basic information source of the National Information System (NIS) for land and ownership. In performing various public services, all public institutions and organizations use verbal registered information and spatial map information containing ownership boundaries (geometry of the land). This emerges a need of institutions for data exchange with Land and Cadastral Survey Registries.

The Prime Ministry whose basic duty in this field in to provide coordination between public institutions and organizations has started the NIS project in order to establish standards in

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information technology projects, to eliminate tangible and intangible losses which may be arisen from the production of the same data by different organizations, to ensure that data are produced once by the responsible organization and used by other institutions and organizations to the extent they may need.
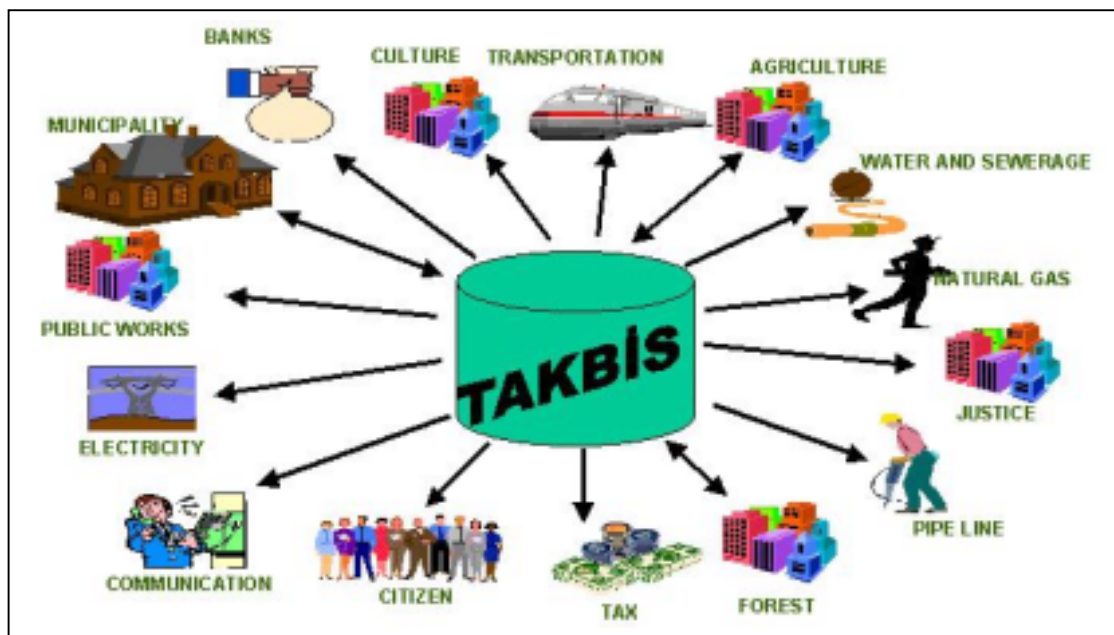

Figure 5: The place of TAKBIS in the National Information System

6.2. Urban Information System

TAKBİS data will be the basic information for Urban Information System works which the municipalities want to establish.

6.3. Marmara Earthquake Region Land Information System (MERLIS)

After the earthquake on 17 August 1999, comprehensive earth crust movements (1-5 m) have been observed in the Marmara region that covers an area of 36.000 km2 and is an intensive settlement and industrial region. As a natural consequence of these earth crust movements the cadastral maps, land registration data and large-scale maps that comprise the basis for the municipality services have lost their value. Consequently, it has become necessary to renew these maps and registers.

5 cadastre and 29 land registry directorates (which are in the scope of MERLIS Project) in Sakarya, Kocaeli and Yalova provinces that have been affected by the earthquake mostly.

It is expected that the data on land registration and cadastre in the Marmara Earthquake Region are renewed and converted into a multipurpose land information system (MERLIS). Fig. 6: MERLIS Region.

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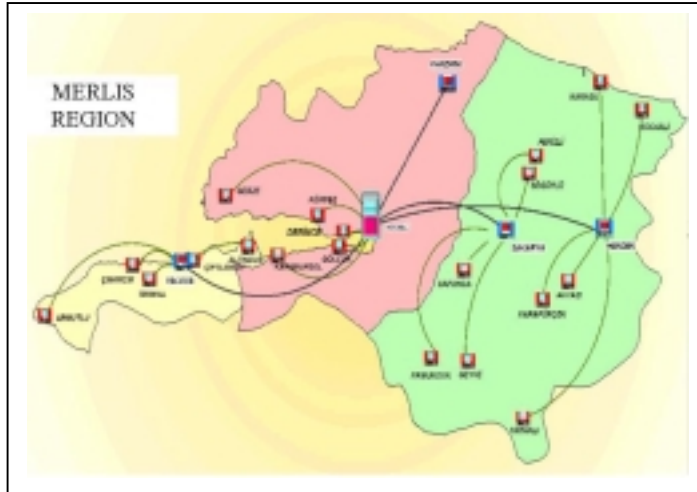Washington, D.C. USA, April 19-26 2002

Fig. 6: MERLIS Region

The following problems will be encountered when using cadastre maps for MERLIS because of the earthquake or other reasons;

- Changes in geometry-due to earth crust movements- after the earthquake.
- Poor quality of some cadastral maps and even their lack for some areas; this refers also to related data and technical documents (measurement values, surveying sketches, demarcation sketches etc.) that serve as a source of information for these maps.

The maps are far from being adequate to be used today, and technically insufficient because of the map production methods and the technology available when they were produced.

The development of the MERLIS System as an expanded TAKBİS includes: (a)design and development of additional software modules, (b) implementation of MERLIS in three provinces of the Marmara Earthquake Region (Sakarya, Kocaeli, Yalova), (c) training of local GDLRC's staff and users' staff, and (d) putting MERLIS into operation.

An additional modules required to TAKBİS for MERLIS are:

- Buildings module with vector geometry and attributes most useful in the earthquake region, such as building unique identifier, address, use, year of construction, construction type, number of floors and total floor area.
- Geological module with parcel-related information on suitability of land for construction in the earthquake region.
- Internet module to improve availability of cadastre, land registry and other MERLIS data.

The GDLRC will implement a set of projects to renovate cadastre and land registry in the

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three provinces which covers an area of 36.000 km^2. In this concept; ToR for Marmara Earthquake Region Geodetic Control Densification Project, Guidelines for cadastre renovation pilot projects for the Marmara Earthquake Region, Implementation Plan of the Cadastre Renovation Pilot Projects, Conceptual design of the MERLIS System and the plan of its implementation in Sakarya, Kocaeli and Yalova provinces (5 Cadastre Offices and 29 Land Registry Offices) are already prepared.

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