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Developing an urban information system for local governments

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Basic services provided in urban areas are continually undergoing a process of change and improvement. Administrative functions also complicate the ability to make prompt and accurate decisions. It is especially important for local governments, which provide technical services in urban areas, to have fast and reliable access to updated map bases and other spatial information. The urban information system (UIS) is a spatial-based information system organising and managing all types of graphic and non-graphic spatial information needed by local governments. In this study, a prototypical interface software for a UIS is designed and developed to share and dynamically update data, thereby increasing the efficiency of location-based services provided by medium-sized municipalities. The result is a software-based UIS that is cost-effective, requires no additional hardware, is flexible, user-friendly and highly adaptable. This prototype application, called DEVKBS V.1.0, is based on ArcView 3.x GIS and is written in ArcView's Avenue language and Visual Basic 6.0. Given the willingness of local authorities to test participatory models, the present paper presents an original implementation of information and communication technologies to support public participation. The system is currently being tested in selected municipalities to understand requirements, problems, data quality and software–hardware components.

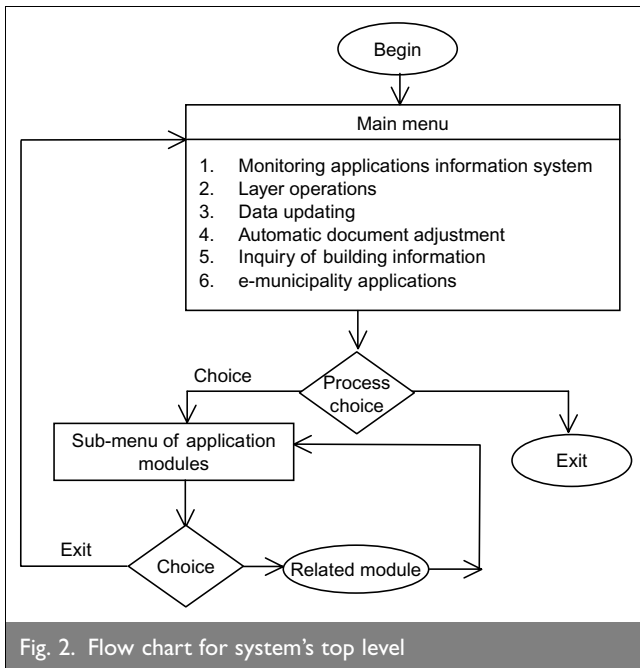
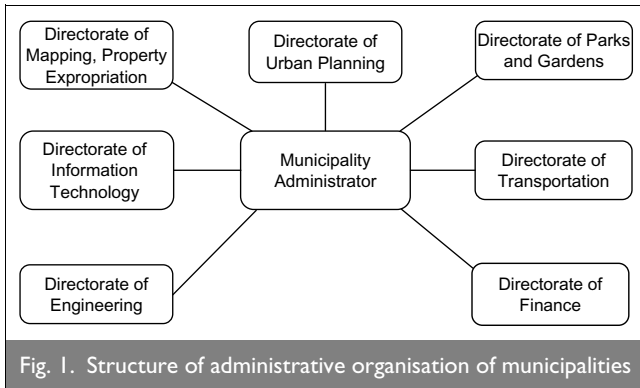
1. INTRODUCTION

Municipalities are institutions charged with providing services to citizens living in urban areas. To discharge their duties effectively, municipal governments must be able to use spatial information effectively, mobilise data intensively and share the data it produces with the general public.¹ Municipality activities are determined by regulations regarding urban planning, building construction, transportation, infrastructure and mapping. Using the latest innovations in computer technology, municipalities accumulate spatial data for their local areas, and often produce new information as a result of sharing information over territories. This quickly becomes ineffective, however, as each unit begins to establish separate information systems, which can result in legal, administrative and economic issues.² Legal disputes may result from the production and sharing of information if administrative safeguards are insufficient to control and supervise information sharing. Economically, the production and storage of information for different standards by several servicing institutions creates a serious problem of data interoperability, thereby increasing costs.

Most municipalities are unable to perform the services demanded because of insufficient resources, lack of modern administrative techniques and servicing standards, inability to improve staff policies and inability to establish cooperation and coordination on a local level.³ To overcome the current problems in municipality services, standardisation, clarity, efficiency and an increase in service quality have to be provided and they must benefit from the innovations of technology.⁴ The lack of adequate access to information is an important aspect in the underdevelopment syndrome. It is generally agreed that the improvement of information has a positive impact on the management and economic development of municipalities.^{5,6} At a more detailed level, decision makers are making their management decisions on the basis of information they have about the land realities and about numerous stakeholders' initiatives. In most developing cities, this information is poor and results in management and communication failures.⁷

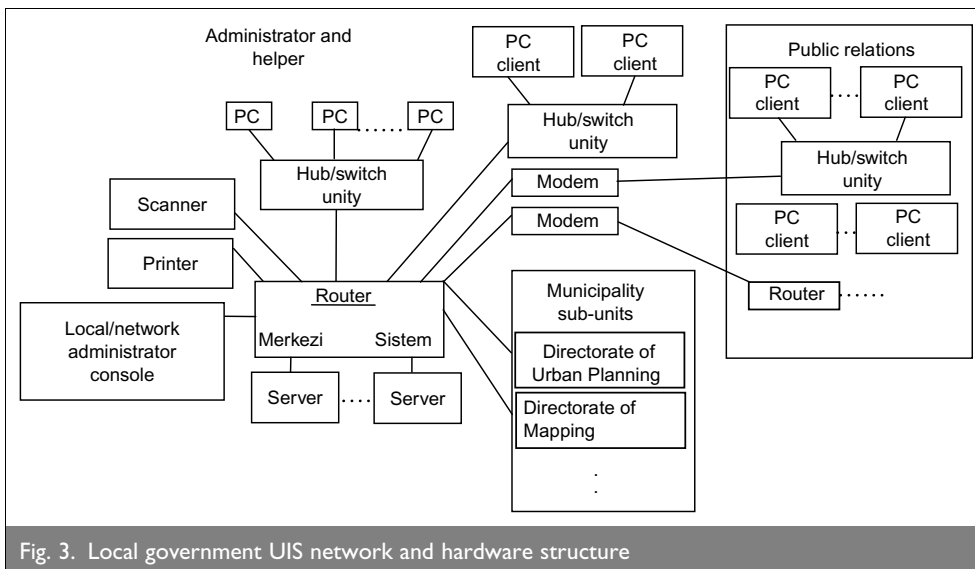
Information and communication technologies (ICT) are powerful tools that can improve sharing of information among decision makers and stakeholders. ICT can support the appropriation of information about land-use and relating conflicts. It can therefore contribute to improving local knowledge. However, ICT can contribute to strengthening management processes only when they are adapted to the context.⁸ For urban planning and management, geographic information systems (GISs) and the web can provide relevant support for the information and diagnosis of urban challenges. They can support decision making, coordination and social functionalities.⁹ As with other technological innovations, these technologies are also ambivalent, with the flaw of privations and the social repercussions of their implementation—sometimes unexpected and not always positive.¹⁰ A GIS that manipulates urban data is called an urban information system (UIS). In municipalities these systems are mainly used in tax and property administration with some key functionalities such as regulating documents for building permission and use, urban and transport planning, first-aid services, projecting, maintenance and treatment of infrastructural systems such as water, sewer system, natural gas, charting and engineering design and drawing.¹¹

Urban managers worldwide are conscious of these information problems and seek technical methods to help solve them. The existing GIS and planning support systems solutions are, however, not adapted to their needs and they require strong skills in computing and significant financial investment for their



implementation and maintenance. Thus administrators are usually interested in GIS alternatives that are easier to afford and learn.

In Turkey, most of the population lives in urban areas and the ratio of urban to rural increases day by day. According to statistics, the volume of data from urban areas increases by a factor of 2 every year.¹² Hence municipalities are increasingly



stressed with intensive and complex knowledge requirements. In this respect, UIS is of great importance for local governments.

In the present study, a prototype UIS was designed and tested on cheap, simple and widely used computers in a selected pilot project region. Emphasis has been placed on the design and performance of the system, in which all of the operations are registered. Data stores in the UIS may be questioned, analysed, reported and updated dynamically in an electronic environment from the initial demand for a conditional activity in municipality structure, through to the very end. The greater availability of information on land and stakeholders' initiatives will thus improve the quality of the diagnosis of the urban realities, and the coordination of the decisions and actions. Further, it is also intended that such an improvement will motivate decision makers and stakeholders to update the common database on a regular basis.

2. METHODOLOGY

For the design of the system, the following steps are taken.

- Review of the literature related to maintenance management systems.
- Definition of the system: to determine the existing conditions and requirements for the system, the activities, human power, workflow, organisational structure, problems, and internal and external relations of the institutions participating in the GIS.
- Design of the system: settling and organisation plans were prepared, and system, data, operation and physical design undertaken in parallel.
- Conceptual database modelling: the asset-relationship (A-R) modelling technique is used to create the conceptual database model for the proposed system based on the data item analysis.
- Relational modelling: the database model from step (d) is transformed to a relational database model.
- Software development: the final step is the implementation of the system using a database management system and front-end software package. It is known that no GIS can meet the institutional requirements exactly, so a flexible design of the interface will increase the longevity of the system.¹³ It is hoped that the development of internet-based web-GIS will help to

bring this electronic environment to broader masses.

- Project performance: project performance has been defined as the extent to which the software development process has been undertaken as well as performance of the delivered system from the viewpoint of the users. Questionnaires were mailed to 200 randomly selected staff of the municipalities. Factor analyses tables were composed for project performance. The

Municipality activities and applications	Municipality administration units							
	Directorate of Mapping, Property Expropriation	Directorate of Urban Planning	Directorate of Engineering	Directorate of Parks and Gardens	Transportation Directorate	Directorate of Information Technology	Secretariat Directorate	Finance Directorate
Base maps	P	U	U	U	U	U	—	—
Real estate information—municipality property information	P	U	U	—	—	U	—	U
Numerical information	P	U	U	—	—	U	—	—
Zoning applications	P	U	U	U	U	U	—	U
Applications Plan procedure	P	U	—	U	—	U	—	—
Plans and revisions	U	P	U	U	U	U	—	U
Building and settlement licence	U	P	U	U	—	U	—	—
Construction control information	—	P	U	—	—	U	—	U
Construction permission	—	P	—	U	—	U	—	U
Road works	—	—	P	—	U	U	—	—
Engine and motor repairs	—	—	P	—	U	U	—	—
Underground projects and maps, underground investments	U	U	P	U	—	U	—	—
Environmental pollution (environmental protection and maps)	—	U	—	P	—	U	—	—
Green area, park and environmental arrangement	—	U	U	P	—	U	—	—
Transportation planning	—	—	U	—	P	U	—	—
Transportation monitoring	—	—	U	—	P	U	—	—
Database management system	U	U	U	U	U	P	U	U
Updating data between units	U	U	U	U	U	P	U	U
Web design and education	U	U	U	U	U	P	U	U
Submitted applications and evaluation	U	U	U	U	U	U	P	U
Budget and accountancy work	U	U	—	—	—	U	—	P

Table 1. Organisation of data in the level of geographical details (P, produced; U, used)

respondents were asked to evaluate each item related to the developed software. A principal components analysis (PCA) followed by varimax rotation was conducted.

3. WORKS CARRIED OUT

In the current study, the Tuzla district and Tuzla municipality in Istanbul were chosen as the pilot region and sample municipality. Duty definitions and spatial activities of servicing units of municipalities that produce and use spatial information related to UIS were inspected and modelled. A general diagram of units and

directorates that use spatial information actively in their municipality's structure is shown in Fig. 1. Basic base maps and attributed data are acquired; data supervision and topological data structures are formed. Operational design, physical design and database design are undertaken and data dictionaries are prepared.

3.1. Data collection

First land-use maps, building information, road and geodetic measurement points were gathered. Cadastre maps were obtained from the Directorate of Land Registry. Building plans were

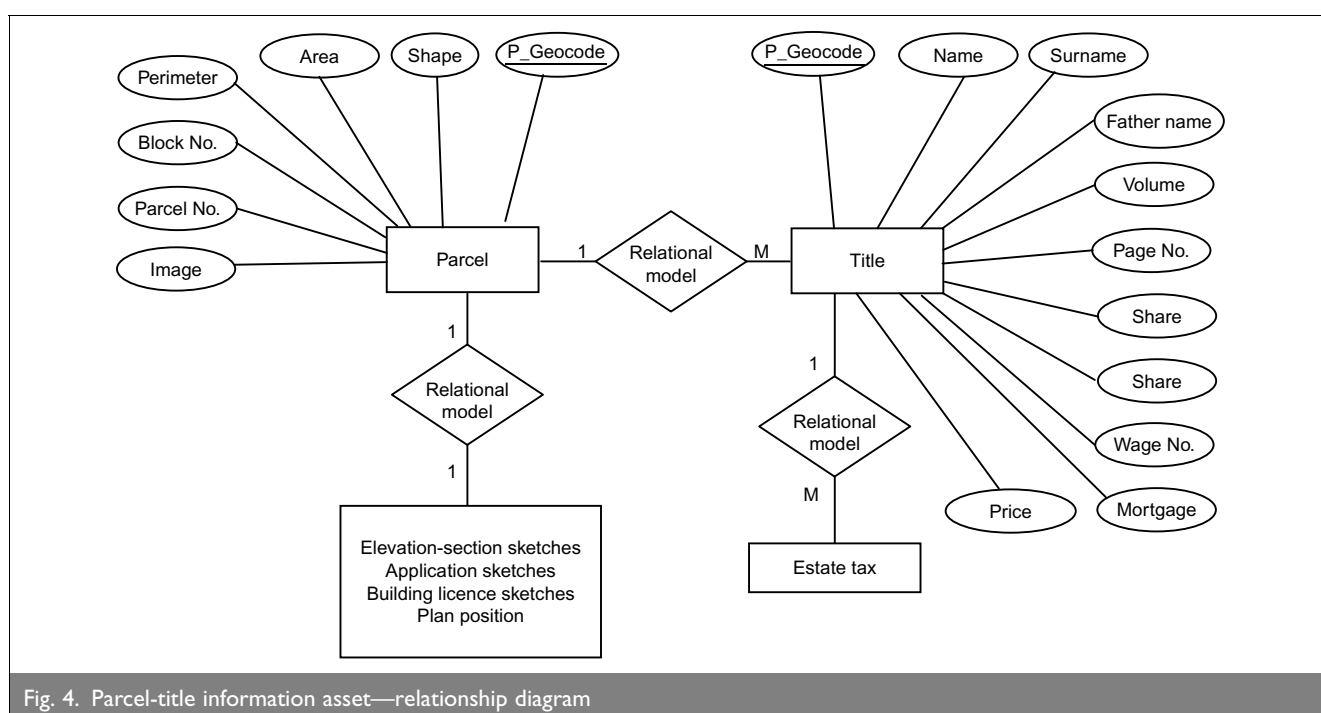


Fig. 4. Parcel-title information asset—relationship diagram

Attributes table	Fields
Basvurular.mdb	Name, Surname, TC_No, District, Main street, Street, Place, Apt_num, Door no, Flat, Part, P.K, City, Town, Tel, Fax, Mail, Application date, Application Number, Application Head, Application Request, Title Town, Title City, Title Maps, Block, Parcel, Area, Personnel, Research, Opinion, Application Evaluation, Results, Reply Date, Reply Attachments.
Tax.mdb	Register Number, Name, Surname, TC_no, Father Name, Mother Name, City, Town, Maps, District, Street, Area, Share, Current Price, Unit Price, Years, Total Depth.
Owner.dbf	Flat Number, Name, Surname, TC__no, Father Name, Mother Name, Citizen, Marital Status, Blood Group, Occupation, Address, Tel.
Parcel.dbf	Shape, Parcel_id, Block, Parcel, Area, Place, Street, Attributes, Share, Maps.
Plan.dbf	Shape, Area, Perimeter, Plan_id, Block/Parcel, I_geocode, TAKS, KAKS, Coordinates, Garden Distance.
Title.dbf	Parcel_id, Volume, Page, Name, Surname, Father Name, Yevmiye_no, Share, Date, Edinme_sebep, Price, Security Justice, mortgage.
Cadaastro.dbf	Shape, Cadaastro_id, p_geocode, District, District Code, TK, City, Town, Maps, Block, Parcel Number, Area, Place, Street.
House.dbf	Shape, House_id, Area, Perimeter, House Name, Building Type, Outside Front, House Type, Flat Number, Using Type, Door No, Elevator, Heating Type, Parking Garage, Address, House Picture.
Road.dbf	Shape, Distance, Road_id, Road Name, Road Covering Type, Class, Road Band Number, Construction Date, Care Date, Repair Date.

Table 2. Database tables and items

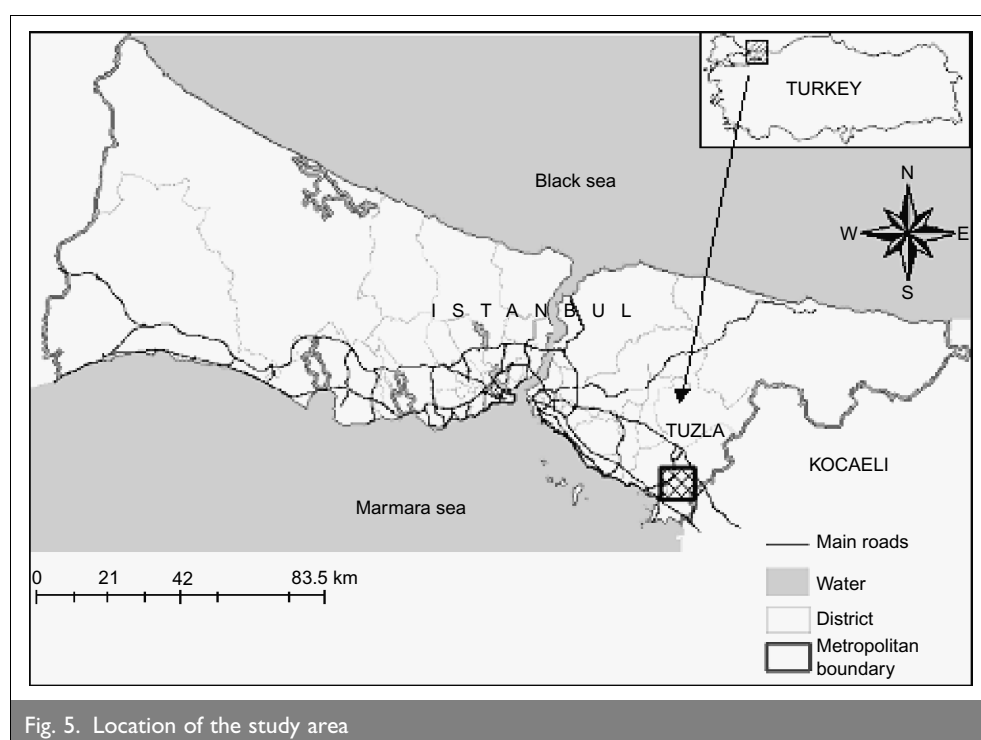


Fig. 5. Location of the study area

gathered from the Directorate of Municipal Building. Parcel ownership information was obtained from the Title Deed Directorate in digital format. The first step was to consolidate the land-use maps into separated layers using the NetCad program. Later, spatial data were transformed into DXF format, and then into SHP file format using ArcView to allow amendments and other modifications to be made. Additional images and videos of buildings are obtained and these images are linked to feature locations in ArcView 3.x tables.

3.2. Operational design

System requirements are classified into six main groups: monitoring applications information system, layer operations, data updating, automatic document adjustment, inquiry-analysis and e-municipality activities. For each group, flow diagrams are prepared. In Fig. 2, the main prototype flow diagram module

pertaining to interface design is shown. Modules of the interface are shown as sub-menus.

3.3. Physical design

The core of the system is made up of the database, the operating system, the main servers to which software is loaded, the router and the modem, which connects the user to the municipalities network. In units, server/router/modem connections that provide a connection with the centre are made up of UIS users and processors (PCs and workstations); servers that enable data preparation and monitoring of the transfer of information to the database, and loading requested information from there and providing

operations on the information; special software packages that are appropriate for the aim of the unit studies and peripheral memory units, and so on (Fig. 3). PCs that are shown in Fig. 3 consist of a Windows XP operating system, Pentium IV processor, 2-66 GHz speed, 100 GB hard disc capacity, 256 MB RAM, 17" LG dimension and 1280 × 1024 pixel monitor, 1 MB display adapter, Ethernet card and hardware structure supporting net connections. Server, router, hub unit with switch unit and modem unit include software that provides the demanded speed and efficiency from the operation of the system.

3.4. Database design

In the database design phase, detailed organisation of the spatial data is critical. To help design the database a data/function matrix (D/F) is formed. One dimension of the matrix is service units that use spatial information in local governments; the other dimension is the practice of these

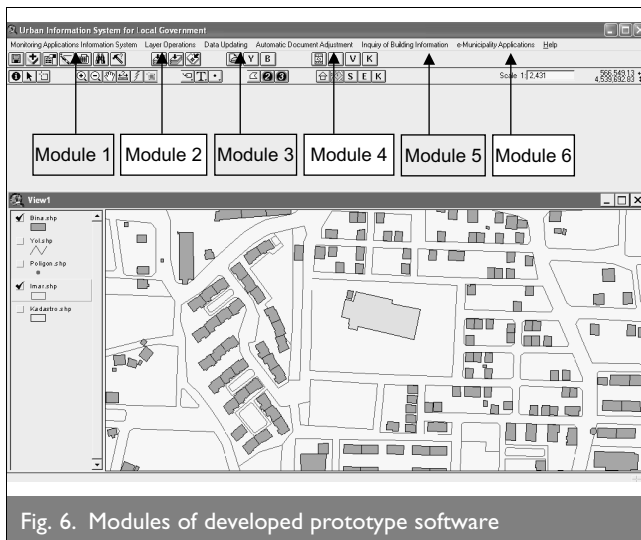


Fig. 6. Modules of developed prototype software

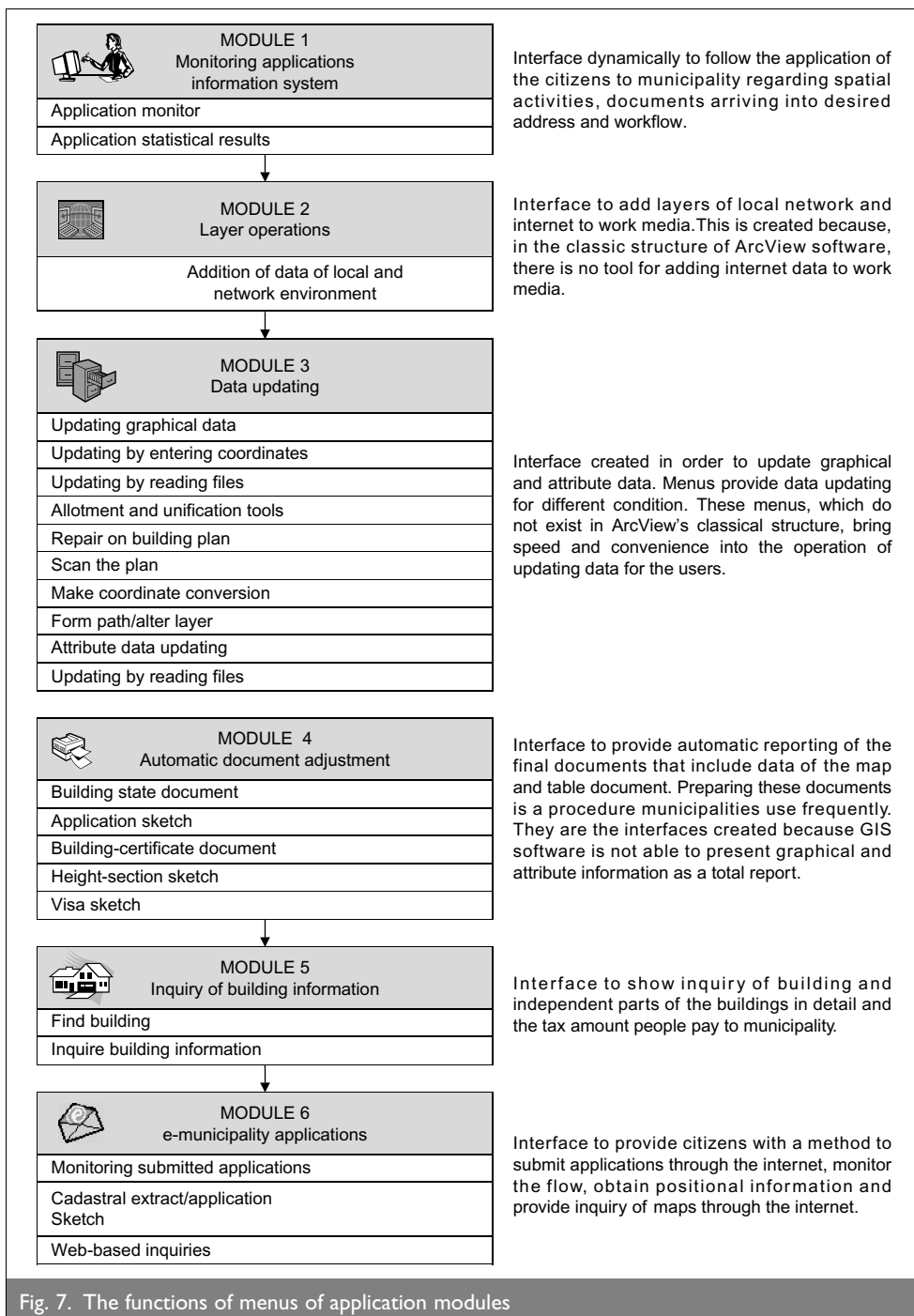


Fig. 7. The functions of menus of application modules

service units (Table 1). In the matrix, data with common characteristics are put closer to each other and applications corresponding to these service units are provided. In the D/F intersecting cell, coding of the characters defines which service unit data are produced (P) or used (U). Here the aim is to define relations between service units–applications at a high level. Producer (P) codes are readjusted to be sorted along a matrix diagonal. A D/F matrix has great importance in the discovery of inner institutional units that will participate in the UIS project. The completion of this matrix is complicated and time-consuming but an iterative approach is important to increase the definitions of service units and applications.

3.5. Regulation of asset–relation diagrams

Asset–relation models are the first prepared patterns in shaping database design, and consist of three basic items.¹⁴ Attributes explaining these assets and relations can help to establish the connection between asset and attribution. It is crucial to determine which relational model—such as one-to-one, one-to-many and many-to-many—is to be used in order to form an associating structure. One of the most important factors in performing UIS successfully is designing database relations in an accurate, reliable and flexible frame. In Fig. 4, example relations between desired data in UIS are shown. Fig. 4 shows a one-to-many relational model between parcel information and title records. Underlined attributes (P_Geocode) represent primary keys in relations.

3.6. The relational database schema

The A–R model was converted into a relational database schema. The resulting relational schema are listed Table 2.

3.7. Preparation of data dictionaries

The documentation to define the characteristic structure of the database resulting from actualisation is known as metadata or data dictionaries. These dictionaries are formed for each layer separately and include information such as data types in layers, obtained

INPUT INFORMATION FOR APPLICATION INFORMATION SYSTEM

Başvuru Sahibinin
T.C. Identification No: 23689712544 ☐ Personal Application ☐ Formal Application ☐ Application Information on Internet

Name: SAFFET EROĞLU

Contact Address
District: Etiliya Çel. Apartment: 12 Blok/Apt: 12 P.K: 12 Tel-1: (121) 212 12 12 Fax: (121) 212 12 12
M.Street: Yüzüncüy. Door No: 12 Flat No: 12 Town: Pendik Tel-2: (121) 212 12 12 PK: 12 12
Street: G12 Place: 1212 Part: 121 City: Kocaeli Tel-3: (121) 212 12 12 e-mail: 1212121212

Formal Application Information
Date: 01.08.2004 Record Number: 0

Personnel Application Information
Date: 01.08.2006 Record Number: 155

Title Information
City: İstanbul Town: Tuzla District: Aydıntepe Maps: 236-ef- Block: 3554 Parcel: 11 Area: 149.99

Search Input Parcel

PARCEL	OWNER NAME	FATHER NAME	AREA	SHARE	MAPS	ATTRIBUTES
11	SAFFET EROĞLU	İSMAIL	149.99	33/2400	236-EF-1 ARSA	

Application
Head: Plan Position
Demand: 6237/1PARSELİN İSKAN-RUHSAT BELGESİ TALEBİ Select Municipality Sub Unit: Directorate of Urban Planning

Başvuru Sahibine Verilecek Bilgiler
 Digital Record Number: 040120051412

Fig. 8. Entrance interface prepared for applications of citizens

PERSONAL INFORMATION - PCnet tarafından sağlanan Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address: http://baz.yms.bilgi.gov.tr

PERSONAL INFORMATION
T.C. Identification No: 2569872331 Name Surname: Abdurrahman Geymen

ADRESSE INFORMATION
City: İstanbul Town: Tuzla District: Aydıntepe Main Street: Hurriyet Street: G12
Buildings: 12 Door No: 5 P.K.: 4 Block: 2
Flat: 1 e-mail: ageymen@gyte.edu.tr Telephone: 6434251

TITLE INFORMATION
City: İstanbul Town: Tuzla District: Postname: Map: 236-EF-2-A Block: 3550 Parcel: 1 Area: 550 m2

DEMAND
Application Head: Building Licence Sketches
Application Demand: Building Licence Sketches -3550/1 parcel

Fig. 9. Interface enabling citizens to apply online through the internet

when and how, by whom access to the system is made, when updating is done and sensitivity.

3.8. Selection of pilot area

The Istanbul city, Tuzla district, Tuzla municipality was chosen as a pilot region (Fig. 5). The Tuzla municipality was chosen because it represented a good medium-sized municipality, it has favourable position to the sea, hills are minimal, it is close to Istanbul and Kocaeli cities, has cultivatable lands and favourable climate conditions. It is also the district with the highest population growth rate in the 2000 census for Turkey.¹⁵ It is an ideal settlement area to test the full range of UIS applications. After the selection was made, basic base maps with appropriate attributes were created and data dictionaries prepared.

4. APPLICATION AND APPLICATION MODULE INTERFACES

This application prototype design is made up of six main modules, which are installed with ESRI-ArcView GIS 3.x software. These six main modules are made up of menus and sub-menus. The modules are

- monitoring applications information system
- layer operations
- data updating
- automatic document adjustment
- inquiry of building information
- e-municipality applications.

The Install file was created with 'Install Shield Express'

software. With the help of a set-up file, the software can be installed on other platforms. When the installation is completed, the program will open the map view interface, which is called 'View' in Fig. 6. Fig. 7 shows the modules of interface design, developed as a prototype, and the sub-menus with their definitions. Each of the modules of the interface are password protected; this was done to provide control of edits and access to the data. Any required information is selected by the use of sub-menus in each of the modules. Graphical and attribute data are stored on a central server and a prototype interface allows a connection to be made to the server. This allows the departments of the municipality to access the data by the sub-menus in each of the modules.

4.1. Module I: monitoring applications information system

The interface provides dynamic monitoring of documents and work flow and visualises desired information related to spatial activities in units in order to provide a standardisation of work, coordination and communication among the departments of a municipality. Applications by any person, business organisation, official administration, and courts to the institutions are stored in the designed system. The official responsible for receiving the application is able to see any applications made to that service unit immediately (Fig. 8) and to coordinate with other departments online. The first part of this form consists of information belonging to citizens applying to the municipality. The second part contains information regarding the requests of citizens from the municipality. Furthermore, users can query past applications made to the municipality using this form and its response status. It can also be used to find taxes paid by citizens to the municipality. This module is intended to help the municipalities in providing citizens with qualified, quick and constant services. It will facilitate an informed decision-making process in the municipalities. As citizens are able to see the

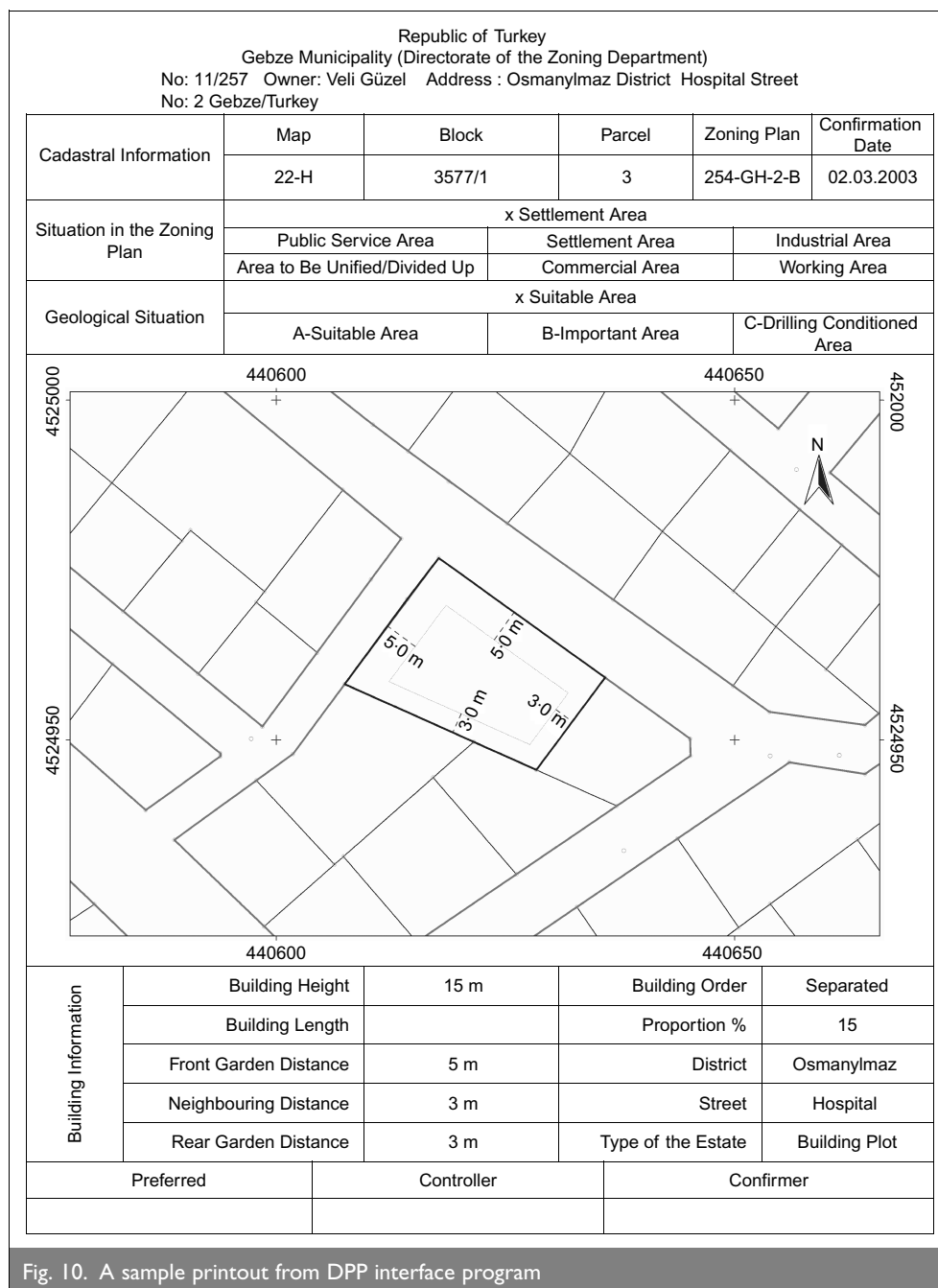


Fig. 10. A sample printout from DPP interface program

results of their applications through the internet, the workload of both citizens and municipality personnel is decreased (Fig. 9).

4.2. Module 2: loading data in intra-unit or network into work media

The 'Add Layer' interface main form was created with the aim of monitoring graphical data collected during UIS application as layers in the View. Users in different units of the municipality can see information placed in the attribute tables by using various interface menus.

4.3. Module 3: data updating

This module is made up of sub-menus and tools providing the ability to update graphical objects and edit attributes data.

4.4. Module 4: automatic document adjustment

This module provides automatic reporting of final documents including maps and document data that are frequently used by

many associations and institutions. It is made up of sub-menus such as elevation-section sketches, application sketches, building licence sketches and plan position. One of the disadvantages of current GIS software in frequent current use is that it is not able to present graphic and non-graphic information in a formulaic way to meet customer demand. The current study also develops the interaction between ArcView and Microsoft Word using the dynamic data exchange (DDE) function for automatic reporting of final documents, including maps and document data tables.

To carry out these works automatically, a number of interface programs have been designed for municipalities as a part of the UIS. The following is brief description of one of these interface programs called 'document preparation program for the planning of building boundaries' (DPP). This program is designed to read the data for required parcels from the 'zoning database' in ArcView Avenue, and to print out formatted and scaled documents which illustrate the plan of building boundaries together with information about the parcels. During the program run, graphical and tabular data are

first automatically brought up from ArcView's zoning database, and then these data are placed at necessary or related positions in MSWord documents following the start of a DDE application in Avenue. The only thing asked of the user at this stage is to type in an identification number and the zoning order of the required parcel. A sample printout of a document produced in this manner is given in Fig. 10.

4.5. Module 5: inquiry of building information

This menu helps the user to see building property data, information regarding individuals living in the buildings and taxes they pay to the municipality (Fig. 11). A building needs to be selected first in order to query the building information. Building and corresponding graphical drawings of the separate sections are created on the same screen as their representations based on the database records. The information belonging to the separate sections can be obtained by making the selections on the screen with the mouse. Thus, as a result of this real estate

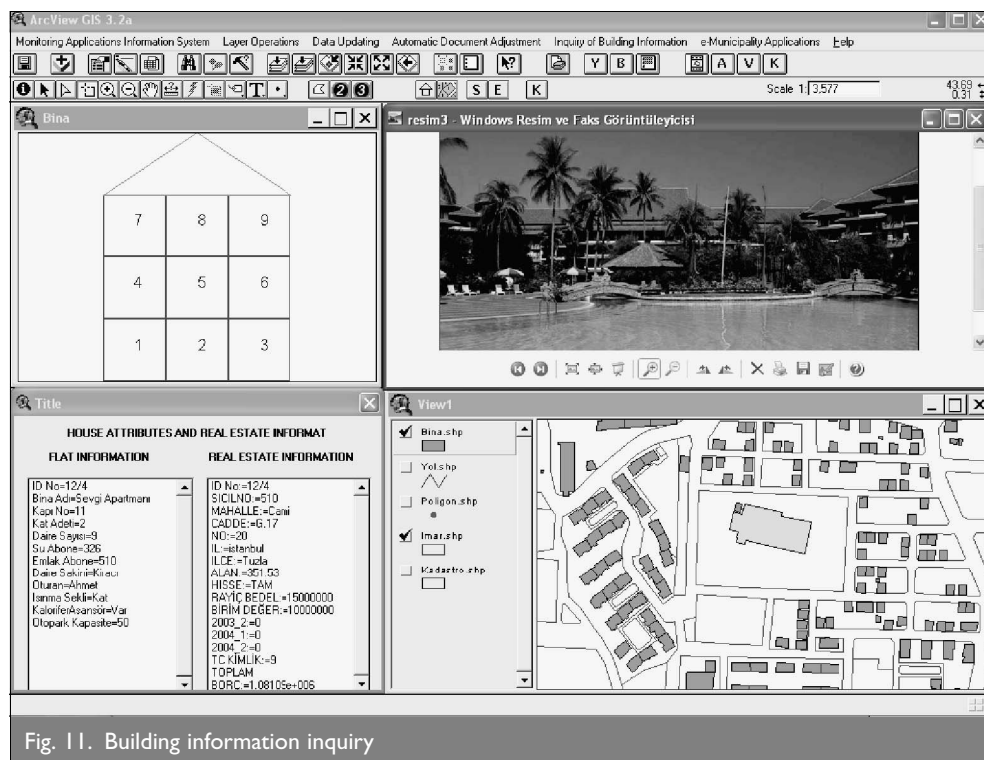


Fig. 11. Building information inquiry

information, an image and a video, if available, of the corresponding building are presented.

4.6. Module 6: e-municipality applications modules

With the help of this module, tax debts can be paid locally or on the internet, results of the applications to the municipality can be monitored again through the internet and users can obtain documents such as online elevation-section sketches, application sketches, building licence sketches, plan position and so on.

Specially preparing documents such as elevation-section sketches, application sketches, building licence sketches, plan position and certificate documents, has become the main task of municipality units. Institutions in rapidly growing, crowded areas are tired of these burdensome and time-consuming tasks that result from using traditional methods. These routine actions, when constant and repeated, often result in slowing of the overall process and complaints from citizens and personnel.

This software application, which is performed over the internet, is designed to solve these kinds of problems for preparing parcel-based information and documents. Its aim is rapidly to produce documents such as elevation-section sketches, application data, building licence data, plan position and others. Following the input of a 'Parcel ID' number, which is the minimum required data to determine a parcel, preparation of the desired information and documents is done automatically (Fig. 12).

5. PROJECT PERFORMANCE

During the preparation of questionnaires, studies related to the software process management of Delkleva and Drehmer were predicated.¹⁶ Questionnaires were mailed to 200 randomly selected staff of the municipality who worked in organisations that had adopted some model activities for managing their software development. Of the 200 initial surveys mailed in the

spring of 2006, a total of 103 responses were received. All respondents were assured that their responses would be kept confidential. In order to increase the sample size, a second mailing to the same sample was conducted in the summer of 2006. The response from both mailings totalled 160, giving an overall response rate of 80%.

t-tests were computed by means of key demographics (work experience, gender, recent project duration and team sizes) to examine whether significant differences existed between early and late respondents. No significant difference was found; therefore, the two rounds of respondents were combined for further analysis.

Respondents were made up of software managers (33%), project leaders (34%) and software professionals (33%). Project performance has often been defined as the extent to which the software development process has been undertaken as well as performance of the delivered system from the viewpoint of the users. It is important to study both the process performance and the product performance aspects, because even though the software delivered by the project may be of high quality, the project itself may have significantly exceeded time and cost projections. On the other hand, well-managed projects that adhere to cost and schedule may deliver poor systems. The project performance model used in this study has been adopted from Tuzla. The specific items are identified in Table 3, the full descriptions may be found in the original source. The respondents have been asked to evaluate each item based upon a five-point Likert-type scale ranging from 'never' (1) (goal is never achieved) to 'always' (5) (goal is always achieved). Five categories are represented by the items, including organisational learning, process controls, interpersonal communication quality, operational efficiency and software flexibility.

Although the project process management maturity activity construct has been examined in prior studies, a PCA followed by varimax rotation was conducted. A factor analysis with varimax rotation was conducted for the project performance items. Adopting the eigenvalue greater than one rule, five factors were extracted. A subsequent varimax rotation constrained to five factors yielded the results. Again, the criteria used to identify, distinguish and interpret factors were that a given item should load 0.45 or higher on a specific factor and have a loading no higher than 0.35 on other factors. The five factors matched exactly with the *a priori* structure. The Cronbach α values for basic learning, control, interaction quality, operational efficiency and software flexibility are 0.80, 0.81, 0.84, 0.80 and 0.88, respectively.

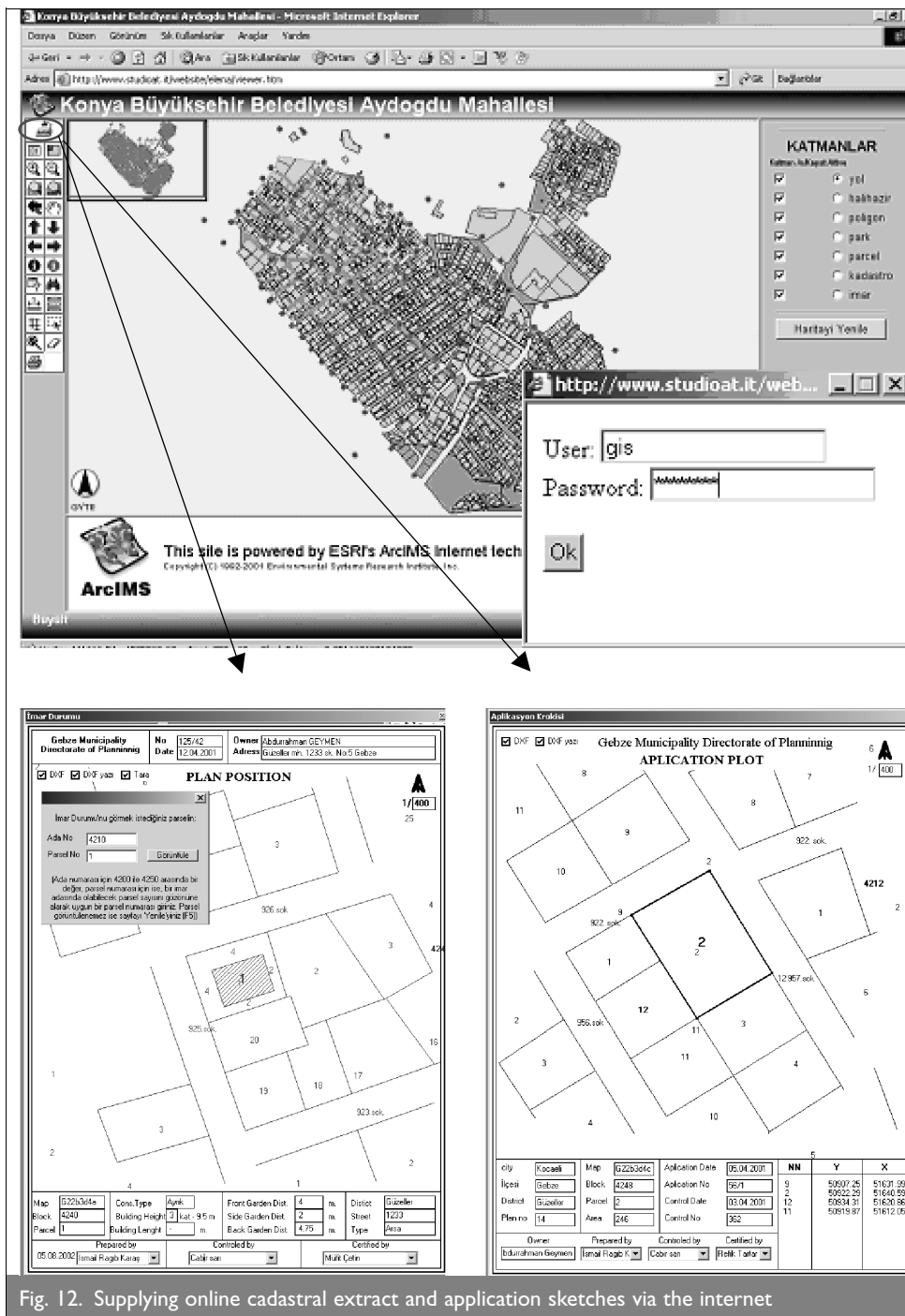


Fig. 12. Supplying online cadastral extract and application sketches via the internet

5.1. Comparison of queries

Another performance analysis test for conventional GIS and interface program queries is carried out with a set of graphical and tabular data created in ArcView databases. Responses were given by staff of the municipality. Test results are given in Tables 4 and 5. As can be seen from these tables, interface programs are very easy and fast for querying processes when compared with conventional GIS queries. Table 5 shows the processing time needed for creating a dialogue. This is to be done once for different kinds of requests.

6. DISCUSSION AND RESULTS

The aim of the current study is to improve UIS-inclined spatial activities of local governments, in order to provide spatial activities of service units of medium-scale municipalities, in a

rapid, rational and economic manner, that is more efficient and can be monitored and is devoid of complex structures. With this aim, institutional requirements for spatial information systems were investigated. By analysing available situations regarding position-based data use of the municipalities in Turkey, a system was designed for the dynamic use of data in service units using positional information.

The basic operational steps that have to be followed to form an UIS in urban municipalities are determined. By following these phases for UIS regarding positional activities in service units, analysis of activities is made, and data, operational and physical design that meet the requirements and expectations that are determined by analysis are made. With the help of ArcView 3.x software with appropriate improved application programs, the design is applied to PCs that have low-cost hardware requirements. In order to increase the functional efficiency of the spatial-based operations executed in the structure of medium-scale municipalities, a prototype UIS interface software was used, including basic functions, providing data sharing and dynamic currency, able to execute operations over

electronic media in real time, of low-cost, independent of costly hardware, flexible and friendly for users, and able to make widespread improvement. The positional activities that will be executed in this system are

- use of current and accurate data/information
- efficient use of speed, time, effort with cost benefits and personnel savings
- making good administrative decisions which will improve quality of life.

Results obtained from system design and application implemented in the study, are shown below.

- In Figs 8 and 9 applications that are related to spatial activities coming from the public in electronic form are monitored. Interface design provides transformation of the applications to

Item		Learning	Control	Interaction quality	Operational efficiency	Flexibility
(1)	Knowledge is acquired by your organisation about use of key techniques	0.92	—	—	—	—
(2)	Knowledge is acquired by your organisation about use of development techniques	0.84	—	—	—	—
(3)	Knowledge is acquired by your organisation about supporting users' business	0.62	—	—	—	—
(4)	Effective control over project costs	—	0.88	—	—	—
(5)	Effective control over project schedules	—	0.79	—	—	—
(6)	Adherence to audit and control standards	—	0.71	—	—	—
(7)	Complete training provided to users	—	—	0.86	—	—
(8)	Quality communication between IS unit and users	—	—	0.82	—	—
(9)	Users' feeling of participation	—	—	0.79	—	—
(10)	Reliable software	—	—	—	0.83	—
(11)	Efficient cost of software operations	—	—	—	0.54	—
(12)	Wide range of outputs that can be generated and queries that can be answered	—	—	—	0.71	—
(13)	Efficient cost of adapting software to changes in municipalities	—	—	—	—	0.90
(14)	Rapid adapting of software to changes in business	—	—	—	—	0.96
(15)	Efficient cost of maintaining software over lifetime	—	—	—	—	0.66
	Cronbach α	0.80	0.81	0.84	0.80	0.88

Table 3. Factor analysis project performance

Processing step	Running time: s
Opening of graphical and tabular data linking	10
Graphical and tabular data linking	60
Activating tables	2
Getting query table on screen	2
Query coding and checking	20
Results obtained	3
Total running time	97

Table 4. Performance analysis for conventional GIS query (for skilled ArcView users)

Processing step	Running time: s
Opening script	1
Execution of dialogue	1
Results obtained	3
Total running time	5

Table 5. Performance analysis for interface programs (for skilled ArcView users)

concerned units and personnel in these units, and an evaluation of final reports and formation in electronic media is made. With the help of work codes related to positional activities in units, it is possible to monitor in which phase the desired information occurs, on which date and at what time application forms are entered and which person performs this service.

- (b) An improved prototype system provides individuals with the facility to make applications directly over the internet.
- (c) During application requests, previous applications of the individuals can be identified and possible available tax debts to municipalities can be determined.
- (d) It is possible to assess statistically, and thus monitor performance of a department's personnel, using spatial information.

- (e) Users, by using the 'automatic document adjustment' module that is in the prototype software, are able to prepare documents with positional content, such as elevation-section sketches, application sketches, or building licence sketches. Institutions in rapidly growing, crowded allocation units are tired of the burdensome and time-consuming actions of traditional methods. In Fig. 10, the improved prototype software application, which is performed through the internet, is automation software designed to solve these kinds of problems, designed to prepare parcel-based information and documents.
- (f) In Fig. 11, DEVKBS has the property of inquiring into buildings and independent parts of the building.
- (g) In Fig. 12, DEVKBS has the structure to be able to establish e-municipality applications added to basic UIS functions. This module is the application of municipalities providing citizens a more qualified, quicker and constant service presentation.

7. CONCLUSION

The current UIS software has various advantageous superior functions. It has, however, a variety of properties that cause some complexities in use; therefore, it has been observed that non-professional users have lost interest and have shown some hesitation in use. This attitude results not only in reluctance in updating the databases but also obstacles for the extensive use of UIS. In the process of UIS applications, it has been observed that current versions of software are problem creators rather than user-friendly attractive problem solvers. The system for the monitoring of municipality functionalities—DEVKBS—aims at reinforcing the decision-making processes. It has developed from the needs of the managers of medium-sized municipalities and follows a complete methodological approach. The DEVKBS implementation clearly demonstrates the potential of ICT in sharing information about land use. The use of the system results in an improvement of the knowledge and of the coordination of decision makers and

stakeholders. With improved DEVKBS design, the related functions of local governments regarding positional activities are demoted to the easiest usage structure, and with the presented modules functionality becomes easier for the user. Thus, by providing more intensive use of the system by final users and operators, it is hoped that use of these systems will become widespread, and also that data are updated dynamically.

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