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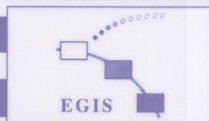
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Digital Cadastral Model - City of Zagreb, Croatia

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Summary:

The main task of this paper is to show the realisation of the project "Digital cadastral model - City of Zagreb, Croatia - graphic data base". Based upon its qualified and specialised potential in the field of geodetic, cadastral and data processing activities, the City of Zagreb, in 1991, started with the development and implementation of the project of the graphic database cadastral register and the digital data base of the cadastral plans in scale 1:000. This work shows the basic principles applied in the Project connected with the process of the restructuring of the geodetic spacious system. The work presents the basic data about the condition and content of the cadastral registers and discussed possibilities of digital data use which will be comprised into the geodetic cadastral data bases on the territory of the City of Zagreb.

1. INTRODUCTION

After the establishment of a sovereign and independent state of Croatia and abandoning the model of the socialist economy, when private property was suppressed, the preconditions for creating and installing a geodetic spatial system on the European level have been actualised. The geodetic spatial system, abundant with data and relations in the space, realistic spatial contents and property-rights relations, came into the focus of interest of the state, the goal of which is the optimal economic development. The land, as a permanent and inalienable part of the space with legally restored property relations, becomes the subject of the transaction, i.e. goods. Efficient, precise and generally available information system about space, based on information subsystems, cadastral land registers, engineer-geodetic, topographic-hydrographic cadastral data, enables management and development of the economic potentiality of the state.

The initiative for the beginning of the project was given by the Municipal institute for cadastral and geodetic activities. In 1990 and 1991 many presentations were made pointing to the usefulness of the information system technologies dealing with spatial cadastral data. Together with the initiative for the development of the geographic information system about space the reorganisation of the data bases and programs concerning the recorded part of the Zagreb cadastre was made. The data related to the recorded part of the city of Zagreb were installed to be used and maintained by the Municipal institute for cadastre in 1991. The process of creating attribute data bases of the cadastral entities was thus accomplished. During 1990 the international tender for the GIS of the city of Zagreb was announced. The HW and SW equipment was chosen and the project team was formed and educated. The war in 1991 and 1992 slowed the development of the project but anyhow the pilot project was prepared. During 1993 started the pilot project that was accomplished in November 1994. In December 1994 started the operative realisation of cadastral maps in 1:1000. The ideas and goals of the GIS project of the city of Zagreb were presented in the papers by Šurina (1990), Lipovscak (1991), Buselic (1992), Lipovscak (1993), Project team (1993).

The new created geodetic cadastral information system is the infrastructure system of the city of Zagreb and other information systems of the city lean on it. The Municipal institute for cadastral and geodetic activities runs the works of the geodetic spatial system for the area of the city of Zagreb. The Institute is the organisation that performs administrative and qualified works concerning the geodetic surveys, land cadastre, facility cadastre, unique register of spatial units, documentation of the city of Zagreb, regulations and other activities according to the Law and regulations.

The cadastral register of the Institute covers the area of the city of about 142.993 ha with 570.730 cadastral entities, 299.174 land users, 194.805 land documents, 2355 cadastral plans and 852.445 digital records in the data base, 220.000 house numbers-addresses, 6500 street names, 316 settlements and 249 maps in 1:5000.

2. PROJECT GOAL

The goal of the project is the automatization of the activities related to cartographic maps of the cadastre and realisation of the information system that will have charts and graphic data, will update records in daily on-line approach and display the situation of the city space within presented registers in the cadastral operate.

Table 1. **G E O D E T I C - C A D A S T R A L   R E G I S T E R S**

LAND CADASTRE	FACILITY CADASTRE	UNIQUE REGISTER OF SPATIAL UNITS
RECORDED PART	**RECORDED PART**	**RECORDED PART**
1) List of cadastral entities	1) Data of mains acc. to the types of mains	1) Lists
2) Users documents	2) Users of mains	2) Registers
3) Summary of users documents	3) Position of the mains on the graphic map	3) Files
4) Surveys of cadastral land users and land classes		
5) Alphabetic list of land users		
GRAPHIC PART	**GRAPHIC PART**	**GRAPHIC PART**
1) Cadastral plans	1) Charts of facilites - summary all facilities	1) Display of chart table
2) Indication draws	2) Manual survey	2) Basic cartographic display
3) Draw of polygon networks		
4) Survey draws		
5) Manual geodetic survey and geodetic survey		

S T A T I S T I C A L   D A T A

Cadastral communities	112	Facilitye's	in km	Number of maps in scale	Number
Cadastral entities	570.730	Electricity	4176	1:5000	259
Land document	194.805	Waterworks	1261	1:25000	24
Cadastral plans in scale		Gas	915	Number of streets and squares	6.500
1:1000	1333	Telephone	1705	Number of objects	220.000
1:2000	151	Heat/pipe	250	Number of settlements	316
1:2500	108	Sewerage	887		
1:2880	763	City trafic	46		
Digital records	852.445	Number of maps in scale			
Surface in ha	142.993	1:500	1310		
Number of land users	299.174	1:1000	117		

The project was conceived to form the digital base of the graphic data, identical to the existing analogue one (proportion 1:1) for the needs of maintaining cadastral operate. Such a data base satisfies the present use and legal status of the data with its identical content, precise mutual relation of the spatial elements, primary entry and dimensions - format. The digital data base must enable the maintenance of the existing maps and data in regard to charting details and area calculations.

The digital data base will be used to:
- make copies of the cadastral plans;
- read relevant data of the spatial position;
- read relevant data of the mutual relation of the spatial elements;
- be a base of different GISs based on the cadastral maps.

It is supposed that once digitilized data is uniquely determined and there is no further questioning of its "take-use-draw" in any later use except the accuracy of its origin. The accuracy of the data origin has many inter-steps and it is not possible to correct it by digitalisation. The installation of the co-ordinate cadastre, that will spring from the digital

cadastral model, will eliminate the defects and problems connected with the accuracy of maps that have been digitalized.

3. DATA SOURCE

During creating digital data base the condition of the existing documentation, that is to be digitized, has to be taken into consideration and can be of different source and accuracy.

The sources for digitising are:
1. "old " graphic surveys (plans in scale 1:2880);
2. new surveys in 1:1000 on the basis of
    - tachimetry
    - aerophotometry;
3. facility's maps in scale 1:500;
4. graphic displays derived from the collected geodetic data
    - technical maps in scale 1:1000
    - basic state map in scale 1:5000
    - maps of the unique register of the spatial units in scale 1:5000

4. SPACE OF THE PROJECT

The space extent (position and largesse) of the project has been thus defined to comprise a somewhat larger area around the city of Zagreb. The area of the project is defined by space 140x90 km. The project has been determined by the valid regulations of the Law on geodetic survey and land cadastre, and the left-handed Gauss-Kruger co-ordinate system has been applied on it.

5. DATA MODEL

Data model has become essential in the creation of the GIS entity definition. The data model comprises the following information:
1. Law definition;
2. GIS definition;
3. list of attributes;
4. original medium where it exists;
5. description of the life cycle.

The data model has been obtained by systematic analysis of data that are basically connected with the entities and minimal basic data for five fields of work were chosen:
a) geodesy;
b) land cadastre;
c) unique register of spatial units;
d) facility's cadastre - electricity - low voltage network;
e) spatial planning.

The entities chosen for the first phase of the project were determined by the suggested model and 119 entities were separated with about 500 attributes.

6. DATA AND DOCUMENTATION CIRCULATION

The digital cadastral model tends to simplify some activities that now exist in the operative work in the cadastral offices. In order to view the present and future organisational activities of data and documentation circulation diagrams of the process have to be made. By creating a diagram it is more easy to see the growth of the activities, needs for possible reorganisation of the service or redistribution of work and competencies. The diagram of the data and documentation circulation and activities of the participants in the working process have been made for each of the works that initialise new activities what results with the changes in the data base.

7. CONNECTION WITH OTHER PROJECTS

The project has been conceived to keep the principle of tolerance and maximum integration with the existing projects. By creating program sets the client/server philosophy was applied in connection with the graphic data base and table data bases of the recorded cadastre. The project anticipates the connection with applications - recorded part of the cadastre, project of streets and address with GIS application of the unique register of spatial units (based on the data of the maps in 1:5000).

8. FUNCTIONS OF THE PROJECT

The way how users communicate with geographic information system has been defined by functions. The functions have been chosen as representative for five fields in the application of the project.

Geodesy
- creation and delete of all related attributes.

Land cadastre
- creation and delete of all related entities;
- list of a copy of the cadastral plan.

Unique register of spatial units
- functions of the address, creation, update, delete, edit;
- functions of the streets, creation, change, delete, register of streets;
- function of the settlement, local district, creation, change, delete.
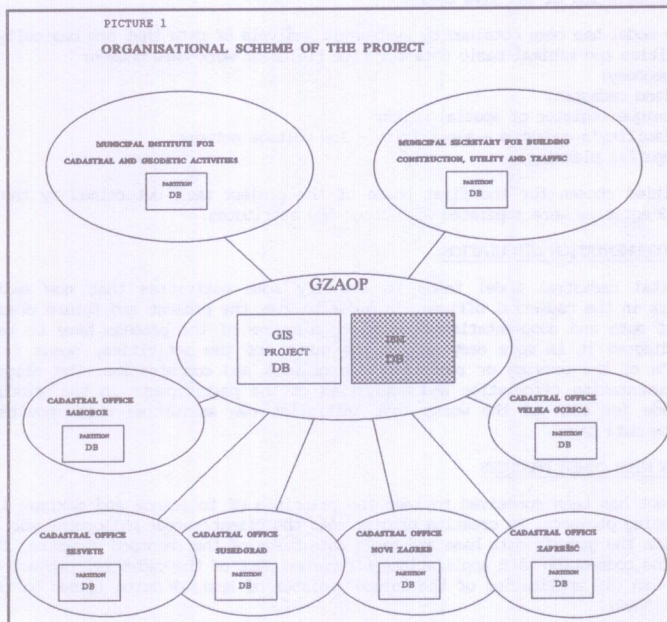
Facility's cadastre - electricity - low voltage network
- creation and delete of all related activities.

Spatial planning
- creation and delete of all related activities;
- cadastral entity provides information about the zone and its purpose, intervention, protection of GUP;
- cadastral entity provides information about the area of PUP or regulation plan, status of PUP
- cadastral entity provides report of the selected and near- to entities, identifications of entities, users of entities, building addresses of entities;
- browsing of building depending on their purpose.

9. EQUIPMENT AND NETWORK

The SUN platform with SYSTEM 9 SW under UNIX has been chosen for the project realisation, with applied client/server philosophy connected with the central base on IBM mainframe of the recorded data on the central IBM computer. The network of the cadastral offices in the city of Zagreb stipulates the formation of separate cadastral offices where register and cartographic

PICTURE 1

ORGANISATIONAL SCHEME OF THE PROJECT

MUNICIPAL INSTITUTE FOR CADASTRAL AND GEODETIC ACTIVITIES
PARTITION DB

MUNICIPAL SECRETARY FOR BUILDING CONSTRUCTION, UTILITY AND TRAFFIC
PARTITION DB

GZAOP
GIS PROJECT DB
IBM DB

CADASTRAL OFFICE SAMOBOR
PARTITION DB

CADASTRAL OFFICE VELIKA GORICA
PARTITION DB

CADASTRAL OFFICE SESVETE
PARTITION DB

CADASTRAL OFFICE SUSEDGRAD
PARTITION DB

CADASTRAL OFFICE NOVI ZAGREB
PARTITION DB

CADASTRAL OFFICE ZAPREŠIĆ
PARTITION DB

data have been processed parallel. The organisational scheme is shown on the picture 1.

The communication scheme of the project is shown on the example of the communication EDP centar (GZAOP)-Cadastre (picture 2).

## 10. PRINCIPLES OF THE GEODETIC SPATIAL SYSTEM OF THE CITY OF ZAGREB

The main principle is connected with the legally established facts, on the basis of which, cadastral entities in space as well as other real estates on them have been formed and positioned. On the basis of these facts the state protects related property and performed rights.

The basic subsystems from the geodetic cadastral registers are:
- cadastral operate - register book part;
- cadastral operate - graphic part;
- unique register of spatial units;
- facility's cadastre;
- register about geodetic nodes.

The data base of the recorded part of the cadastral operate
The recorded part of the cadastral operate comprises and maintains the registers regulated by Law on land cadastre and keeps data on land, ownership, income and all changes performed on the land. The data of the created digital base of the recorded part of the operate have been used inside the unique information system of the city of Zagreb for the needs of prompt service to users and document editing by terminal stations on six locations. 70 terminal stations and 16 printers have been in function on the level of the Institute for the needs of the operate maintenance and processing of spatial and property changes on land as for various use of the data of the recorded part of the cadastral operate.

PICTURE 2
COMMUNICATION SCHEME

CADASTRAL OFFICE

GZAOP
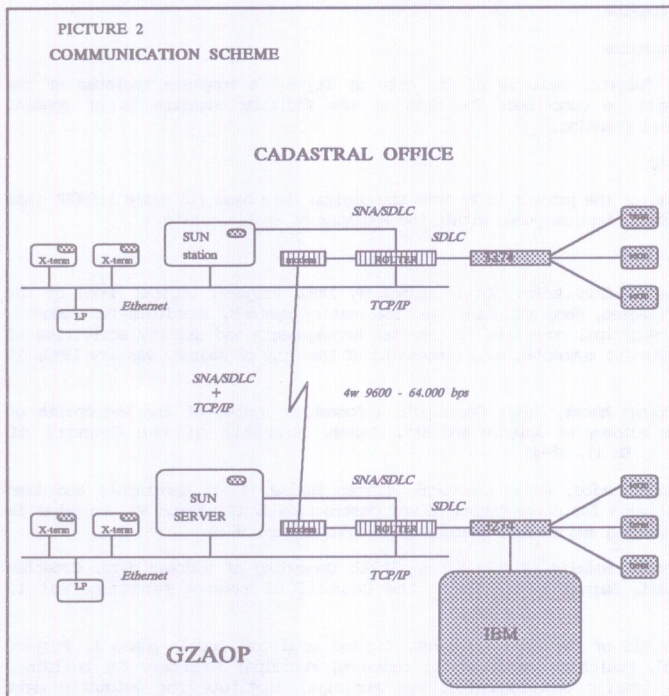
Graphic data base of the cadastral operate

The interest for the geodetic spatial information is especially focused on the graphic display of conditions about space and technical possibilities of the data use in order to plan the space.
- cadastral entity is the basic entity that connects all data;
- data are registered in the relational base;
- cadastral entity is represented by the polygon obtained by the digitised and scanned cadastral plans in scale 1:1000;
- each graphic data is uniquely defined;
- digitised border nodes are not the nodes of the coordinate cadastre;
- the form of the digitised entity precisely matches the existing graphic display on the plan in scale 1:1000;
- cadastral parcel presents the cadastral entity with all its content obtained by digitalisation;
- defined geometry is connected with the valid recorded part of the operate by means of the "key" - related element of the cadastral community code and cadastral entity number;
- computer surface serves only as information and has no legal status, but is aid in defining the consistency of the data base;
- by using data base the following has to be taken into consideration
  - geometry - the form of the cadastral entity,
  - content of the cadastral entity,
  - spatial position of the cadastral entity,
  - spatial relations,
- all other data - surface, land user, land use - are parts of the recorded part of the operate.

Data base of facility cadastre

Within the project "Digital cadastre of the city of Zagreb" a complete register of the cadastral facility's will be comprised. The data of the facility cadastre is of special importance for the spatial planning.

Register of spatial units

The goal of this part of the project is to make the digital data base (in scale 1:5000) that will be gathered, processed, kept and used within the Register of spatial units.

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