Pirot Municipality

GIS DEVELOPMENT STRATEGY OF PIROT MUNICIPALITY

Pirot, August, 2006

Preparation of the document:

MapSoft. d.o.o

Željko Cvijetinović, Ph.D., M.Sc., B.Sc. Geod.Eng

Momir Mitrović, B.Sc., Geod. Eng

Project team for building Pirot Municipality GIS:

Milorad Spasić, B.Sc. Constr.Eng, Pirot Municipality

Jovan Jovanović, B.Sc. Constr.Eng, Local Government Pirot

Ivan Todorović, Electr.Eng, Local Government Pirot

Slaviša Jelenković, B.Sc. Electr.Eng, Local Government Pirot

Ivica Mančić, B.Sc. Constr.Eng, Local Government Pirot

Zoran Jovanović, B.Sc. Geod. Eng, Real Estate Cadastre Unit, Pirot

Vladeta Gošić, B.Sc. Electr.Eng, ED "Jugoistok" d.o.o. Niš - "Electrodistribution Pirot"

Danilo Vujičić, B.Sc. Electr.Eng, Telekom Srbija AD - RC Pirot

Dragan Aleksić, Lawyer, PC "Komunalac"

Novica Zlatanović, B.Sc. Constr.Eng, Land Development Agency, Pirot

Žaklina Stojanović, Mech.Eng, " Water and Sewage Company"

Ivana Džunić, B.Sc. Spatial planner, Public Town Planning Agency, Pirot

Gordan Džunić, Mech.Eng, ''Public Heating Company"

C O N T E N T S

Foreword:

GIS Development Strategy of Pirot Municipality is a direct result of the project called: ''Building up Pirot Municipality GIS Centre'', realised by the resources of European reconstruction Agency as a part of a support programme to local self governments called ''Exchange'' and Pirot Municipality. It is aimed to form a proposition of a strategic document which would guarantee a long-term vision of GIS development in Pirot Municipality and would therefore provide a long-term perspective for Pirot Municipality GIS Centre. It is conceived to subject the proposition document to the wider public and expert debate and afterwards to forward it to Pirot Municipality to be accepted. GIS Development Strategy of Pirot Municipality would therefore become a basis for long term planning of all further activities concerning GIS in Pirot Municipality.

1 PREFACE

There is an increasing number of local administration activities partly or completely automated due to information technology. A large number of these activities relate to the objects and phenomena that are spatially defined. Additionally, most municipal departments and services, although performing different sorts of activities, often use the same or similar spatial data in their everyday activities.

The basic use of the spatial data is spatial representation of the objects and phenomena that are of interest, while some activities demand more complex processing and analysis of spatial data. Using and processing of spatial data is performed optimally applying the technology of geographical information systems. Geographic information system (GIS) of Pirot Municipality is a system for collecting, processing, archiving, analysis and presentation of spatial and other data related to town planning and spatial arrangement, construction land, traffic, communal services and other aspects of life and work of Pirot Municipality.

Implementation of Municipality GIS implies significant investments and long-term realisation. This specifically refers to collection and processing of data that are the contents of the Municipality GIS. Additionally, a successful implementation of such complicated system also implies its linking and integration to other segments of municipal information system, as well as the information systems of the agencies and institutions whose activities and data are linked with the municipal systems. All this qualifies that the development and implementation of the Municipality GIS demands a longer period of time and a step-by-step realisation of all tasks.

This strategy is to enable a planned and coordinated development of the Municipality GIS and in this context it is a basis for the detailed elaboration of the mentioned tasks. It is important to recognise which organisational units of the Local Government have a need for using the spatial data in realisation of works and tasks from their competency. As it is an expensive and a long-term process, it is vital the priorities for the step-by-step development and implementation of Municipality GIS be defined. The priorities are to be defined in the way that together with implementing GIS technology the most critical activities be made more efficient and thus significant savings be realised in the shortest period of time, both concerning the resources and the time needed for the individual performance of works.

The primal objective of introducing the GIS methodology in the work of Pirot Municipality structure is to achieve more efficient work of local government. It also assumes more efficient work of municipal departments and offering of services to the citizens and other legal subject. GIS should provide support to making decisions process by analyzing spatial and other available data, including support to the process of planning. Some of the effects that are thence expected are:

- more precise long-term planning in different areas (town planning, utility, ecology, demographic movements, agriculture, forestry, erosion and flood protection etc.);

- a better administration of the existing resources so as to gain savings and prevent damage to the environment;

- more efficient administration and maintenance of communal infrastructure (utilities);

- more efficient and more objective collection of public income based on ownership by more precise record of the taxpayers;

- creation of distributed spatial databases used by the Local Government , public agencies and republic agencies thus making the data flow faster and solving citizens', investors' and other legal subjects' demands expedite;

- speeding up the legalisation process of illegally constructed objects etc.

2 BASIC ASSUMPTIONS

The ability of Municipality GIS to integrate spatial and nonspatial data, as well as to support analysis and process modelling, makes it a good platform for the integration of business processes and activities of multiple departments of local administration and other municipal institutions and agencies. In that sense, Municipal GIS should be considered as a basic element of e-government.

Fundamental assumptions for GIS Development Strategy of Pirot Municipality could be presented though the following aspects:

- legal aspect;
- interests of all key participants in GIS municipal development have been stated in Pirot Municipality;
- taking into consideration the existing state concerning the data;
- taking into consideration the existing state concerning the authority;
- taking into consideration the existing state concerning IT development;
- stable and sustainable development.

2.1 Legal aspect

Municipality GIS development strategy implies appreciation of the existing law regulations, not only in the project phases but also during its realisation as concrete projects. The laws important in this sense are:

- Self-government Law,
- Planning and Construction Law,
- Public Agencies and Performance of Common Interest Tasks Law,
- State Survey, Cadastral and Registry Rights on Real Estates Law,
- Public Roads Law,
- Environment Protection Law,
- Electronic Signature Law,
- Record Books Law etc.

Additionally, respecting all other sub legal acts and other documents that define the leading lines in Serbia relevant for these activities is understood. Some of these documents are Strategy of the local sustainable development and Strategy of information society development.

Respecting all mentioned legal and sub legal acts and documents, GIS Strategy of Pirot Municipality implies that work of municipal apparatus and institutions, i.e. activities of managing the resources are done by the municipality and settled by municipal documents. These documents are a significant help in further detail construction and implementation of the strategy.

2.2   Interest of all key participants for the Municipality GIS development

The strategy has a presumption that there is a very clear strong common concern for the forming of the Municipality GIS.

This interest is confirmed by the fact that the key institutions concerned with development and maintenance of the utility, and other tasks are of interest for the wide scope of citizens and legal subjects:

- Municipality,
- Real Estate Cadastre Unit (RECU), Pirot,
- Public Town Planning Agency (PTPA), Pirot,
- Land Development Agency, Pirot,
- "Water and Sewage Company",
- PC "Komunalac"
- "Public Heating Company",
- "Jugoistok" d.o.o. Niš – "Electro-distribution Pirot"
- Telekom, shareholder company – WC Pirot

In June 2006, signed a document called "Agreement on cooperation in construction and establishment of Geographic Information System of Pirot Municipality.

It is stated in this document that "*in order to plan the integral development of Pirot Municipality and to modernise the services Pirot Municipality offers all interested parties and citizens, the construction and establishing the Geographic Information System as a tool for achieving this aim, is one of the most important activities Pirot Municipality in cooperation with the signing parties of this Agreement will be carrying out in the period to come*."

The signing parties also agreed that "*in purpose of organization and establishing GIS, they will put all the human and expert resources at disposal in order to achieve a reliable common information system at the level of the municipality that will serve as a tool for spatial and town planning, municipal development planning as well as the governing of the town infrastructures*."

2.3   Taking into consideration the existing state concerning the data

The strategy respects the existing state in Pirot Municipality concerning the state of the existing spatial and other data that can be used for forming of the Municipality GIS, as well as the humand, technical and other resources municipal institutions and agencies have at their disposal.

The strategy is based on the analysis of the existing state in the Local Government, Municipal public agencies, Real Estate Cadastre Unit Pirot and other relevant institutions and

agencies. In this context, the existing work processes and activities performed by the potential users of the Municipality GIS are analysed. A special importance for the successful implementation of GIS technology in the municipal departments and services is the realistic analysis of the quality and accessibility of the existing spatial data that should comprise the Municipality GIS.

The strategy has a presumption that the system should be constructed in a way that will maximize use of the existing record and to strictly respect which institutions and agencies are responsible for maintaining individual spatial records and other data. In this way, maintenance of duplicated records and wasting resources unnecessarily is evaded and efficient information exchange is enabled. On the other hand, using the existing data enables fast realisation of some aims, which is of great significance for obtaining the wider support for further development and strategy implementation. In this context, successful strategy realisation depends on the cooperation of all authority institutions and agencies dealing with collecting, maintaining and distribution of data which are part of the Municipality GIS. Cooperation with the Real Estate Cadastre Unit Pirot is critical as the Local Government does not have a possibility to manage and control this institution, and data at their disposal is a very important segment of the Municipality GIS.

2.4 Taking into consideration the existing state concerning the authority

The strategy specialises in global analysis of the existing state in the institutions and agencies that are the participants in the chain of collecting, maintaining and using the spatial data in Pirot Municipality, as well as in defining the measures and tasks for the development and implementation of Municipality GIS. Detailed analysis of the state and the development of the suggested measures are subjects of special studies and projects which should be constructed for every individual activity concerning the development works of IT infrastructure (modelling of work processes and data, collecting the spatial data, obtaining software and hardware, development of telecommunication infrastructure, reorganisation and staff). Institutions responsible for acquisition and maintenance of spatial databases are also responsible for the design and realisation of these projects. One of strategy goals is to define more precisely place and role of the relevant institutions and agencies in forming activities of the Municipality GIS. In this manner, a coordinated action of all participants in the process will be obtained.

2.5 Taking into consideration the existing state concerning IT development

The strategy has a presumption that the existing level of development of IT technology (software, hardware and telecommunication infrastructure) is on such a level generally speaking that with relatively small investments and for a short period of time the development and implementation of the system can successfully respond the needs of the Municipality GIS. The explanation is in the fact that most institutions and agencies on Pirot territory already possess computer technology that could be used to access the data of the Municipality GIS. Therefore, telecommunication infrastructure is of much greater significance and special notice was put on its developmental strategy.

The software is more important than the hardware, since software is more expensive than the hardware, and has a generally longer durability. It also demands special costs for training and customization for the individual user demands. The right choice of software is directly related with the system functioning, and the strategy must offer instructions for the easier choice.

Greatest attention in the strategy has been aimed at the data collection and organization that should comprise the Municipality GIS. This is understood if one bears in mind data is the most expansive component of GIS and that it has the longest durability (related to software and hardware).

2.6   Stable and sustainable development

Successful strategy realisation implies realisation of significant savings in time and resources. Nevertheless, significant investments are to be expected, especially for spatial data acquisition. Taking into consideration the unlimited resources, it is presumed that implementation of Municipality GIS should be carried out in stages, respecting the priorities and equal burden related to financing the entire process. The strategy is adjusted with the needs and the financial scope of Pirot municipality and institutions and agencies that will provide the resources for Strategy implementation.

The strategy also implies respecting the present personnel capabilities most of whom encounter with this kind of work technology for the first time. The strategy development and implementation are to be adjusted with the human resources potential. It is presumed that all participants of strategy implementation will obtain a needed number of experts for these works and to provide adequate education and training for the personnel for the work with new technologies.

The solutions suggested in the strategy have the aim to provide a stable and sustainable development and functioning of GIS for a longer period of time. Hence a principle has been accepted that the proposed solutions should be based on commonly accepted standards and proved values.

3   ANALYSIS OF THE EXISTING STATE

Analysis of the existing state is the basis for the conceptual model of GIS of Pirot Municipality formation and its strategy development construction. In this document the existing state analysis is presented through the following aspects:

- basic data about Pirot Municipality;

- potential users of the Municipality GIS;

- IT infrastructure in the Local Government ;

- spatial data for establishing the Municipality GIS.

3.1   Basic data about Pirot Municipality

Pirot Municipality is situated in the south-east part of Serbia in the valley of the same name ("Pirotska kotlina", the valley of Pirot) and is lying on the banks of the river Nišava. Pirot Municipality borders with:

- Dimitrovgrad Municipality in the South-East,

- Babušnica Municipality in the South-West,

- Bela Palanka Municipality in the North-West,

- Knjaževac Municipality in the North and

- Republic of Bulgaria in the North-East (the border is 65 km long).

With the area of **1232.84 km^2**, Pirot Municipality is the third biggest municipality in Serbia. The mountainous landscape makes 40% of the area and the hills and plains make 30%. Forests, meadows and pastures cover much greater area than the arable land. The meadows and pastures make 62% of the agricultural land. The arable soil is the valley of the rivers Nišava and Jerma.

According to the census in 2002, Pirot Municipality had a population of **63,791**. The population lives in **22,711** households and **28,115** flats, both rural and urban. Of this number, **40,678** people or 64% live in the urban area, whilst 23,113 or 36% lives in the rural area. Average density of population in Pirot Municipality is 52 inhabitants per km^2 which is bellow the republic average. The villages with population more than 1,000 are: Gnjilan with 2,543, Berilovac 1,961, Krupac 1,474 and Poljska Ržana 1,358. The smallest villages have the population of: Basara 8. Milojkovac 7, Pasjač 32, Planinica 18, Mirkovci 25. There are 71 villages in the territory.

The municipal territory is divided into **74** cadastral municipalities.
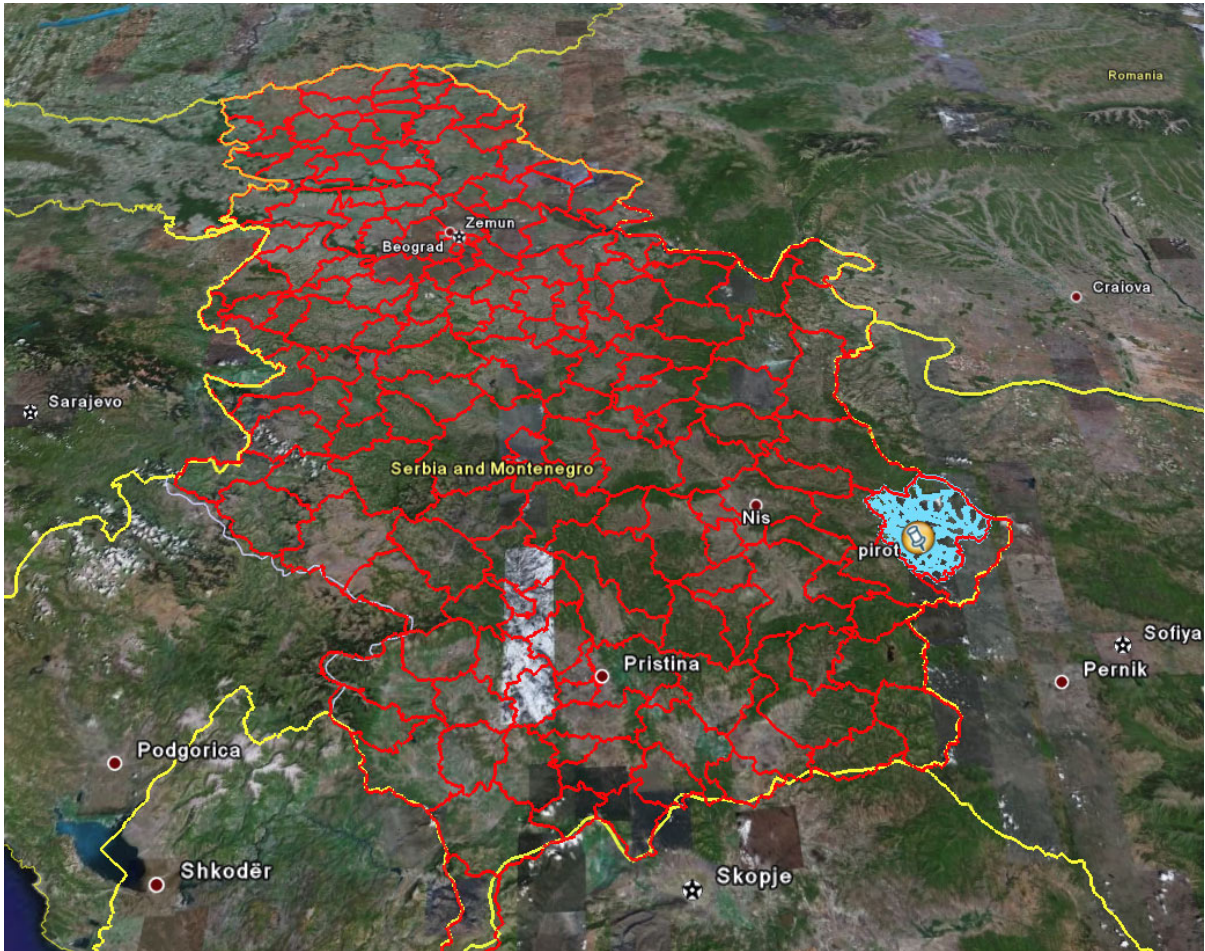
Figure 3-1 : Location of Pirot Municipality

The lakes in the territory are: Zavojsko, Krupačko, and the lake near the village of Sukovo. The rivers that run through the town of Pirot are the Nišava and the Gradašnica. The territory of Pirot Municipality is very rich in water.

The area is also rich in forests. The total area covered with forests is estimated to be about **417.56 km²**.

Some of the comparative advantages of Pirot Municipality are the following facts:

- Geographical position – due to the closeness to the border and the international corridor E-10;

- Natural resources in the places where the area is ecologically clean: healthy food, clean water, forests, hydro potential of the river Nišava and its confluents;

- Stara Mountain.
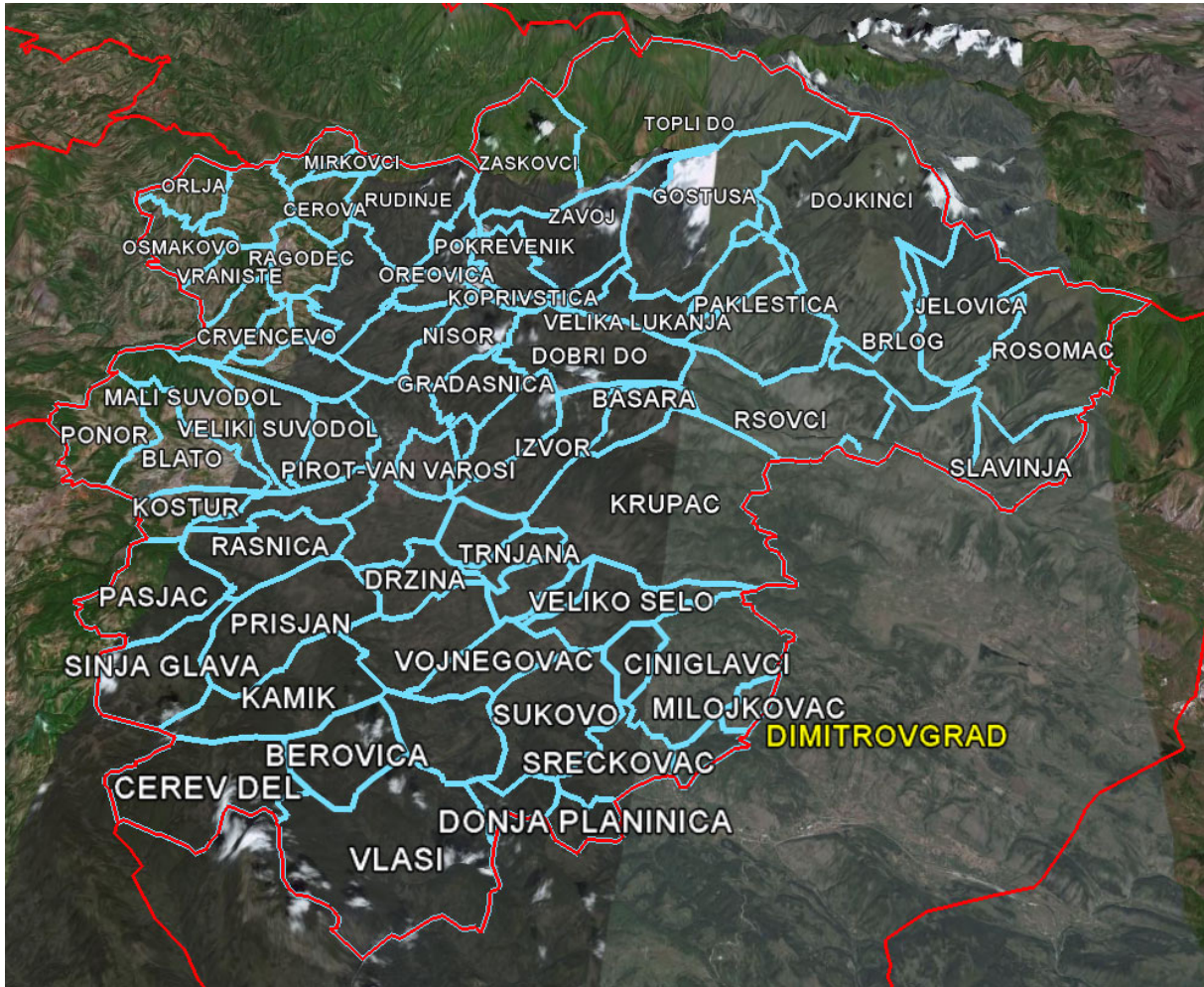
Figure 3-2 : Division of Pirot Municipality into Cadastral municipalities

3.2   Potential users of the Municipality GIS

A large number of daily activities in the Municipality refer to works located in the space. The most often spatial determinants are: addresses, cadastral parcels and zones. Almost all parts of the Local Government, public companies and agencies have a need to use spatial data daily not only in performing their activities but also in communication with other institutions and with citizens.

The users can generally be divided into those who maintain spatial data and spatial record and the users who only use the data. Additionally, the users could be ranked according to the frequency of data use– those who use them daily in their activities and those who have occasional need to access spatial data.

In the following chapters there are brief descriptions of the users, those who are estimated to maintain and use the data in their daily duties. In the description the emphasis is on the GIS potentials of the individual users.

In the sense of organisation the potential users of GIS of Pirot Municipality could be divided into:

- Local Government ,
- Public agencies,

9

- Geodetic Governmental Authority (GGA) – Real Estate Cadastre Unit (RECU), Pirot,
- Other institutions and agencies and
- Citizens.

3.2.1   Local Government

Pirot Municipality performs activities of direct interest to the citizens in respect to the Constitution, the Law and the Municipal Statute. The citizens participate in the work of the Municipality in the way determined by these acts. In the authority of the municipality the citizens decide about the works: by deciding directly, by populous initiative, and by their freely elected representatives.

The municipality realises cooperation in the country and abroad in accordance with the Law.

Pirot Municipality organs: *Pirot Municipality, Municipality President, Municipality Council, Local Government, Municipality Manager, Municipality Public Legal Office.*

Municipal sphere of authority:

- decides on (a part of its authority) the development programme and legal acts for its realisation;
- decides on the town planning and performance acts;
- decides on the budget and final bill;
- defines and assures the using land and business space;
- defines and assures performance and development of the communal activity;
- assures the conditions for construction, maintenance and usage of the utility, residential, business and other objects, arranges and assures the conditions for arrangement and usage of the public area and other space for specific purposes;
- takes care of the construction, maintenance, managing the citizens' needs related to education, culture, sport;
- takes care of satisfying specific citizens' needs related to heath care, social care and social care of children and youth;
- satisfying specific citizens' needs related to public information;
- takes care of the development of hotels and restaurants, craftsmanship, tourism, and arranges specific conditions for work in the particular domain;
- takes care of the environment protection, using and improving natural resources and areas of combined natural quality;
- takes care of the rural development, its protection, using agricultural land and water and arranges specific conditions in this domain and in the domain of protection and improvement of flora and fauna.

3.2.1.1 Local Government (Municipal Administration) Pirot

Local Government (Municipal Administration) Pirot is divided into four departments referring to organisation. At the top of every department, there is a head, and departments are divided into smaller organisation units – groups. They are led by chiefs and some groups are divided into groups or services as lower organisation units. Figure 3-3 is an illustration of the organisation scheme of Local Government Pirot. In the further text we will discuss only those departments and groups of the Local Government estimated to be able to improve their activity after implementation of GIS technology.
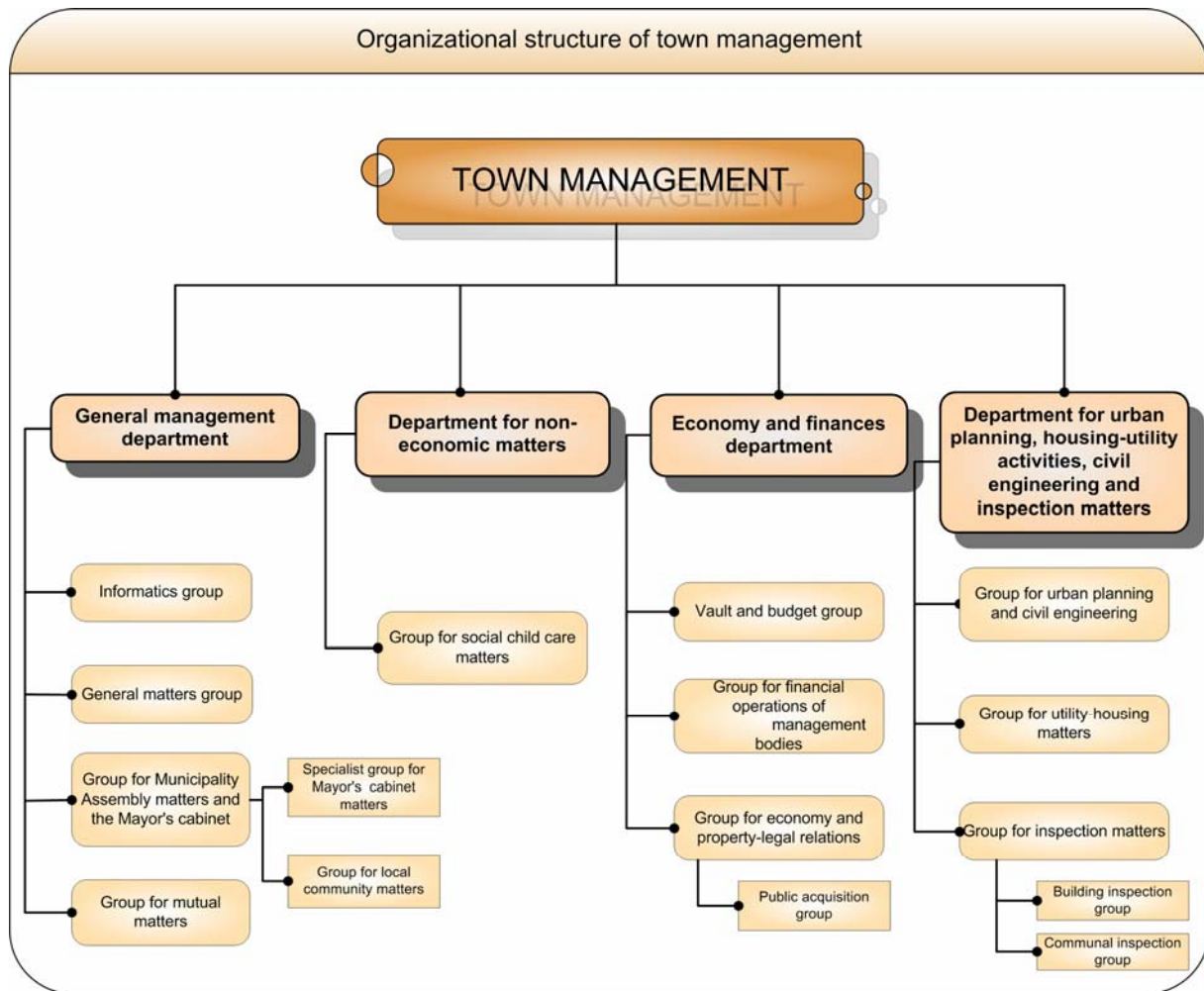
Figure 3-3 : Organisation scheme of Local Government (Municipal Administration) Pirot

3.2.1.1.1 Town planning, Residential and Communal, Construction and Inspection Activity Department

This department is divided into:

- Town planning and Construction Group,
- Communal and Residential Activity Group and
- Inspection Activity Group.

Owing to the importance the groups of this department have for the development of the Municipality GIS, their activities will be analysed separately.

Town Planning and Construction Group

In the domain of town planning this group performs the following activities:

- performs public announcement to consign the construction of the methodical document;
- takes care of displaying the methodical document to public;
- provides the existing copies of the topographic and cadastral maps;
- collects data for the programme production dealing with the plan construction;
- prepares decision proposals on town planning production;
- issues extracts form town planning and acts on town planning conditions;
- organises public presentation of town planning projects;
- confirms the town planning project was produced in accordance with the basic town planning.

In the construction domain the group performs the following activities:

- provides accessions administered by special laws and that are a condition for issuing building permits;
- provides conditions for joining to traffic and utility and other administered conditions;
- solves applications of objects whose building, i.e. reconstruction was finalised without the building permits (legalisation);
- issues building permits;
- issues use licenses for objects under municipality authority.

Along with the mentioned activities, the group performs the following:

- forming the committee for technical inspection of objects;
- enacts decisions to demolish objects at a demand of a party;

The main data this group is based on are spatial maps, town planning, town planning projects, cadastral maps, cadastral operate, cadastral maps of utilities, different assembly decisions, object database etc. A significant help to the group is offered by the Public Town Planning Agency.

Archiving the existing documentation is a very serious problem in the activity of the group. There is a numerous and large archive of issued permits and decisions of this domain and parties very often ask for this archive documentation. Presently, searching and finding these documents is very slow.

Communal and Residential Activity Group

The group performs activities related to arranging, performing and accomplishing communal activities, takes care of providing conditions for long-term communal activity. It also performs activity of protection and improvement of the environment in the accordance with the Law. It performs the eviction procedure of illegal residents from the flats and common premises. It proposes act outlines accepted by the Municipality Assembly, Municipality President and Municipality Council and related to these domains. It implements the municipality regulations directly in the domain.

It handles processes for state flats ransom, performs illegal evictions, registers the tenant assembly as the legal party and issues orders for residential buildings maintenance, performs inspection of the occupied public area, performs control and collection of local communal tax.

Inspection Activity Group

Construction inspection

The activity of this group is inspection of the entire object construction process: issuing building permits, issuing use license and inspection related to existing objects, illegal objects and objects in the process of legalisation. Administration process is in progress and administration activity is performed in the domain of supervision inspection, in accordance with the existing regulations.

This organ performs supervision inspection activity in construction domain in accordance with the Law and also performs some other activities in residential domain.

Communal inspection

Based on Communal Activity Law, Environment Protection Law, Water Law, Roads Law, from the responsible apparatus and on the grounds of decisions and rules, Communal inspection performs controls of:

- using the public area space or in front of office premises in business purposes;
- taking care of the playground resources;
- organization of music programmes in hotels and restaurants;
- displaying firms or names of the office premises;
- using shower cases for displaying goods outside the office premises;
- using advertisement panels;
- maintenance of the public area;
- control of working hours;
- control of environment protection, control of noise intensity;
- control of road traffic, regulation of traffic in the populated area, control of local and uncategorised road state, control of parking in the public area;
- control of putting fire in the agricultural area and fire protection;
- agricultural activities and hail protection;
- control of application of the Law related with burying in cemeteries;
- control of Communal Activity Decision (water supply, sewage) implementation;
- defining and communal taxes remuneration for using objects and services in the area of Pirot Municipality;
- environment protection (in accordance with Performance Law, regulating Municipality authority);
- noise protection;
- air pollution protection;
- inspection of the office premises (of device and equipment, as a preventive activity and environment protection);
- inspection of public agency activity (water and sewage system, drinking water quality, waste and drainage water, disposal area and animal cemetery);
- discarding and disposal of refuse material;
- green market maintenance;
- keeping animals;

13

- defining conditions for water economy, its approvals and licenses.

Traffic inspection

- appliance inspection of Road Law, Road Traffic Law and other sub-law acts in the domain

Environment protection inspection

- appliance inspection of Environment Protection Law and other sub-law acts in the domain

Almost all activities of this group are strictly spatially oriented. Additionally, a large number of public and other agencies and citizens use the services of this group and installing GIS technology would thus greatly facilitate the processes in the group authority.

Despite using computer technology in daily activities, degree of automation is at this moment very low. All spatial records (master map, detailed regulation plan, zoning map used in its analog form, without the possibility of automated data processing. Using GIS technology would significantly speed the procedure of issuing town planning plan excerpts and town planning condition acts, as well as the issuing of permits and decisions in the building process, which would greatly simplify the procedure and investments in Pirot Municipality and thus make it more attractive for the potential investors.

For the needs of the legalisation process of illegally built objects and due to the lack of up-to-date data, this department has performed an inventory of the objects on the town territory. This record is described in detail in chapter 3.4.6.

3.2.1.1.2 Economy and Finance Department - Economy, Property and Legal Relations Group

This group performs activities in property and legal area, performs the procedure of expropriation, returning land, dispossession, renting municipality grounds (agricultural and town planning), evaluates the value of real estates, issues deeds, performs definition of right of way and other activities in accordance with the Law, Statute and municipality decisions.

In every procedure lead by this group, parties make a request necessarily enclosing the evidence of ownership and a copy of the plan from the Real Estate Cadastre Unit Pirot. This organ is officially obliged to collect the data in possession of other administrative organs or state organs. In the request solving procedure this organ conducts an investigation on spot with the geodesy, town planning and agriculture experts, in order to provide evidence and make a decision at the individual request. It is authorised in property and legal activity and applies General Administration Procedure Law and material legal regulations (Planning and Construction Law, Expropriation Law, Property Land Returning, Cooperatives Law, Law on Pasture Returning to the villages for their usage).

This group has requirements for cadastral data (cadastral maps and cadastral records), up-to-date geodetic basis and object data (construction, town planning licenses, in the process of legalisation…) on a daily basis. The employees are often enforced to forward the public several times to cadastral office and other groups in order to check the data.

Despite being equipped with computers, the group does not use GIS or CAD technology in everyday activities. The group does not have digital spatial data at their disposal.

Spatial record of real estates orientation values of some parts of the town would be very useful. These values could significantly improve the objective evaluation of real estates. This evaluation will especially be important in the period to come since the tax income on

absolute rights transfer will be taken by the Municipality. Besides, automation of data record related to renting land and its spatial location is vital.

3.2.1.2 General Administration Department

General Administration Department is divided into five groups. The basic activities of the department are the following

- activities related to managing, development and improvement of information system;

- registration office activity; signature, transcript and manuscript attestation activities; issuing working booklets;

- conducting public electoral poll activities;

- administrative activities related to citizens' status, personal names;

- officiating record books and nationality books;

- expert and administrative-technical activity for the Municipality, Municipality President and Municipality Council;

- performing expert and administrative activities for the local communities;

In General Administration Group, GIS or CAD technology is presently not used in the work process.

Informatics group takes care of IT structure of Local Government and is an important factor in GIS implementation in Pirot Municipality. At the moment, this department has three permanent employees. Owing to the fact municipal information system is much more intensive it is to be expected a number of the employed in this area should increase simultaneously with the process of Municipality GIS implementation.

Along with the process of Municipality GIS implementation the records this department has authority of will be able to combine with the spatial data.

Accessibility of GIS data will facilitate the communication and work in the department especially in the *Assembly Activity and President Cabinet Group.*

3.2.1.3 Municipality public legal office

Municipality public legal officer directs Municipality public legal office and performs actions the office has authority of. It performs activities of legal protection of the Property rights and interests of Pirot Municipality, its organs and other legal entities performing activities of interest for Pirot Municipality and financed by the Pirot Municipality budget. Municipality public legal officer can represent some other legal persons at their request provided it is not opposed to the interests of the subject he deputises by law. Municipality public legal officer has complete authority of a legal attorney, gives legal opinion related to negotiating property and legal contracts as well as legal opinions on other property and legal matters to persons whose property rights and interests he deputises.

There is a constant daily need for accessing town planning, cadastral maps and cadastral records, address register and up-to-date site state in the work process of Municipality public legal officer.

GIS and CAD technology is not used in public legal office at the moment. Municipality public legal office does not have digital spatial data at its disposal.

3.2.1.4 Land Development Agency

Agencies purpose is collecting restricted funds and there are four funds in the authority of Land Development Agency:

1. Land Development Fund

    - construction land arrangement tax;

    - construction land usage tax;

    - tax for bringing construction land into original state;

2. Roads Fund

    - road tax on vehicle registration;

3. Residential Solidarity Construction

4. Common Goods Protection Fund

    - tax paid by HE Pirot.

The Agency manages the investments on behalf of Pirot Municipality based on an annual plan. Most resources is used for construction and maintenance of town traffic arteries and pavements, construction and maintenance of non categorised roads, arrangement of common grounds (infrastructure and capital objects), construction and maintenance of public lighting etc.

The Agency also takes care of the construction grounds, i.e. rents them after Pirot Municipality Assembly decision.

In daily activities, the Agency most often cooperates with the following institutions:

- PTPA Pirot (arrangement of grounds activities);

- Telecom Serbia;

- Public agencies: PC "Komunalac", "Water and Sewage Company", ED "Jugoistok" d.o.o. Niš "Electro distribution Pirot", "Public Heating Company" (utilities data);

- Town planning, Residential and Communal Activity, Construction and Inspection Department of Pirot Municipality;

- Economy, Property and Legal Relations Group at Economy and Finance Department (land renting);

- Municipality public legal office.

The Agency has a developed computer network and good hardware (18 employees, 14-15 computers, 8 Intel P4, the rest are Intel 484). Microsoft Office and AutoCAD are the available software.

Among the data important for GIS of Pirot Municipality, the Agency has a database in their disposal related to its users and to the tax liquidation for using construction grounds for legal entities and physical persons. This database is described in more details in chapter 3.4.7.

Despite the fact the Agency premises are 80m away from the Local Government premises, there is no telecommunication infrastructure connecting the two local networks formed in the premises.

The Land Development Agency is one of the most important municipal institutions when the spatial data is concerned. Agency activities could be significantly improved if up-to-date quality spatial data were used, such as:

- real estate cadastre data;
- utilities cadastre data;
- orthophoto;
- buildings database (formed for the needs illegally built object legalisation);
- town planning (both general and detailed regulation plan).

3.2.2 Municipality public agencies

A public agency performs activities of common interest and is set up by the state, i.e. the local self-government unit. Those of interest for GIS of Pirot Municipality could be divided into public agencies set up by municipal and those set up by republic authorities. Municipal public agencies are "Komunalac", "Water and Sewage Company", "Public Heating Company" and Public Town Planning Agency Pirot. The republic public agency in Pirot Municipality related to GIS is agency for electric energy distribution, ED "Jugoistok", d.o.o. Niš "Electro distribution Pirot".

3.2.2.1 „Water and Sewage Company"

Basic activities of this public agency are the following:

- production and distribution of water;
- maintenance of water supply and sewage network;
- filter refining and waste water drainage.

„Water and Sewage Company" has infrastructure activity, i.e. common interest activity for the populated areas. Water supply activity is one of the basic need activities among the communal ones so it can be referred to as the basic communal activity.

Presently, town water supply uses spring water from four springs near Pirot. „Water and Sewage Company" provides conditions for average monthly consumption of 450, 000 m^3 of water, and owing to a water system *120 km* total length (with the main line of 15 km and 105 km of transmission network) and three reservoirs of 7250 m3 total volume.

„Water and Sewage Company" Pirot supplies healthy fresh water to almost 40,000 town inhabitants, i.e. 10500 individual households and 150 tenants' council, as well as the town economy, 99% of the town territory being covered with the water supply installations. It is also possible to supply 11 villages with about 9,500 inhabitants, with over *30 km* of transmission network.

Total number of water metres used for measuring spent water in the town and villages is 14,400.

Town drainage system is defined as a general system – the same pipe line network is used for evacuation of fecal and atmospheric water. The drainage pipe line network in Pirot is **105 km** long (the main collector being 2 km). The percentage of town coverage is 98%. Besides having constructed drainage in the town area, „Water and Sewage Company"Pirot has built a drainage network in the several villages of Pirot Municipality (**8 km** presently in function). The total number of water drains for the town draining area is 1,600.

Total number of employees is 106, 10 of them having advanced specialist's training. „Water and Sewage Company" Pirot has a developed local computer network with 16 computers AMD and INTEL P4 as well as 10 computers PENTIUM 1.

About 45% out of 150 km of water supply network is geodetically surveyed and mapped on analogue maps in cadastre. A total of 113 km of drainage network, 35% is recorded. The official records „Water and Sewage Company" has:

- records of consumers needed for the tax liquidation for spent water and drainage (using) service;

- water metre records;

- records related to agency work activity.

Most frequent communication related to GIS, „Water and Sewage Company" has with Town Planning Department, communal, residential activity and construction. It is from this department the technical service „Water and Sewage Company" needs approvals for building the Water and Sewage Company network. For construction works on the public areas due to interventions and network building, „Water and Sewage Company" is obliged to obtain Assents and decisions. On the other hand the Department, for the needs of plan production for detailed regulation and other plans, makes a request to „Water and Sewage Company" for production of technical conditions of Water and Sewage Company network and planned activity of this public agency for the fore coming period.

3.2.2.2   PC "Komunalac"

Basic activities of PC "Komunalac" are the following:

- sanitising the common area and maintenance of public hygiene (streets, pavements, squares)

- refuse disposal;

- maintenance of greenery in the public area (parks, alleys, jardinières)

- cleaning snow and ice in the public area;

- capturing and annihilation of stray dogs;

- maintenance of cemeteries;

- maintenance of town markets;

- maintenance of town bathing resort;

- organisation of fair.

Activities of sanitising the public area, maintenance of public hygiene, maintenance of greenery in the public area, winter service, kennel service and town bathing resort maintenance are all financed from the Municipality budget and they are performed at the basis of annual activity programme. The town is divided onto zones and the intensity of activities is based on this division. These activities are all under inspection of municipal

communal inspection. C PC "Komunalac" collects tax from citizens, a fee for the service of refuse removal and has a database on users' addresses.

Among the mentioned activities PC "Komunalac" performs works for citizens' needs.

Most frequent way of communication with the Local Government is accomplished through the Town planning, Residential and Communal Activity, Construction and Inspection Department. This refers to the following subjects:

- solving claims for issuing acts on town planning-technical conditions
- solving claims for issuing of town planning extracts
- solving claims for issuing building permits
- solving claims for issuing usage license
- applications for beginning of performing works
- issuing decisions on cutting trees permits
- other acts necessary for functioning of WU "Town cleanness" and WU "Greenery, markets and cemeteries"

Data about applications of works in public area this agency maintains is of great significance to them. This information is in the Town planning, Residential and Communal Activity, Construction and Inspection Department of the Local Government . The data would help in cases of digging up, closing streets for traffic, asphalt-paving etc. and in cases of activity planning such as planting the common, planting trees etc.

PC "Komunalac" has a database related to their service to users. Besides, there is a town map divided into town street cleaning zones and numbered refuse containers.

3.2.2.3   "Public Heating Company"

"Public Heating Company" is a public municipal agency whose main activities relate to production, distribution and sale of thermal energy and maintenance of the existing system. This agency's service covers about 18% of the town territory with about *12 km* of thermal pipes and 5 remote heating plants.

The agency has 33 employees, only four of them being technical personage. There is almost no computer system and they are not connected to the rest of the communal agencies and Local Government.

The distribution network is partly recorded geodetically and put into the cadastral maps of utilities. A schematic drawing of the lines is done and is based on the Basic state map scale 1:5000 with pipe diameters given. Additionally, there is data of thermal springs, sub stations and potential consumer areas.

In accordance with the Energetic Law a municipality decision is expected to be reached related to thermal distribution network as well as the energetic strategy document whose projects has already been presented.

Related to GIS, a cooperation between "Public Heating Company" and the Local Government   is mutual and basically in regard to issuing "Thermo energetic Agreement" on joining objects to the central heating system, and issuing of "Reconstruction Agreement" for primary and secondary network.

The cooperation with the communal services is in relation with digging the common area due to construction work, reconstruction and thermal line breakdown rehabilitation.

More intensive work related to thermal energy installment in the town is expected to occur in the next few years due to the small coverage of the town and there is readiness of Local Government to improve the service for the citizens' behalf. "Public Heating Company" has a special interest in implementation of GIS due to intensive thermal installment works and a very complicated procedure of giving approvals and technical conditions.

3.2.2.4   Public Town Planning Agency, Pirot

Basic activities of Public Town Planning Agency Pirot are production of town planning plans and projects and help to Town planning, Residential and Communal Activity, Construction and Inspection Department with issuing town planning-technical conditions and other extracts from town planning. It is mainly financed by the municipality budget while a lesser part (about 30%) has its own income.

The agency has 20 employees, 9 of them having higher specialisation. It has a good modern hardware computer equipment, printers and A0 plotter. The computers are neither linked into a local network nor with the other institutions since the premises are expected to be moved by the end of the year.

This agency produced a Master map of Pirot in 2005. Existing regulation plan were revised afterwards. Presently, new plans of a more detailed regulation are being produced.

More information on town planning data is given in chapter 3.4.5.

Lack of up-to-date database is a great obstacle in the town planning project production and with issuing town planning-technical conditions.

3.2.3   ED "Jugoistok" d.o.o. Niš - "Electro distribution Pirot"

As a part of Economic association for electric energy distribution "Jugoistok" d.o.o Niš, and by the latest organization, ED Pirot, spatially covers the areas of Pirot, Bela Palanka, Babušnica and Dimitrovgrad Municipality, as far as providing electrical energy is concerned.

In Pirot Municipality territory, ED Pirot has a total of 24,837 users in the category of households, 1,883 users in the category called "transfer", 119 low voltage users and 28 10kw users.

ED Pirot has 109 employees, and has the following hardware:

- 79 computers (76 P4 + 3 PIII);
- 47 printers (26 laser + 17 metrics + 4 inkjet);
- 3 scanners.

ED Pirot has the following software:

- operative system: Windows XP Professional + SP2;
- Microsoft Office 2003;
- Oracle;
- Several freeware serviceable programmes.

IT network infrastructure of ED Pirot has the following characteristics:

- Ethernet network is done with UTP cables of 5e category (100 Mb/s);

- operative system: Microsoft Windows Server 2003;

- 2 servers (controllers domain) + rooter + modem;

- One 24-port, two 16-port and three 8-port switches 10/100;

- 2Mb link to Niš and 256 kb link to Babušnica and Dimitrovgrad.

ED Pirot presently does not have an established technical-information system. DMS programme is in its experimental phase and it should provide this functionality in the future. At the moment, record of electro-energetic objects are in Word and Excel documents (physical scope, EEO with construction and usage permits, Record of electric stations, Record of issued technical conditions of electro-energetic agreement..)

At the moment there is no information about the length of lines (canals) of the electro-energetic network for the territory of Pirot.

3.2.4 Geodetic Governmental Authority – Real Estate Cadastre Unit, Pirot

Geodetic Governmental Authority (GGA) is a special organization whose activity is that of expert and administrative nature and that relate to the state survey, land cadastre, Real Estate Cadastre, utilities cadastre and proprietary real estate enlisting, maintenance and reconstruction of these records as well as some other activities defined by act 28, Ministries Law ("Službeni glasnik RS" No 35/2003). It is comprised of:

- state survey, cadastre and proprietary real estate enlisting, their maintenance and reconstruction;

- producing technical documentation;

- basic geodetic works;

- production of Base State Map – BSM;

- maintenance of Spatial Units Register (Administrative Units Register);

- defining house numbers, marking buildings by numbers and denomination of settlements, streets and squares;

- register maintenance of household numbers, streets and squares – Address System (Address Register);

- cadastral classification and land categorisation;

- definition of cadastral income;

- land consolidation;

- linking of geodetic network and exchange of geodetic and cartographic data with the neighbouring states;

- production and development of geodetic information system;

- maintenance of State survey technical documentation archive, plans and maps;

- expert inspection;

- normative activity (making regulations).

Speaking in territorial terms, Geodetic Governmental Authority is organised in the concept of Serbia being divided into *10 Real Estate Cadastre Centres* divided further into *Real Estate Cadastre Units*. The territory of Pirot is covered by the *Real Estate Cadastre Unit Pirot* belonging to Niš Centre.

Pirot Municipality territory is divided into 74 cadastral municipalities, 5 of them being town planning: Pirot Grad, Pirot Van Varoš, Gnjilan, Berilovac and Gradašnica.

Real Estate Cadastre Unit Pirot has 18 employees, two of them being graduated engineers of geodesy. It has good computer equipment and all computers are linked into a local network and with the other institutions.

The Unit has one MapSoft software package installation, used for handling the digital data of the cadastral and topographic maps. The software works under Windows operative system and it is based on GIS technology and concepts. The data is stored and maintained as a part of commercial relational data base with the geo-relational model of spatial data. Network data access is possible with the simultaneous access to databases by more users. The software is coordinated with the existing regulations of the Geodetic Governmental Authority. The Unit also has in their disposal *JE* software that provides support to Real Estate Cadastre.

Real Estate Cadastre Unit Pirot processes about 1200 matters annually, 300 of them relating to changes in cadastral maps. The changes mostly refer to records in the town planning area cadastre municipalities – 90% of changes, whereas the rest of changes refer to the other of cadastre municipalities.

Following the Change of state survey law from 2003, GGA has drastically reduced the scope of operational work at Real Estate Cadastre and Utilities Cadastre maintenance. These activities are presently done entirely by the private geodetic firms. There are two geodetic firms on the territory of Pirot.

More details on the register state lead by the Real Estate Cadastre Unit Pirot and the future plans can be found in chapters: 3.4.1, 3.4.2, 3.4.3 I 3.4.4.

Using the register is supervised by the Geodetic Governmental Authority and is defined by the "Regulation of Maintenance, Usage and Inspection of Survey, Land Cadastre, Real Estate Cadastre and Utilities Cadastre Data" ("Službeni glasnik RS" No 42/2003). This regulates the cadastral data distribution via the media, Internet and Intranet. Based on this special agreement, it is possible for legal entities to use the cadastral data via the Internet, Intranet and to physical persons via the Internet.

3.2.5 Corporate company "Telecom Serbia" – WC Pirot

Telecommunication Company "Telecom Serbia", was founded as a corporate company in June 1997. Since 2003 it has been owned by two shareholders: JP PTT traffic "Serbia" and OTE Greece.

JP PTT traffic "Serbia", i.e. the Republic of Serbia as the founder, has retained a "Golden share", a right of veto for every decision of the Administrative board.

Telecommunication Company "Telecom Serbia" offers the users:

- all kinds of fixed telecommunication services;
- services of data transmission, telematic services; services with additional value, ISDN services, services of intelligent network, fixed satellite services, fixed services for using DECT standard, internet services, multimedia services;
- mobile telephony services;
- maintenance and service of the telecommunication installation and network.

In addition to the mentioned above, activity of "Telecom Serbia" comprises of spatial, town planning, projecting and construction of telecommunication object, service of data

transmit, ISDN, ADSL and Frame Relay services for business systems and business users as well as direct internet access, renting internet ports, telehousing services, free call services, universal access number, additional tariff calls and voting via telephone.

Working centre Pirot, MG 010 area (Pirot, Babušnica i Dimitrovgrad) has 77 employees, 15% of them having high specialised degree, 12% having advanced specialisation and the rest – intermediate specialisation.

All "Telecom Serbia" employees in the organizational structure have a type Pentium 4 or more. All 4000 computers are connected into one computer network. The skeleton network is the gigabit large intranet. The software is of network kind and all databases are a part of Oracle RDBMS. All technical capacity data, personnel data, store work, strategy and development etc. are in network databases and access right is regulated by the organisation structure.

All underground lines and TT canalisation on the territory of WC Pirot are geodetically recorded and the data is stored in real estate Cadastral Service Pirot.

"Telecom Serbia" has a plan to develop digital communication networks for 100% of all major towns up to the end of 2007 and to introduce wide range services, to simplify the prepaying process, to separate double lines and to implement digital node as close to the users as possible (DSLAM).

3.2.6 Citizens and other legal entities

In order to solve their needs, citizens and other legal entities, can appeal to some of the Local Government departments. Non-existence of the unique record used by all Local Government organs, public and other agencies, often force a party to visit many institutions to accomplish their needs. It is also reflected in the institutions themselves, as an unnecessary engagement of the employed dealing with the claims and, on the other hand, very long procedures of claim resolution.

Opening the Service centre and building up the municipality information system facilitates municipality activity a great deal. A prerequisite is an up-to-date spatial and other record. Implementation of GIS technology as a part of the municipal information system in the future opens possibilities to perform one part of the service activity automatically and remotely (Internet/Intranet). Additionally, better informative conditions will be provided, related to informing the citizens on the municipality territory and thus making the local self-government activity more transparent.

Presence of big economic subjects, such as "Tigar", "Prvi Maj" and fore coming investments in these agencies, will open new possibilities for development of Pirot Municipality. The municipality should follow the economy in terms of development and offer new possibilities though faster and more efficient administration.

Implementation of GIS technology into municipality organs activity could be of great importance to those who want to invest into building new object on Pirot Municipality territory. It is realistic to expect that Implementation of new technology will significantly speed and simplify the procedure of the issuing of the needed approvals, and thus influence the reduction of illegally built objects.

3.2.7 Information and document flow between the potential Municipality GIS users

The greatest scope of spatial information exchange between the potential Municipality GIS users occurs in the following relations:

- Local Government (Town planning, Residential and Communal Activity, Construction and Inspection Department) - Real Estate Cadastre Unit Pirot;

- Local Government (Town planning, Residential and Communal Activity, Construction and Inspection Department) - Land Development Agency;

- Local Government (Town planning, Residential and Communal Activity, Construction and Inspection Department) – municipal and republic public agencies ("Komunalac", "Water and Sewage Company", "Public Heating Company" and Public Town Planning Agency, "Electro distribution Pirot", Telecom);

- Local Government (Economy, Property and Legal Relations Group at Economy and Finance Department) and Public Legal Office - Real Estate Cadastre Unit Pirot ;

- Land Development Agency - Real Estate Cadastre Unit Pirot;

- Land Development Agency - municipal and republic public agencies ("Komunalac", "Water and Sewage Company", "Public Heating Company" and Public Town Planning Agency, "Electro distribution Pirot", Telecom).
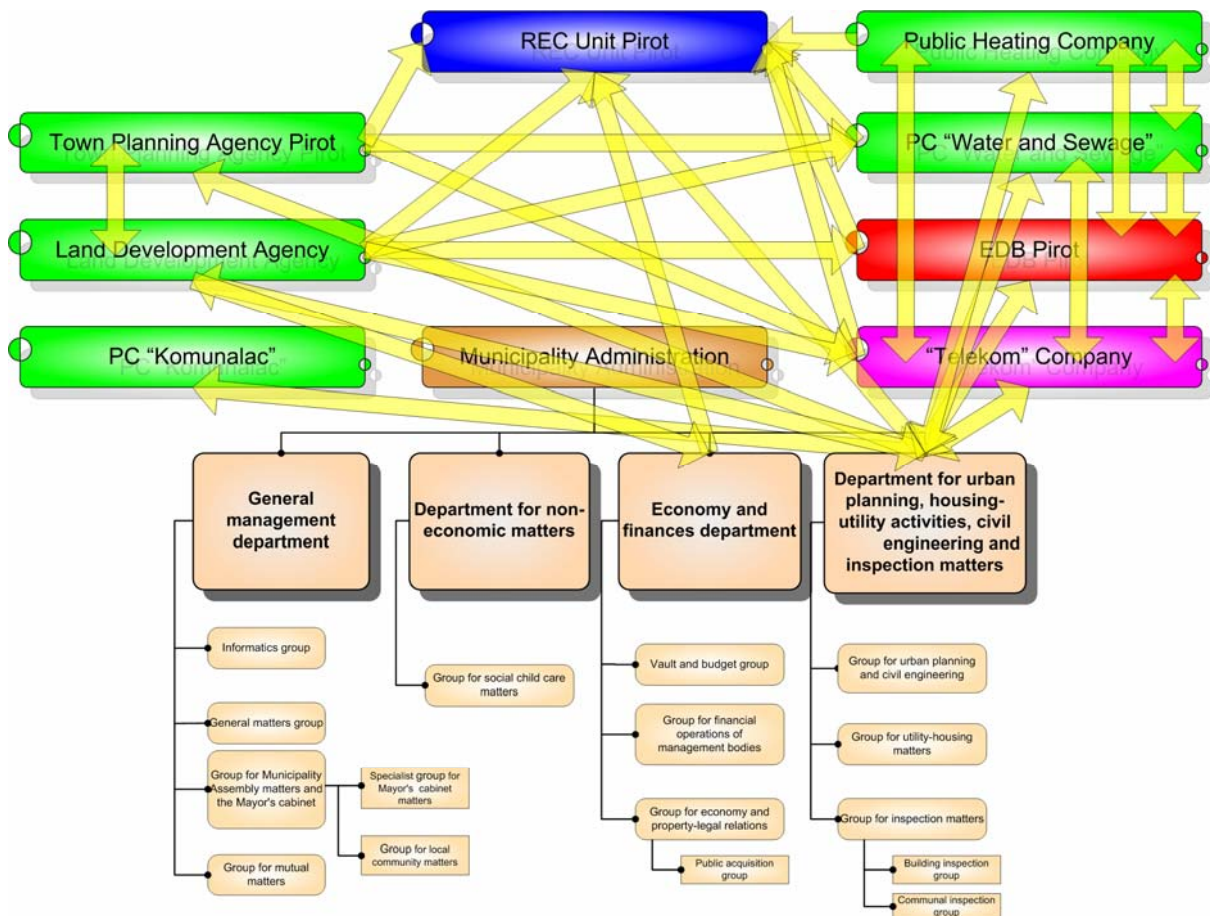
Figure 3-4 : Information and document flow between potential users of Municipality GIS

In most cases, the activities relate to:

- claims for act issuing on town planning conditions or town planning extracts;
- claims for obtaining agreement for building, reporting works and usage approvals for utilities objects;
- obtaining agreement and decisions for digging public area;
- issuing conditions for joining to traffic and utility;
- issuing copies of the parcel plans and evidence of ownership;
- defining tax for land maintenance;
- renting land for tenure or usage.

These everyday activities mostly need using the spatial data from the Real Estate Cadastre Unit Pirot (Real Estate Cadastre, Utilities cadastre). As the cadastral utilities data is not up-to-date it is a rule that public communal agencies and Telecom (agency dealing with maintenance and construction of utility network) mutually exchange the data relating to their utilities infrastructure and give construction approvals.

3.3   IT infrastructure in Local Government

As a part of the present state analysis, an overview of the existent IT infrastructure in Local Government will be given separately, as it is the GIS development carrier in the Municipality. In this context, a brief overview will be given relating to hardware, software and especially telecommunication infrastructure, which is one of the most important conditions of Municipality GIS development and implementation as a distributed system.

3.3.1   Hardware

In the process of "Forming GIS centre for Pirot Municipality" project, Local Government has obtained two desktop computers, one computer for GIS server implementation, one A0 colour plotter and one colour laser printer. The hardware is installed in the GIS Centre for Pirot Municipality. It is high quality hardware completely satisfying the needs of the Centre.

3.3.2   Software

Based on state analysis in some departments of the Local Government, municipal public agencies and other relevant institutions it can be concluded that only Real Estate Cadastre Unit Pirot uses software tools for GIS. On one hand, it is not good, as it means most employed in these institutions did not have an opportunity to get to know GIS technology. On the other hand, this eliminates the need of separate analysis of the existent application and data and their including into Municipality GIS.

In the process of "Forming GIS centre for Pirot Municipality" project, the Local Government has obtained GIS software – two GIS desktop server installations and one GIS server installation. The obtained software is a solid basis for GIS technology implementation as a part of the Local Government. Two GIS desktop server installations are entirely adequate for data record supervised by the Local Government and GIS centre for Pirot

Municipality. Software solution for GIS server should provide distribution of spatial data for all interested user via Web service.

In addition to GIS software, it is important to know Local Government has installed software application that provides support to information system of a local government – application Hermes. Concerning the fact this application covers a wide range of Local Government activities, including those related to administration of spatial resources, it is clear a very close data and application integration of this information system and of Municipality GIS application is to be provided.

3.3.3 LAN and telephone network

This year, in Local Government Pirot premises, a modern 1 Gbit LAN telephone network was designed and implemented. Cables category 7 were used. The network has 152 LAN and 149 telephone connections installed in 165 connections in the following way:

- 136 LAN/telephone connections;
- 16 LAN connections, and
- 13 telephone connections.

The network entirely covers the building (Figure 3-5), including the ground floor (together with the Municipal Service Centre), the first, second, third and fourth floor.

Figure 3-5 : LAN and telephone network in Municipality Pirot building – lines through floors (August 2006)

The network is segmented in logical units, that is, floors and each unit has switches. One HUB and five switches, as well as the cables category enable gigabit data transfer.

A telephone operator Ericsson MD 110 has been installed and it enables good communication, easy configuration and maintenance of the telephone network.

3.3.4   The Internet

It is planned to realise connection to Internet using ADSL 768/192 kb/s Telecom services in August 2006.

3.3.5   MAN

Presently, there is no computer connection between the Pirot Municipality building and other agencies and institutions that are potential GIS users, but not in the Local Government Pirot premises. There is no connection between other users of Municipality GIS, but it is important that some of the most significant users (Local Government, Real Estate Cadastre Unit Pirot, Land Development Agency, Public Town Planning Agency) are relatively close physically. The location of potential users of Municipality GIS is shown in the following figure:
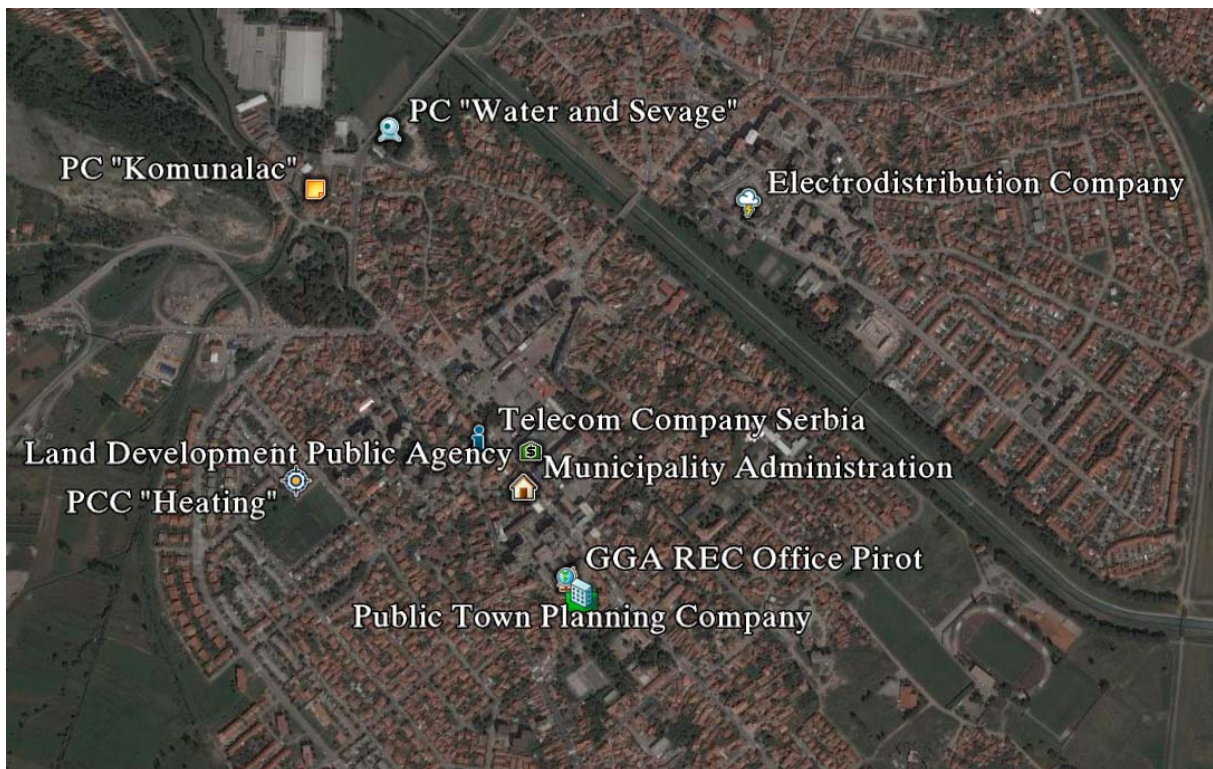
Figure 3-6 : Location of potential Municipality GIS users

3.4   Spatial data for Municipality GIS implementation

Based on the present state analysis there is available data significant for Pirot Municipality GIS implementation. In the following chapters, there is a record and data survey of importance for successful Pirot Municipality GIS implementation.
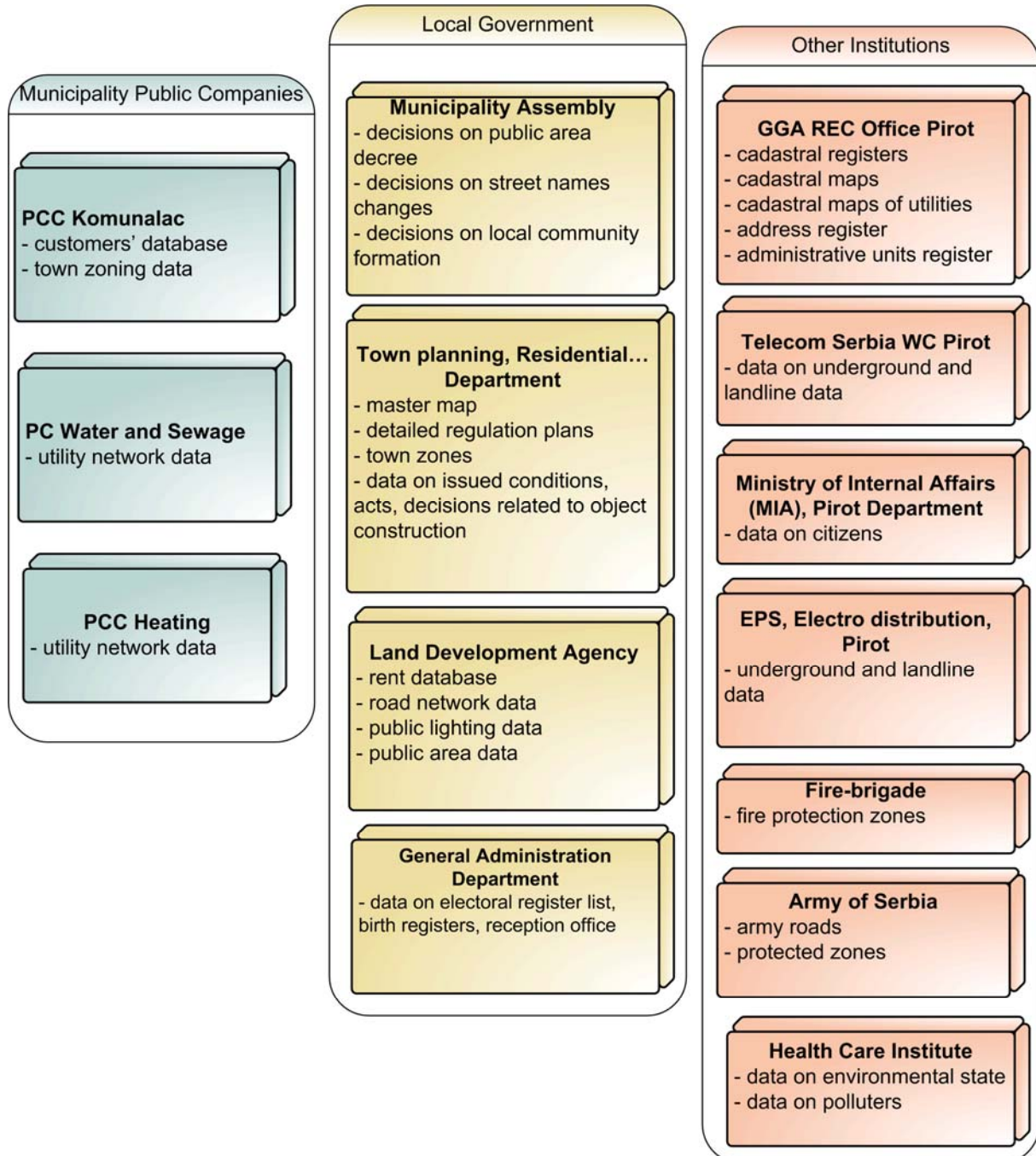
Figure 3-7 : Survey of existing data for Pirot Municipality GIS implementation

3.4.1 Real Estate Cadastre data

Real Estate Cadastre is a public record containing land data (name of cadastral municipality, number, shape, area size, using purpose, land category, cadastral class and cadastral income on cadastral parcel), data about buildings, flats, business premises as well as the special parts of buildings (position, shape, size, using purpose, number of floors and number of flats) and other construction object and data about rights and right bearers, treatments and limitations.

Real Estate Cadastre consists of:

- Cadastral Records;
- Cadastral maps (original working maps);
- Collection of documents.

In Serbia, there is a process in progress that aims at transforming old Land Cadastre Register, which was a land user register at its basis, to the new Real Estate Cadastre.

Real Estate Cadastre is based on cadastral municipalities. The territory of Pirot Municipality is divided into 74 cadastral municipalities, 5 of them being urban. The construction land is covered with 15,963 parcels, and a total of 405,458 parcels on Pirot territory.

Real Estate Cadastre record consists of Real Estate Cadastre records and cadastral maps. Real Estate Cadastre Unit Pirot estimates that maps and records corresponding to town cadastral municipalities are 60-70% updated whereas the same estimate for the data for other cadastral municipalities is 80-90%.

In the following two chapters, Real Estate Cadastre data description is divided into Cadastral Records and Cadastral Map state description.

3.4.1.1 Cadastral Records

Real Estate Cadastral Records (CR) and Land Cadastre have been a part of the official electronic database in Real Estate Cadastre Unit Pirot for the last 10 years. RECU Pirot has a special application for cadastral operative database maintenance, used in all real estate cadastral units in the Geodetic Governmental Authority.

RECU was established in 69 non-constructional cadastral municipalities by a so called "faster procedure", a simple land and Real Estate Cadastre record estanlishment, with a right for complaint at the existent data. A part of cadastral municipality Pirot Grad has a status of Real Estate Cadastre (a greater part of the industrial quarter and some residential and office buildings in the town). A process of entering records on all residential objects into Real Estate Cadastre is in progress and this is expected to be finished by the end of 2006. Part of the cadastral municipality Pirot Grad that is already recorded in Real Estate Cadastre has 637 parcels.

In Serbia, a project called "Real Estate Cadastre production and modernisation project in the Republic of Serbia" is in progress at the moment and is mainly financed by the World Bank loan. This project's idea is to implement Real Estate Cadastre in almost all urban centres in the Republic of Serbia. Moreover, for all 5 town cadastral municipalities in Pirot the Real Estate Cadastre will be established by 2010.

3.4.1.2   Cadastral maps – Digital cadastral map

Data about position and shape of parcels and its parts are maintained on cadastral maps. Cadastral maps in Real Estate Cadastre Unit Pirot are still in analogue form. In the last ten years in Serbia, there is a process of cadastral map digitisation, transforming them from their analogue, paper form into the digital form - *Digital cadastral map*.

Cadastral maps are produced and maintained in different scales. The area of town cadastral municipalities is covered with 92 cadastral maps in scale 1:500, 1:1000 and 1:2500. According to the scale these map sheets can be divided into the following groups:

- 47 sheets 1:500,
- 34 sheets 1:1000,
- 11 sheets 1:2500.

The entire territory of Pirot is covered with 978 cadastral maps 1:500, 1:1000 and 1:2500. According to the scale these map sheets can be divided into the following groups:

- 47 sheets 1:500,
- 64 sheets 1:1000,
- 867 sheets 1:2500.

Currently, the Main Project for Digital cadastral map production is in progress and it is expected to be finished by September 2006. A contractor tender for the production of Digital cadastral map of Pirot should be performed immediately after. These works are financed as a part of the above mentioned project "Real Estate Cadastre production and modernisation project in the Republic of Serbia". The subject of this project is digitisation of analogue cadastral map but not their updating.

For the needs of the Master map, the cadastral maps have been scanned, geo-referenced and conveyed to the Local Government.

3.4.2   Utilities cadastre

Utilities cadastre has records on underground and above land utilities network lines along with their installations and equipage. It is necessary to obtain construction and using permit for: water supply, sewage, thermal lines, steam lines, electrical power lines, telecommunication lines, petrol lines, gas lines and drainage lines. It consists of:

- original land data elaborates produced by utilities line survey;
- utilities line maps with characteristic utilities line data description;
- utilities line survey, and
- utilities line register

Utilities cadastre in the town of Pirot was established in 1978 and has existed ever since. Updating the utilities cadastre depends on how the authorised agencies respect the regulations on registering and recording the bedded lines. According to the Real Estate Cadastral Unit data line registration and their recording is decreasing. Roughly estimated, up-to-date utilities line percentage is the following:

- telecommunication lines 100% (there is no record on total length);
- electrical power lines (estimation of Real Estate Cadastral Office, there is no record on total length);

- water supply lines 45% (from a total of 120 km) and sewage network 35% (from a total of 105 km);

- thermal (heating) lines 20% (from a total of 12 km).

Telecom Serbia records new utility lines up-to-date.

The state of electrical power line network is the worst as there is no reliable data about the quantity of the existent, surveyed and mapped utilities lines. According to data from Electro distribution Pirot, underground and above land electrical power network lines are recorded, but they do not have records on the mapping percentage level. On the other hand, according to data from the Real Estate Cadastral Office, there is only a small percentage of field works that relate to electrical power that are reported for geodetic surveys. The estimate that 50% of electrical power network lines is surveyed and mapped is therefore very rough.

"Public Heating Company" has recorded all new utilities lines in the last two years.

Utilities line maps in Real Estate Cadastre unit Pirot are kept in their analogue form. Utilities cadastre maps are kept in the scales of 1:500 and 1:1000 and there is a total of 89. According to the scale, there are the following utilities cadastre maps:

- 47 sheets 1:500,

- 34 sheets 1:1000,

- 8 sheets 1:1000 (produced by magnifying the 1:2500 plans for the cadastral municipality Pirot Van Varoš).

3.4.3   Spatial units register

According to *Spatial Units Register law* ("Službeni glasnik" RS 19/89) and Ministries Law ("Službeni glasnik" RS 44/91, 67/93, 23/96, 47/99), Geodetic Governmental Authority is obliged to keep the graphical part of spatial unit register. *Republic Statistics Bureau* decides on Spatial Units Register numbers.

Spatial units register types are defined by the law and they are: *Republic, Province, District, Cadastral canton, Municipality, Settlement, Cadastral municipality, Local community, Statistic circle*. In addition to these units, there are also: national parks, free and custom zones and border areas. Spatial units have their name, register number, link to a higher rank unit and a border.

Special maps for *Spatial Units Register* are kept in Real Estate Cadastre Unit Pirot. The maps are updated on tracing paper, and most of these have been digitised (vector form).

It is pointed out in Real Estate Cadastre Unit Pirot they have unsatisfactory cooperation with the Local Government as formation of Local communities is not performed by the administered procedure and Real Estate Cadastre Unit is not able to update the borders.

3.4.4   Address register

Identifying house numbers, marking buildings and construction parcels with house numbers, denomination of settlements, streets, squares, maintaining house number, street and square register is defined by "Regulation on house number, denomination of settlements, streets, squares and marking names of settlements, streets, squares" ("Službeni glasnik RS" No 110/03). This document regulates that these activities are under competence of Geodetic Governmental Authority and that Real Estate Cadastre offices have the authority

of operative record maintenance. Before enacting this Regulation all these activities were in the authority of the local self-government. In 2004, an annex was enacted called "Regulation on house number, denomination of settlements, streets, squares and marking names of settlements, streets, squares Annex" (Službeni glasnik RS No 137/03).

Due to the accumulated problems in record maintenance in Pirot 2001, there was a renumeration of house numbers and street names marking. A land record of house numbers was performed in the manner that all new numbers were marked red. The record was produced both in notebooks and special maps where the house numbers were recorded.

Real Estate Cadastre Unit Pirot has a software solution for address register database maintenance at their disposal. At the time being, only new numbers requested by parties when allocating a new number are put into RECU address register database. There are but few such requests. The majority of data is old numbers.

Some institutions use new addresses, such as PC "Komunalac" and Land Development Public Agency, but generally, old addresses are used. Every institution that uses addresses in their activity has their database and maintains it.

RECU Pirot has the official street codes (index) register, but it is not in use. Other institutions either have their internal registers or do not use street codes at all but rather use house numbers and streets as one combined attribute (text field).

3.4.5   Town planning maps

Local Government is in charge of producing town planning maps in the municipality territory. The Municipality Assembly brings decisions and programmes on process commencement for town planning maps production. In most cases the contractor is Public Town Planning Agency, Pirot.

Spatial plan for the urban territory of Pirot municipality has not been done although the legal terms have ended.

Master map of the urban plan for Pirot municipality was done twice. The first one was done in 1991, and the second, current one, was accepted at the Municipality Assembly on 19 September 2005 and was issued in "Službeni list of the city of Niš" No 74/05. The territory of Master map coverage is 5276 ha.

The graphic part of the master map was done in *AutoCAD DWG* in the local coordinate system. The basis for master map was scanned cadastral basis and Base State Map 1:5000. The graphic part of the master map is divided into:

- Wider area plan;
- Construction land zones;
- Present land using in construction region;
- Planned land using in construction region;
- Traffic plan and traffic infrastructure realisation plan;
- Received obligations and planned expending of electro–energy network;
- Received obligations and planned expending of water and sewage network;
- Received obligations and planned expending of thermal energy and natural gas provision system;
- Received obligations and planned expending of telecommunication network;

- Objects and protection zones;

- Town planning instruments of plan implementation;

- Infrastructure corridors.

After the acceptance of Master map during 2003 the following plans are reviewed. Review decisions were brought by the Pirot Municipality Assembly (Pirot MA):

- Decision on reviewed town planning for: Pazar 2, Gnjilan 2, Free Zone, Tigar, Službeni list of the city of Niš No. 50/03;

- Decision on reviewed town planning for: Pazar 1, Tijabara 1, Đeram 1, Božurato, Prisjanski put , Službeni list of the city of Niš No. 58/03.

The graphic parts of these plans are mostly preserved in their analogue form as blue prints (ozolide copies, it is possible there are versions on tracing paper in Public Town Planning Agency Pirot archive) and they are not scanned.

All town planning maps are produced in accordance with the Master map, after its acceptance and they are all in digital form. The graphic part is available in its AutoCAD form. Therefore the following detailed regulation plans are accepted:

- Detailed regulation plan "Senjak" accepted at Pirot MA meeting on 22 Feb 2006, issued in "Službeni list of the city of Niš" No 25/06;

- Detailed regulation plan "Tijabarsko groblje" accepted at Pirot MA meeting on 22 Feb 2006, issued in "Službeni list of the city of Niš" No 25/06;

- Detailed regulation plan "Žukovo" accepted at Pirot MA meeting on 5 June 2006, issued in "Službeni list of the city of Niš" No 42/06;

Presently, there is further intensive activity related to detailed regulation plans production so there are 2 of them to be accepted and there are 5 of them with the accepted activities programme. The greatest problems that occur in the process of the production and the further town planning maps implementation are produced on non up-to-date basis.

In addition to the mentioned town planning maps, the territory of Pirot Municipality is a part of two more spatial maps. The first one is *Spatial map of infrastructure corridor Niš-border with Bulgaria* produced by Public Town Planning Agency, Niš. The second one is Special purpose spatial map of a tourist region of Stara planina. The production of this spatial map is in progress, and is done by the Urbanism and Architecture Institute, Belgrade.

3.4.6   Object register

For the needs of object legalisation, and because of lack of updated existing objects register, a register of all town objects was performed, except collective residential objects. Outlines made from cadastral maps copies were used as a basis for this register. The register officers surveyed people in the objects and got data from them. If the object did not exist in the cadastral map copy, it was outlined in its approximate dimensions. About 22000 objects were included in the register. For each of the object the following data was obtained:

- object internal code (ID);

- address – street and house number;

- cadastral parcel number, which cadastral municipality it belongs to;

- data about the parcel owner (name, surname, address, personal ID);

- data about the object owner (name, surname, address, personal ID);

- object type and dimension;

- number of floors and level of construction;

- data about construction permit (number and date of issue);

- data about using permit (number and date of issue);

- year of construction;

- information on joining the electrical power, water supply, sewage and telecommunication network;

- date of input.

All data is stored in the database (FoxPro DBF form), and there is an application for data input and its maintenance.

The data do not have officially, but they are the most updated record about the objects and basic object attributes.

3.4.7   Other spatial data and record

Topographic Map 1:25000 (TM25)

Topographic Map 1:25000 is a topographic map covering the entire territory of the Republic of Serbia. For performance, updating and distribution of this map Military Geographic Institute, Belgrade.

The main topics of TM25 are the following: mathematical basis, hydrography, flora and altitude presentation of the terrain. Presently, TM25 maps are available in the analogue and raster form. Only digital terrain model is available in the vector form.

The last update of these maps covering Pirot Municipality was done in 1969.
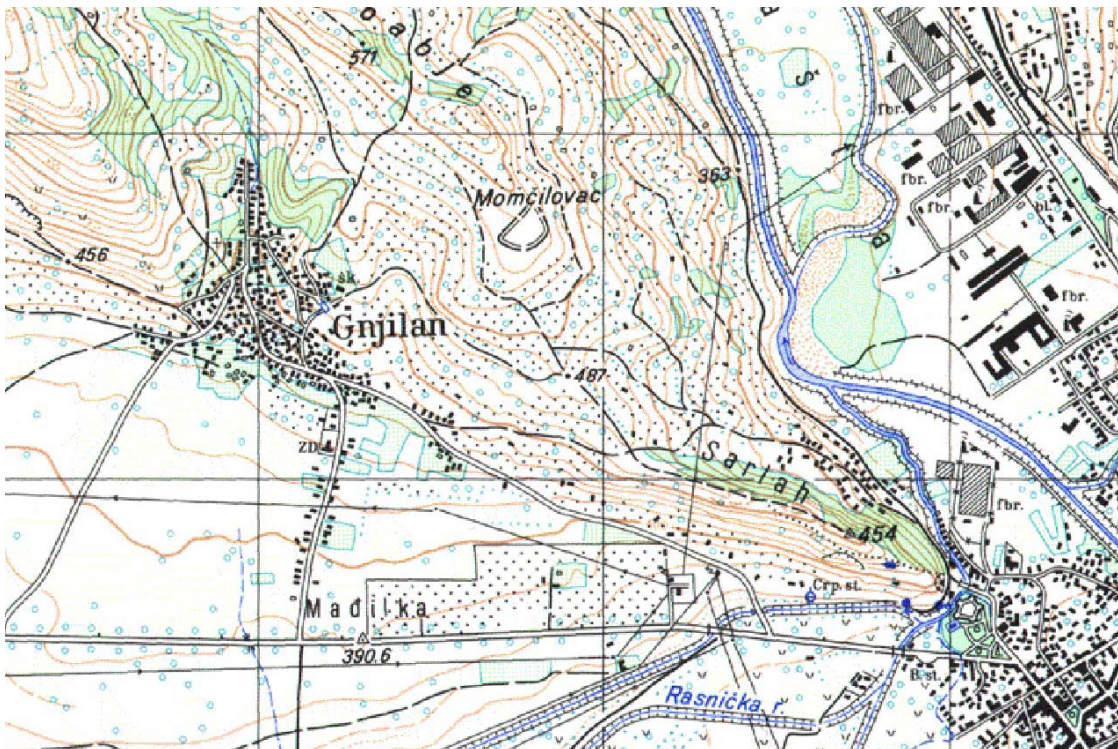
Figure 3-8 : An example of topographic map 1:25000

Orthophoto

There is no digital orthophoto for Pirot Municipality area. There is analogue orthophoto done back in 1985. A as part of project financed by CARDS programme, it is planned to produce a digital orthophoto for the entire territory of the Republic of Serbia. The town area is expected to be done in 1:1000 scale, (ground pixel size of 10 cm), and the rest in 1:5000, (ground pixel size of 50 cm). For some areas in Vojvodina orthophoto will be made in 1:2500 (ground pixel size of 25 cm). The project is expected to last three years, taking into consideration that orthophoto is to be done for Belgrade and Vojvodina territory in the first year. The project was supposed to start in August, 2005, but it officially started in November 2005. Nevertheless, no photos have been taken yet.

Base State Map

Ten sheets of Base State Map 1:5000 and with height representation of terrain of the Pirot territory was produced in 1988. Due to lack of more updated data sets, these maps are frequently used by municipal administration.

It is obvious there have been many changes on the terrain since these maps have been produced – 18 years ago. In Figure 3-9 there is a detail of Base state map (in red) covered by digital orthophoto showing it is not updated.

Figure 3-9 : Base state map (in red) covered by digital orthophoto

Objects and users records

For construction land tax remuneration purposes, Land Development Public Agency has formed their own database on users. The database was created when PC "Komunalac" database was taken and updated in the next few years. It is in FoxPro DBF form. It consists of the basic data structured according to physical and legal entities carrying the burden of tax remuneration. Data about physical persons are the following:

- Name and surname;

- Address (as a single attribute, together in one text field);

- Total residential area of one particular person;

- Total business area of one particular person;

- Zone (the town is divided into 6 zones).

Data about legal entities are the following:

- Name;

- Address (as a single attribute, together in one text field);

- Total area by groups of using (9 groups);

- Zone.

The database has records of 13,780 physical persons and 2,211 legal entities. Public budget financed legal entities are not included as they are not obliged to pay tax for using construction land.

For the service remuneration purposes PC "Komunalac" have created their own database. It consists of records of households that are their users: the name of the user, address, etc. Concerning the fact PC „Komunalac" have regular contact with their users, this database is considered updated.

Zone division

The town is divided into zones by several criteria (maintenance zones, sanitizing zones, residential zones, construction land tax remuneration zones, fire protection zones etc.) The zone borders are mainly defined by the analog town map, or by street list surrounding a particular zone. In both cases, this data could very easily be transferred into digital ones and become a part of Pirot Municipality GIS database.

3.5   Conclusion

Despite the fact all potential Pirot Municipality GIS users are not included, according to the previous chapters, the present existing state can objectively be analysed relating to activities certain institutions and agencies perform and relating to available IT infrastructure data. Generally, GIS is a new technology, whose primal aim is to introduce standards and automation into the existing ones and new procedures into Local Government activities. Taking all this into consideration, the Local Government state is at its expected level and the level of other municipalities in Serbia. The present state is a good starting basis for implementation of the new technology, although the aim is very demanding.

From the point of view of GIS technology, the following conclusions on the existing state can be drawn:

- GIS technology is neither used in Local Government and in public companies nor in most other bigger institutions;

- Most institutions have formed information systems based on related databases (JP Komunalac, Land Development Public Agency, Town Planning Department etc.), and some use CAD tools (AutoCAD) for realisation of some activities (Public Town Planning Agency);

- Present activity does not fulfil user needs – solving claims related to spatial interventions is slow and takes lots of visits to different institutions;

- The most frequent spatial data exchange occurs between Real Estate Cadastre Unit and Local Government and other public companies and agencies;

- This way of conducting business is inappropriate considering current level of technology development;

- Insufficient respect of the existing laws and regulations is noticeable – this especially refers to reporting changes in the field to supervising (authorised) institutions (reporting and recording utilities lines placement);

- Institutions and agencies requiring cadastral data for their activities do not have efficient access to data owned and maintained by RECU Pirot;

- There are several address systems in use and this additionally complicates data exchange between some institutions in the town;

- Most spatial data are not up-to-date and there is few digital spatial data which will significantly protract and make Municipality GIS implementation more expensive.

4 MUNICIPALITY GIS DEVELOPMENT

The Municipality GIS should represent the environment in which the institutions of local self-government, and some other institutions and companies will collect and share information which concern activities, population, infrastructure and other resources. Such architecture of the Municipality GIS is adopted that implies that resources which it consists of are kept and maintained within the departments, institutions and companies under whose purview these resources are. That way the most effective data processing and delivery of products and services to the final beneficiaries will be provided.

The adopted concept implies the formation of several GIS sub-systems whose integration will be made with the use of standards, procedures and protocols which will be adopted later.

The successful formation and realization of the strategy includes finding the answers to the questions which can be divided into:

- organisational,
- financial and
- technical.

Organisational questions refer, above all, to the coordination of the activities to implement the Municipality GIS. This implies close cooperation between institutions and companies which should be responsible for the realisation of the activities of collecting, maintenance and distribution of information for the formation of the Municipality GIS. In Chapter 3.2 of this document, these participants have been identified: Local Government Pirot with its departments, Municipal public companies and corporations (Land Development Public Agency, PC "Komunalac", Public Town Planning Agency Pirot, PC "Water and Sewage Company" and PC "Municipal Heating Company"), Real Estates Cadastre Unit, Pirot, "Electrodistribution Pirot" and "Telekom Srbija" – RC Pirot. The Municipality of Pirot recognises these companies and institutions as strategic partners in GIS development.

Good organisation means strict observance of guidelines and measurements given in this strategy. In that sense, the strategy envisages the formation of a special body which is to observe the adherence and realisation of proposed measures, as well as take part in the preparation and realisation of the projects in which these measures will be planned and realised in detail. That body should include representatives of the aforementioned institutions and companies. Therefore it is necessary to legally and formally regulate mutual relations (agreements, contracts).

For the successful realisation of the strategy, which means gathering spatial data, making detailed data models and processes, acquisition of IT equipment, training existing and employing new experts, adequate financial means are necessary. The financial support to such a complex project as is the formation of the Municipality GIS can be obtained only by starting common projects, which includes co-financing of institutions and companies which are interested. It is realistic to presume that the means invested will be refunded through savings made in a relatively short period of time.

Technical matters involve the use of modern technologies, above all, web technology for information linking of remote users in the business process. Solving certain problems involves the use of standard solutions and the use of experiences of others who deal with similar problems.

The problems and challenges expected with the implementation of this strategy are:

- Great initial investments to establish the system;

- Possible disproportion between the interests and priorities for certain institutions and companies (Local Government and municipal public companies, as local institutions on the one hand, and Real Estates Cadastre Unit, "Telekom Srbija" and "Electrodistribution Pirot" as separate companies);

- Ambition to maintain the acquired positions of individuals which are the result of monopolistic position;

- Automation of work requires strict formulation and obedience of the work procedures which has not been the case so far, and certain procedures have not been clearly defined;

- Cooperation between certain institutions and companies;

- Lack of expertise of staff who are to develop and run the system - for some jobs outside experts and companies are to be hired;

- Increased need for professional IT personnel to administer the system should be expected;

- GIS tools should be designed in such a way that they contain the existing work processes, and also plan the introduction of completely new processes;

- GIS tools should be simple to use even for people with no special IT knowledge or GIS knowledge, and at the same time enable fulfilment of very complex requirements;

- The format of spatial data which had previously been used is often unsuitable for GIS analyses, so that implies a great deal of work to gather and prepare the data (digitalisation, vectorisation, topology formation);

- Several records with redundant or unofficial data are in use, so this requires their coordination and formatting;

- Lack of official (state) standards for formatting data.

Basic guidelines for the development and implementation of Municipality GIS are:

- To develop and implement the Municipality GIS more easily as many interested institutions and companies as possible should be included an all the activities (mutual goals, mutual co-financing and management of the projects, sharing resources);

- Cooperation with other municipalities should be established and matters which refer to tasks with republic and other institutions and companies which are not on the local level should be solved mutually;

- Gradual implementation of Municipality GIS involves the use of existing data with the check of their quality (form, accuracy, completeness, updating, validity, etc);

- Since the institutions and companies in Pirot do not have a sufficient number of experts with knowledge and experience in IT and GIS it is anticipated that professional consultants will be hired for the realisation of certain projects;

- Permanent education and periodic training courses in GIS and IT technologies for all participants on the realisation of the activities outlined in this strategy is necessary;

- Wherever it is possible official records, i.e. records gathered and maintained by the institution in charge will be used – keeping double records should be avoided in every way – the largest part of the content of the Municipality GIS consists of the data gathered and maintained by the Real Estates Cadastre Unit Pirot, so on-line access to this data is of particular importance;

- Permanent work on precise defining of work procedures (gathering and maintaining data, data safety, quality control, distribution of data) and securing and supervising these procedures in everyday work;

- Constant work on defining standards for data structure and format, procedures of exchange and use of data, which means following standards (international and domestic), in that sense adherence to standards defined by international organizations is of particular importance, so the strategy indicates that the IT infrastructure concerning GIS data and software should rely in great measure on the standards adopted by ISO (TC 211) and OGC consortium;

- The realisation of the strategy requires a transparent way of work for all participants in its realisation, which includes writing and distribution of documents which contain a description of adopted work procedures, detailed description of data structure, and interface for the use of data.

The development and implementation of the Municipality GIS requires considering the following GIS:

- Data and functional model;

- System infrastructure (hardware, software for GIS, databases and other communicational infrastructure);

- GIS applications;

- Organisation and human resources.

Special attention has been given to the data and functional model, as well as procedures for initial building of databases of the Municipality GIS in the strategy. This is quite understandable considering the fact that this GIS component is the most expensive and crucial for the whole system.

The system infrastructure was also considered in detail, while organisational aspects and matters concerning finding appropriate employees will be given only generally. GIS applications have not been considered separately.

4.1   Conceptual Data and Functional Model

Considering all the facts which are included in it and purview over gathering and maintaining data, it is evident that the Municipality GIS should be realized as a distributed system. At the beginning period of development the greatest part of the contents would be data which should be kept by Local Government (GIS Centre) and Real Estates Cadastre Unit, Pirot, while this content is gradually expanded by data maintained by municipal public companies and institutions. Above all this refers to Land Development Public Agency and PC "Komunalac". Other institutions (municipal and other companies dealing with network infrastructure) whose activities are connected to the formation and development of the municipal system can so far be considered only beneficiaries of the system.

In the strategy only the conceptual data and functional model of the Municipality GIS is given, primarily with the aim to identify the beneficiaries of the Municipality GIS who will be in charge of data maintenance, as well as see the tasks for the formation of these databases. A detailed elaboration of the data model should be done within each project of formation of subsystems of the Municipality GIS. During the detailed elaboration of the data model the following aspects should be considered:

- Multi-purpose nature of the data;
- Functions for updating and maintaining data (departments, services, institutions and companies in charge);
- Adherence to the objectively oriented data model for defining spatial entities and their behaviour;
- Integration of data which belong to different thematic units;
- Making documentation and metadata.

It is understood that detailed elaboration of the data model should be done using standard tools like UML (Universal Modelling Language).

Figure 4-1 : The concept of the Municipality GIS considering the participants

Content of the Municipality GIS is divided into the following sections:

- Base map;
- Spatial Units (Administrative Units);

- Spatial and Urban Development Plans;

- Real Estates;

- Address System (Address Register);

- Network Infrastructure (Utilities Network);

- Traffic Infrastructure;

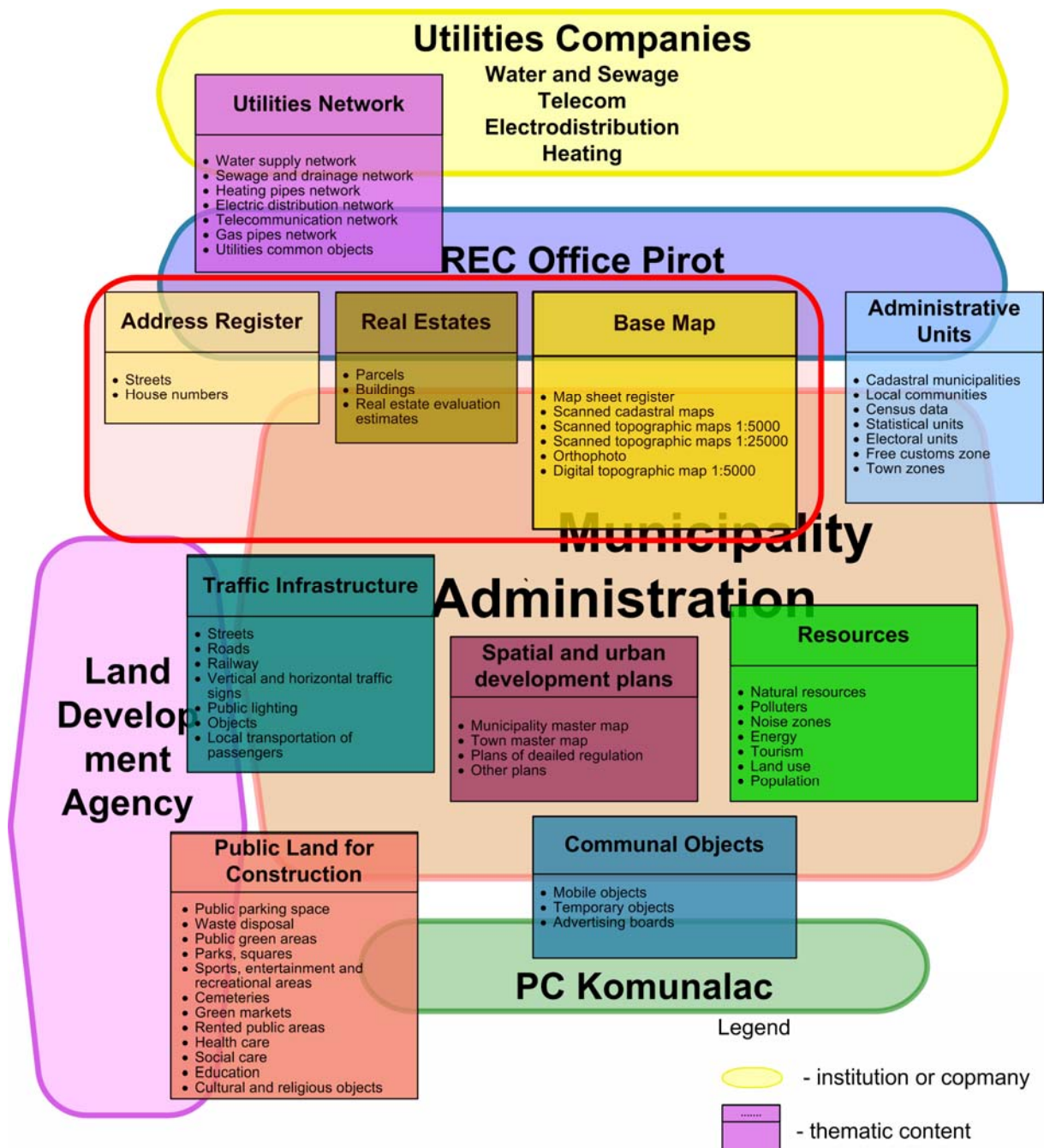- Communal Objects;

- Public Construction Land;

- Resources;

Figure 4-2 : Representation of the thematic content and the institutions and companies which gather and maintain this content

This division was primarily based on purviews which some companies and institutions have over gathering and maintenance of spatial data. In this way data exchange and update, and implementation of the distributed system is made possible, where the data for certain themes are physically and logically with those who gather and maintain them. Naturally, it is understood that the division of contents was done in such a way that there are logical theme units (theme groups).

The basic conception of data model is that the key spatial objects (address, building, parcel, pipe in network infrastructure etc.) are defined only once in the system, and after that through the unique identificator only used. The exceptions are only cases when because of a great difference in detail (scale) of representation of an object this is not possible, or when an object is represented in two ways (polygon and line, point and polygon).

Considering the fact that *Address Register*, *Real Estate Cadastre*, *Utilities Cadastre and Spatial Units Register* are under the purview of the Geodetic Governmental Authority of Serbia and that for there records maintenance in digital form there are precisely defined in detail data models and procedures of data collecting, organisation and maintenance, all presumptions are made to use all key spatial entities (address, building, parcel, pipe in network infrastructure etc.) to link a great deal of other information. This especially refers to address, because the greatest number of features and objects in space, when it refers to standard databases, where no records of position and geometry through coordinates are kept, so it is by using this address that they can be located in space. Locating malfunction reports by citizens, the communal users of the building is an example of this. Through the address system these data can efficiently be linked to the other spatial contents (orthophoto, scanned cadastral or topographical maps and other raster and vector contents).

4.1.1   Base Map

This theme unit represents the referential spatial basis for the rest of the thematic contents. It contains all scanned cadastral and topographical maps and other georeferenced raster images (orthophoto), as well as other vector contents which have been georeferenced. It has not been set to have special thematic attributes as contents elements, except data about the data itself (metadata: georeference data, source of data, producer, etc). The contents are generally large in size (large memory requirements concerning archives of raster images) and the data is static (no or rare update). Based on insight into existing data, by investigating the possibility of their processing (scanning) and the possibility of collecting new data (making orthophoto), it can be presumed with great probability that this theme unit will consist of the following contents:

- Division into plan sheets and maps;
- Scanned cadastral maps (cadastral maps in scale 1:500, 1:1000 and 1:2500);
- Scanned topographic maps (Base State Map 1:5000 and Topographic Map 1:25000);
- Orthophoto (1:1000 – 0.10m ground pixel size, 1:5000 – 0.3 (0.5) ground pixel size);
- Digital Topographic Map in scale 1:5000;
- Digital Terrain Model.

The last two items need to be pointed out: *Digital Topographic Map* in scale 1:5000 (*DTK5*) and *Digital Terrain Model* (*DTM*). Unlike other contents which serve only as a spatial reference base without the possibility of spatial analyses, DTK5 and DTM represent very valuable data sets.

DTM can be realised as a regular network of points with known heights or a set of points, lines and surfaces. The quality of DTM is most often defined through interpolation of height accuracy from DTM. To simplify, this accuracy depends on the accuracy of measured heights, detail or density of measurement per area unit and type of measurement (regular network of height points, or heights of characteristic points and terrain lines). The quality of DTM is chosen according to needs, but generally speaking, its quality is chosen according to type of terrain and the scale of the map it corresponds with. For Local Government basic needs DTM with height points in a regular network with 25-50m distance and height accuracy of 1-2m for flat terrain and 3-7m in mountainous areas is sufficient. In that case, DTM, according to its accuracy corresponds with topographic base maps in scale 1:5000.

DTK5 represents a digital, vector version of *Base State Map* 1:5000 (*BSM*). In that sense, it is a good replacement for BSM. DTK5 concept is based on GIS technology, so its contents consist of spatial entities with spatial and thematic attributes located in GIS geodatabase (geo-relational model).
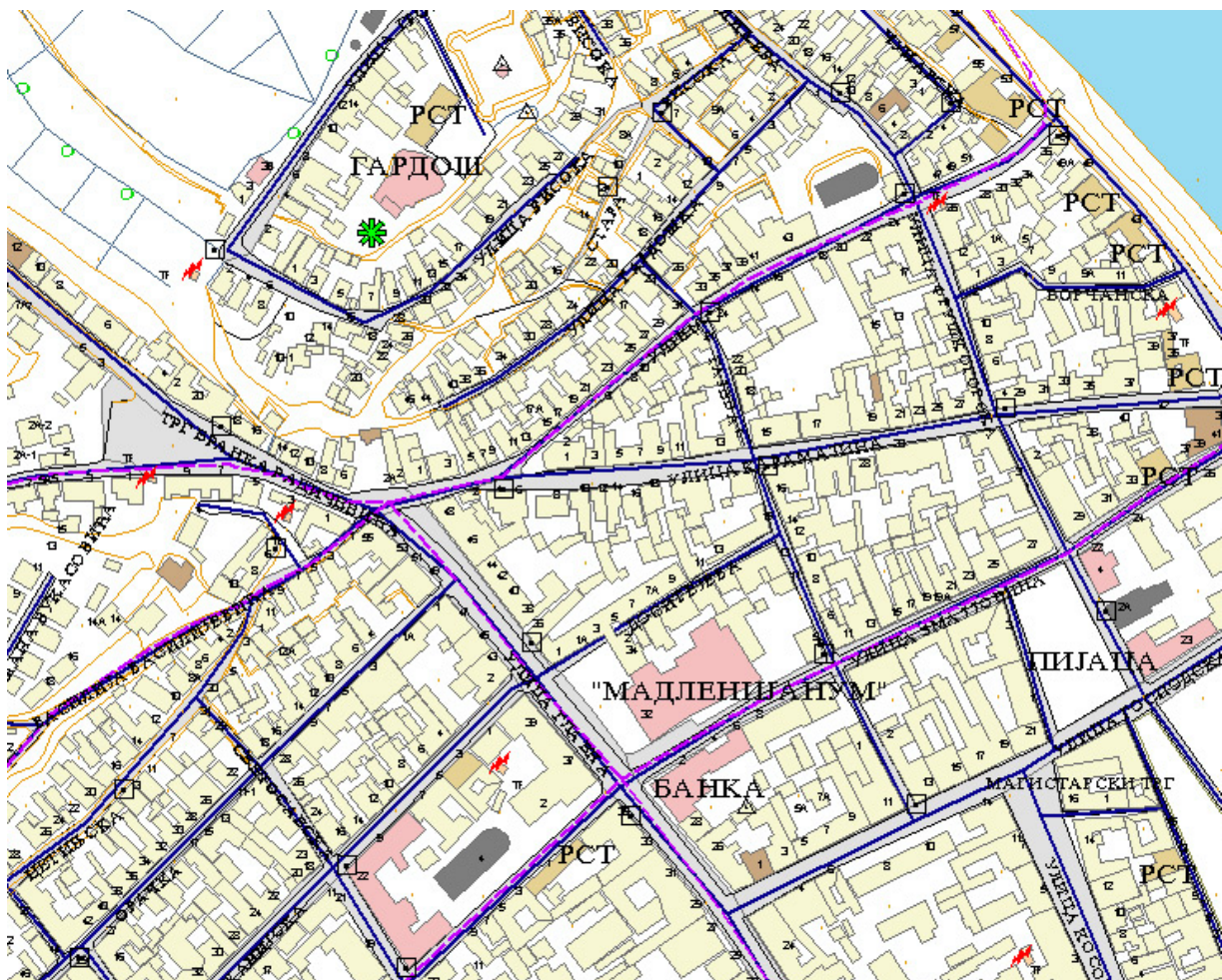
Figure 4-3 : Digital topographic map 1:5000:

Apart from the quality of the cartographic representation of the contents which serves as a solid spatial reference basis (Figure 4-3), DTK5 offers a great number of spatial entities (point, line, polygon and text) which are divided into theme groups:

- *Geodetic and cartographic basis* (division into sheets, characteristic points of geodetic network);
- *Objects* (residential, industrial, public, business, religious, complexes (sports centres, training centres, etc), house numbers);
- *Traffic network* (railroads, roads, roads axis, streets, cableways);

- *Hydrography* (running and still waters and objects on them);

- Vegetation (cultures, parks, individual trees, hedges);

- *Electric power network above ground* (high-voltage electric power network, surface electrical posts);

- *Administrative borders* (borders of cadastral units, borders of political units);

- *Height terrain representation* (mass height points in a regular grid, distinctive height spots, structure and break lines of the terrain, characteristic areas).

As can be seen, DTM (H*eight terrain representation*) is one of the themes of DTK5, so it is understood that when DTK5 is made there is no need to make DTM separately. Also, according to the list above it can be seen that a great deal of contents of DTK5 database can be successfully used to form parts of certain theme units of the Municipality GIS (buildings, address system, streets, roads, railroads, public green areas, hydrography etc). This requires that additional attributes which will be defined in the detailed data model of the Municipality GIS should be linked to the spatial entities of DTK5.

4.1.2   Spatial Units

This theme unit consists of themes which contain spatial units representations by surface entities (closed polygons):

- Cadastral units;

- Local communities;

- Statistic circles;

- Census circles;

- Electoral units;

- Free customs zone;

- Town zones (to determine public utility taxes, to determine the compensation for the regulation and use of construction land, construction zones, industrial zone, fire prevention zone).

The contents of these themes are not large and the data model itself is rather simple. When defining the features care should be taken that there is no overlapping of features belonging to the same theme. For some of the themes there are additional requirements that space is divided without blank spaces – full area coverage (*cadastral units, local communities, census circles, electoral units*). Here it is important to point out that a certain number of themes are under the purview of the GGA (*Cadastral units, Local communities, Statistic circles, Free customs zone*), some are under the purview of the municipality (*Town zones*), so they should be taken from the companies and institutions under whose purview they are. Codes of spatial units are given by the *Republic Statistics Institute.*

4.1.3   Spatial and Urban Plans

This theme unit contains spatial entities defined by spatial and urban plans:

- Municipality spatial plan;

- Master map;

- Detailed regulation plans;

- Other plans;

The contents of spatial and urban plans are represented geometrically using points, lines and polygons.

The Master map of the Municipality of Pirot has been adopted and it consists of ten themes which are divided into a great number of layers. Each theme is a separate whole although they can be combined spatially. It is necessary to adjust the CAD drawing to GIS technology which means that layers will be transformed into spatial features. Some of the layers can be grouped into one spatial feature with different attribute values. General plans are not adopted often so the model of the current master map will not fully correspond to the future.

For detailed regulation plans there are no unique contents so the data model will be changeable. These data are static and are rarely changed. For the present these plans are made using CAD technology so the geometrical contents have no additional descriptive attributes.

All adopted plans should be a part of the Municipality GIS and all other plans which are currently being presented to the public so that they are made available to the Local Government and general public. In addition, the contents would also contain the borders of plans which are currently being made with the basic attributes and information about the stage of the making of the plan and when completion and adoption are expected.

4.1.4   Real Estates

This theme unit is very important because it contains official data which refer to real estates and are necessary for almost all activities which change the situation on the field (building objects, dividing parcels, setting borders, expropriation), buy and sell real estates, charge real estates and other transactions. The basic themes from this theme unit are:

- Parcels;

- Objects;

- Valuation of real estates.

This theme unit is based on the data from the Real Estate Cadastre and represents a very useful part of the Municipality GIS, because a great number of transactions in the municipal and other institutions and companies are connected with real estates. Insight into updated, official data is of vital importance, since these data refer to the matters of ownership, and at the same time these data are subject to frequent changes (buying and selling real estates, demolition and construction of objects, dividing parcels, parcelling etc).

Geodetic Governmental Authority has positional and geometrical records of these objects within the Digital Cadastral Map (DCM), while other information kept in the alphanumeric part of the Real Estate Cadastre database.

The unique ID of these objects consists of the parcel number and its sub number (if there is one). A building has not only the parcel number and sub number but also an ordinal number within the parcel. For these data a number of other information is kept. Information which refers to charges and ownership are kept in the Real Estate Cadastre database. A detailed data model of the Digital Cadastral Map is administered by regulations of the Geodetic Governmental Authority. A representation of UML data model is given in the Appendix (Figure 6-4).

The question of status, geometry and some other attributes of these features is very delicate and requires strict use of the official ones. The procedure of changing this information is very strict and requires implementation and verification by governmental bodies. Considering the fact that these changes are relatively frequent, and that almost always the information required is the one which is updated at the moment of search, it is very impractical to use a copy of the official database for these needs.

Valuation of real estates is a theme whose goal is easier determination of the market value of real estates. This theme should contain the basic indicators in that sense (division into zones with values or realised prices of real estates represented using points, with additional information.

4.1.5   Address System

This theme unit is used the most often and represents the basis for a number of other records. *The Address System* is divided into two themes:

- Streets;
- House numbers.

As it was described in Chapter 3.4.4 to keep these records is under the purview of the Geodetic Governmental Authority. GGA defined the data model of the address register which includes recording the history of changes in street and house numbers. This data model requires that streets are defined as parcel polygons, and house numbers as object polygons. Since this model has not been applied much and a negligible amount of data has been collected in Serbia in this way, it can be expected that it will be changed. On the other hand, Serbian Post Office, which has for the last two years been working on collecting address system data in all areas where orthophoto had been done, applies another model. The Serbian Post Office model includes representation of streets as lines and house numbers as points. GGA has a signed protocol of cooperation with the PO which determines that GGA will take the data collected by the PO.

For the theme Streets it is necessary to define the official street codebook. With the valid street name it is necessary to keep previous street names because in many paper records they are still valid.

It is very important that all other institutions adopt the data model of the municipal Address system so that records integration is made possible.

4.1.6   Utilities Network

The contents of this theme unit are surface and underground utilities and it was divided into the following theme groups:

- Water supply network;
- Sewage and drainage network;
- Heating pipes network;
- Electrical power network;
- Telecommunication network;
- Gas pipes network;

- Common objects.

The content of this theme unit is based on the *Utilities Cadastre*. As it was stated in Chapter 3.4.2 the *Utilities Cadastre* is under the purview of the Geodetic Governmental Authority. This institution has defined data model in the *Technical manual for the creation and maintenance of the Utilities Cadastre digital database*. With this manual the contents, technical normatives, way of making and archiving of the Utilities Cadastre digital database as well as securing data protection have been regulated.

The thematic division of the Utilities Cadastre database matches the division in this theme unit of the Municipality GIS, except that the theme Pipeline network has been left out. With this data model feature classes, their spatial representation, their attributes and relations and cartographical representation have been defined. Formal description of the database given in the *Technical Manual* was based on UML language. The data model contains:

- Data catalogue;

- Data model in UML notation.

The data model was done according to themes. A list of defined feature classes according to themes was given in the Appendix, Table 6-1 : Feature (object) classes for the cadastre of utilities. All classes of the Utilities Cadastre have been generated from the basic class *Feature.* The obligatory attribute of this class is *DKPVID*. It is a unique ID of objects of *the Utilities Cadastre* on the territory of the Republic of Serbia. In this way unification is made possible which enables the extension of this system with additional contents kept by public utility companies.

This model contains basic spatial and descriptive data about the utility network which are common for all public utility companies and as such should be the basis of development of technical information systems of some public utility companies. The development of technical information systems of some public utility companies is not the topic of this strategy, but this strategy is considered to give outlines and bases for their development especially when it comes to data models.

4.1.7   Traffic Infrastructure

The contents of this theme unit are:

- Streets;

- Roads;

- Vertical and horizontal traffic signs;

- Public lighting;

- Traffic objects;

- Local passengers transport

Streets and Roads themes should represent the spatial basis for roads network maintenance. During the initial phases these themes can be spatially defined in lines with certain attributes about road category, width and kind of patch, width and type of pavement, their condition, curb, berm etc. As such they should represent the basis for keeping records of conditions and interventions on streets and roads. During later phases more detailed records of their geometry can be used by defining the surface of streets and roads and their parts (roadway, pavement, curb, protective belt, etc). In the first and second stage keeping

records refers to roads whose maintenance is under the purview of local self government (municipal roads and streets).

Vertical and horizontal traffic signs theme represents the spatial basis for keeping records of conditions and interventions on traffic signalisation. The basic contents of this theme are traffic signs, light signalisation and roadway marks. Geometrically this theme would be represented by point features with basic attributes which describe the kind, character and condition of traffic signalisation.

Public lighting theme represents the spatial records for public lights on the territory of the Municipality of Pirot. The content of this theme is spatially represented using point features for point objects and line features for public lights utilities lines. This theme apart from geometry has basic attributes about objects (kind of post, type, number and kind of lights etc) and represents the basis for the system development to track interventions and maintenance of public lights elements.

Traffic objects theme consists of two sub themes, road objects and concomitant roads contents.

Road objects include bridges, overpasses, underpasses, viaducts, aquaducts, gates, tunnels, galleries, support and coating walls.

Concomitant roads contents include motels, restaurants, services, petrol stations, shops, recreational objects and other objects with the purpose of offering service to the road users.

Local passengers transport theme represents the spatial basis for keeping records of lines of local passengers transport with the basic attributes and bus stops. This theme is the basis for supervising and planning local passengers transport.

4.1.8   Communal Objects with Special Purposes

The contents of this theme unit are:

- Movable objects;
- Temporary objects;
- Advertising hoardings.

Movable objects theme contains movable objects such as benches, planters, rubbish bins etc. In the greatest number of cases a representation of these objects with point features will be sufficient.

Temporary objects theme contains objects which are temporary. These objects can be represented with point or polygon features.

Advertising hoardings theme comprises spatial data about advertising hoardings, advertising boards and devices for visual or audio information or announcements which are placed on public areas. The contents of this theme is geometrically represented with point features, and as for other spatial features of the Municipality GIS keeping additional attributes is required, which is the subject of a different project.

4.1.9 Public Construction Land (Public Areas)

The theme unit Public Construction Land is divided into:

- Public parking space;
- Refuse dumps;
- Public green areas;
- Parks, squares;
- Sports, amusement and recreational fields;
- Cemeteries;
- Markets;
- Leased public areas;
- Health;
- Social security;
- Education;
- Cultural and religious objects.

All these themes rely on cadastral parcels and are represented with polygon features. The Municipality GIS should provide the geometry with the basic attributes of these features. Keeping separate records about these entities (about interventions and inspections made, deadlines etc) is the subject of different projects. The information system for realisation and supervision of interventions over certain objects as subsystems of the municipal information system should be the result of these projects. In these special projects (applications) the basis are spatial theme objects from this theme unit, and link to spatial objects through unique identification mark. In this way these records can be viewed as integrated with spatial data.

4.1.10 Resources

Theme unit *Resources* is divided into the following themes:

- Natural values;
- Polluters;
- Noise zones;
- Energetic;
- Tourism;
- Use of land;
- Population.

Natural values theme comprises the spatial basis for maintainable use and protection:

- Natural resources (air, water, underground water, land, forests, mineral resources, natural sources of energy etc);

- Natural goods:

  - Public natural goods (land, landscapes, public areas, water goods, underground goods etc) and

  - Natural goods of special values (biodiversity and heritage; geological diversity and heritage; land and landscapes of special values, wild flora and fauna etc).

This theme serves as a basis for the making of the programme of use and protection of natural values, i.e. as an instrument for supervising the status of natural values and the programme realisation.

Polluters theme represents a business register of all kinds of polluters, with records of their location, business processes, characteristics and financial balances in material, semi finished products, raw material input and output, refinement plants, waste and polluting material flows and place of their evacuation and disposal.

Natural values and *Polluters* themes contain the basic infrastructure and mechanism for continual supervision of the state of the environment and preservation of natural resources at the disposal of the Municipality of Pirot.

Noise zones theme consists of spatial features (polygons) with the same noise level.

Energetics theme represents the spatial basis for efficient energetic planning and the making of database of the energetics status and expenditure of energy on the territory of the Municipality of Pirot. Under the purview of local self-government is the making of the plan of development of energetics which will establish the needs for energy in this area, as well as the conditions and the ways to provide the necessary energy capacity. In addition, it is under the purview of the municipal bodies to issue energetic permits for some categories of objects.

Tourism theme represents the spatial basis for keeping records of tourism resources of the Municipality. The town has important catering and tourism facilities and in the following period the construction of tourist objects by private entrepreneurs. Tourist Organisation of Pirot is also founded.

Use of land theme contains information about the use of land (agricultural, forest, industrial, residential, economic etc).

Population theme is meant for keeping spatial records of the population. Forming themes which contain the division of the area into zones with certain characteristics is mainly anticipated. An example of such a theme is *Density of population.* Other themes and the necessary attribute contents for spatial entities which should be established afterwards.

4.2   Collecting Data to Form the Municipality GIS

Collecting spatial data is the most demanding part of the work to form the Municipality GIS. This refers to:

- The time necessary to realise these tasks;

- Engagement of considerable human and financial resources;

- Careful definition of the data models and their strict observance, because additional work to correct mistakes can be immense;

- Strict observance of certain procedures when official data are involved, especially those which refer to real estates and rights and burdens over them.

Considering the importance and volume of this work it is necessary to perform:

- Valuation and selection of suitable methods to collect spatial data;
- Organisation of work meaning defining purview and possible;
- Making the main work project design (if it is required);
- Selection of performers if the work cannot be done using own resources;
- Providing financial means, etc.

4.2.1 Methods of Collecting Data

To collect existing spatial data three approaches can be applied:

- Transformation of existing data from analogue into digital form;
- Use of existing data in digital form and their reorganisation and amendment;
- Collection of source data.

4.2.1.1 Existing Data in Digital Form

Generally speaking, the takeover and use of existing data in digital form, with possible reorganisation and amendment of these data, is the quickest and most economical way to form the spatial contents. Problems arise if these data are not structured well enough, so the procedure cannot be done completely automatically, but manual data processing is necessary.

When spatial data of the Municipality GIS are in question, this approach can be expected with collecting data to build the theme unit *Spatial and Urban Plans*. Most of these plans are in digital form, but for their making CAD technology was used with inadequate data structuring, so additional work should be expected to process these data. In addition to these data, there is a possibility that a part of data about spatial units will be provided in digital form. Considering the fact that these data are under the purview of GGA it can be presumed that no special processing of these data will be required.

Since there are no other spatial data in digital form, this method of collecting spatial data will not be used significantly.

4.2.1.2 Existing Data in Analogue Form

One of the most efficient ways to collect spatial data is to use existing sources which are available in analogue form. The data can be given in textual form (lists of coordinates, surveying records, registers etc) or graphically, i.e. on plans and maps.

There is almost no data in textual form which could be of interest for forming the Municipality GIS. Exceptionally these could be data in reports from surveying utilities. However, collecting data in this way is very uneconomical compared to the digitalisation of existing cadastral maps with utilities, so this method should be used only if there are no data in graphical form, or it is estimated that the accuracy of these data (graphical accuracy) on the maps is significantly diminished compared to surveying records.

Graphical sources of spatial data in the Municipality of Pirot are:

- Cadastral maps 1:500, 1:1000 and 1:2500 (47+34+11 sheets for the town territory and 47+64+867 sheets for the municipal territory);

- Utilities Cadastre data - Utilities Cadastre maps 1:500 and 1:1000 (47+42 sheets for the town territory);

- Spatial Units Maps;

- Manuals with house numbers;

- Base State Map 1:5000 (10 sheets for the town territory);

- Topographic Map 1:25000 (4 sheets for the town territory, 17 sheets for the municipal territory).

Transferring cadastral maps is certainly the most complex and expensive task. There is an initiative that soon, besides making *Digital Cadastral Map (DCM)* for the town cadastral units, which was planned by the World Bank project to modernise the Cadastre in Serbia, GGA will independently start with the formation of DCM database for other cadastral units on the territory of the Municipality of Pirot. The successful realisation of these projects would significantly improve the quality of the Municipality GIS. Collected data would secure the validity of information for the most important features of the Municipality GIS (parcel, building, flats and offices as separate parts of the buildings). Above all, this refers to the position and geometry of these features, because all other data about these features (ownership, use, burdens etc) are already in the Real Estate Cadastre database. In any case, for the Municipality of Pirot the most rational solution is to wait until this work is done and eventually use (buy) these data paying GGA standard prices. In case of this work being significantly behind schedule, the Municipality will finance projects with the goal of collection only limited contents from cadastral maps or orthophoto (buildings, locations, parcel number, etc) or will be limited to bases of smaller scales (BSM).

Utilities Cadastre, unlike the Real Estate Cadastre, is not of primary importance for GGA. Because of the great amount of work which GGA expects on the modernisation of Real Estates Cadastre, it is not realistic to expect that GGA will form the Utilities Cadastre database (*Utilities Cadastre Digital base*). The realisation of this task requires the digitalisation of utilities with 89 sheets of details and the forming of database with appropriate features with attribute data. The estimation is that the Municipality of Pirot along with Telekom and Electrodistribution should jointly start and finance the project of making the utilities cadastre database. After the realisation of this job the formed database will be put to official use, and those who financed the project, will get the right to use the data under very favourable conditions. When the database is formed it is necessary to strictly obey the specifications from the *Technical manual for the creation and maintenance of the Utilities Cadastre digital database* (Chapter 3.4.2), since this is the condition for GGA to certify the database and put it into official use.

If for one part of spatial units the geometry cannot be directly taken in digital form, these spatial units should be digitalised from existing maps.

The manuals with house numbers will not be used for digitalisation but to establish the official house number for the given object. The use of orthophoto is an alternative to the manuals in the areas where they have not been made. The house numbers position will be determined according to orthophoto or scanned cadastral maps.

The digitalization of sheets of the Base State Map 1:5000 is not justified. It is more rational to make orthophoto, and to use orthophoto and photos to produce maps of DTK5 contents. If DTK5 is not made, then it is most rational to use BSM5 as spatial base in raster form.

The Topographic Map 1:25000 will be used only in raster form.

4.2.1.3 Collecting New Spatial Data

The possibility of collecting new spatial data sets is anticipated as:

- Making orthophoto;

- Recording and making maps of utilities;

- Making records of all other objects and features in space which have not been included in the previous methods.

Making orthophoto is one of the most economical ways to get an accurate and updated cartographical base as quickly as possible. Orthophoto accuracy is easily adjusted to the needs and financial potential of the purchaser. Production orthophoto with the ground pixel size of 10cm (matches a map in scale 1:1000) for the area of the Master Map of the town of Pirot is to be realised by the end of 2008. At approximately the same time production of orthophoto with the ground pixel size of 50cm (matches a map in scale 1:5000) for the whole territory of the Municipality of Pirot should be expected. Orthophoto will be produced within the *CARDS* project *Making digital orthophoto for Serbia*. This project is behind schedule at the moment. If it turns out (based on estimation) that this project will not be realised in two years' time, the Municipality of Pirot will start the project of orthophoto production for the whole territory of the Municipality of Pirot. For the area of the major map it is planned to produce orthophoto with the ground pixel size of 30cm, and for the rest of the municipal territory orthophoto with the ground pixel size of 50cm.

Surveying and mapping (in digital form) utilities network lines and objects which have not been mapped on the existing utilities maps is necessary to complete the records. This is of vital importance for the successful work of the town utilities companies which are responsible for the maintenance and development of the utilities network. The companies which have placed these utilities and have not obeyed the legal procedure that the utilities have to be surveyed before covering them will defray the expenses of surveying and making maps. Resistance to such measures can be expected, but the Municipality is determined to solve these issues, because they are of general interest.

Collecting data is understood for all other objects and features in space which have not been covered by previous methods, and are part of the contents of the Municipality GIS. This mostly refers to the theme units: *Utility objects of special purpose*, *Resources* and some others. Since these are new records, it is evident that this is the only possible way. For these features high accuracy of determining geometry and location is not required. For mapping these features maps and spatial data from other theme units will be used as referential base, mainly from the theme unit *Major Map*.

4.2.1.4 Organisation of Work on Collecting Data

In Chapter 4.1 the purview of certain companies and institutions over collection and maintenance of the contents of the Municipality GIS has already been discussed (Figure 4-2). It can be concluded that the greater part of responsibility of collecting data is on:

- the Local Government and its bodies (Urbanism, Residential and Communal Activity, Construction and Supervision Department, GIS Centre), and

- Real Estates Cadastre Unit (RECU Pirot).

These two institutions should form the greater part of the Municipality GIS. RECU in concordance with regulations is in charge of the *Address System*, *Real Estates* (*Digital Cadastral Map*), *Spatial Units* and *Utilities Network* (*Utilities Cadastre Digital base*). It would be logical to entrust the making of the greater part of the other theme units to the Local

Government, i.e. to its GIS Centre. It is evident that these two institutions with their limited resources cannot realise such great jobs. The solution lies in joint financing and support to all large projects.

Therefore with the making of *Utilities Network* the municipal public utility companies, Electrodistribution and Telekom must be included in this work. With joint financing of all the tasks to realise this job and joint participation in solving all problems which arise there in a relatively short time and with acceptable investments for each of the participants the final goal – updated records of the utilities network in digital form can be reached. It is understood that with these tasks the contents collecting will be financed only up to that level which all participants in the tasks are interested in. For the utilities network the situation in that sense is very clear. It is the volume of data as proscribed in the following acts:

- *State Survey and Cadastral and Registry Rights on Real Estates Law*;

- *Bylaw on Utilities Cadastre*, and

- *Technical manual for the creation and maintenance of the Utilities Cadastre digital database*.

Public companies and Telekom will supplement these data with their data and in this way form their own geographical and technical information systems (TIS).

A similar scenario is applied to the spatial data which comprise the *Major Map (orthophoto, Digital topographical map)* and for the *Address system*. Since these data are necessary for all users of the Municipality GIS it is logical that all users are involved in the process of their collection, if not organisationally, then at least by co-financing. For these spatial data the same assumptions apply when the amount of data is concerned as for the Utilities Network data.

It is under the purview of the Local Government and municipal public companies PC "Komunalac" and PC "Municipal Heating Company", as well as Land Development Public Agency (Figure 4-2) to collect other contents. It is expected that these institutions will, besides using their own resources, also hire outside performers for this work.

The activities to collect the thematic contents of the Municipality GIS with activities bearers, sources of data and expenses are given in the Table 4-2.

All nine key users (the Municipality, RECU Pirot, Public Town Planning Agency Pirot, Land Development Public Agency, PC " Water and Sewage Company", PC "Komunalac", PC "Municipal Heating Company", ED "Jugoistok" d.o.o. Niš - "Electrodistribution Pirot" and Telekom AD – RC Pirot) which will be engaged on the task of forming the Municipality GIS (Figure 4-1) signed a document "Agreement on cooperation in construction and establishment of Geographic Information System Pirot Municipality" in June 2006. In this document it was stated that the coordination of work of those who signed this Agreement will be made by the *Project team for the organisation of formation of GIS of the Municipality of Pirot*, appointed by the Municipality of Pirot President. Those who signed this Agreement have also agreed that *"with the purpose of organisation and implementation of GIS, they will make available all their human and expert resources for the performance of this task in order to obtain a reliable mutual information system on the municipal level which will serve as a tool for spatial and urban planning, Municipality development planning and managing the town infrastructures"*.

Municipality GIS development

	Thematic content	Collecting Contents Activities Bearer	Sources of information	Current state	Expenses for forming bases
Basic map	Division into plan sheets and maps	GGA RECU Pirot	Official division into plans and maps	In analogue form	3 norm days
	Scanned cadastral maps	GGA RECU Pirot	Working originals of cadastral maps	Exists from 2003	600 EUR for the town of Pirot 6000 EUR for the rest + Use of REC data
	Scanned topographic maps 1:5000 (BSM)	GGA RECU Pirot	Base State Map 1:5000 from 1980	Exists	-
	Scanned topographic maps 1:25000 (MTM)	Local Government	Topographic Map 1:25000 from 1969	Exists	-
	Orthophoto	GGA RECU Local Government	Aerial or satellite imagery	Does not exist	35 000 EUR (whole municipality territory 0.3m town, 0.5m rest)
	Digital Topographic Map in scale 1:5000 (DTK5)	Local Government	Sterorestitution on the basis of aerial photography and field work	Does not exist	50 000 EUR (10 maps, the town of Pirot)
	Digital Terrain Model	Local Government	From MTM 25000	Exists	1 200 EUR (town of Pirot) 4 000 - 5 000 (municipality)
Spatial units	Cadastral units	GGA RECU Pirot	Spatial Units Register	Exists	?
	Local communities	GGA RECU Pirot	Spatial Units Register	In analogue form	?
	Statistic circles	GGA RECU Pirot	Spatial Units Register	In analogue form	?
	Census circles	GGA RECU Pirot	Spatial Units Register	In analogue form	?
	Electoral units	GGA RECU Pirot	-	-	?
	Free customs zone	GGA RECU Pirot	Spatial Units Register	In analogue form	?
Spatial and urban plans	Town zones	Urbanism Group	Municipal decisions, etc	Described in decisions and on analogue maps	30 norm days
	Municipality spatial plan	Urbanism Group	-	Does not exist	-
	Master map	Urbanism Group	Master map	Exists	10 norm days
	Detailed regulation plans	Urbanism Group	Adopted detailed regulation plans	Partially for the town Pirot	2 norm days according to plan
	Other plans	Urbanism Group	Adopted spatial plans	In the process of making	2-10 norm days according to plan

Municipality GIS development

Category	Item	Institution	Data	Status	Cost / Effort
Real Estate	Parcels	GGA RECU Pirot	Real Estates Cadastre	Real Estates Cadastre exists for cadastral units outside the town and partly for the town of Pirot without DCM	5 000 EUR (digitalisation, the town of Pirot)
Real Estate	Buildings	GGA RECU Pirot	Real Estates Cadastre		-
Real Estate	Valuation of Real Estates	Economy, Property and Legal Relations Group	Records of Real Estates evaluation	Does not exist	
Address system	Streets	GGA RECU Pirot	Address register	Only lists in notebooks and manuals	3 500 EUR (the town of Pirot)
Address system	House numbers	GGA RECU Pirot	Address register		
Network	Water-supply network	GGA RECU Pirot and PC Water and Sewage Company	Utilities Cadastre	Exists in analogue form (not updated)	10 000 EUR To form a database of Utilities Cadastre based on digitalisation of cadastral utilities maps 100 000 EUR to update database by recording utilities lines in the field
Network	Sewage and drainage network		Utilities Cadastre	Exists in analogue form (not updated)	
Network	Heating pipes network	GGA RECU Pirot and PC Municipal Heating Company	Utilities Cadastre	Exists in analogue form (not updated)	
Network	Electric power network	GGA RECU Pirot and ED Pirot	Utilities Cadastre	Exists in analogue form (not updated)	
Network	Telecommunication network	GGA RECU Pirot and Telekom Srbija	Utilities Cadastre	Exists in analogue form (not updated)	
Network	Gaspipes network	?	Utilities Cadastre	Does not exist	
Network	Common objects	GGA RECU Pirot and public companies	Utilities Cadastre	Exists in analogue form (not updated)	
Traffic infrastructure	Streets	Land Development Public Agency	Fund database, gathering information in the field, digitalization from existing bases	Does not exist	100 norm days
Traffic infrastructure	Roads	Land Development Public Agency		Does not exist	
Traffic infrastructure	Vertical and horizontal signalisation	Land Development Public Agency	Gathering information in the field	Does not exist	
Traffic infrastructure	Public lights	Land Development Public Agency	Gathering information in the field	Does not exist	30 norm days
Traffic infrastructure	Traffic objects	Land Development Public Agency	Gathering information in the field	Does not exist	30 norm days
Traffic infrastructure	Local passengers transport	Urbanism Group	Digitalisation from maps and plans, traffic records	Does not exist	?

Municipality GIS development

Category	Object	Bearer	Source of information	Existence	Expenses
Utility objects	Movable objects	PC Komunalac	Digitalisation from maps, paper records	Exists partially in analogue form	20 norm days
	Temporary objects	Urbanism Group	Digitalisation from maps, paper records	Does not exist	?
	Advertising hoardings	Urbanism Group	Digitalisation from maps, paper records	Does not exist	?
Public Town Construction Land	Public parking space	Urbanism Group	Municipal decisions, existing maps, gathering information in the field.	Does not exist or exists as description	?
	Refuse dumps	PC Komunalac			
	Public green areas	PC Komunalac			
	Parks, squares	PC Komunalac			
	Sports, amusement and recreational fields	PC Komunalac			
	Cemeteries	PC Komunalac			
	Markets	PC Komunalac			
	Leased public areas				
	Health	Economy, Property and Legal Relations Group			
	Social security				
	Education				
	Cultural and religious objects				
Resources	Natural values	GIS Centre	Orthophoto, gathering information in the field	?	30 norm days
	Polluters	GIS Centre	Gathering information in the field	Does not exist	?
	Noise zone	GIS Centre	Gathering information in the field	Does not exist	?
	Energetics	GIS Centre	Orthophoto, gathering information in the field	Does not exist	?
	Tourism	GIS Centre	Orthophoto, gathering information in the field	?	?
	Use of land	GIS Centre	Orthophoto	Does not exist	60 norm days
	Population	GIS Centre	Orthophoto, different records	Does not exist	?

Table 4-1 : Gathering thematic content of the Municipality GIS with bearers of activities, sources of information, and expenses

4.3   IT Infrastructure

The architecture of the system which relies on web technology, i.e. the use of Intranet/Internet concept is adopted. Such architecture means that the greater part of the data will be stored and maintained within the services, institutions and companies which are in charge of the data. The distribution of these data to other users of the Municipality GIS will be made using a web GIS servers and databases. It is understood that in some cases, where the data security issues or procedures for data maintenance require that, the principle of publishing databases will be used, i.e. establishment of separate databases for data maintenance and distribution.

The development should be based on the *Microsoft Windows* family of operational systems and PC compatible computers. This is quite understandable if the fact that all computers currently used in the Local Government, municipal public companies, Land Development Public Agency, Real Estates Cadastre Unit, and most other institutions, have one of the versions of Windows operational system is considered. In addition, the software application for support of the information system of the Local Government   (*Hermes* application), as the most complex and the most widely used application in Local Government Pirot, works in Windows operational system and relies on other Microsoft products (*Microsoft SQL Server*, *Microsoft Internet Information Server, ASP .NET*) a great deal. Naturally, whenever it is possible software solutions which work in several operational systems (*Windows, Linux*) should be chosen.

4.3.1   GIS System Architecture

The Municipality GIS requires the use and implementation of:

- GIS desktop;
- Client-server GIS (GIS server);
- Web GIS (Web GIS services and easy clients).

4.3.1.1 GIS Desktop

GIS desktop requires the installation of GIS desktop software on end user's computer. The GIS desktop will be installed in those work places where:

- Input and processing of a great amount of spatial data is anticipated, especially with the initial formation of Municipality GIS database;

- Processing and complex GIS data analysis for the needs of special projects, studies, etc is planned;

- Direct link to the data which are in the central GIS server is not possible (remote departments, public companies which do not have a local computer network or the need for GIS server) – data processing is done by using local spatial databases.

GIS desktop should provide all GIS functions which are relevant for the needs of local self-government. This especially refers to data representation and search which relate to

59

cadastral and topographical maps with large scales and cadastral data, as well as layers which are included in the Major map contents. Since these data are heterogeneous, the software should provide processing of raster and vector data for different data. A detailed specification of requirements that GIS desktop software has to meet is given in Chapter 4.3.4 of this document.

Apart from the last case, the possibility of access and processing of GIS data which are on the desktop computer, but also data in the remote database. It is understood that the greatest part of data processing is to be done on the client side, i.e. on end user's computer.

The first desktop GIS applications will be installed in the Municipality GIS centre itself, and after that the purchase of desktop GIS software is expected in public companies (PC "Komunalac", PC "Water and Sewage Company", PC Municipal Heating Company and Public Town Planning Agency) and Land Development Public Agency. The purchase of this software for each company or institution separately should follow the dynamics of work to collect spatial data within those companies or institutions.

4.3.1.2 GIS Server (Client - Server)

Client-server processing assumes heavy GIS clients and data processing on GIS server side. GIS client has a complex user interface for spatial data collection and editing and one part of the analyses, while the maintenance and complex analyses of a great amount of data are done on the server side. It has been evaluated that for the needs of the Municipality GIS implementation this approach will not be used very often.

4.3.1.3 Web GIS

Web GIS architecture is a multi-layered client-server architecture, which is implemented by using web technology. The use of thin clients is anticipated, that means for the implementation of GIS functionality Windows operative system and Internet browser are sufficient. The complete processing of spatial and non-spatial data is done on the server side, and the user is sent only results. The solution architecture enables data exchange, with the condition that these changes do not include a massive input of spatial data and complex changes in geometry and topology of spatial data. These kinds of changes would otherwise demand a complex user interface on the client side, so these tasks should be performed using the GIS software desktop.

On the server side the implementation of server functionality for the distribution of spatial data and maps according to *OpenGIS WMS specification (Web Map Server)* is required. Spatial and non-spatial data are stored in the standard RDBMS on the server side. In the Local Government Pirot for these needs *Microsoft SQL Server* is used, but GIS architecture (including GIS server software above all) should be such that it could be realised with other RDBMS's without any bigger problems.

This architecture is relatively easy for implementation and maintenance, because it includes thin, browser based clients and central system administration. The use of this architecture is anticipated for:

- Access to the Municipality GIS within the institutions and companies themselves (Local Government);

- The establishment of the Municipality GIS using data stored and maintained in several remote databases;

- Access from the outside (citizens and other interested legal entities).

Implementation of the Municipality GIS using this architecture requires that according to *OpenGIS* (or *OGC*) consortium *WMS* specification spatial data web servers should be set up in institutions and companies which are in charge of storage and maintenance of certain theme units of the Municipality GIS. It is planned to set up two such servers which will be the foundation of the Municipality GIS: a server in the Local Government and a server in the Real Estates Cadastre Unit.

After the successful implementation of WMS service, the implementation of other Web services for the spatial data distribution which have been defined by OGC consortium should follow. It has been estimated that, considering the present needs and degree of development of IT infrastructure (data, hardware and software) in the municipal institutions and companies, these implementations should be planned only after 2010.

4.3.2   Link to the Information system of Local Government and Information systems of Other Municipality GIS Users

The Municipality GIS spatial data will be integrated into the local management information system through the Web service. The local management information system data model should be modified in such a way that redundancy of data kept in the Municipality GIS is avoided. Hermes application should be modified so that formation of spatial queries and their direction to the Web GIS server is enabled. After the search processing, the results are sent to the client in the form of graphical representation (raster or vector map) or as a table. The implementation of this functionality is relatively simple, because Hermes applications work using web technology and client-server architecture, and GIS server software purchased by the Local Government makes the Web GIS service implementation possible.

The connection between the information systems (technical, business, etc) of the other users with GIS data should be realised in a similar way – using Web technologies. Naturally, other solutions based on desktop or client-server data processing have not been ruled out. The details of the implementation for linking each specific case should be the subject of special projects in which the current status should be examined, the problem defined and a suitable solution chosen.

4.3.3   Telecommunication Infrastructure

Considering the fact that the Municipality GIS represents a system which incorporates several institutions it is understandable that the question of telecommunication infrastructure is very important. The development of telecommunication infrastructure should go towards linking all significant GIS users in one system, which means connecting remote computers and computer networks. Also, one part of the users which are expected to use the system intensely and which are the Local Government itself, Real Estate Cadastre Unit, municipal public companies and a number of other institutions, should be directly connected using *MAN* optical network. The other part of users, which consists of citizens and other interested legal entities, will be connected to the system through the Internet.
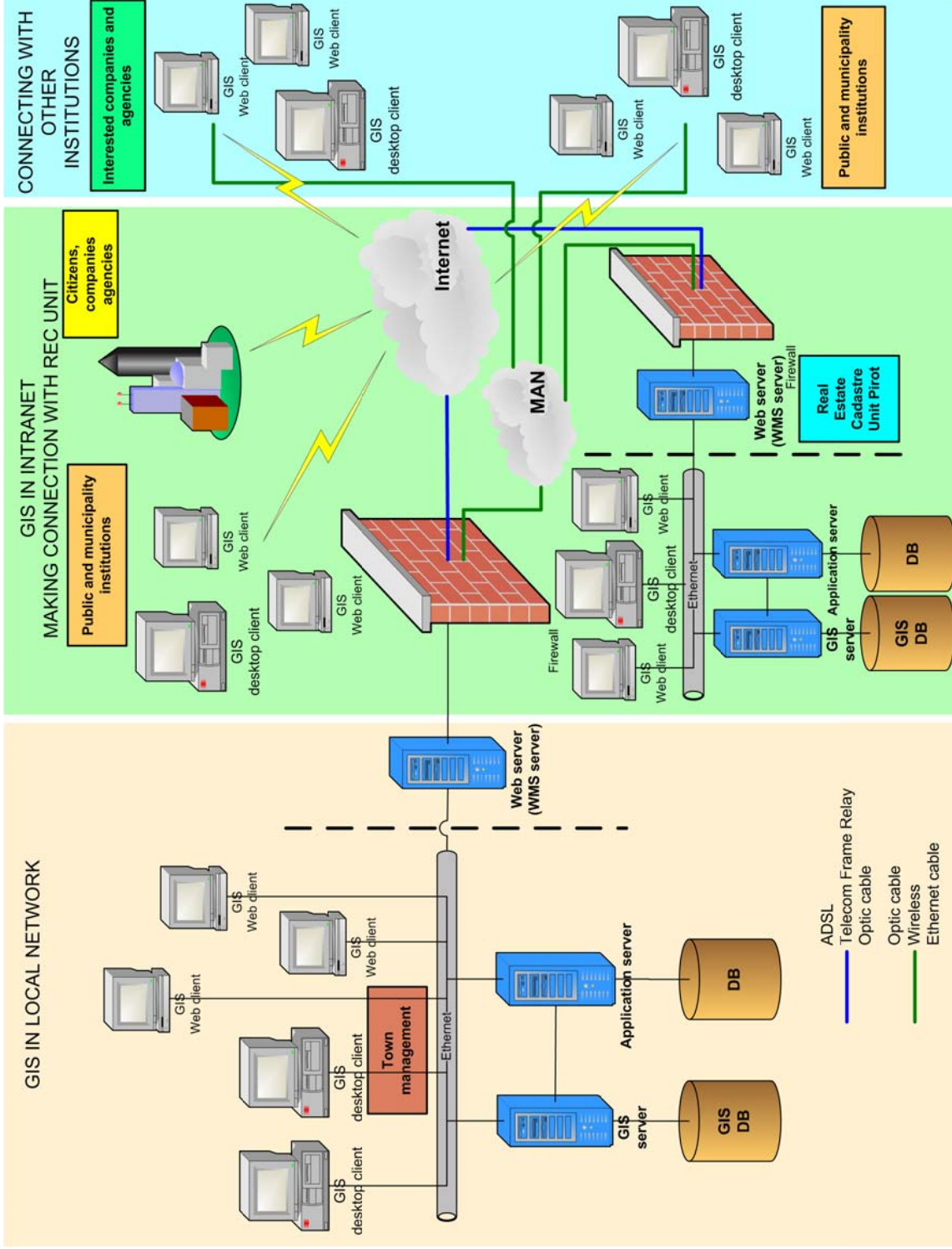
Municipality GIS development

Figure 4-4 : Municipality GIS telecommunication infrastructure development

62

The telecommunication infrastructure development should be made gradually so that it follows and supports the formation of other system segments. Above all this refers to the making of databases which are the core of the Municipality GIS. First some system components should be realised, and then in concordance with priorities they should be linked into a system. Concerning telecommunication infrastructure, the Municipality GIS should be realised in the following stages (Figure 4-4):

- Implementation of the Municipality GIS within the local network of the Local Government and linking it with existing applications and enabling its use in all relevant departments of the Local Government ;

- Linking GIS data and applications of the Local Government with the data and applications of the Real Estate Cadastre Unit Pirot and development of the Municipality GIS Internet services for users outside of the Local Government (municipal and other public companies, citizens and other interested institutions);

- Inclusion of the municipal public companies and other interested legal entities into MAN optical network which connects users of the Municipality GIS.

4.3.3.1 GIS Implementation in the Local Government Local Network

The objective of this stage is to provide access to the Municipality GIS*/WMS* server for users from approximately ten work places within the computer network of the Municipality of Pirot Administration. By providing basic connection between Municipality GIS and the information system of local self-government (Hermes) it will be possible to use the services and data from the *GIS/WMS* server for relevant functions from application of the Hermes system. Local Government computers will be connected to the Internet using *ADSL 768/192 kb/s* service of Telekom Serbia. The existing telecommunication infrastructure is completely sufficient for the first stage of GIS development.

4.3.3.2 Links to Real Estate Cadastre and Implementation of Internet GIS Service for Users outside the Local Government

The objective of this stage is to provide access to cadastral data for users outside of the Local Government. As it has already been stated several times in this document, the data stored and maintained in the Real Estate Cadastre Unit Pirot are one of the most important segments of the Municipality GIS. At the same time, it is by far the largest amount of spatial data of the Municipality GIS that almost all groups of users of the Municipality GIS are interested in. In addition, these data are changed every day, so that necessitates that users are provided on-line insight in the current status of these data. Bearing all this in mind, it is very important to make a link of very good quality to the data stored in the cadastre. Some of the options which make that possible are:

- *ADSL* connection – the cadastre should set up their own database server and provide ADSL 768/192 kb/s Internet link; the compensation for the use of this service per month is 5,500 dinars; the lease of this service means that there are no limitations and extra payments according to the realised traffic, i.e. the amount of transferred data;

- *Frame Relay service* - this service is offered by Telekom Serbia – the compensation for the establishment of this connection includes expenses which

amount to approximately 270 EUR to meet the technical prerequisites, plus 50 EUR (up to 128kb/s) or 250 EUR (up to 2 Mb/s) for monthly payment, plus compensation which depends on the realised traffic for that month;

- *Optical cable* – a direct link between the Local Government and the Real Estate Cadastre Unit would include expenses of 3 EUR * 150m, plus the services of work execution, plus approximately 2000 EUR for the establishment of the connection LAN, the total of which is approximately 3000 EUR; unlike the previous options, expenses are paid here only with the establishment of the connection, and there are no monthly payments for lease or traffic.

The last option is the best and in the long term, the most economical solution, and if financial capabilities allow this, everything should be done to establish this connection. Considering the short distance, this can be done using *ADSS* cables, which are a good alternative to underground installations. *ADSS* cables have the following characteristics: completely non-metal self-carrying optical cables, without EM influence, light weight – about 160 kg/km, high security level, extreme durability (theoretic force of breaking the cable 45 kN or more), work in temperatures from - 30°C to 70°C and are suitable for all air lines.

Only some basic guidelines and options for connecting the Local Government and Real Estate Cadastre Unit are given here. A detailed review and elaboration of all options should certainly be done in a separate project. This is especially important for the last option, within which the design and construction of a wire telecommunication infrastructure should be done, which includes the following tasks:

- Making investment technical documentation;

- Purchase of components;

- Organisation and execution of work;

- Organisation and execution of montage work;

- Testing and release.

The Geodetic Governmental Authority has anticipated in its development programme that by 2010 all interested customers will have access to Real Estates Cadastre Web services. According to this plan it is anticipated that for users outside of GGA access will be made possible in two ways:

- Through the web - the Real Estates Cadastre data will be stored in the GGA central server (Appendix, Figure 6-1), and

- Through MAN network for users connected to the local Municipal intranet (only for the Municipalities which are centres of RECC – large cities); data for these users will be stored in the servers which will be set up in 10 regional Real Estates Cadastre Centres (Appendix, Figure 6-2).

RECU Pirot already has an established Real Estates Cadastre for all cadastral units outside of the Major Map area, and the formation of DCM database for the larger part of the Municipality is expected soon. Considering this and the importance of these data for the work of the Local Government, if GGA does not provide these Web services by 2007, the Local Government will establish these services by setting a Web server in RECU Pirot office in cooperation with GGA.

According to the GGA official price list, a year's subscription for access to the Real Estates Cadastre data from one computer is approximately 3500 EUR. There is a possibility of buying data in digital form in a single purchase. In that case the prices per point and line feature of a cadastral map are 0.017 EUR, and per polygon feature 0.067 EUR. A single purchase of large quantity of cadastral data is not recommended, because in a relatively short time these data will no longer be official or updated.

For this stage it is also planned to provide through the Internet a number of services implemented by GIS/WMS server of the Local Government to citizens and other interested institutions as well. Above all, this refers to municipal and other public companies (PC "Komunalac", Public Town Planning Agency, Land Development Public Agency, and PC "Municipal Heating Company"). When such a great number of prospective Internet users who can be connected to the Municipality GIS are in question, it should be mentioned that ADSL 768/192 kb/s Internet connection provided by Telekom Srbija can become insufficient for the system. The cheapest way to increase traffic bandwidth is to lease another ADSL line, which would cost an additional 5,500 din a month. And it would be expedient to use these two ADSL connections by dividing the Municipality GIS users into two groups. The first group of users would consist of professional users (town and republic companies and institutions), and the other citizens. In that case, it would be possible to track how groups of users use telecommunication resources and make the optimum distribution of resources according to the needs.

At this stage Internet access to simple services of the Municipality GIS is anticipated so it has been evaluated that by leasing the extra ADSL lines the citizens' needs of will be successfully met.

4.3.3.3 Links to Public Companies and Other Interested Institutions

If from the group of professional users there is greater pressure on the Web services of the Municipality GIS it should be suggested to these institutions that they along with the Local Government should provide better ways of connecting, i.e. to provide a connection between the Local Government and these institutions in one of the suggested ways as well as the connection with the Real Estate Cadastre Unit.

4.3.4 GIS Software

Exchange project "*Formation of Centre for Geographic Information System of the Municipality of Pirot*" includes purchase of two installations of GIS desktop software and one installation of GIS server software. With proper implementation of this software and the development of suitable customized software applications, needs for GIS software in the Local Government can mainly be fulfilled.

In addition, purchase of software for GIS server and other necessary components for the implementation of Web GIS service for RECU Pirot cadastral data distribution for users of the Municipality GIS is anticipated. It can be the same software used for the formation of Web GIS service within the Local Government, but that is not necessary.

At the moment the volume of purchase of additional desktop installations of GIS software in the Local Government departments cannot be planned with certainty, but the purchase of desktop GIS software is expected for public companies: Public Town Planning Agency, PC " Water and Sewage Company ", PC "Komunalac", PC "Municipal Heating Company" and Land Development Public Agency. Purchase of one installation of desktop GIS software for these companies is a necessary step towards GIS implementation, i.e. technical information systems of these companies and institutions.

The Municipality GIS is a complex and heterogeneous system based on a large amount of spatial and other data collected and maintained by different users. These users mainly use those software tools which are the most suitable for support for their activities and it is not very realistic to expect all users to use the same software or software of the same

software vendor. This opens up the question of exchange of data between some users of the Municipality GIS.

In GIS area there is a tendency to use less and less files with specialised formats (often not documented well) for storing geometry, topology and spatial data attributes. An increasing number of GIS software enables storing of spatial and no spatial data within standard (commercial) relational databases. The systems for management of relational databases (*Relational Database Management Systems - RDBMS*) offer as standard great possibilities to manipulate data arranged into relations (tables): table formation and their linking, preserving data integrity, transactions, protection of data and data safety, complex queries, high performances and work with extremely large amounts data and many others. For large amounts of data specialised database servers are standard used, from which Oracle and Microsoft SQL Server is the best-known here.

With modern implementation of GIS databases, the database geometry of spatial and other entities becomes only one of special types for database table field. Some implementations of RDBMS, as it is the case with Oracle, have special extensions which support spatial data as well (field type geometry, indexing of the field of geometry type, geometry and topology queries and operations, etc). Modern software tools support spatial data standards regulated by the OGC consortium (*Open Geospatial Consortium*, *http://www.opengeospatial.org*). These standards are also accepted and verified by International Standards Organisation - ISO (*ISO/TC 211*). OpenGIS is the old name of this consortium, so numerous documents have this mark. These standards have been classified into two groups:

- OpenGIS Abstract Specifications (Feature Geometry, Spatial Referencing by Coordinates, Features, Feature Collections, Metadata, The Open GIS Service Architecture, etc);

- OpenGIS Implementation Specifications (Simple Features Implementation Specifications, Web Mapping Service, Web Feature Service, Web Coverage Service, Geographic Objects, etc)

These standards, among other things, define:

- Interfaces for finding, searching and query distributed servers with catalogues which contain data about available spatial data (metadata);

- Use of coordinates and different coordinate systems, coordinates transformations;

- Description, maintenance, representation and manipulation of geometry and geographical objects within a software environment;

- Interface to access spatial data which are stored in heterogeneous systems;

- Interface to access web services for spatial data distribution;

- Software interface to access spatial features and services.

The implementation of these standards makes processing spatial data in different GIS software environments relatively easy. Concerning implementation, the simplest way to distribute spatial information is using standard RDBMS and *WKB/WKT* specification format for geometry of spatial feature when it is placed in the field of relation table.

In addition, most software currently offered in the market support direct or indirect access to GIS data in different forms of representation, so even spatial data not stored in standard RDBMS (*ESRI Shape* format, *MapInfo TAB* format etc) can be efficiently shared.

Because of all of the aforementioned, when the suitable software solution for GIS is chosen the guiding principle should be the demand that this solution uses a geo-relational model with which spatial data is stored in standard relational databases and that this solution

supports some of the more important standards for spatial data. It could be OGC standard or the standard imposed by major GIS software vendor, such as ESRI, MapInfo, Integraph or some other. If these conditions are fulfilled, it is realistic to expect that the data this solution supports will be integrated in the Municipality GIS relatively easily.

When software is chosen, solutions based on OGC standards and *Open Source* licence should be given advantage. In that way technological dependence on one particular software house can be avoided.

It is recommended that, when software is purchased, care should be taken of other demands which can significantly improve the efficient use of software and its data within the Municipality GIS, data exchange with other software in and outside of the system, and also the possibility of further development. Some of the most important demands are:

- Spatial and no spatial attributes of GIS features should be stored and maintained in the commercial RDBMS (use geo-relational data model);

- Generally speaking, such software solutions for which it can be assumed with great certainty that in the future they will be developed in conformity with further development of GIS and IT technology (new operative system platforms, new formats for data storing and exchange, new services, improvements in functionality, possibility of new software functionality development by the users themselves etc) should be chosen;

- Implementation of geometry and topology of spatial features (representation in database) should enable easy access and use of these features, i.e. geometry and topology representation should be completely open and documented (there should be a detailed specification of geometry field in the databases tables, description of implementation of spatial indexing of data, description of topology implementation) – *OpenGIS WKB* format for storing geometry of entities is recommended;

- Software should have standard GIS tools for editing, search and representation of spatial and no spatial data;

- It should be insisted on the purchase of software which will be localised – text messages, menus, dialogues, complete help, documentation and tutorials should be in Serbian;

- Solutions should be chosen to enable simultaneous access to spatial data stored in the central database – editing of spatial features stored in the same table or several tables of one database should be made possible;

- Software should provide support for the use of data model for large scaled cadastral and topographic maps as defined by Geodetic Governmental Authority of Serbia (*Digital Cadastral Map - DCM, Digital Geodetic Map – DGM, Utilities Cadastre, Address Register*);

- Software should provide support for cartographical representation of cadastral and topographic maps in accordance with the standards and regulations used in Serbia – cartographical symbols for point, line and polygon features should be compliant with the symbols defined by Geodetic Governmental Authority; the use of Cyrillic letters for text display on maps should be supported;

- Software should enable georeferencing and display of raster images (scanned cadastral and topographic maps, orthophoto); support for all important raster format (TIFF, JPEG, ECW, JPEG2000, BMP, etc) should be provided;

- Import and quick display of a great number of georeferenced raster images within one project or a group of projects should be supported;

- Import and export of data using standard GIS/CAD file formats should be supported (*ESRI shape* files, *MapInfo MID/MIF, DXF*, etc);

- It would be desirable for the GIS software to support the display of spatial data distributed using *OpenGIS WMS* specification, and for the software to have possibility to access and use other Web GIS services regulated by OGC consortium;

- Local support and maintenance for a longer period of time should be provided for the software;

- Adequate training for the use of delivered software should be provided;

- Software should provide extensive customization for end users' requirements;

- Software should use the standard graphical user interface (GUI);

- Advanced tools for collecting and editing spatial data should be provided (digitalisation on the screen, COGO tools, error corrections);

- Software should enable preparation and publishing of map documents for printing and drawing, with the possibility of using different document layouts (additional contents of a map - legend, title, map grid, coordinates, etc).

Software used for development and implementation of functionality of GIS server and making complex Web GIS application must, in addition to the aforementioned conditions fulfil the following conditions:

- Access to GIS server functions by other software applications (software of other software vendors) must be provided; this access should be provided by using an open and completely documented software interface;

- Efficient manipulation of a large amount of spatial features stored in a single database table or in several tables stored in distributed databases;

- Software should contain development tools and software components for making customised solutions for web-based map distribution (Web GIS publishing tools);

- It is desirable that the software chosen should enable development of Web GIS application that support access, cartographical representation and search for spatial and no spatial data stored within the GIS database server using thin clients (Internet browser based clients with no need for additional software and software licences on the client side); this will enable easy access to GIS data to numerous clients, which is especially important for citizens and legal entities which are not in the system of Local Government, public companies or other state organs (lawyers' offices, real estate agencies, the media etc);

- Special preparation of data for publishing on the web is undesirable; it is desirable for the software to support direct access to data used and maintained by GIS desktop software; in this way it will always be possible to access updated data and system administration is made easier;

- Support should be provided for a greater number of clients to access GIS server spatial data simultaneously;

- GIS server should implement *Web Map Server* functionality in conformity with OpenGIS standard of *Web Map Server Specification Implementation*; implementation of *Web Map Feature* and *Web Map Coverage* specification is desirable.

- Software should contain tools for user administration (authorisation, access rights, password, role manipulation, user access statistics);

- Software should contain software components for implementation of functionality of access, search and cartographical representation of spatial data stored in GIS data server; software components must provide close integration with existing software applications used in the particular institution for business process support.

When the choice and purchase of particular GIS software solutions for the needs of public companies are made, with observation of the aforementioned requirements, those solutions which solve the special needs which arise in these companies in the best possible way should be chosen. For example, for the needs of PC "Water and Sewage Company" such software solution should be chosen which enables efficient management of the Water and Sewage Company network system in the best possible way. Such solution should contain a number of specialised functions required for such network systems in addition to standard GIS functionality.

To sum up, it should be emphasised that for Municipality GIS development data are by far the most significant matter (data model, their volume and quality – accuracy, updating and completeness) rather than the question of purchase of GIS software. If it is estimated that the previously chosen software solutions do not meet current and future needs of the system, they can always be replaced or supplemented by other software solutions without any drastic changes and great financial investments.

4.3.5 Hardware

Hardware is objectively the least expensive item when the implementation of GIS system is concerned. Therefore it will be discussed only generally here.

Computers and peripheral equipment purchased within the project "*Formation of Geographic Information System Centre of the Municipality of Pirot*" are sufficient for the successful implementation of the Municipality GIS within the Local Government itself at the moment. Replacement of these computers should be planned for three to four years' time.

Municipal public companies and institutions should expect acquisition of suitable hardware for the needs of Municipality GIS development in the preparation of their year plans. If this is not solved in a different way by an agreement between the Municipality of Pirot and Geodetic Governmental Authority (RECU Pirot), the acquisition of computer configuration which will enable the implementation of Web service for distribution of Real Estate Cadastre data will be done.

4.4 Personnel

Considering the fact that an increased volume of work is expected in the GIS Centre of the Municipality of Pirot, employing an expert in geodesy and an expert in informatics is planned. The expert in geodesy would primarily work on the collection and maintenance of spatial data, while the expert in informatics would work on system administration (system and application software, databases etc). The employment should be realised by 2007, when a great deal of work on initial formation of the Municipality GIS databases is expected.

Providing personnel in the municipal public companies and institutions necessary for the realisation of work of importance to of the Municipality GIS should be done by each company or institution in conformity with their capabilities and plans. If the company or institution is not able to provide their own personnel with appropriate qualifications, engagement of an outside expert must be anticipated when planning the budget.

Personnel education and training is a permanent task for all institutions and companies which plan to take part in the establishment and utilisation of the Municipality GIS, so that should be anticipated when planning the budget.

4.5   Strategy Implementation and Priority Projects

To realise the Municipality GIS successfully it is necessary to realise a number of projects with which some segments of the Municipality GIS will be realised:

- Spatial databases which represent theme units of the Municipality GIS;

- Data models and software applications which will enable the efficient use of GIS;

- Telecommunication infrastructure which enables linking the Municipality GIS.

Suggested projects (with the year when they are to be realised) are:

- Municipality GIS implementation (2006, 2007);

- Address system database forming (2007);

- Including Real Estate Cadastre data into Municipality GIS (2007);

- Development of GIS public lights maintenance (2007);

- Making a digital orthophoto map of the Municipality of Pirot (2007);

- Forming Utilities Cadastre database (2007, 2008);

- Development of GIS roads, streets and traffic signalisation maintenance (2007, 2008);

- Making a digital topographical map of the town of Pirot 1:5000 (2008);

- Development of GIS communal objects maintenance (2008);

- Development of GIS based on the thematic unit Resources (2009);

- Updating Utilities Cadastre database (2009);

- Building MAN telecommunication infrastructure of the Municipality GIS (2007, 2008, and 2009).

In Appendices (Table 6-2 to Table 6-13) a detailed description of these projects was given. The prerequirements that have to be met before starting each new project are stated as well. For some projects this requires the realisation of some other suggested projects.

Projects which have the goal of purchase of software and hardware for users of the Municipality GIS are not anticipated here. Apart from GIS Centre of the Municipality of Pirot Administration, for which the necessary IT equipment has already been purchased, most of other institutions and companies must plan and set aside the resources for these needs.

Municipality GIS development is an expensive and long-term process, so it has to be realised step by step and with planning. This means deciding on priority projects and a general sequence of their execution. The priorities were chosen in such a way that by implementation of GIS technology the crucial activities will be made much more efficient and thus in the shortest time possible create significant savings, both concerning the use of resources, and the time necessary for doing certain work. Care has been taken of even distribution of existing financial and human resources, as well as even financial support to the strategy implementation.

The realisation of a number of activities and projects depends in a great deal on factors which are not solely under the control of local self-government (CARDS project of making orthophoto for the whole territory of Serbia, Real Estate Cadastre set up, establishment and update of Utilities Cadastre database, building MAN telecommunication infrastructure of the town of Pirot). Therefore it is realistic to expect that this general framework of activities and projects programme will be honoured only partly.

4.5.1   Planned Projects and Activities in 2006

The projects and activities planned for 2006 have the goal of initial establishment of services of GIS Centre of the Municipality of Pirot for users in the Local Government. Existing spatial data is to be processed for the needs of the Municipality GIS and made available to all interested parties in the Local Government Pirot, but also to users outside of it (using the Internet). These activities are an extension of work started within the Exchange project and they were planned to be done without starting special projects which would require additional financial means. Considering the fact that the start of these activities is not expected until September, and that this is the introduction of completely new work technology, it should be expected that these activities will continue in the first few months of 2007.

		Project name	Expenses [EUR]
Planned projects and activities in 2006	**Projects**	Municipality GIS implementation (70%, 0)	0
		TOTAL:	0
	Activities	Preparation work to form the Address System (agreement between the Municipality of Pirot, Serbian Post Office and RECU Pirot)	
		Preparation work to link with RECU Pirot (agreement on distribution of responsibilities and tasks between the Local Government and RECU (GGA), the role and place of other institutions and companies)	
	Expected results	Software and hardware of the Municipality GIS Centre in Pirot are operative	
		Access to the basic set of spatial data and functions for the users from the Local Government - GIS technology is in operation of the Local Government bodies	
		Bases for further development of the Municipal GIS are set	
		Some requests of customers are solved more quickly	

Table 4-2 : Projects, activities and expected results in 2006

4.5.1.1 Planned Projects and Activities in 2007

For 2007 it was planned to finish the project of Municipality GIS establishment as well as start and realise a number of new projects. From these projects the formation of a unique *Address System* for the whole territory of the Municipality and connection to the Real Estates Cadastre data has priority.

The *Address System* should be formed as soon as possible, and then implemented within all databases and applications which are used in the Local Government and municipal companies and institutions.

The formation of the *Address System* can be greatly facilitated by providing orthophoto of suitable quality. Orthophoto is very useful, if not necessary, for the formation and use of the Municipality GIS databases for the following needs: public lights maintenance; roads, streets and traffic signalisation maintenance; communal infrastructure maintenance. The majority of these projects should start in 2007. Therefore in 2007 making a digital orthophoto for the whole territory of the Municipality is required. This project should not be realised if orthophoto is provided through the *CARDS* project of orthophoto production for the whole territory of Serbia by 2008.

One of the crucial activities in this year is the establishment of cooperation with the Geodetic Governmental Authority and the Real Estates Cadastre Unit Pirot. The realisation of a number of projects and activities which include the formation and use of official databases: the Address System, Real Estates Cadastre, Utilities Cadastre and Spatial Units Register depend on the success of this cooperation. Within this cooperation a web server should be set up in RECU Pirot through whose service Real Estates Cadastre data will be distributed. For a year's subscription for the use of these data it is necessary to pay approximately 4000 EUR. Within the cooperation with GGA in 2007 preparatory activities for the formation of Utilities Cadastre database are anticipated: signing of Agreement of cooperation between the Municipality and GGA and the making of the geodetic work main project.

In 2007 all objects on the territory of the Municipality of Pirot should be digitalised for the needs of the Local Government Pirot.

Also, in 2007 the realisation of the project of building the town MAN network should start by providing connection between the Local Government and two institutions: RECU Pirot and Land Development Public Agency.

		Project name	Expenses [EUR]
Planned projects and activities in 2007	**Projects**	Municipality GIS implementation (30%)	3000
		Formation of the Address System database	4000
		Inclusion of Real Estate Cadastre data into Municipality GIS	15000
		Development of Public Lights Maintenance GIS	10000
		Digital orthophoto production for the Municipality of Pirot	35000
		Formation of the Utilities Cadastre database – Production of the main project of geodetic work (10%)	1000
		Development of Roads, Streets and Traffic Signalisation Maintenance GIS - (10%)	1000
		Building MAN telecommunication infrastructure of the Municipality GIS - Links to RECU Pirot and Land Development Public Agency (9%)	6000
		TOTAL:	75000
	Activities	Implementation of the Address System within the databases used in the Local Government and Municipal public companies	
		Digitalisation of objects and their linking to the data stored within objects database	
		Preparation work to form Utilities Cadastre database (making the project, signing the contract on financing, putting out to tender)	
	Expected results	Access to the data of the Municipality GIS is made possible for citizens and other interested customers (through Web GIS services)	
		In the Municipality of Pirot a database of the unified, official address system which represents the basis for Development of other segments of the Municipal information systems is formed	
		Insight into updated cadastral data is made possible (for citizens and employees in the Local Government) without going to RECU Pirot	
		Less engagement for employees in RECU Pirot	
		Requests of citizens who come to the Local Government of Pirot Care dealt with more quickly, concerning building and housing-communal jobs and Real Estates	
		By setting up a Web service in RECU Pirot for the distribution of cadastral data it is possible for other users apart from the Municipal of Pirot to use cadastral data	
		Public lights GIS is formed and thus the official tracking of the status of public lights and investments, and making projects and work plans is facilitated	
		RECU Pirot and Land Development Public Agency is linked into MAN network of the Municipality of Pirot	

Table 4-3 : Projects, activities and expected results in 2007

4.5.2 Planned Projects and Activities in 2008

In 2008 the work started on the initial formation of Utilities Cadastre databases should be continued and finished. The production of a digital topographic map 1:5000 (DTK5), as well as spatial database with contents which can be the basis for development of a number of GIS subsystems of the Municipality GIS is also planned. An example of such subsystems are *Roads, Streets and Traffic Signalisation Maintenance GIS* and *Communal Objects Maintenance GIS* whose development is also planned for 2008.

Considering the fact that by the end of 2008 a large amount of spatial data concerning utility networks will be available, in that year the municipal companies and institutions should be provided with GIS desktop work stations, which involves purchase of suitable software and hardware.

<table>
<tr><td rowspan="19">Planned projects and activities in 2008</td><td rowspan="7">Projects</td><td>Project name</td><td>Expenses [EUR]</td></tr>
<tr><td>Forming Utilities Cadastre database– realisation of work (90%)</td><td>9000</td></tr>
<tr><td>Digital topographic map 1:5000 production</td><td>50000</td></tr>
<tr><td>Development of Roads, Streets and Traffic Signalisation Maintenance GIS (90%)</td><td>9000</td></tr>
<tr><td>Development of Communal Objects Maintenance GIS</td><td>10000</td></tr>
<tr><td>Building MAN telecommunication infrastructure of the Municipality GIS - connecting PC "Komunalac" (12%)</td><td>8000</td></tr>
<tr><td style="text-align:right">TOTAL:</td><td>86000</td></tr>
<tr><td rowspan="2">Activities</td><td>Access to the additional services of the Municipality GIS is made possible for citizens (using the Internet)</td><td></td></tr>
<tr><td>Acquisition of desktop GIS software for Municipal public companies: Public Urbanistic Agency, PC "Water and Sewage Company", PC "Komunalac", PC "Heating Company" and Land Development Public Agency</td><td></td></tr>
<tr><td rowspan="9">Expected results</td><td>More efficient maintenance and management of network infrastructure by using GIS</td><td></td></tr>
<tr><td>Insight into updated data of network infrastructure is made possible for all users of the Municipality GIS – there is no need to go to RECU Pirot</td><td></td></tr>
<tr><td>Getting approvals for work performance on the utilities network is faster</td><td></td></tr>
<tr><td>Land Development Public Agency determines and collects payments of compensations for arrangement and use of construction land</td><td></td></tr>
<tr><td>RECU Pirot maintains data in digital form, recorded data can be given in digital form – faster data processing is realised</td><td></td></tr>
<tr><td>Prerequisites for building GIS/TIS of public companies are realised</td><td></td></tr>
<tr><td>Formed database of spatial entities can be used to form other theme units of the Municipality GIS, by simply adding attributes to existing features</td><td></td></tr>
<tr><td>Complex GIS searches can be made in the digital topographical map database</td><td></td></tr>
<tr><td>PC "Komunalac" is joined into MAN network of the Municipality of Pirot</td><td></td></tr>
</table>

Table 4-4 : Projects, activities and expected results in 2008

4.5.2.1 Planned Projects and Activities in 2009

In 2009 the realisation of the largest project on the formation of the Municipality GIS is anticipated. It is the project of updating Utilities Cadastre database. Since the current status analysis has shown that these data have largely not been updated, it can be presumed that considerable means should be provide for the realisation of this project. This especially refers to Water and Sewage Company network, but also electrical power network. Geodetic survey of these utilities networks should be done using field survey methods.

In 2009 the setting up of MAN telecommunication infrastructure of the Municipality GIS should be finished, so all key users of the Municipality GIS will be connected.

<table>
<tr><td rowspan="11">Planned projects and activities in 2009</td><td rowspan="4">Projects</td><td>**Project name**</td><td>Expenses [EUR]</td></tr>
<tr><td>Development of GIS based on the thematic unit Resources</td><td>10000</td></tr>
<tr><td>Updating Utilities Cadastre database</td><td>100000</td></tr>
<tr><td>Building MAN telecommunication infrastructure of the Municipality GIS (84%)</td><td>46000</td></tr>
<tr><td></td><td>**TOTAL:**</td><td>156000</td></tr>
<tr><td rowspan="3">Activities</td><td colspan="2">Implementation of GIS functionality into business processes</td></tr>
<tr><td colspan="2">Integration of functions and data of the Municipality GIS into information systems which are used by officials in Municipal institutions</td></tr>
<tr><td colspan="2">Access to the additional services of the Municipality GIS is made possible for citizens and other institutions (using the Internet)</td></tr>
<tr><td rowspan="4">Expected results</td><td colspan="2">By forming GIS thematic unit Resources the use of available resources is made easier with a better control</td></tr>
<tr><td colspan="2">More efficient environment protection and polluters control is realised</td></tr>
<tr><td colspan="2">Base maps and spatial data sets for the making of programmes and projects in environment protection and energetic efficiency are made</td></tr>
<tr><td colspan="2">All key users of the Municipality GIS (Local Government , Municipal public companies, Land Development Public Agency, Electrodistribution and Telekom) are joined into MAN network of the Municipality of Pirot</td></tr>
</table>

Table 4-5 : Projects, activities and expected results in 2009

4.6   Support of the Implementation of the Municipality GIS Development

The key condition for the successful realisation of the Municipality GIS development strategy is a proper support, above all the one provided by the Municipality itself, and then support provided by other institutions which produce, maintain or use Municipality GIS data. In that sense it is necessary to provide:

- Close cooperation between all institutions and companies which work with Municipality GIS data;

- Means for the realisation of the strategy;

- Institutional support and supervision of the strategy realisation.

4.6.1   Cooperation with the Real Estate Cadastral Unit Pirot

As it has been stated several times in this document, it is under Geodetic Governmental Authority (GGA) purview to manage the Real Estates Cadastre, Utilities Cadastre, Administrative Units Register and Address Register. Since cadastral data and the data from these registers comprise the largest part both of the Municipality GIS and of the technical information system (TIS) of some companies, it is evident that the establishment of these systems depends on the formation of official databases for all data which are under the purview of GGA. On the other hand, whether the data maintained by the Real Estates Cadastre Unit (RECU) Pirot, as an organisational unit of GGA, is up-to-date, depends in a great deal of reports on changes in the field, which is often connected to the activities of the companies which deal with the utility network. That is why the cooperation between local self-government bodies, municipal public companies, PC "Elektroprivreda" Niš – pogon Pirot and Telekom Serbia AD, on the one hand, and RECU Pirot, on the other hand is vital for Municipality GIS.

The aggravating circumstances for communication between the Municipality of Pirot and RECU Pirot are that GGA is a republic body, and RECU is only a part of it. Therefore the Municipality of Pirot should partner up with other municipalities and by joint action, in Standing of Towns and Municipalities (STM), realise communication with the Geodetic Governmental Authority management and in this way enable and exhort the formation of databases under the purview of GGA, and also secure favourable conditions for its own access to these data. At the same the Municipality should assure that all interventions in the field, under the purview of the Municipality and its companies, are reported to RECU Pirot promptly and regularly, so that they could be recorded.

4.6.2   Means for Realisation of the Strategy

The means for realisation of the Strategy of GIS Development will be provided from the Municipality budget, the budgets of municipal public companies and institutions which are to be the key users of the Municipality GIS, as anticipated in this strategy, and also from means received as donations and other forms of support of the European Union for advancement of work of local self-governments in Serbia. The dynamics of setting these means aside will be coordinated with the estimation of necessary means given in Chapter 4.2 and stages of strategy implementation (Chapter 4.5).

Table 4-6 contains an estimate of expenses according to years of realisation. The estimate was given only for key projects and the use of GGA data. It does not include

expenses for IT maintenance and additional equipment of the municipal public companies and institutions, or expenses for personnel (courses and education, employment of new personnel, etc) and other activities (consultants' services etc). At this moment it is difficult to give a realistic estimate of these expenses, but it could be anticipated that these additional expenses will amount to 10-20 percent of the expenses already given in the table.

It should be mentioned that the given prices are estimated market prices for the realisation of certain projects and acquisition of services. Some of the larger items refer to:

- Digital orthophoto production (35 000 EUR),

- Setting up a Web server in RECU Pirot (15 000 EUR),

- Digital topographic map 1:5000 production (50 000),

- Establishment and updating the Utilities Cadastre database (110000 EUR),

- Building MAN telecommunication infrastructure (60 000 EUR).

However, if it is presumed:

- That means for the projects from the first two items will not be required - GGA will provide orthophoto and set up a Web server in RECU Pirot;

- That the making of digital topographical map is not necessary,

- That the Municipality will finance only a part of the expenses of forming and updating Utilities Cadastre databases – the part which refers to the heating pipes, water-supply and sewage network (these expenses are about 70 000 EUR)

- That Electrodistribution and Telekom will finance their own linking into the town MAN network (these expenses are about 20 000 EUR),

the result is that the Municipality will, instead the expected 341000 EUR, have to invest around 181 000 EUR for the development of the Municipality GIS.

It is realistic to presume that a great part of the means (or data sets) for the realisation of aforementioned projects will be provided by other institutions (GGA, Electrodistribution, and Telekom). Therefore if all anticipated projects are realized it should be expected that the Municipal participation is much less than the aforementioned 341000 EUR and that it should be around 220000 EUR.

Municipality GIS development

Ordinal number	Expenses	2006	2007	2008	2009	Total
1	Municipality GIS implementation		3000			3000
2	Formation of the Address system database		4000			4000
3	Inclusion of Real Estate Cadastre data into Municipality GIS		15000			15000
4	Development of Public Lights Maintenance GIS		10000			10000
5	Digital orthophoto production for the Municipality of Pirot		35000			35000
6	Production of Digital topographical map of the town of Pirot 1:5000			50000		50000
7	Forming Utilities Cadastre database		1000	9000		10000
8	Development of Roads, Streets and Traffic Signalisation Maintenance GIS		1000	9000		10000
9	Development of Communal Objects Maintenance GIS			10000		10000
10	Updating Utilities Cadastre database				100000	100000
11	Development of GIS based on the thematic unit Resources				10000	10000
12	Building MAN telecommunication infrastructure of the Municipality GIS		6000	8000	46000	60000
13	Annual subscription for the use of data of RECU Pirot		4000	8000	12000	24000
			79000	94000	168000	341000

Table 4-6 : Estimate of expenses according to projects and year of realisation

4.6.3 Bodies for Support and Supervision of the Implementation of the Strategy

Considering the fact that the development and implementation of the Municipality GIS will take a long period of time and that a number of institutions and companies, both on the local and republic level, will be involved in this work, it is necessary to form bodies whose task would be supervision and coordination of activities for the implementation of development strategy of the Municipality GIS.

The Project of formation of the Centre for Geographic Information System of the Municipality of Pirot includes the formation of the *Municipality GIS Council*, as a permanent supervising council. The primary role of this Council is to supervise further development of the Municipality GIS and the practical application of the Development Strategy. The Council would consist of: the Municipality President, the Municipality Manager, key person for informatics in the Municipality of Pirot and an independent GIS expert. One of the basic tasks of this body would be to start projects included in this strategy with the goal of development and implementation of the Municipality GIS.

The Project team for construction and establishment of GIS of the Municipality of Pirot was formed in the Municipality of Pirot, it was appointed by the Municipality President. This body consists of representatives of the following institutions and companies:

- Local Government Pirot,
- Public Town Planning Agency Pirot,
- Land Development Public Agency,
- PC "Komunalac",
- PC " Water and Sewage Company",
- PC "Municipal Heating Company",
- ED "Jugoistok" d.o.o. Niš - "Electrodistribution Pirot",
- Telekom Srbija – RC Pirot,
- Geodetic Governmental Authority Serbia - Real Estates Cadastre Unit, Pirot.

One of the tasks of this body is to work on standards and rules for procedures and data concerning the Municipality GIS which have not been defined by the existing laws and regulations. The standards and rules that this body adopts would be proposed for adoption to the appropriate institutions. If all institutions which work with data relevant for the Municipality GIS observe these standards and rules, that will secure a simpler and more efficient communication and information exchange between these institutions. The members of this body would actively work on the promotion of the Municipality GIS in institutions they represent and ensure that the adopted standards and procedures are observed. Body should have sessions once a month and the aims of these meetings are:

- Adoption and implementation of standards;
- Knowledge and experience transfer;
- Design of common strategy of GIS development and implementation;
- Expressing and coordinating interests of some Municipality GIS users;
- Coordination of plans and actions in GIS development and implementation;
- Coordination of similar and realization of mutual projects;
- Building a unified GIS infrastructure;
- Public Relations.

5 CONCLUSION

The strategy comprises of the detailed analysis of the present state in Pirot Municipality relating to business processing, spatial data and IT infrastructure relevant from the aspect of Municipality GIS development. The results of this analysis enabled realising the needs, possibilities both of the institutions' place and role, which are marked as potential users and participants in the system of Municipality GIS.

The strategy proposes a concept of the development and functioning of Municipal GIS for a longer time period.

The strategy proposes a Municipality GIS architecture based on web technology, i.e. using Intranet/internet concept. Such architecture means most data will be maintained and stored within the service, institution or agency responsible for them. Distribution of the data to other GIS users will be performed via web GIS server and with the access to central (remote) and local GIS databases.

The Municipality GIS strategy assumes respecting and implementing IT, ISO/OGC and national standards, respecting openness and interoperability concepts and the possibility of further expansion.

Far greater importance is given to formation of adequate spatial databases in the strategy than to aspects related to development and implementation of software tools that will provide the data is used efficiently. A special emphasis is put on respecting the existing regulations relating to responsibility and procedures for official records spatial data maintenance.

The Municipality GIS development strategy is a long and expensive process, and it is planned it should be realised gradually and methodically. Realisation of a greater number of projects and activities is a part of the strategy. Priority projects have been defined as well as the outlined sequence of their performance. The priorities have been chosen so that the most critical activities are made to be significantly more efficient by implementation of GIS technology and thus significant savings are made in the shortest possible period of time. Strategy is flexible because time schedule for the realisation of certain projects is just provisional and can be changed according to the current situation (provided resources and financing, cooperation or lack of cooperation of certain institutions and agencies, provision of data from other sources, etc.)

It is also planned in the strategy to build MAN communication infrastructure that will connect all important institutions and agencies of the town of Pirot. This network exceeds the needs of the Municipality GIS and it can be considered only conditionally as a part of Municipality GIS development.

The most important results that can be expected after strategy is successfully accomplished are the following:

- improved decision making process by using advanced GIS analyses (efficiency, objectivity, precision);

- faster solving of customers requests (permits, approvals, terms, ...);

- supervision of certain institutions and agencies will be more efficient and transparent (public hygiene, maintenance of public areas, collecting taxes);

- reduced workload of employees in local administration, RECU Pirot and other institutions and agencies which use Municipality GIS;

- digital technology will enable more efficient exchange of information between municipal and other institutions and agencies;

- access to the Municipality GIS data (web GIS services) – data on real estates, communal infrastructure and other municipal resources will be provided for interested customers (institutions, agencies and citizens) – transparent functioning of the local government;

- insight into updated cadastral data will be enabled without visit to the RECU Pirot (for employees in municipal and other institutions and agencies, and for the citizens as well);

- spatial data collected for the Municipal GIS (unique address system, orthophoto, spatial units register, ...) can be used for the development of other GIS applications;

- upon building GIS of communal network infrastructure (utilities network infrastructure) efficient maintenance and planning of investments in this area will be provided;

- preconditions for building technical and business IT of communal and other companies, institutions and agencies will be met;

- more efficient and fair collection of public income will be provided by having precise records of all taxes based on ownership and use of real estates;

- it will be possible to estimate taxes for construction land arrangement and construction land usage more efficiently and more fairly, and also it will be possible to have a precise evidence on collected taxes;

- maps and other data for the preparation of all sorts of programs, projects and studies will be available;

- preconditions for more efficient protection of environment and control of polluters will be met.

Finally, it should be emphasised that key factors for the strategy implementation are management support and cooperation of all institutions and agencies marked as key users of the Municipality GIS. Again, this does not refer solely to local self government institutions and agencies but also to those at republic level. In addition to management, all those who are to develop, implement and use the system, are clearly of greatest importance.

The analysis of Municipality GIS implementation and development costs has shown that the spatial databases formation and establishment of the town MAN communication infrastructure investments is expected to amount to about €340,000. Adding to this all the necessary investments into IT equipment (software and hardware), a total of €400,000 is to be planned for Municipality GIS development, provided that a part of this amount is provided by institutions and agencies except the local self government. The investment is clearly a significant one, but it is estimated it will be paid back, as a long-term one.
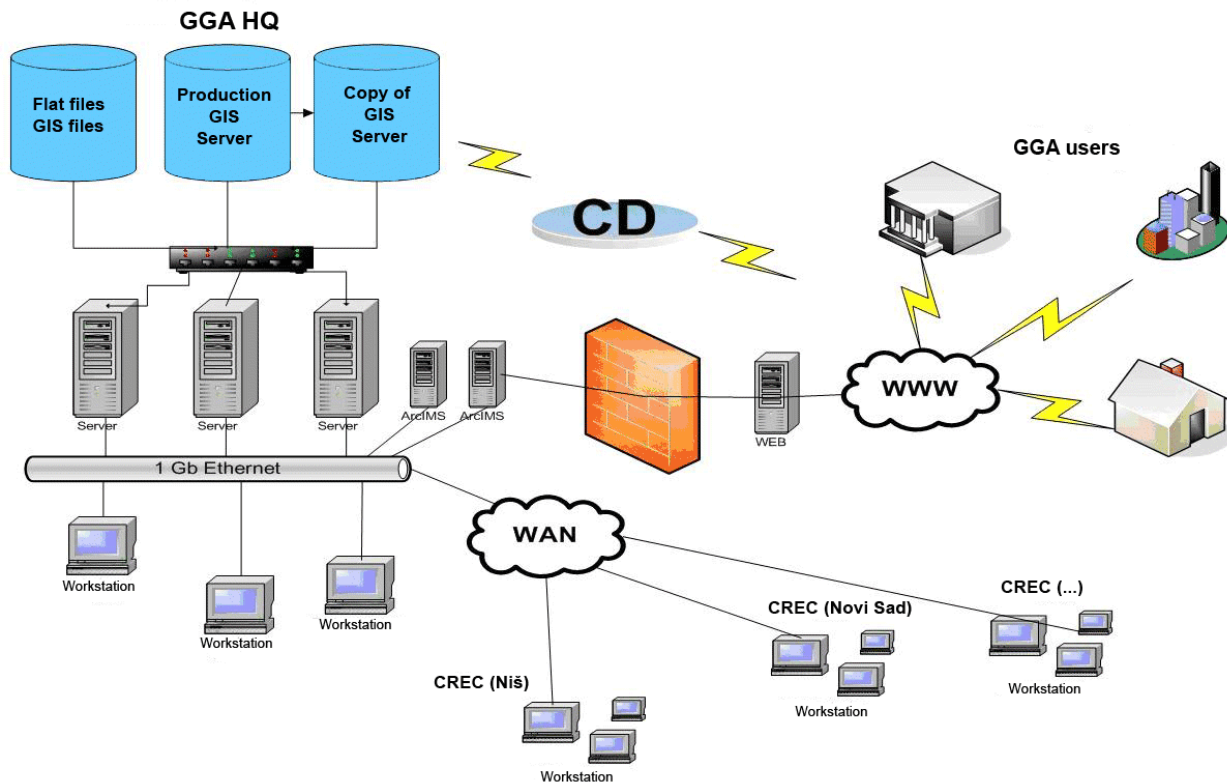
6 APPENDIX

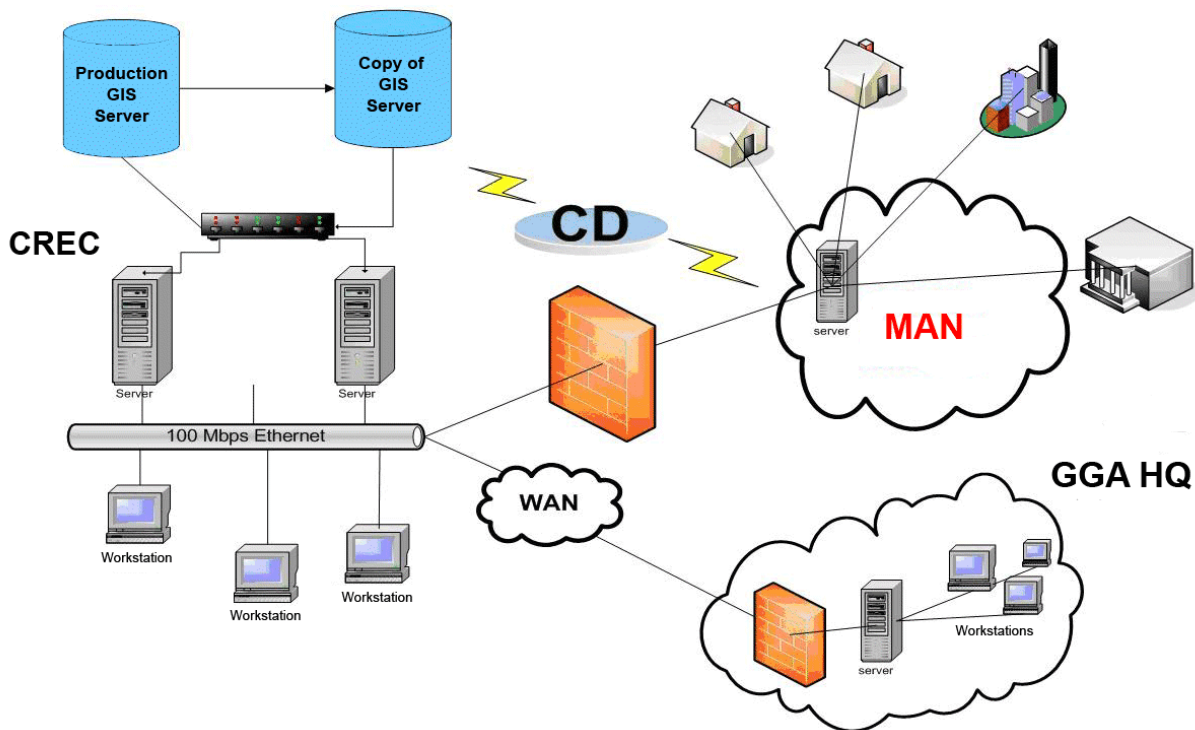Figure 6-1 : Distribution of the cadastral data from the GGA headquarters

Figure 6-2 : Distribution of the cadastral data from the regional center for the REC (CREC)

Vodovodna mreža
- T_HIDRANT_VM
- T_OBJEKTI_VM
- T_OKNO_VM
- T_PIKIR_VM
- T_REDUKCIJA_VM
- T_UREĐAJ_VM
- L_PRIKKJUČAK_VM
- L_VOD_VM
- P_OBJEKTI_VM
- P_OKNO_VM

Kanalizaciona i drenažna mreža:
- T_KONTROLNO_OKNO_DM
- T_OKNO_KM
- T_OTVORI_KM
- T_PIKIR_KM
- T_PRELIVNA_BRANA_KM
- T_SLIVNIK_KM
- L_PRELIVNA_BRANA_KM
- L_PRIKLJUČAK_KM
- L_ULIČNI_ODVODNICI_KM
- L_VOD_KM
- P_KOMORA_KM
- P_KONTROLNO_OKNO_DM
- P_OBJEKTI_KM
- P_OKNO_KM
- P_VOD_KM

Toplovodna mreža:
- T_OBJEKTI_TM
- T_OKNO_TM
- T_PIKIR_TM
- T_ZATVARAC_TM
- L_PRIKKJUČAK_TM
- L_VOD_TM
- P_OBJEKTI_TM
- P_OKNO_TM
- P_REZERVOARI_TM
- P_VOD_TM

Elektroenergetska mreža:
- T_KABLOVSKA _SPOJNICA_EM
- T_OBJEKTI_EM
- T_OKNO_EM
- T_PIKIR_EM
- T_PRIKLJUCNI_ORMANI_EM
- T_RAZVODNI_ORMANI_EM
- T_REZERVA_KABLA_EM
- T_STUB_EM
- T_TS_EM
- L_PRIKKJUČAK_EM
- L_VOD_EM
- P_REZERVOARI_EM
- P_VOD_EM

Telekomunikaciona mreža:
- T_NASTAVAK_TK
- T_OBJEKTI_TK
- T_OKNO_TK
- T_PIKIR_TK
- T_STUB_TK
- T_TELEFON_TK
- L_PRIKLJUČAK_TK
- L_VOD_TK
- P_CENTRALA_TK
- P_OBJEKTI_TK
- P_OKNO_TK
- P_VOD_TK

Naftovodna mreža:
- T_OBJEKTI_NM
- T_OKNO_NM
- T_PIKIR_NM
- T_STANICE_NM
- T_VENTILI_NM
- L_PRIKLJUCAK_NM
- L_VOD_NM
- P_OBJEKTI_NM
- P_OKNO_NM
- P_REZERVOARI_NM
- P_VOD_NM

Gasovodna mreža:
- T_OBJEKTI_GM
- T_OKNO_GM
- T_PIKIR_GM
- T_STANICE_GM
- T_VENTILI_GM
- L_PRIKLJUCAK_GM
- L_VOD_GM
- P_OBJEKTI_GM
- P_OKNO_GM
- P_REZERVOARI_GM
- P_VOD_GM
- T_OBJEKTI_GM
- T_OKNO_GM

Zajednički objekti:
- T_ZAJEDNIČKI
- L_ZAJEDNIČKI
- P_ZAJEDNIČKI

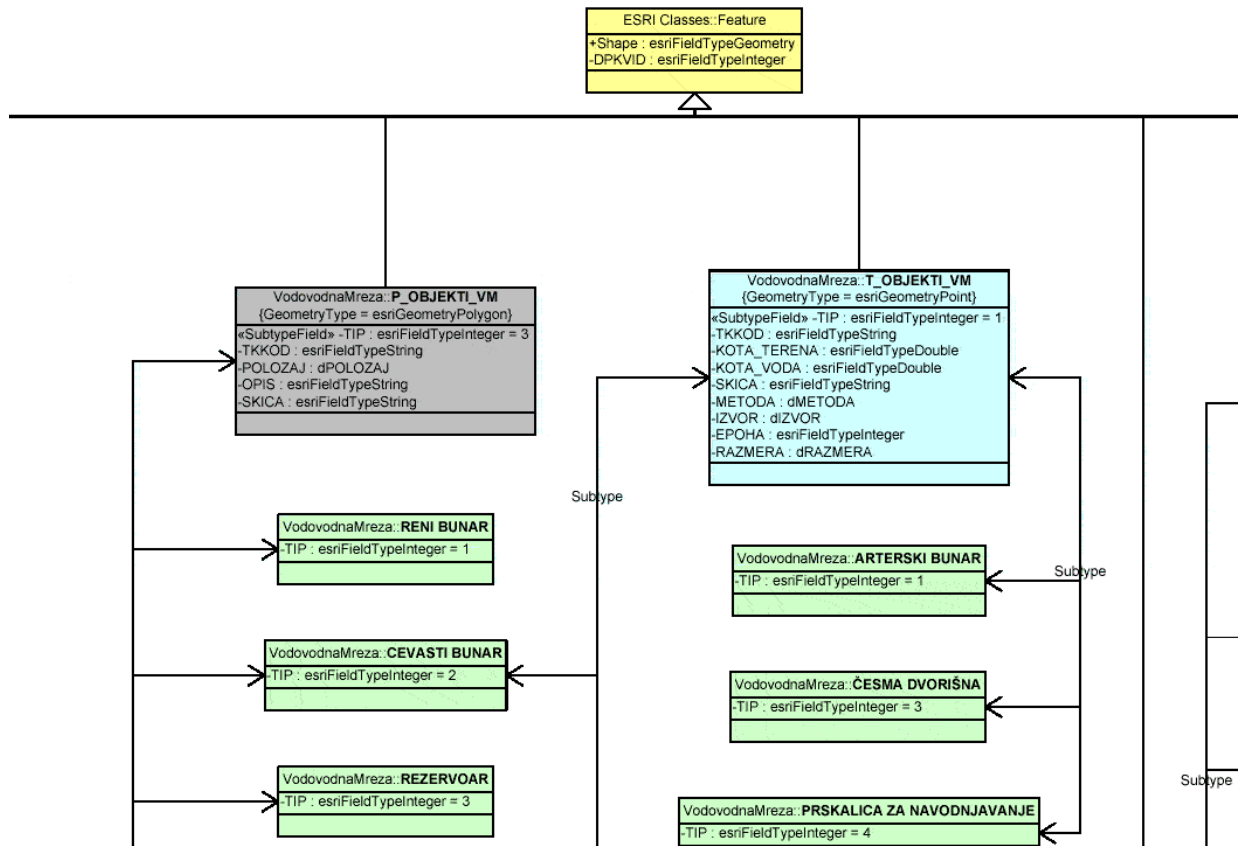*Table 6-1 : Feature (object) classes for the cadastre of utilities*

Figure 6-3 : Part of the UML diagram of the data model for the cadastre of utilities - theme Water Supply network

Katastarski plan::Tacka
{GeometryType = esriGeometryPoint}
-BrojTacke : esriFieldTypeString
«SubtypeField» -VrstaTacke : esriFieldTypeInteger = 1
-TikKod : esriFieldTypeString
-Skica : esriFieldTypeString
-Metoda : dMETODA
-Izvor : dIZVOR
-Epoha : esriFieldTypeInteger
-Razmera : dRAZMERA

Katastarski plan::TackaDetaljna
-VrstaTacke : esriFieldTypeInteger = 1

Katastarski plan::TackaPomocna
-VrstaTacke : esriFieldTypeInteger = 2

Katastarski plan::PomocnaLinija
{GeometryType = esriGeometryPolyline}
«SubtypeField» -VrstaLinije : esriFieldTypeInteger

Katastarski plan::ProlaziIspodZgrade
-VrstaLinije : esriFieldTypeInteger = 1

Katastarski plan::ProlaziIspodGradObjekta
-VrstaLinije : esriFieldTypeInteger = 2

Katastarski plan::GranicaGradjObjekta
-VrstaLinije : esriFieldTypeInteger = 3

Katastarski plan::GranicaEksproprijacije
-VrstaLinije : esriFieldTypeInteger = 4

Katastarski plan::OsovinaPruge
-VrstaLinije : esriFieldTypeInteger = 5

Katastarski plan::GranicnaLinija
{GeometryType = esriGeometryPolyline}
-Pripadnost : esriFieldTypeString
-TikKod : esriFieldTypeString

Katastarski plan::Ko
{GeometryType = esriGeometryPolygon}
-NazivKo : esriFieldTypeString
-MaticniBrojKo : esriFieldTypeInteger
-Povrsina : esriFieldTypeInteger

Katastarski plan::Razmera
{GeometryType = esriGeometryPolygon}
-Razmera : dRAZMERA
-Povrsina : esriFieldTypeInteger

Katastarski plan::ListDetalja
{GeometryType = esriGeometryPolygon}
-BrojLista : esriFieldTypeInteger
-Razmera : dRAZMERA
-OpstaOznakaLista : esriFieldTypeString
-LokalnaOznakaLista : esriFieldTypeString

Katastarski plan::StatKrug
{GeometryType = esriGeometryPolygon}
-MatBrStatKrug : esriFieldTypeInteger

Katastarski plan::Parcela
{GeometryType = esriGeometryPolygon}
-BrParc : esriFieldTypeInteger
-PodbParc : esriFieldTypeInteger
-Status : dSTATUS_PARCELE = 0
-Povrsina : esriFieldTypeInteger
-OznakaY : esriFieldTypeDouble
-OznakaX : esriFieldTypeDouble
-OznakaAzimut : esriFieldTypeDouble
-OznakaRazmera : esriFieldTypeDouble

Katastarski plan::DeoParcele
{GeometryType = esriGeometryPolygon}
-BrDelaParc : esriFieldTypeInteger
«SubtypeField» -NacinKoriscenja : esriFieldTypeInteger
-Spratnost : esriFieldTypeString
-StatusObjekta : dSTATUS_OBJEKTA = 0
-Povrsina : esriFieldTypeInteger
-OpisObjekta : esriFieldTypeString
-OznakaY : esriFieldTypeDouble
-OznakaX : esriFieldTypeDouble
-OznakaRazmera : esriFieldTypeDouble

Katastarski plan::StambenaZgrada
-NacinKoriscenja : esriFieldTypeInteger = 1

Katastarski plan::PoslovnaZgrada
-NacinKoriscenja : esriFieldTypeInteger = 2

Katastarski plan::StambenoPoslovnaZgrada
-NacinKoriscenca : esriFieldTypeInteger = 3

Katastarski plan::JavnaZgrada
-NacinKoriscenja : esriFieldTypeInteger = 4

Katastarski plan::PrivredniObjekat
-NacinKoriscenja : esriFieldTypeInteger = 5

Katastarski plan::PomocnaZgrada
-NacinKoriscenja : esriFieldTypeInteger = 6

Katastarski plan::NerazvrstanObjekat
-NacinKoriscenja : esriFieldTypeInteger = 7

Katastarski plan::OstaliDeloviParcele
-NacinKoriscenja : esriFieldTypeInteger = 8

Katastarski plan::KucniBroj
{GeometryType = esriGeometryPoint}
-KB : esriFieldTypeString
-UlicaID : esriFieldTypeString
-BrojAzimut : esriFieldTypeDouble
-BrojRazmera : esriFieldTypeDouble

Ulica
-UlicaID : esriFieldTy
-ImeUlice : esriFieldT

Katastarski plan::Nazivi
{GeometryType = esriGeometry
«SubtypeField» -Vrsta : esriFieldTyp
-Naziv : esriFieldTypeString
-NazivAzimut : esriFieldTypeDouble

Katastarski plan::NazivPJ
-Vrsta : esriFieldTypeInteger =

Katastarski plan::NazivPote
-Vrsta : esriFieldTypeInteger =

Katastarski plan::NazivUliceT
-Vrsta : esriFieldTypeInteger =

Katastarski plan::NazivVod
-Vrsta : esriFieldTypeInteger =

Katastarski plan::NazivGradOb
-Vrsta : esriFieldTypeInteger =

Katastarski plan::OznakaGran
-Vrsta : esriFieldTypeInteger =

Generalization26

Subtype

Figure 6-4 : UML diagram representing the data model of the Digital Cadastral Map

Project name	Implementation of Municipality GIS			
Brief description of the project	This project is a prerequisite for the implementation of all other projects of the strategy. It is expected to perform activities related to establishment of the basic functionalities of GIS centre as a basis for further development of GIS.			
Aims	• Introducing GIS technology into Local Government activities • Enabling access to basic spatial data set and functions for users besides Local Government • Establishing basis for further development of the Municipality GIS			
Prerequisites for implementation	• Completed installation of hardware and applicative software • Developed LAN of Local Government • GIS server linked with LAN of Local Government			
Activities bearers	GIS Center, Informatics Department			
Activities	• Preparatory activities and formation of Municipality GIS server • Processing existing spatial data owned by Local Government (scanned cadastral and topographic maps, master map and regulation maps data, administrative units) and inputting the data into Municipality GIS server • Installing Municipal WMS server • Implementation of basic GIS functions for the needs of the Local Government through adequate web GIS application (access to data of the Municipality GIS/WMS server) • Linking the Municipality GIS with the Local self-government information system (Hermes applications and data) • Training of Local Government employees for using GIS • Enabling access to several Municipality GIS services via the Internet for citizens • Enabling access to some services of Municipality GIS via the Internet for: public companies, Land Development Public Agency, Public Town Planning Agency, Telekom, Electro distribution) • Expanding the Municipality GIS using the Cadastral data (application changes that are done in the Local Government)			
Estimated implementation time schedule	Year 1 2006(70%)	Year 2 2007(30%)	Year 3 2008(0%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	0	0	0
Expected users (target groups)	Local Government, citizens, Municipal public companies, Land Dev. Public Agency, Public Town Planning Agency, Telekom, EDB			
Expected benefits	• Use GIS functionality in everyday Local Government activities • Citizens and institutions have insight into Municipality GIS data • Speeding up the spatially orientated business processes			
State of project prep.	• No project documentation has been done			
Note	• *Exchange* project "Building up Pirot Municipality GIS Centre " anticipates realisation of some of the activities within this project			

Table 6-2

87

Project Name	Formation of Address System database			
Brief description of the project	It is expected to perform activities related to forming Address System database. Realisation of this project is an important prerequisite for a successful functioning of the other information systems and sub systems of Pirot Municipality GIS as a large number of objects and phenomena is defined by addresses.			
Aims	• Forming the Address System which would be official and unique for all users in Pirot Municipality • Building basis for the development of other segments of municipal information systems			
Prerequisites for implementation	• Updated spatial bases (Thematic contents of the *Base Map* – orthophoto, cadastral maps)			
Activitiy bearers	GIS Centre, Informatics Department, RECU Pirot			
Activities	• Street and house number digitalisation by using sketches and going on site if needed • Putting address system database (RECU uses the term 'Address Register) into official use			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(100%)	Year 3 2008(0%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	4000 EUR	0	0
Expected users (target groups)	All potential users of the Municipality GIS (Local Government , Municipal public companies, Land Development Public Agency, Public Town Planning Agency, Telekom, Electro distribution, citizens)			
Expected benefits	• Enabling spatial search based on addresses for all users of the Municipality GIS • Using unique addresses in all institutions and agencies			
State of project prep.	• No project documentation has been done			
Note	• The address system is in disposal of Geodetic Governmental Authority and it is preferable if it accepts the formed database, proclaims it official and maintains it further (by RECU, Pirot) • The Post of Serbia works on the production of the address system, and it can also be a potential partner with Pirot Municipalities in these activities			

Table 6-3

Project Name	**Inclusion of Real Estate Cadastre data into Pirot Municipality GIS**			
Brief description of the project	It is planned by the project to connect Local Government and Real Estate Cadastre Unit (RECU), Pirot and to establish Web service in RECU, Pirot.			
Aims	• Using Real Estate Cadastre data within Local Government Pirot			
Prerequisites for implementation	• Agreement signed between Pirot Municipality and Geodetic Governmental Authority (GGA) on providing web service for RECU Pirot			
Activity bearers	Pirot Municipality, RECU (PC "Komunalac", Water and Sewage Company, Public Heating Company**,** Land Development Public Agency, Public Town Planning Agency, Telekom, Electro distribution)			
Activities	• Project for telecommunication infrastructure - optional • Preparation of tender and selecting a contractor for telecommunication infrastructure - optional • Provision of hardware and software for wed GIS server which is to be established in RECU Pirot - optional • Preparation of data and establishing a web service - optional			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(100%)	Year 3 2008(0%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	15,000 EUR	0	0
Expected users (target groups)	Local Government			
Expected benefits	• Insight into updated cadastral data without going to RECU Pirot (for citizens and Local Government employees) • Less engagement of RECU Pirot employees • Faster solving of citizen's request • Establishing web services in RECU Pirot for cadastral data distribution a prerequisite will be made for other users than the Local Government to access and use the cadastral data			
State of project prep.	• No project documentation has been done			
Note	• Telecommunication infrastructure can be realised in three ways (significant difference in activities and costs): using Frame Relay service, Telecom, ADSL connections in RECU Pirot or connection with optical cable • There is a possibility for GGA to individually establish a web service (hardware and software) – no expences for the Municipality, besides the subscription for using data (4,000 EUR) • There is a possibility of financing other users of the Municipality GIS			

Table 6-4

Project Name	Development of Public Lights Maintenance GIS			
Brief description of the project	The state of public lighting is estimated as unsatisfactory in Pirot Municipality. Improving this service depends on spatial analysis and defining development and maintenance priorities, something this system can contribute a lot. The project should comprise project and implementation of GIS which supports the process of public lighting maintenance. This means collecting spatial data by a premeditated project model and providing GIS functionality at the applicative level.			
Aims	• Establishing basis for efficient supervision of the state and investment during the process of construction and maintenance of the common lighting			
Prerequisites for implementation	• Realised project Building up the Municipality GIS • Land Development Public Agency connected with the Local Government • Updated spatial base (Thematic contents of the Base *Map* – orthophoto, cadastral maps, DTK5)			
Activities bearers	GIS Centre, Land Development Public Agency			
Activities	• Design of a detailed data and function model • Development of GIS functionality • Collecting spatial and descriptive data • Tuition of the employed in Land Development Public Agency and Local Government • Update of base maps and data sets (Thematic contents of the *Base Map* – orthophoto, cadastral maps, DTK5)			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(100%)	Year 3 2008(0%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	10,000 EUR	0	0
Expected users (target groups)	• Land Development Public Agency; Town planning, Residential and Communal Activity, Construction and Inspection Department; Municipality Manager; Municipality President			
Expected benefits	• The state of the common lighting efficiently supervised • Investments efficiently supervised • Facilitated of network projecting process and activity planning			
State of project prep.	• No project documentation has been done			
Note				

Table 6-5

Project Name	**Production of digital orthophoto for the Pirot Municipality**			
Brief description of the project	It is planned by the project to produce digital orthophoto covering the Major map with ground pixel size 30cm and digital orthophoto for the rest of Pirot Municipality territory, with ground pixel size 50cm. A digital terrain model with heights in a grid (cell size 50 m) will also be produced within the project			
Aims	• Updated spatial data sets			
Prerequisites for implementation	• Digital orthophoto planned by CARDS project will not be done until 2008			
Activities bearers	Pirot Municipality, PC "Komunalac", Water and Sewage Company, Public Heating Company**,** Land Development Public Agency, Public Town Planning Agency, Electro distribution, Telekom			
Activities	• Producing the main geodetic works project • Preparation of the tender and selection of the contractor • Realisation of the project			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(100%)	Year 3 2008(0%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	35,000 EUR	0	0
Expected users (target groups)	• All users of the Municipality GIS			
Expected benefits	• Inexpensive and updated referent spatial base for the entire territory Pirot Municipality • Orthophoto can be used as a base for formation of other thematic units of GIS (digitalistion from ortphoto) • More efficient update of spatial modification and all kinds of projects • Digital terrain model for spatial analysis and projects			
State of project prep.	• No project documentation has been done			
Note	• Concerning the large number of the interested institutions, a share of Pirot Municipality in project financing can be very small			

Table 6-6

Project Name	Formation of the Utilities Cadastre database
Brief description of the project	Utilities Cadastre database is planned to be formed within this project (digitalising the existing cadastral maps with utilities networks). The database will be created according to GGA regulations and will be in official use. RECU will continue to maintain the data base afterwards.
Aims	• Establishing updated and official utilities cadastre database as a base for GIS utility network
Prerequisites for implementation	• The signed agreements between GGA and the institutions that build and maintain the utilities networks (Water and Sewage Company, Public Heating Company, Electro distribution, Telekom)
Activities bearers	(Water and Sewage Company, Public Heating Company, Electro distribution, Telekom, RECU Pirot
Activities	• Creation of the main project for the geodetic works • Preparation of tender and selection of the contractor • Project realization • Putting the database into official use

Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(10%)	Year 3 2008(90%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	1,000 EUR	9,000 EUR	0

Expected users (target groups)	• Land Development Public Agency, Town planning, Residential and Communal Activity, Construction and Inspection Department, JP PC "Komunalac", Water and Sewage Company, Public Heating Company, Electro distribution, Telekom, RECU Pirot
Expected benefits	• More efficient maintenance and management of the utility network by using GIS • Enables insight into updated utilities cadastre data base for all users of the Municipality GIS – the is no need to go to RECU • Reaching agreement faster related to works performed on the network • Land Development Public Agency defines the tax for construction land arrangement easier and faster • RECU Pirot maintains the data in their digital form. The survey data may be delivered in non-digital form – data processing is faster • Prerequisites for building GIS/TIS of utility companies have been obtained
State of project prep.	• No project documentation has been done
Note	• Concerning the large number of interested institutions, a share of Pirot Municipality for the project financing may be significantly small

Table 6-7

Project Name	Digital Topographic Map 1:5000 production			
Brief description of the project	It is planned by the project to produce a Digital Topographic Map 1:5000 (DTK5). For the area of Master Map for the town of Pirot. DTK5 will be done in the form of GIS database (geo-relational model) by using aerial photogrammetry.			
Aims	• Getting updated database with features required by Municipality GIS			
Prerequisites for implementation	• A digital orthophoto, with aerial photogrammetry photos are available in digital form, as well as DMT.			
Activities bearers	Pirot Municipality, PC "Komunalac", Water and Sewage Company, Public Heating Company, Land Development Public Agency, Public Town Planning Agency, Electro distribution, Telekom			
Activities	• Creation of the main project for the geodetic works • Preparation of tender and selection of the contractor • Project realisation			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(0%)	Year 3 2008(100%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	0	50,000 EUR	0
Expected users (target groups)	• All users of the Municipality GIS			
Expected benefits	• Obtained database of spatial features may be used for formation of other thematic units of the Municipality GIS, by simply assigning attributes to the existing features • Complex search can be performed with the digital topographic map database			
State of project prep.	• No project documentation has been done			
Note	• Concerning the large number of interested institutions, a share of Pirot Municipality for the project financing may be significantly small			

Table 6-8

Project Name	Development of Roads, Streets and Traffic Signalisation Maintenance GIS			
Brief description of the project	Significant capital is taken from the Municipal budget for this domain. Automation of this process is of great significance for the Municipality not only for future action planning but also for supervision of the works already performed. The project should comprise projecting and implementation of GIS which supports the process of roads, streets, road objects and traffic signalisation maintenance			
Aims	• Building a base for efficient observation of the road infrastructure state under authority of local self government and investments in this domain			
Prerequisites for implementation	• Building up Municipality GIS project realisation • Land Development Public Agency connected with the Local Government via telecommunication infrastructure • Updated maps and spatial data sets (Thematic contents of the *Base Map* – orthophoto, cadastral maps, DTK5)			
Activity bearers	GIS Centre, Land Development Public Agency			
Activities	• Design of a detailed data and function model • Development of GIS functionality • Collecting spatial and description data • Tuition of the employed in Land Development Public Agency and Local Government			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(10%)	Year 3 2008(90%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	1,000 EUR	9,000 EUR	0
Expected users (target groups)	• Land Development Public Agency; Town planning, Residential and Communal Activity, Construction and Inspection Department; Municipality Manager; Municipality President			
Expected benefits	• Efficient observation of the municipality road infrastructure state • Efficient investment observation • Facilitated observation of the budget capital spending • Facilitated process of work planning • Improving the road infrastructure state			
State of project prep.	• No project documentation has been done			
Note				

Table 6-9

Project Name	**Development of Communal Objects Maintenance GIS**			
Brief description of the project	One of the basic town features is the state of its communal objects. As this is a daily activity engaging a large number of employees both related to maintenance and to management and control and as the competence in all this is divided, the automation of this observation would significantly make the process more efficient. Establishing the system has the aim to provide basis for efficient planning and realisation of activities related to maintenance of markets, cemeteries, public greenery, disposal area and other utility objects.			
Aims	• Establishing a basis for markets, cemeteries, public greenery, disposal area and other utility objects maintenance			
Prerequisites for implementation	• Building up Municipality GIS project realisation • PC "Komunalac" connected with the Local Government • Updated maps and spatial data sets (Thematic contents of the *Base Map* – orthophoto, cadastral maps, DTK5)			
Activity bearers	GIS Centre, PC "Komunalac"			
Activities	• Design of a detailed data and function model • Developing GIS functionality on the applicative level • Collecting spatial and description data • Tuition of the employed in Local Government and PC "Komunalac"			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(0%)	Year 3 2008(100%)	Year 4 2009 (0%)
Estimated project implementation and operative costs	0	0	10,000 EUR	0
Expected users (target groups)	• Town planning, Residential and Communal Activity, Construction and Inspection Department; PC "Komunalac"; Municipality Manager; Municipality President			
Expected benefits	• Facilitated performance of work programme • Facilitated planning of works related to utility objects maintenance • More efficient system management • More efficient control of budget capital • More efficient inspection supervision			
State of project prep.	• No project documentation has been done			
Note				

Table 6-10

Project Name	Updating Utilities Cadastre database
Brief description of the project	It is planned by the project to update Utility Cadastre database produced by digitalisation of the existing cadastral maps with utilities network maintained by RECU Pirot. The database will be updated using data in disposal of companies responsible for utilities networks maintenance, as well as for recording utility lines in terrain. The updated data base will be verified by GGA, and RECU will continue to maintain it.
Aims	• Establishing updated and official utilities networks database as a basis for GIS utility network.
Prerequisites for implementation	• Signed agreements between GGA and the institutions that build and maintain the utilities networks (Water and Sewage Company, Public Heating Company, Electro distribution, Telekom) • Realised project "Formation of utilities cadastre data base"
Activity bearers	Water and Sewage Company, Public Heating Company, Electro distribution, Telekom, RECU Pirot
Activities	• Creation of the main project for the geodetic works • Preparation of tender and selection of the contractor • Project realisation • Putting data base into official use

Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(0%)	Year 3 2008(0%)	Year 4 2009 (100%)
Estimated project implementation and operative costs	0	0	0	100,000 EUR

Expected users (target groups)	• Land Development Public Agency, Town planning, Residential and Communal Activity, Construction and Inspection Department, PC "Komunalac", Water and Sewage Company, Public Heating Company, Electro distribution, Telekom
Expected benefits	• More efficient maintenance and management of utility network by using GIS • Enabled insight into updated utilities cadastre data for all users of Municipality GIS – unnecessary to go RECU • Permits for works on the network will be issued faster • Land Development Public Agency defines the tax for construction land arrangement easier and faster • RECU Pirot maintains the data in their digital form. The survey data may be delivered in digital form – data processing is faster • Prerequisites for building GIS/TIS of utility companies have been obtained
State of project prep.	• No project documentation has been done
Note	• Concerning the large number of interested institutions, a share of Pirot Municipality for the project financing may be significantly smaller • Estimation of costs for the project is based on very imprecise data about the number of surveyed lines, so it could be very unreliable

Table 6-11

Project Name	**Development of GIS based on the thematic unit Resources**			
Brief description of the project	• Pirot Municipality is very rich in various natural resources, but there is no unique record about it. Records that are a part of this project are records about natural resources, polluters, land using, tourist objects, energetics resources and population. This project represents collection of data by a previously defined model and providing GIS functionality in an applicative level.			
Aims	• Establishing a basis for observing natural resources and protection of environment			
Prerequisites for implementation	• Building up Municipality GIS project realisation • Land Development Public Agency connected with Local Government • Updated maps and spatial data sets (Thematic contents of the *Base Map* – orthophoto, cadastral maps, DTK5)			
Activity bearers	GIS Centre, Land Development Public Agency			
Activities	• Design of a detailed data and function model • Developing GIS functionality • Collecting spatial and description data • Tuition of the employed in Local Government			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(0%)	Year 3 2008(0%)	Year 4 2009 (100%)
Estimated project implementation and operative costs	0	0	0	10,000 EUR
Expected users (target groups)	• Town planning, Residential and Communal Activity, Construction and Inspection Department; Municipality Manager; Municipality President			
Expected benefits	• Facilitated using existing resources and their better control • More efficient environment protection • More efficient polluter control • Provided bases for programme and project development related to the topic			
State of project prep.	• No project documentation has been done			
Note				

Table 6-12

Project Name	**Building MAN telecommunication infrastructure of the Municipality GIS**			
Brief description of the project	Building telecommunication infrastructure of the Municipality GIS. Key participants in building the Municipality and its key users (municipal public companies, RECU, Land Development Public Agency, Telekom, Electro distribution) and would in this manner be connected in MAN network with optic cables.			
Aims	• Providing conditions for efficient information exchange between key institutions and agencies in Pirot, which use the Municipality GIS			
Prerequisites for implementation	• None			
Activity bearers	Pirot Municipality, PC "Komunalac", Water and Sewage Company, Public Heating Company**,** Land Development Public Agency, Public Town Planning Agency, Electro distribution, Telekom			
Activities	• Making the project • Making the tender documentation • Selection of the contractor • Work realisation in phases: • RECU Pirot and Land Development Public Agency (2007) • PC "Komunalac" • Other users (2009)			
Estimated implementation time schedule	Year 1 2006(0%)	Year 2 2007(10%)	Year 3 2008(13%)	Year 4 2009 (77%)
Estimated project implementation and operative costs	0	6,000 EUR	8,000 EUR	46,000 EUR
Expected users (target groups)	• All key users of the Municipality GIS (Local Government , municipal public companies, Land Development Public Agency, Telekom, Electro distribution)			
Expected benefits	• Efficient spatial data and other information exchange between all users of the Municipality GIS			
State of project prep.	• No project documentation has been done			
Note	• Realisation of this project is not strictly related to the development of the Municipality GIS, since the realised telecommunication infrastructure may be used in all other information flows			

Table 6-13

7 ABBREVIATIONS

BSM   -   Base State Map

BSM5   -   Base State Map in 1:5000 scale

CAD   -   Computer Aided Design

DCM   -   Digital Cadastral Map

DGM   -   Digital Geodetic Map

DTK5   -   Digital Topographic Map in 1:5000 scale

DTM   -   Digital Terrain Model

ED   -   Electro-distribution

GGA   -   Geodetic Governmental Authority

GIS   -   Geographic Information System

IT   -   Information technology

LAN   -   Local Area Network

MAN   -   Metro Area Network

MM   -   Master Map

OGC   -   Open Geospatial Consortium

PC   -   Public company

PCC   -   Public Communal Company

PTPA   -   Public Town Planning Agency

RDBMS   -   Relational Database Management System

REC   -   Real Estate Cadastre

RECC   -   Real Estate Cadastre Center

RECU   -   Real Estate Cadastre Unit

TIS   -   Technical Information System

TM25   -   Topographic map in 1:25000 scale

UML   -   Unified Modeling Language

WKB   -   Well Known Binary Format

WKT   -   Well Known Text Format

WMS   -   Web Map Server

8 LITERATURE

1. Arponen, M., Holopainen, M. (2002) : *Ground Level SDI, Building up a Common Municipality Data Transfer Interface*, City of Helsinki,

2. Grisé, S., (2003): *ArcGIS Urban Data Model (Draft)*, ESRI, January 2003.

3. ESRI, (2003) : *Enterprise GIS for Municipal Government,* ESRI white paper, *www.esri.com*, July 2003

4. Hartschuch, K., Mohl, H.U. (2005) : *Geoinformacioni sistem pokrajinskog glavnog grada Štutgarta*, Conference on Land management and GIS in Serbian municipalities – a tool for efficient citizen service, Belgrade, September 2005.

5. MassGIS, (2002) : *Getting Started With GIS – A Guide for Municipalities*, The Office of Geographic and Environmental Information (MassGIS), Executive Office of Environmental Affairs, Boston, Massachusetts, *www.state.ma.us*, 2002.

6. OU Pirot : *Specifikacija dokumenata OU Opštine Pirot, Odeljenje za urbanizam, komunalno-stambenu delatnost, građevinarstvo i inspekcijske poslove*, Interni dokument OU

7. RGZ, (2005) : *Stručno uputstvo za izradu i održavanje digitalne baze katastra vodova - Verzija 1.0*, Republika Srbija, Republički geodetski zavod, april 2005.

8. RGZ, (2005): *Stručno uputstvo za izradu digitalnog katastarskog plana (digitalizacijom skeniranih analognih katastarskih planova) - Verzija 1.0*, Republika Srbija, Republički geodetski zavod, jun 2005.

9. SKGO, (2005): *Strategija lokalnog održivog razvoja*, Program zaštite životne sredine i održivog razvoja u gradovima i opštinama Srbije 2004-2006, Stalna konferencija gradova i opština (SKGO), 26. maj 2005.

10. Uprava za informatičke i komunikacione tehnologije grada Niša, (2005) : *GIS Projekat grada Niša*, , Conference on Land management and GIS in Serbian municipalities – a tool for efficient citizen service, Belgrade, September 2005.

11. Valjevo (2005): *GIS Opštine Valjevo*, Conference on Land management and GIS in Serbian municipalities – a tool for efficient citizen service, Belgrade, September 2005.

12. *www.ogc.org*