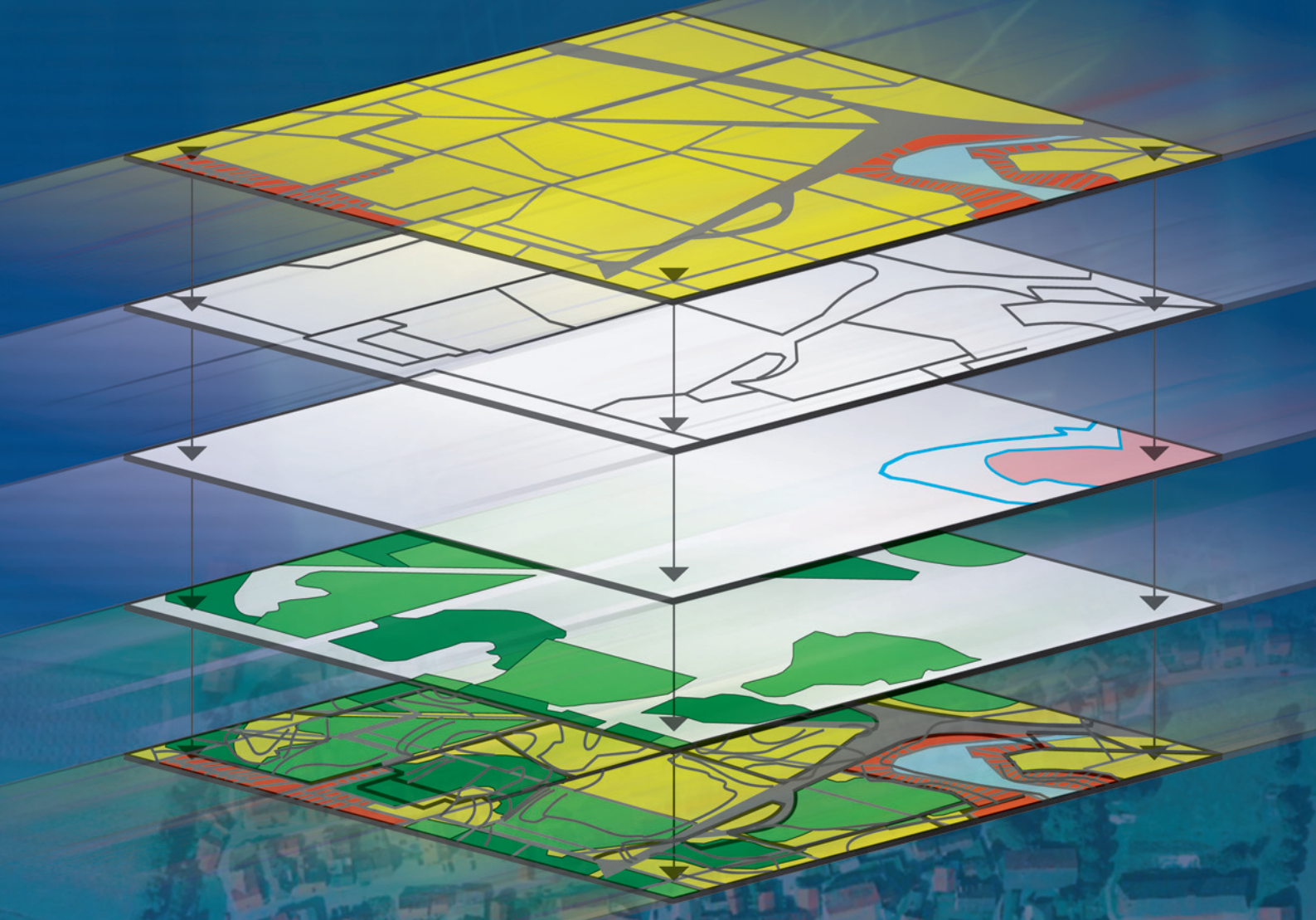
COOPERATION
REPUBLIC OF SERBIA
FEDERAL REPUBLIC OF GERMANY

GIS GUIDELINE

FOR LOCAL SELF-GOVERNMENT IN SERBIA



gtz German Technical Cooperation

SKGO

REPUBLIC GEODETIC AUTHORITY

Imprint:

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn
T: +49 6196 79-0
F: +49 6196 79-1115
E: **info@gtz.de**
I: www.gtz@de

Project Land management / Cadastre in Serbia
Kralja Vukašina no. 2
11000 Belgrade
T: +381 11 3693436
F: +381 11 3693439
E: gtz.lamacad@eunet.rs

Standing Conference of Towns and Municipalities
Makedonska 22/VIII
11000 Belgrade
T: +381 11 3223446
F: +381 11 3221215
E: secretariat@skgo.org

Republic Geodethic Authority
Bulevar vojvode Mišića 39
11000 Belgrade
T: +381 11 2650886
F: +381 11 2651076
E: office@rgz.sr.gov.yu

GIS Guideline for Local Self-Government in Serbia

Technical Cooperation between the Republic of Serbia and the Federal Republic of Germany

Land Management / Cadastre in Serbia

Authors:
Ulrich Voerkelius, Jelena Glavina, Claudia Specht-Mohl, Matthäus Schilcher,
Co-Authors: Bojan Cvetković, Klara Danilović, Dejan Petrović

Publisher:
German Technical Cooperation (GTZ)
Standing Conference of Towns and Municipalities (SCTM)

Editorial Board:

Kraljevo:
Dušan Simović

Kruševac:
Jelena Sekulić
Dragana Stepanović

Pančevo:
Miloš Stanković
Vladimir Vukajlović

Pirot:
Jovan Jovanović

Užice:
Mile Dikić
Miodrag Mijović

Further Organizations:

MSP

MEGA

PALGO

UN HABITAT

Project Management:

Christoph Steinacher, Team Leader
Branko Begović, Project Assistant
Reinhold Bäuerle, Program Coordinator

Preamble by GTZ

While working on the GTZ-project „Land Management / Cadastre in Serbia" the importance of GIS implementation in local self-governments became more and more obvious.

The majority of administrative tasks in local self-government units refer to a certain extent to spatial data. GIS is a highly effective instrument for modern administration dealing with spatial data and it becomes a more and more appreciated tool for improvement of land related administration.

This has led to GIS usage in local self-government units. But GIS has often developed in different departments of their own institution without any coordination. Different local self-governments in Serbia are developing GIS-Systems without common strategies, concepts and coordination.

To support a coordinated and structured GIS-implementation in Serbian local self-government units the GTZ project management decided to bring out a guideline on this topic. A General Agreement confirmed this decision during the National GIS-Conference held at Sava-Centre in September 2005.

One important basis for the elaboration of the guideline was the German "Guideline for GIS-implementation", published by the "Round Table GIS" (RTG) at the Technical University of Munich and the Bavarian Ministry of Finances. But it was an important issue to adapt this basis to the situation in Serbia concerning political, legal, financial and other aspects within a participative and transparent working process. Therefore five pilot self-government units have been involved in the development of the guideline. They are Kragujevac, Niš, Subotica, Sombor and Valjevo. Several visits helped to establish a close cooperation and to discuss the process of implementation. This experience was of high importance for adaption.

Several editorial meetings have been carried out in Belgrade. Beside the five pilots other Serbian self-governments which have already undergone this process or are far ahead were invited to contribute to the discussions. Therefore chapter 9.2 contains experiences from different self-government units.
Further support for the development of the GIS-Guideline was provided by SCTM, the RGZ and international donor organizations working in this field.

Christoph Steinacher
Team Leader
Land Management / Cadastre in Serbia

Preamble by SCTM

The book in front of you - The Guide for Implementation of Geographic Information Systems in local self-government units - is the first publication of that kind in our country. The purpose of the Guide is to accumulate technical, professional, methodological and other directions for all those who referred to our organization seeking for advice or help. This Guide should be of use to experts from local administrations, public utility companies, planning offices, as well as to decision makers on local level, if they still have any doubts of the necessity of GIS.

The amount of tasks which local government units are empowered to perform is increasing every day, along with the expectations of citizens and potential investors. Some local administrations started to implement modern technologies, which represent a part of *e - government,* in order to raise the effectiveness and quality of their everyday work. Since a large number of tasks is more or less related to spatial data, a many local self-governments choose to implement GIS - Geographic Information Systems.

The pioneer steps in this field were taken by some local administrations about ten years ago, by using local capacities and enthusiasm of the individuals who wanted to implement modern technologies and software into their everyday work.

However, during the last few years the number of local administrations which replace certain procedures with computer technologies has been increasing, together with the number of local representatives who refer to our organization requesting technical assistance.

These tendencies corresponded with the establishment of cooperation between SCTM and Land Management / Cadastre project implemented by GTZ based on the Agreement on cooperation between the governments of the Republic of Serbia and the Federal Republic of Germany. In December 2005, the agreement on cooperation was signed, according to which GTZ started supporting SCTM's Committee for Urban Planning (CUP), helping it to become a platform for dialogue and information exchange in the field of land management and GIS. Apart from this agreed objective, very soon it became clear that the role of CUP is to advocate for the interests of its members, due to the fact that neither relevant legislative framework nor unique methodology on national level existed. Some of the CUP's initiatives aimed in that direction, such as one targeting the creation of a National Coordination Body for GIS by the Ministry in charge. Another engagement of CUP in the future should be the initiation of a dialogue with the National Geodetic Authority (RGZ), about the kind of data which local governments need, and transfer and costs of data managed by RGZ. Those issues obviously require a joint approach.

It is important to mention the transparency of this Guide's elaboration process. In order to make full adjustment of this Guide to the Serbian legal system, a series of public presentations and discussions have been organized, with the presence of representatives from over ten local self-governments, RGZ and other partner organizations.

We use this opportunity to mention the special contribution of representatives from Niš, Kragujevac, Sombor, Valjevo and Subotica. With technical assistance of GTZ, they are establishing their own local GIS, using the methodology described in this particular Guide. We strongly believe that their experience would be at disposal to other Serbian towns and municipalities.

Secretary General
Đorđe Staničić

Preamble by RGZ

Supporting transitional goals of the Government of Republic of Serbia and the society as a whole, the Republic Geodetic Authority (RGZ) is aware that the real estate market, together with the financial market, will represent a precondition for the realization of individual and collective development in the future. Real Estate Cadastre (REC), as unique property evidence under the authority of RGZ, presents a guarantor of security and legality in the activities of real estate management, as well as land management in the entire Republic of Serbia. Apart from the ownership dimension, REC data are of high if not the vital importance for decision making in other domains of state interest like: spatial and urban planning; budget creation, investments programs, development plans and management of public finances in municipalities; protection of Constitutional rights; determination of a market value of real estate; creation of the policy and strategic documents in all areas of common and special state and society interest, etc.

As one of the most important strategic goals to be achieved by 2015, RGZ has placed realization of irrefutable position of RGZ as the most competent institution for collection, maintenance and distribution of spatial data on the territory of the Republic of Serbia. RGZ will take over the primacy in defining the national geoinformation policy, as well as a leadership position in development of the unique national spatial data infrastructure which will support conducting such a policy.

In order to satisfy variable and various needs and requests of numerous end users of cadastral products, RGZ will continue permanently to adjust the data quality, working processes and services with international standards and norms, while flexibly defined organizational structure will provide undisturbed and open two-way communication between RGZ and its surroundings.

Republic geodetic authority supports publishing of the GIS-guide for local self governments in Serbia, which should help management structures in cities and municipalities to better envisage what GIS means and its implementation and function in the processes of efficient decision making. We are faced daily with ever increasing needs of local self-governments for introduction of modern tools for planning and management of space based on information technologies. Apart from that, it is noticeable that there is no clear vision. There is also a lack of knowledge in requirements and role of GIS in the routine workings of local self-government. All of that imposes a need for the creation of guidelines, which will inform a wide audience of creators and GIS users about the benefits of modern technologies implementation and also about possible obstacles during implementation. GIS is an instrument to increase the efficiency and reliability in the work of local self-governments and enables citizens and other users to have better access to services at lower costs.

RGZ is authorized for collection, maintenance, guardianship and distribution of basic spatial data and information which relies on spatial data. Therefore, connection and cooperation with local self-governments is inevitable in order to provide more efficient system for decision making procedures.

In accordance with reform aspirations of the Government of Serbia and the best traditions of developed democracies and state administrations, RGZ will become an important public service that will efficiently and responsibly conduct its business for the benefits of the state, society and citizens.

Nenad Tesla

RGZ Director

General Table of Contents

Table of Contents in Detail

Summary

What is GIS?

GIS is an aggregation of databases, software and hardware which provides new possibilities of editing, manipulating spatial data while connecting graphic spatial data with tabular attributive data. GIS achieves a higher efficacy of management of spatial resources and of planning of future needs of a self-government unit. The GIS is a high quality instrument that supports the decision-making process.

In a GIS environment digital maps are connected to tables providing additional attributes, so maps which used to be only for viewing are now “speaking“.

With GIS, geodata may be

- captured and edited,
- stored and administrated,
- analyzed and queried,
- and put into a layout.

(For further information see chapter 1 and 2)

What is the benefit of GIS implementation for local self-governments?

80 % of decisions in local self-governments have to do with spatial relation, for example with cadastral parcels. Well known applications are utility cadastre, land management and planning.

GIS application foresees benefits:

- raised efficiency and cost reduction in administration,
- faster and better decision process,
- better connection to citizens.

What are reasons for GIS implementation in local self-governments now?

The duty of local self-governments, public enterprises and other public institutions to provide qualitative and effective services demand the implementation of new technologies which enable them to do so. GIS meets all those conditions.

Increasing tasks, more and more complex decision-making situations, the wish for more transparency, fast and fair tax collection make the application of modern information technologies necessary.

What sorts of GIS operations are conceivable?

Depending on the individual situation, different methods of operation for the GIS are conceivable:

- the local self-government operates the GIS itself;
- several local self-governments work together;
- the local self-government works together with a private service provider (partly or completely).

What steps for GIS implementation are necessary?

The implementation of GIS in a local self-government is not trivial. So a project for this ought to be created. Very simplified, the following steps are necessary:

- defining acquirements of the local self-government to GIS and working out a concept,
- decision for possible cooperation or outsourcing,
- looking for capable partners and GIS software,
- acquisition of geodata,
- training of staff.

(For further information see chapter 8)

First steps

To ensure the benefits of GIS implementation and to guarantee a stable process the following steps are suggested:

- Choice of a Project leader, supported by a GIS team with members of all involved organizations and companies,
- working out a project plan,
- organize information presentation for all involved, including deciders,
- inventory of tasks in the local self-government and acquirements for an potential GIS solution.

(For further information see chapter 8)

1 Introduction

1.1 Geographic Information Systems in Local Self-Governments

The majority of administrative tasks in local self-government units refer to a certain extent to spatial data. Modern information technologies bring with relatively small investments new services – information about space, about infra- and superstructures of urban and other zones, about plans on all levels and possibilities for carrying out plans.

During the last decade a steadily growing number of local self-governments throughout Europe have gone through the process of implementation of a Geographic Information System. GIS offers new possibilities of data storage and management and enables significantly quicker data analysis. Therefore, it makes administration and government tasks in various fields of application more efficient.

1.2 Goal of this Guide

The Guide is addressed to all self-government units in Serbia which are interested in an implementation of GIS to any extent or in an extension of their existing system.

It should help decision makers to get an overview of benefits and requirements of a Geographic Information System and enable them to decide: GIS – yes or no? Furthermore it should help those who are responsible for a GIS implementation in their local self-government to organize and manage the whole process.

The Guide is meant to provide basic information on the technology of GIS, the possible fields of application, the costs and the benefits of GIS and each step of procedure for implementation.

It is meant to be a practical work tool for planning and implementation as well as for including strategic and organizational management tasks.

The Guide consists of a technical part which is usable universally and a part adjusted specially to the circumstances in Serbian local self-government units. As an implementation of GIS doesn't only depend on political, legal and financial aspects, but also on socio-cultural aspects, these will be taken up in chapter 8.

The Guide is not meant to provide detailed technical information like other technical or scientific publications as external service providers are necessary anyway to fulfil the implementation itself.

Neutrality is one of the quality marks of this Guide. Therefore there will be no recommendations on certain software or service provider.

Another aim of the Guide is the clarification of the term GIS on local self-government level and the differences to other geoinformation systems, cadastre and other data.

1.3 How to Use this Guide

To find the information you are seeking, it is not necessary to read the whole Guide. The structure of the Guide allows you to concentrate on certain chapters which are relevant to your group.

In addition to the Guide there is a brochure directed at decision-makers containing a summary of the basic information.

The chapters which might be most important for decision makers are 2 where general information about GIS is given, 3 where reasons for an implementation are explained as well as the costs expected, and to a smaller extent 9 to get an overview of what the results of the whole procedure might look like. The project group should be familiar with chapters 2, 3, 4 which show the possible technical components of GIS and chapter 7 which deals with preparing contacts to the RGZ and chapter 8 where the workflow of the group itself is described. For technicians, chapter 4 is the most important one.

Finally the employees who are going to work with GIS are interested mainly in the chapters 3 where applications are described and 5 which provides information on data.

1.4 Where to Get Consultancy

When starting to plan the implementation of GIS, local self-government units may run into different dilemmas or problems. For all kind of question which might appear various possibilities or consultancy are given.

The SCTM has been observing the development of GIS in Serbian self-government units especially at the Committee for Urbanism. The process of implementation in all five pilot units of the GTZ project was

observed, but also other units of local self-government have provided the SCTM with data on their activities in this field. All collected experiences and observations are available for interested units by contacting the mentioned committee.

If interest is shown, there is a possibility to organize specific training in the field of GIS based on this guide at the SCTM Training Center. For further information on training, contact the SCTM and its Training Center.

Another possibility is the SCTM Consulting Center that provides consultation on this and various other topics of interest for local self-government units.

The pilot local self-government units Niš, Subotica, Sombor, Kragujevac and Valjevo as well as some other units that are quite far ahead with GIS implementation can provide detailed information on the procedure and especially on possible problems and how to avoid them. It is recommendable to build up a network of interested local self-governments for the exchange of experiences.

Some sort of network of local self-governments is the working group GIS established by the Urban Planning Committee of the SCTM. This working group has created an internet site for the exchange of experiences on the field of GIS implementation: http://gis.skgo.org

The private sector is another source of information as the amount of private consulting companies is steadily growing. Still you have to keep in mind that a private consultant is not always looking for the best solution for your local self-government but also for the most profitable one for himself. Therefore if the solution with an extern consultant is chosen his complete neutrality can't be guaranteed.

A national consulting body was developed to establish national regulations and to define standardizations especially for the exchange of data.

2 What is a Geographic Information System?

Traditionally, spatial data was represented in analogue maps (e. g. cadastral, topographic, thematic maps). Any kind of attributive data (e. g. property owner) was stored in lists or files. In case of inquiries, all necessary information was found by searching through maps and archives. With the development of digital maps it became possible to connect map objects directly with the attributive data information stored in databases. This made inquiries more efficient and opened up new possibilities for information retrieval.

Finally, this development resulted in the Geographic Information System technology, GIS.

GIS is an organized collection of computer hardware, software and procedures designed to support the capturing, editing, management, manipulation, analysis, modeling and display of data with a spatial reference for solving complex planning and management problems. GIS makes it possible to connect spatial data that consists of objects with a defined shape and location directly with attributive alphanumeric data.

A GIS project includes various so-called layers or feature types containing spatial data on different topics. Those layers can be arranged in an optional order depending on what exactly is to be presented. Every layer is connected to its own attribute table, that is to say its own database. By selecting one or more objects in the layer, the corresponding alphanumeric data in the table can be viewed.

With this new possibility of combined data storage, the retrieval of spatial and attributive data is speeded up enormously. By combining different layers new possibilities of data analysis open up.

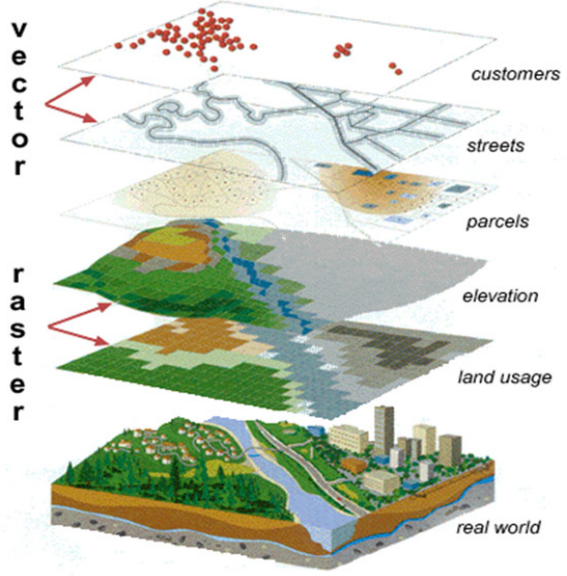


Figure 2.1: Typical examples of thematic data making up a GIS project
Source: ETHZ, 2006

Some basic GIS software functions are listed in the following:

Information on Features by Selection

Use the information button of the GIS Software to click and select on one or more objects in the map. The selected area being viewed is indicated by the change of contour color. The attribute table opens up and data concerning the selected features appears.

Spatial Queries

It is possible to select features located within or outside a certain defined zone, which cross the borders of that zone or are within a certain distance of another object. (Example: select all cities in Serbia through which the river Danube flows)

Attributive Queries

By using another function of the query builder you query for attributes fulfilling one or more defined conditions (e. g. cadastral parcel > 10.000 ha used as farmland with a certain soil quality) (Example: select all buildings in town X, which have a value > 100.000 €)

Buffering

This function creates one or more rings of a certain width around an object indicating the possible impact on the neighboring areas (e. g. noise from a highway, air pollution from a factory)

(Example: show an area of 200 m around a Kindergarten)

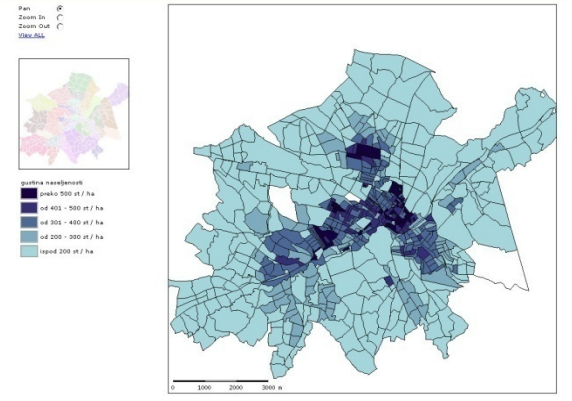
Further Spatial Functions

Intersection, spatial difference, etc.

(Example: show all parcel parts, which are not within a buffer zone of 100 m along the river)

Statistics

This function allows creating diagrams showing the percentile/classification distribution of attributes (See Fig. 2.2)



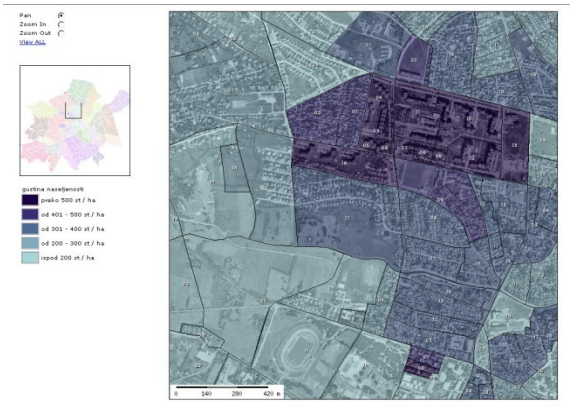


Figure 2.2/3: Example of thematic mapping: population density in the local self-government unit of Kragujevac
Source: Local self-government of Kragujevac

Table functions

The attribute table offers options like add/delete field so the user can edit data according to his needs, also he can carry out calculations with the existing data. (Example: area or outline of polygons)

Thematic Mapping

Thematic mapping is done via attributes or range of attributes of features. (See Fig. 2.4)

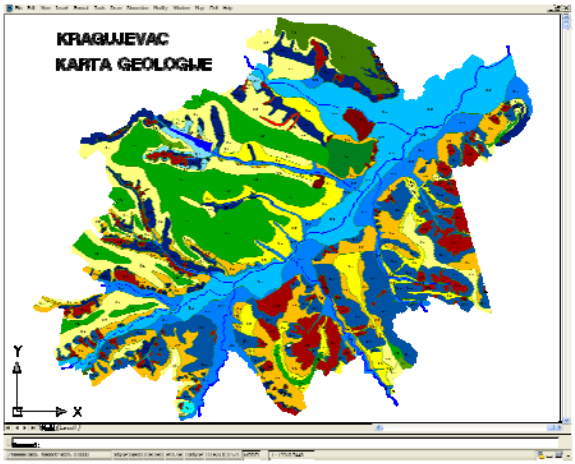


Figure 2.4: Digital geological map of Kragujevac
Source: Local self-government of Kragujevac

Layout

This function enables the user to prepare a printout including a scale, a north arrow, a legend and one or more maps.

3 Field of Application and Benefit of Geographic Information Systems in Local Self-Government Units

3.1 Why should GIS be implemented in a Local Self-Government Unit?

On a local self-government level, 80 % of all information, decisions and tasks are directly or indirectly related to spatial data.

In the course of decentralization Serbian local self-governments are turning more and more towards customer oriented service enterprises and administrations. Citizens' demands and expectations of Serbian local self-governments as well as of the economy and politics are increasing constantly. The use of GIS might be a means to help meet those expectations.

As in a lot of local self-governments where different city departments distribute spatial information as well as other local and national authorities and institutions, the data exchange is difficult and cost intensive. A lot of data related to property are out-of-date and only available in analogue form.

GIS provides the possibility to store data, maps as well as alphanumerical data in digital form, enabling authorities to exchange data more quickly and easily, even via Internet. Plus, GIS data has to be stored in a standardized way so that data from another institution doesn't have to be converted before using it.

In digital form, data can be combined more easily, that is to say different layers or feature types containing data from different institutions can be shown together so that data based decisions can be done much faster. Also, the retrieval and update of data can be handled with less effort.

All those points allow a quicker processing of every day internal activities in local self-governments as well as customer oriented services and, therefore, help increase the efficiency of a local self-government.

3.2 Field of Applications of local Self-Governmental GIS

Generally, GIS provides a wide range of possible applications. It can be found in almost any kind of institution dealing with spatial data (see Fig. 3.1), such as local self-governments, utility companies, tourist information, forestry and many more. It is used for organization and management of resources connected with space, planning and development of space.

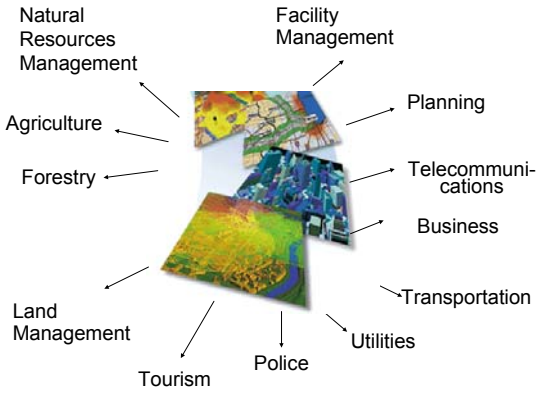


Figure 3.1: General field of applications of GIS
Source: Schilcher, 2006

Fundamental GIS applications in local self-governments are based on the real estate cadastre (REC) and the utility cadastre and are used for town and land use planning.

The real estate cadastre contains the necessary information on cadastral lots, buildings and parts of buildings (spatial data, area, purpose, number of floors, house number etc.). Also, it contains data on the holders of property rights and the possible obligations and limitations (mortgages, usufructs etc.). Changes in spatial data on real estate (division of the lot, construction or removal of a building etc.) and changes of ownership on real estate (decrees, court decisions, contracts etc.) are recorded in the real estate cadastre. Because a great number of transactions are connected to real estate, updated official data are of vital importance.

Utility cadastres help organize infrastructure elements namely for the waterworks, sewerage, drainage, hot water, electric power, telecommunication, oil and gas network. (see fig. 3.2). The plan illustrates underground and aboveground lines together with the devices that facilitate system functionality (manholes, chambers, pillars, pumps and other elements). Elevation, material, dimensions of piping, capacity and other similar characteristics are included as attributes of the spatial data. The Republican Geodetic Authority is in charge of establishing and maintaining the cadastre of lines.

Once special tools are installed it is possible to calculate e.g. the optimal location and material needs for a new pipe connection within a few minutes; something that takes days without the help of GIS.

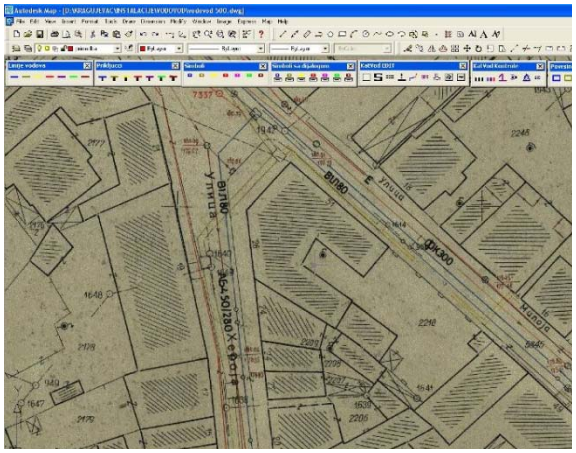


Figure 3.2: Digital utility cadastre Kragujevac
Source: Local self-government of Kragujevac, 2007

The field of urban and land use planning offers a number of possibilities for GIS applications, such as the spatial plan of the local self-government unit, master map, detailed regulations plan and others.

Showing different kinds of urban areas (residential, industrial areas, public buildings, green areas) enables the user to create and update maps quickly and easily (see Fig.3.3/4)

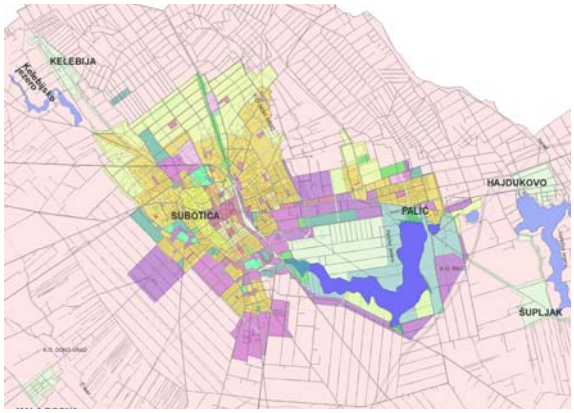


Figure 3.3: Master map Subotica
Source: Local self-government of Subotica, 2007

Figure 3.4: Master map Subotica, zoom on parcels
Source: Local self-government of Subotica, 2007

Site plans and area profiles are possible as well as rezoning and urban development planning (see Fig. 3.5).

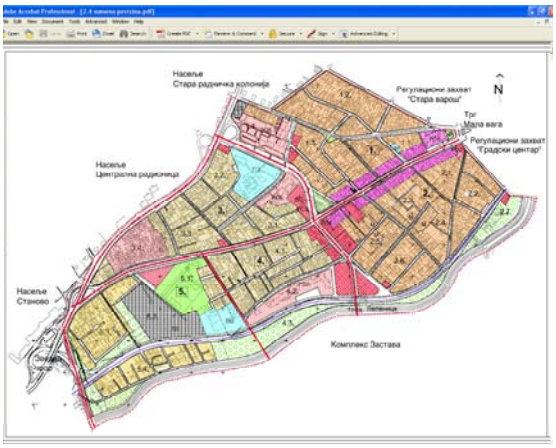


Figure 3.5: Urban plan Kragujevac
Source: Local self-government of Kragujevac, 2007

Apart from those typical applications dealing with every day procedures in local self-government, a well-developed GIS offers some more profitable possibilities for providing services. For example, cemeteries can be organized, the road network checked, maintained and developed in a way that helps prevent traffic jams. In recreational planning the need for parks and sports grounds can be analyzed and the cadastre of trees can be kept digitally. Further functions include recreation facilities management and parks maintenance. In tourism, trail systems can be developed, sights and tourism infrastructure managed. The results of votes or public opinion polls, e.g. on political items can be represented easily in GIS.

Figure 3.6: Digital road net Kragujevac
Source: Local self-government of Kragujevac, 2007

Furthermore, a well-developed GIS can be a source of additional income for a local self-government unit. Any kind of data integrated in a GIS can be easily combined with newly gathered data or such from other institutions. Therefore, different kinds of analyses can be carried out depending on the demand and the results then sold to interested customers. For example, a potential investor searching for a new location for his company might be interested in free well-connected parcels with a certain scope and not included in a future plan.

Utilities	Municipal Departments
- Water supply - Energy supply - Municipal cleaning	- Finance - Common business
Customers	**Governmental Institutions**
- Citizens - Corporations - Banks, insurances	- RGZ - Ministry of Interior…

Figure 3.7: Applications and users of GIS on local self-government level
Source: Modified after Specht-Mohl, 2006

3.3 Expected Benefits of GIS Implementation on the Level of Local Self-Government Units

Many local self-government units expect an improvement of land management by GIS implementation.

Essential enhancements are expected particularly for administration of the most important local self-government resources, for administration of real estate property and for execution of community tasks such as planning and direction. Serbian local self-government units can expect an increase in administration efficiency, resulting in cost saving, and improved and fairer decision-making processes. Consequently, the local self-government becomes more citizen and customer oriented.

The benefit caused by implementation of GIS to the local self-government level can be summarized in seven points:

- Citizen oriented services – quicker handling of inquiries;
- Permissions – speeding up and simplifying approval processes;
- Fees Assessment– fair and more efficient assessment and collection of taxes and fees;
- Administration efficiency – better information exchange between administrative bodies;
- Zone and regional planning – more efficient use and control of property;
- Economic and industrial development – quicker handling of investor's inquiries;
- Legalization – speeding up of legalization processes;
- Creation of cadastres under the responsibility of local self-government units (public lighting, local streets and roads, urban equipment…);

Speeding up of approval processes

One of the main reasons for a low rate of FDI in Serbia, recognized by experts, private sector and local officials, is the very complicated process of attaining building approvals for new construction. More than 100 different documents have to be collected from different offices from both local and national level authorities. The process sometimes lasts several months to more than a year. During that period the investor usually changes his mind and invests somewhere else.

Local self-governments that try to make some progress in this field already use software for handling and managing investor inquires by organizing one-stop counters and trying in different ways to help potential investors attain all the permissions faster.

GIS in local self-governments is also recognized as a good tool for better cooperation between different local institutions involved in the building approval process.

Land related taxes and other charges of local self-governments

In 2006 Serbia adopted a new law on local self-government finance. According to this law, property tax became the genuine local income, meaning local self-government units will be directly responsible for collection of this tax. To fulfill this task they will need accurate databases about all the buildings and property in their territory. Because the current databases kept by local tax administration offices are very inaccurate, local self-governments will have to update these databases with new relevant data to achieve efficiency of tax levy. Until now, property tax income didn't represent a significant part of the local budget. By introducing GIS into local self-government a significant improvement in property tax collection could be achieved, which could represent a visible and measurable gain for local authorities.

Apart from property tax, there are a few other local fees directly or indirectly related to land that are collected on a local level. Fees for construction land (city rent) or occupation of public space (summer beer gardens, stands etc.) are just a few examples of the local fees that can be collected and managed more efficiently by using GIS.

Regional and urban planning – physical planning

Most of the local self-government units in Serbia suffer from a constant lack of quality in urban and regional planning. Even though they were obliged by the law (law on planning and construction from 2003, amendments from 2006) to design and adopt a spatial (development) in local self-governments over a two-year period, only a few local self-governments succeeded in fulfilling this task. Lack of planning documents is recognized as the main reason for very low local economic development and a low level of FDI (foreign direct investments). Lack of plans is leading to illegal construction, urban sprawl and uncontrolled consumption of green land around Serbian towns and cities.

Professionals and local representatives agree that designing and adopting urban plans should be a priority for Serbian local authorities. GIS in local self-government could be recognized as an excellent tool for creating these plans, especially when it consists of accurate data from RGZ and public utility enterprises. Good cadastral data and utility cadastre represent the basic input for the creation of urban planning.

Legalization process

According to the 2003 law on planning and construction, a huge campaign for legalization of illegal construction has started. It was intended to cover all buildings built without building permits and all the other unregistered property. As a result of this campaign, and the second one from 2006, there were more than 450,000 applications submitted from all over Serbia. According to the official data from the Ministry for Infrastructure, by mid-2007 only 10% of all applications had been resolved successfully. The reason for such a low rate is mainly the bad documentation, small capacity of local self-governments administration and lack of up-to-date urban plans.

Some local self-government units in Serbia are already using GIS applications for solving legalization inquiries. GIS is a tool by which more efficiency in legalization process could be reached.

3.4 Costs of GIS in Local Self-Government Units

While deciding on a Geographic Information System for a local self-government, an analysis of economic efficiency is always part of the process. In the first phase of GIS implementation significant additional costs appear. A greater part of those costs are single costs while a certain amount of the budget has to be reserved for running costs.

In the following, the main items of the cost structure (see Tab. 3.1) are described.

Technology builds the background frame of any GIS and has to be installed before any kind of application can be started. The hardware includes the computers themselves as well as additional equipment such as scanner, printer, and plotter. These are single costs, plus there is the regular maintenance of running costs. The software is the GIS software itself, which is composed nowadays by a database and a data viewer in its most basic form. Data protection products such as firewall and antivirus software should be acquired before starting the system and updated from time to time, therefore this item appears both on the single costs and on the running costs side.

As data makes up the heart of every GIS the costs are also considerable. The building of a first database that facilitates the retrieval and organization of any kind of spatial, thematic or alphanumerical data is to be considered a single cost. The regular updating of this database as well as the retrieval of new data depending on the analysis requirements cause running costs that can differ from year to year.

The costs of staff depend mainly on whether new staff has to be employed or if existing personnel can improve their GIS skills. As project management is a very demanding task especially during the first phases of implementation it is advisable to make sure the persons involved have enough time for the GIS project. Therefore, some new employees might be necessary. Apart from management staff, further staff for building the database and the IT system should be considered from the start. An external service provider usually provides staff for GIS training but those costs should also be considered in the item "staff". On the side of running costs the item "staff" gets clearly reduced. The system administration and the use of GIS itself incur certain staff costs but as GIS applications help to save time in every day procedures those costs can be recovered.

In further costs the most significant item in the single costs might be the possible reorganization of parts of buildings to create adequate room for the technical equipment and working stations. With running costs the need for working materials like paper or data carrier might increase slightly with the use of GIS, as samples of maps are often printed or copied for exchange.

Table 3.1: Overview of costs
Source: Runder Tisch GIS, 2006

	Single Costs	**Running Costs**
Technology	- hardware - software - data security - internet - intranet	- system maintenance - data security - internet - intranet
Data	- data retrieval (spatial base data, spatial thematic data)	- updating - gathering of new data
Staff	- project management - building of a geodata base - IT-staff - training	- system administration - GIS staff - running training
Further Costs	- materials - reorganisation of buildings	

Cost Distribution

An analysis of the cost distribution makes it obvious that data and any costs related to the data make up more than one half of the total costs (see Fig. 3.8). The technical equipment, that is to say the hardware and software make up about one third of the total costs. The costs for consulting and training can vary between different local self-governments. On one hand they depend on the size and therefore the requirements of the local self-government and on the other on the know-how already available of the local self-government staff.

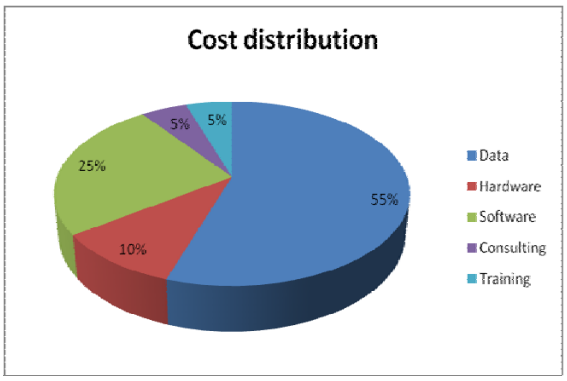


Figure 3.8: Cost distribution of GIS
Source: Voerkelius

4 GIS Components and Systems

As the figure below shows, three basic components make up a GIS. They are hardware, database and software.

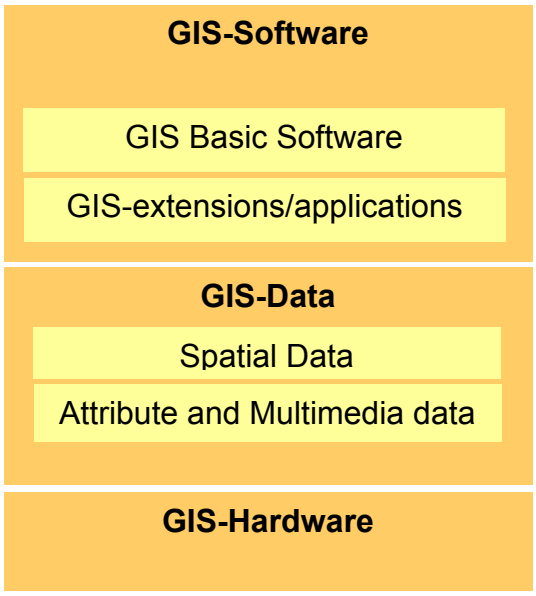


Figure 4.1: GIS components
Source: Changed after Technical University of Munich, Schilcher, 2006 and RT-GIS, 2003

The hardware includes the computer, usually a personal computer, storage media, input and output components.

The GIS basic software provides the user with numerous GIS-functions for editing, data query and presentation. Depending on the system, powerful tools for programming and model building are available.

Set up on this basic software different applications are running. They provide the user with additional functions and tools for special usages, like utility cadastre or urban planning. They make the GIS much more powerful and user friendly in special fields of application.

The necessary data for using GIS are stored in files or in a geodatabase. Besides the geographic information for geo objects like coordinates of points, lines and polygons are linked with the attribute data, which describe these geo objects. Depending on the data model further more sorts of data like meta data and multimedia data are stored. Modern GIS-software usually includes a database management system, and provides furthermore the possibility to get connected to external geo databases.

The lifetime of these components is different and may be estimated as shown in the following table:

computer equipment	2 - 5 years
software	3 - 8 years
data	10 - 50 years

For the GIS software different concepts are available, which complement one another. Even if a clear separation is not always possible, the following architectures may be listed:

- Desktop GIS
- Client Server GIS
- Internet GIS
- Mobile GIS.

4.1 Desktop GIS

Desktop GIS solutions run on personal computers at the workplace. Often these systems specializing in certain applications have basic GIS functionalities. They are mostly easy to use, keeping training costs low.

They are often used as standalone working stations or they are used in a network with a common database.

Scaled down from these systems there are “low cost” systems only for querying, viewing and printing prepared datasets.

But there are also systems belonging to this desktop architecture that have the complete functionality of a high end GIS.

So on one hand, with desktop GIS a very simple solution can be implemented, for example only for one working place. On the other hand, more complex systems with working places for viewing, editing and high end GIS working, with common data storage used by intranet, (see Fig.4.2) can be developed.

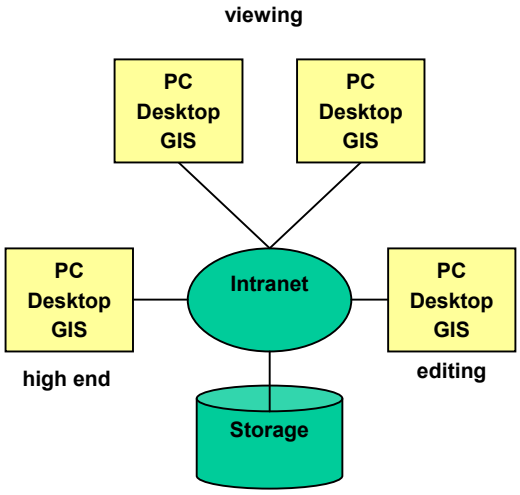


Figure 4.2: Possible desktop GIS solution

4.2 Client -Server

Client Server Systems follow another philosophy. In the center a powerful server computer provides the so-called clients with geodata and GIS functionalities. Often clients are used as terminals; in that case they only send questions to the server and get answers in the form of screen pictures. That means they only need low computing power. The server carries out the whole data processing.

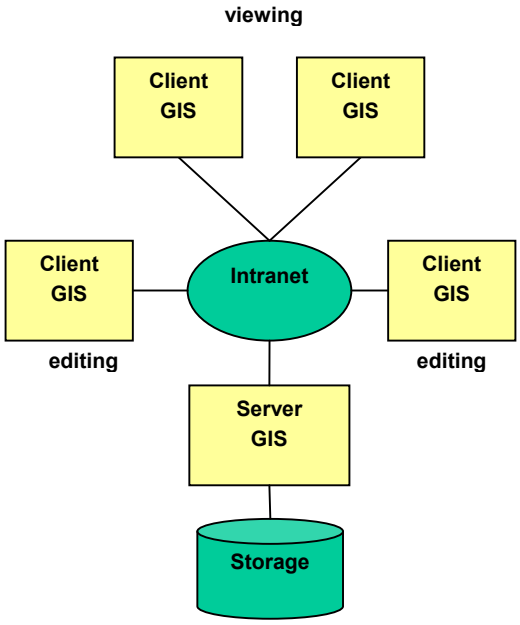


Figure 4.3: Client server GIS solution

In short the functionalities of clients can vary from simple viewing functions up to full GIS functionality with editing and data processing. Usually, the implemented server software is a high-end GIS software.

4.3 Internet GIS or Web GIS

4.3.1 Web GIS

Another form of client server system is the so-called web GIS. The server provides the clients with information via Internet. An Internet browser represents the client. Like in other Internet applications, the browser sends requests to a server in the Internet. These applications do not need additional software to be installed. Sometimes java plug-ins are needed.

So the amount spent on administration is very low. Instead of using the Internet, these systems may be installed within an institution using an Internet mapping server within the intranet.

The functionality of web GIS is limited. Normally, it is used to view solutions with simple data query. Partly, simple editing functions are available, more or less as redlining. Only a few systems allow editing of the geo database via Internet.

4.3.2 Google and other Earth Viewers

Since 2005 when Google's products Google Map and Google Earth first appeared several other companies came out with similar Earth Viewers.

What exactly is an Earth Viewer?

- An internet based public system which enables the user to view a basic set of spatial data built upon satellite and aerial images;
- usually used for private needs, but also in tourism, real estate marketing, insurance;
- offers possibility of implementation of own data.

The most common Earth Viewers are:

- GoogleMaps und GoogleEarth (Google)
- Virtual Earth (Microsoft)
- Map24 (Mapsolute)
- Yahoo!Maps (Yahoo)
- NASA World Wind (NASA)
- ArcWeb Explorer (ESRI)

Because Google Earth offers its basic services for free, it has become the most used Earth Viewer. Its main advantages will be explained here.

Google Earth provides the user with a set of high resolution and regularly updated global images. Its interface is easy to control even for new users and doesn't require any training. A 3-D visualization of the globe offers the possibility to turn it in any direction, to zoom in and out or to set own marking points. With further zooming in, the visualization changes from satellite to aerial images where available (mostly for cities). Further functionalities enable the user to create personal data with a spatial reference and to present it in a graphically adequate way. Any kind of personal data can be stored and reused.

The invention of earth viewers, especially by Google, Microsoft und Yahoo, has caused significant developments in the geoinformation market. New user groups are interested in geodata and new possibilities for commercial use are developing.

In the field of classic GIS applications, EarthViewer establishes new possibilities for data integration and may be used additionally for data presentation. This is possible by keyhole mark-up language interfaces (KML) and interoperability between Web GIS und Google Earth via Open Geospatial Consortium Interfaces (OGC).

At the moment several research projects are underway. They mainly aim at data acquisition, user-friendly functionalities and 3D animations.

These systems may not replace classic GIS.

4.4 Open Source Systems

These systems are based on software with an open source code which is often available as a free Internet download. For the most part, no solutions for special applications as utility cadastre are available. So these systems have to be adapted by experts. Some private companies specialize in this.

GIS software for desktop use is available as open source systems but also as solutions for web mapping. It has to be kept in mind that there often is no commercial support or training and that in overall calculation these systems are not automatically cheaper than proprietary systems. It is necessary to clear this up with thoughtful examination.

Some software houses have simple solutions for data viewing, mostly free or available as shareware.

4.5 Mobile GIS

Special systems have been developed for using GIS technology outside. They run on tablet computers or as very handy tools on PDA systems. In the first case, they may have full GIS functionality including complex editing of geodata.

On PDA systems they are more useful for providing the user with geodata, in combination with simple GPS for positioning. With forms they even allow input of attribute data. Some systems allow editing. The limited screen size prohibits easy viewing.

Figure 4.4: Mobile GIS running on a PDA

4.6 Geoportal (Usage of Shared Data)

Benefits of using GIS increase with geodata availability. So it is important to be able to integrate different sources of geodata. In the future, more and more geodata shared on different web servers will be available. So-called geoportals are nodes, from which the user can integrate offered geodata and geo web services. This data access may be connected with costs or not.

So the ability of systems to embed these services, based on OGC standards like WMS or WFS, becomes more and more important.

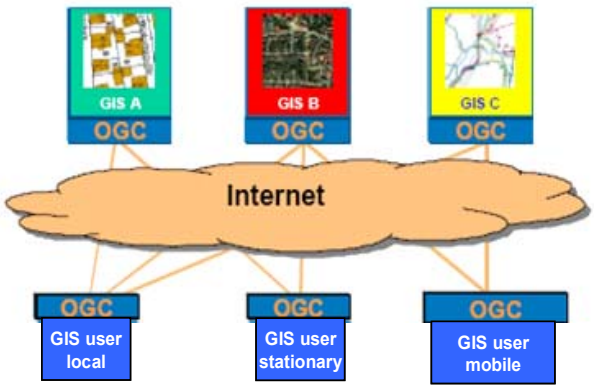


Figure 4.5: Online access on shared geodata on basis of OGC standards
Source: Schilcher, 2004

4.7 Method of Operation

Depending on the individual situation, different operation methods for the GIS are conceivable:

- The local self-government unit operates the GIS itself.
- Several local self-government units work together.
- The local self-government unit works together with a private service provider (in part or completely).

4.8 What's the Suitable GIS Architecture for a Local Self-Government Unit?

It is not possible to say in general which GIS architecture is the best for a local self-government unit. But there are some aspects that should be considered.

The choice depends on the individual requirements of the local self-government, plus the existing software and know-how. Finally, it should be taken into account to whom data exchange is important.

To assure that all these facts are considered a structured approach to GIS implementation is given in chapter 8.

First, it should be decided who will use GIS. It is not only a tool for specialists. An administration should provide many employees with access to GIS to reap the full benefits. In keeping with this, it has to be determined who needs what functionality. Only a few specialists need all GIS functionality and must have the necessary knowledge. Most only need simple functions for geodata viewing that only require simple and easy to use systems.

To assure suitable and smooth work when using geodata in the network requires a powerful network within IT.

5 Data in Geographic Information Systems

Spatial data includes any kind of data with a reference to the location and shape of objects and makes up the most important part of GIS, which will be explained in more detail in chapter 5.1. Furthermore, other types of data make the system complete and enhance it.

Within a GIS project non-spatial data, also called attribute data, consists of alphanumerical data with a reference to its corresponding spatial data. Usually it is stored in tables or databases that can be connected to the GIS project. An attribute table consists of several rows containing thematic information of the geometric elements they are connected with.

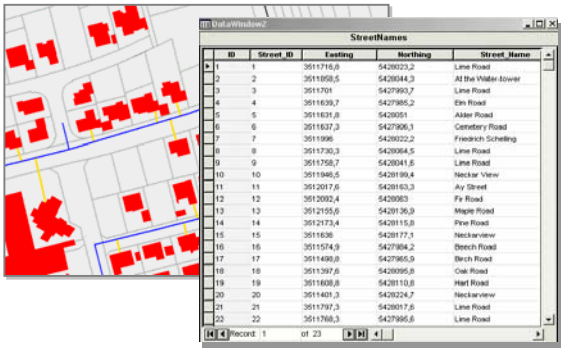


Figure 5.1: Connection of graphical and alphanumerical data in GIS
Source: Stuttgart University of Cooperative Education, Specht-Mohl, 2004

Metadata is a summary document providing descriptive information about the data used in a project. It may contain the content, quality, owner, origin, reference system and spatial information about a data set. It can be stored in any format such as a text file, Extensible Mark-up Language (XML) or a data base record. Collections of metadata records are the basis for data catalogues that can be searched by potential data users. Metadata makes it easier to share data and reduces data duplication. Information about existing data becomes readily available to anyone seeking it.

Multimedia data are not an obligatory part of a GIS project but offer possibilities for a more attractive presentation of the project. They can consist of simple text documents or images for simulation, animation and audio or video files.

5.1 Spatial Data in Detail

5.1.1 Reference Systems and Georeferencing

Data with different places of origin can refer to different reference systems and projections. For example, some data have an UTM projection and other a Gauss-Krueger-Projection or they refer to different meridians in the same projection. Therefore, it should be possible for data to be transformed or converted into the coordinate system which is used by the local self-government, meaning the one used by the RGZ, when it is imported into a GIS. In the future, the official projection will be UTM.

Reference Systems

A reference system describes the position of Geo data on the earth. It comprises the geodetic datum (reference Ellipsoid and its local fixation on it), the coordinate system and its projection. In this interrelation the European terrestrial reference system ETRS should be mentioned (see links in Chapter 10).

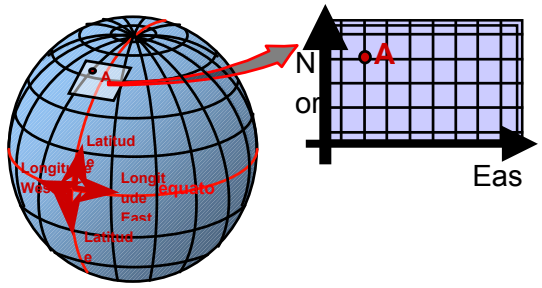


Figure 5.2: Giving spatial data a direct spatial reference
Source: TUM, Schilcher & Voerkelius, 2006

Georeferencing

Analogous maps and plans can be converted into a digital form (raster) by scanning. Scanned maps and plans are to be georeferenced via transformation from a raster into a state or local coordinate system. Georeferencing is done by using points taken from the state or local coordinate system with the help of special software. After this, georeferencing maps and plans can be used for GIS needs.

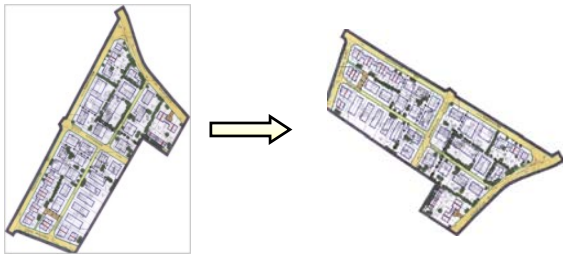


Figure 5.3: From a scanned to a georeferenced map
Source: as above

5.1.2 Raster, Vector Data

Spatial data can be split up into vector and raster data. The type of data usually depends on the purpose for which it is intended. In the case of vector data, basic graphic elements are points, lines and areas with their own coordinates, while raster data consists of pixel. The conversion of data from one type to the other is possible but can be connected to a loss of data.

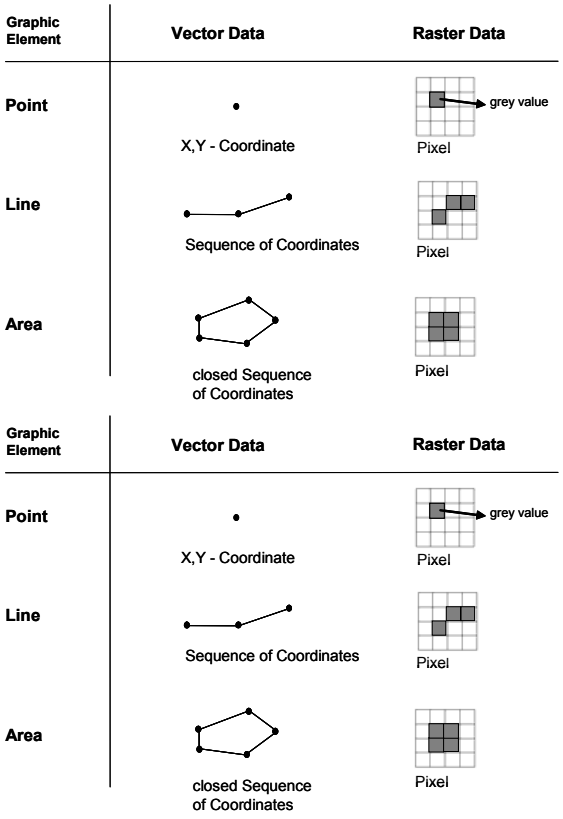


Figure 5.4: Difference between vector and raster data
Source: Bill & Fritsch ,1991, modified by Specht-Mohl

5.1.2.1 Vector data

For GIS vector data a topological data structure is indispensable. Topology describes the relative position of graphic elements to each other in a certain neighborhood. Many spatial queries can only be solved if the topology is known. Topological information is necessary, for example, to find the optimum path between two locations. Redundant data can only be eliminated if topology is stored. For example, the common border between 2 parcels has only to be stored once.

Vector data requires only a minimal storage volume while it enables the user to create accurate and attractive graphics. Also the updating and generalization processes are easy to handle. Still, the analysis of data may cause problems.

5.1.2.2 Raster data

Raster data in GIS is mainly used in raster maps, orthophotos and satellite images (see below). It consists of cells (pixels) arranged in rows and columns. Each cell has its unique x-y address and is assigned a specific value.

Raster maps are used in smaller scales, especially in fields of environmental analyses and planning. Raster data make complex analysis processes easier (e. g. spatial analyses, hydrological analyses). In terms of data collection and data structure raster data work simply and quickly. Compared to vector data the hardware requirements are very high. With cells discrete features are represented inaccurately and also a graphical hardcopy looks less attractive than one with vector data.

In the following, some of the most frequently used raster data products are explained in detail.

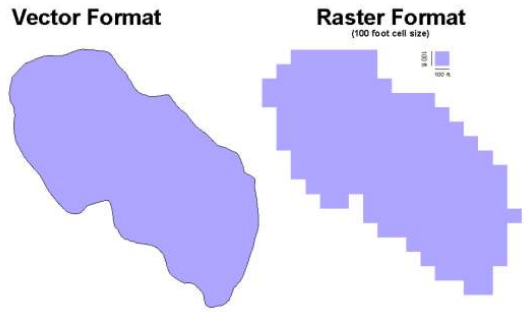


Figure 5.5: Area presented in vector and raster format
Source: Technical University of Munich, Schilcher & Voerkelius, 2006

Raster maps

Raster maps are scanned and are georeferenced analogous maps or they are converted from vector data. They are used to show one single kind of classification. Typical examples are maps of soil type, soil texture, land use, water body type, road class, and housing type.

Orthophotos

Aerial images never have a homogenous scale, so they have to be rectified. Differential rectification represents a state of the art process for guaranteeing a high geometrical quality. The image is rectified in differential small portions onto the XY plane (orthoprojection).

Furthermore, the quality of the digital elevation model (DEM) has a large influence on the orthophoto quality. Nowadays, the ground resolution (GSD) of orthophotos can be up to 5 cm.

Orthophotos make visual orientation easier and deliver additional topographic information.

Figure 5.6: Orthophoto Niš
Source: Local self-government of Niš, 2007

Satellite images

Satellite images are taken with line sensors from the orbit. They are finally georeferenced by planimetric polynomial transformations or orthorectification using a DEM. Actually the maximum possible ground resolution is 0.61 m. They are used to create or update maps, land use data, digital terrain models.

Digital Terrain Models

Digital Terrain Models describe the terrain surface by three-dimensional points (X, Y, Z-coordinates). These “height points” are e.g. integrated in a Triangulated Irregular Network (TIN) or in regular grids. Visualization tools can generate 3D perspective views. This application is not normally used in everyday government procedures but can be of great interest for example in tourism for planning trekking roads.

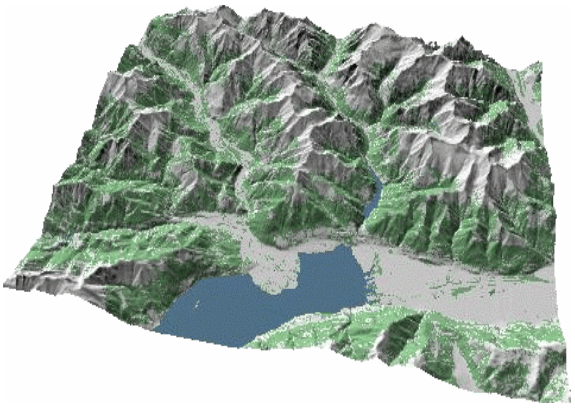


Figure 5.7: Digital Terrain Model (DGM)
Source: ETHZ, 2006

5.1.3 Spatial Base Data

Spatial base data in local self-governmental GIS are mainly data that are delivered by public geodetic authorities and are required by law. In the case of Serbia, the **Republički Geodetski Zavod** (RGZ) is the responsible institution. Available planning and thematic data in GIS should be based on official data provided by the RGZ. At the moment most of the data provided exist only in an analogous form, but scanning and digitalizing are taking place.

The Republican Geodetic Authority is authorized to keep the following data: (RGZ, 2007)

- **Real estate cadastre** consisting of the cadastral plan, the ledger and the collection of titles and documents. The cadastral plan is drawn for the territory of the cadastral unit. The plan contains data on the geodetic base, parcels, buildings and names (cadastral units, farmlands, roads, waterways, house numbers etc.) The entire territory of the Republic of Serbia is covered by cadastral plans. The greatest part of the plan is drawn in the Gauss-Krueger-Projection (scale 1:500, 1:1000, 1:2000, 1:2500 and 1:5000). There are a small percentage of plans in stereographic projection in Vojvodina (scales 1:1440 and 1:2880) and in the Soldner projection in central Serbia (scale 1:2500). The cadastral ledger is kept per cadastral units and it consists of the real estate folios. The real estate folios contain data on the parcels, buildings, parts of buildings (apartment, office space, garage), and on the holders of rights for such real estate (owners, holders and users), limitations and obligations regarding the real estate (mortgages, usufructs, permits).

  The collection of titles is a set of documents (contracts, decrees, decisions, rulings etc.) based on which the rights and the obligations are recorded.
- The **address register** comprises data on streets and house numbers.
- The **register of spatial units** comprises all the data on the border, name and ID number (or code) for the state, provinces, local self-government units, settlements, cadastral units, local communities and statistical circles.
- The **fundamental state map** is drawn in 1:5000 and 1:10000 scale.
- **Orthophoto** is a digital image in the orthogonal projection from a digital aerial photogrammetric image, a satellite image or an image made using other methods of aerial imaging.
- The **digital terrain model** is a continuous terrain surface with the buildings and phenomena that are visible, with known X, Y, Z coordinates.
- **Cadastre of lines** - above and underground lines and devices for all the infrastructure networks local self-government units namely waterworks, sewerage and drainage, heating pipes, electric power, telecommunications, oil and gas network.
- The **topographic plan** contains data on buildings and other constructions, materialized borders of the parcels (fences), type of use of the terrain and the existing vegetation, roads, waterways, visible parts of the lines, relief, names, house numbers, geodetic points etc. Topographic plans are important for local self-government planning and urban planning services to function. Topographic plans are made by authorized geodetic organizations at the request of investors.

Data kept in the cadastral ledger are kept in digital form for the entire territory of Serbia and are kept in digital base files (DBF). Data kept in the digital cadastral plans, the register of spatial units and in the cadastre of lines can be exchanged in standard formats for data exchange (DXF, SHAPE, ASCII, DBF). Data in the address register can be exchanged in the ASCII format.

Cadastral plans, the plans in the cadastre of lines and the register of spatial units are usually in analogue form. Their transfer into digital form is under way.

The digital terrain model is derived from stereo models and exists so far only for smaller land areas but is in progress.

Currently there is an ongoing project for the creation of a digital orthophoto for the entire Serbian territory, including the digital terrain model as one of the products. The resolution is going to be 40 cm in rural and 10 cm in urban areas.

The real-estate cadastre, the land cadastre, the address register and the utility cadastre are created and kept within the local geodetic authority which is responsible for a certain local self-government. At the moment the public and private sector have access to this data at a local level from the local cadastral authorities. In the near future, access on a regional level will be possible and on a long-term scale even access to the central RGZ database will be possible.

The work in the field of general geometry, the survey of the state border, projecting and professional supervising are under the central responsibility of the RGZ. Furthermore, the register of spatial units, the fundamental state map as well as all topographic-cartographic products are collected and kept on the central level.

In order to use survey data or data from the real-estate cadastre and the utility cadastre, for viewing the Real-estate Cadastre, as well as for services provided by the Republican Geodetic Authority a fee is paid in accordance to the Decree on the amounts charged for the use of survey and cadastre data and for services provided by the Republican Geodetic Authority (Article 131. Item 1 of the Law on State Survey, Cadastre and Registration of Real-estate Rights," Official Herald of RS", no. 83192, 53193, 67193, 48194, 12196, 15/96, 34/2001 and 25/2002).

5.1.4 Thematic Spatial Data

Spatial thematic data are data, which come from special disciplines like agencies for town and land use planning, cemeteries, forestry, environmental protection, traffic, water etc.

Some examples are listed below:

- Traffic infrastructure containing streets, roads, traffic signs, lighting, traffic objects, passengers transport, data on their condition, traffic density etc.
- Public areas containing green areas, parking spaces, sports, amusement and recreational fields, cemeteries, markets, health, social, educational, cultural and religious objects.
- Natural resources such as air, water, underground water, forests, mineral resources, natural sources of energy, natural values with their quality, threads, sources of noise etc.
- Statistical data are becoming an important part of spatial data for the analysis of the present state and planning. Also statistical data from the past are important to analyze and project trends.

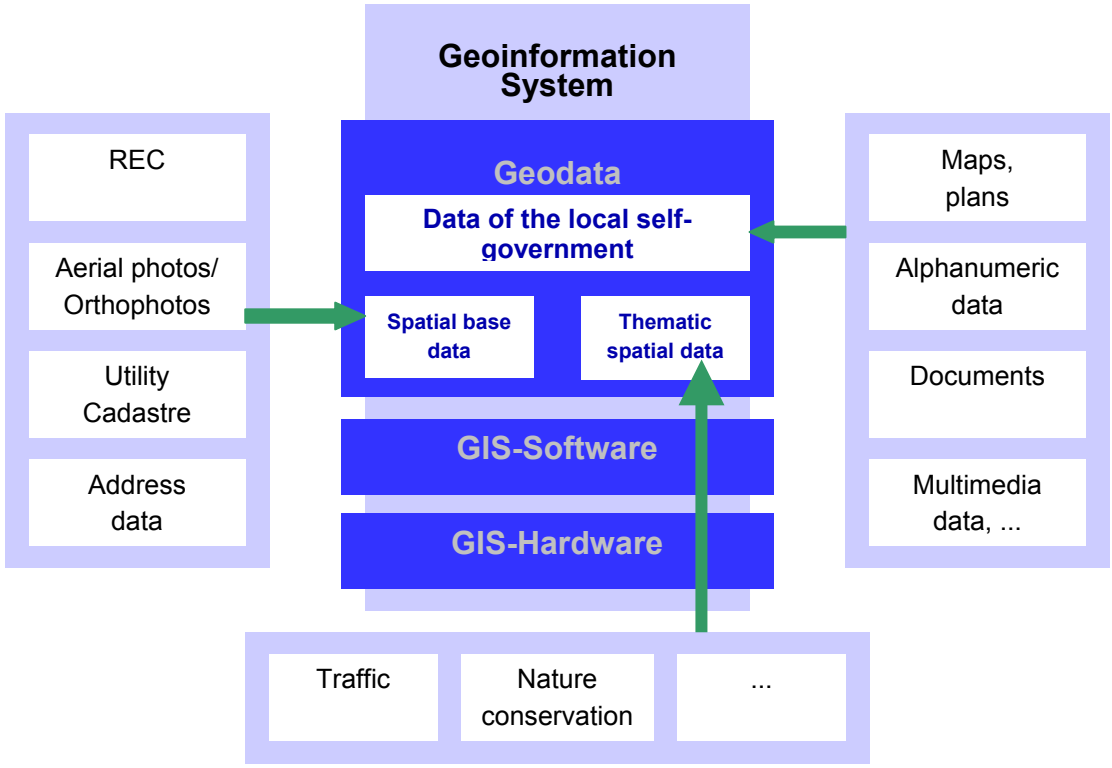


Figure 5.8: Geodata as an essential part of GIS
Source: Modified after RT GIS, 2003

5.2 Object Oriented Data Structure in Modern GIS versus CAD Based Structure

People often tend to confuse GIS with CAD as both systems offer possibilities of graphical presentation of space. This chapter is meant to explain the basic differences and to point out that they are meant for different kinds of tasks.

Computer Aided Design (CAD) was created for the construction of objects in the field of mechanics and architecture. GIS is meant for the derivation of spatial data out of geo databases. CAD systems offer a certain possibility of connection to tables (for example .mdb) but only for specific needs. Parallel manipulation of huge databases and the presentation of selected parts of data are only possible with GIS. Furthermore, it makes easy protection of data possible. Contemporary GIS tools enable the user to work with basic CAD functions. While information query in pure CAD is not possible at all, in GIS there are several possibilities of query building using special GIS and database functions.

CAD consists of graphic elements that are annotated by text elements. Layers differentiate different graphic element types. On the other hand a modern GIS contains spatial features or geo objects which are composed of geometry (points, lines, polygons) and attributes stored in a database.

Therefore, a CAD system may act as a kind of viewer and as editor for graphic data, but for complex analysis of spatial data only a GIS provides sufficient functions.

Still, nowadays, CAD systems often fulfill some of the typical GIS functions while GIS are expanding their functions towards CAD.

5.3 Data Sources

There are different possibilities for gathering spatial data depending on what kind and quality of data is needed and what already exists. The most commonly used data acquisition methods are listed in the following:

- **Scanning** of analogous maps results in raster data
- **Digitizing** of analogous maps results in vector data
- **Migration** of digital data from one format to another
- Gathering of new data by **surveying** or **mapping.**

Of course, the time needed for digitizing is greater than for scanning, but the result is also of higher quality. The costs for surveying and mapping can be very high, depending on the area and the data needed, but if the only existing data are not up to date this method leads to the most satisfying results on a long-term scale.

Traditionally, the production of geospatial data was the domain of governmental agencies (RGZ, see chap. 5.1). But nowadays the private sector is increasing its own data production. Private companies, such as engineering offices provide mapping and surveying services upon agreement.

By using GIS for land survey, which is possible under certain conditions, the aforementioned cost can be decreased. To achieve a high degree of precision the use of permanent stations, for example, the AGROS service (Active Geodetic Referent Network) is a possibility. It was established on 05.12.2005 and is controlled by the RGZ. Among other services, it offers the possibility of high precision positioning by implementing the kinematic method (RTK), differential method (DGPS) and static method (PP). In addition to AGROS, in some regions private services are available.

(For more details see chapter 10 – Web Sites.)

5.4 Data Exchange/Conversion

Data transfer

As different institutions often use differing data formats the transfer of data should be possible in a functioning GIS on local self-government level. Interfaces make it possible to export spatial data from one system to another. But as there are no standardizations for the formats a transfer is not always possible without a loss of data. Typically used formats are TIFF (Tagged Image File Format) for raster data, DXF (Drawing Exchange Format) for CAD-data and DWG, SQD or Shape File for GIS-data. For an optimal preparation of transfer schemata it might be useful to involve an extern service provider specialized on data conversion. Generally the easier the data structure is the easier also the exchange is.

5.5 Data Quality

How to define quality?

The word “quality” is commonly used to indicate the superiority of manufactured goods. In the case of data quality, it always depends on the context and the purpose, meaning data can only be suitable for a certain task. Data quality is defined by the following parameters:

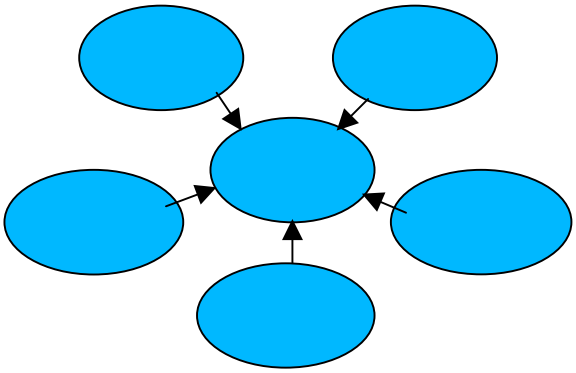


Figure 5.9: Parameters of data quality
Source: Modified after RT GIS, 2005

Topicality or relevance to the present

Depending on the kind of data, the surveying date might have an influence on the analysis results. For example, data on land use change permanently while data on soil conditions (agro quality) are applicable for decades. Data provided by state agencies can even have a limited period of validity.

Precision or resolution

Precision refers to the amount of detail that can be discerned, with raster data it is known as resolution. Resolution is always limited because no measuring system is infinitely precise and because data are generalized to create databases. Generalization includes elimination and merging of entities, reduction of detail, smoothing, thinning, and classification. The resolution of the database must match the level of detail required for certain tasks and is directly connected to the scale of data which the exact location of the objects depends on. The lower the resolution of an image, the lower the storage volume requirements are, which might make a low resolution desirable to a certain extent.

Accuracy

Accuracy is given if there are no discrepancies between the stored and actual value of a particular feature, its attribute or its geometric position. Problems with the accuracy of data appear in case of surveying, classification or the georeferencing errors. The most common discrepancies are spatial, temporal or thematic. The consequence can be an incorrect data analysis.

Completeness

Completeness refers to the amount of data included in the dataset. The whole area of analysis has to be covered (e. g. no clouds on an aerial photograph), including all the objects with all their attributes and values.

Consistency

Consistency refers to the absence of apparent contradictions in a database. Data should be free of redundancies hence stored only once. Furthermore, any kind of alphanumerical data must be clearly connected to the spatial data. Concerning vector data, there mustn’t be any gaps or overlapping.

Quality check

When ordering spatial data from an institution or gathering new data, the purpose has to be clear as well as the quality required. Usually a data model is drawn up containing general information like structure, scale (of the original digitized document), format, a short description, the spatial reference system, the way data are stored and the metadata. The quality of data should be checked before starting an analysis to avoid problems of reworking. The higher the requirements, the higher also the costs are.

The GIS software is able to check the consistency itself. By sampling a small percentage of the data, the other quality requirements can be checked quickly. It is also possible to install or automatically program checking processes within the software.

If an external service provider gathers data, the institution it is done for should have the only license and right of use.

If a GIS doesn’t exist yet in an institution but is in planning, state data should be gathered in way so that it can be integrated in the system later on without technical difficulties. Therefore, data of the same kind should always have the same structure (e. g. layers, legends, attribute table). Standardizations should be used if possible (see chapter 5.6). Metadata should provide sufficient information and CAD data should be of a structure, which makes it possible to be integrated into GIS.

5.6 Standards and Regulations

To enable a flexible exchange of data among different institutions and systems it is important to keep to some international, national or internal standards. Data transfer becomes considerably simplified then. Systems should be kept flexible even if the costs of such system architecture might be higher.

On an international level there are two GIS standardizations, the OGC (Open Geospatial Consortium) made up of worldwide leading GIS producers to promote standardizations and interoperability and the ISO (International Organization on Standardization). Free downloads are available on the Internet (see Chap. 10). The most important standards defined by them are listed below:

Examples of OGC:

- Simple Features

The purpose of these specifications is to describe interfaces, allowing GIS software engineers to develop applications that expose the functionality required to access and manipulate geospatial information comprised of features with 'simple' geometry and using different technologies.

- WMS: Web Map Service

Standardizations on how to request and provide a map as a picture or set of features, information about the content of a map and information about what types of maps a server can deliver

- WFS: Web Feature Service

Allows a client to retrieve and update geospatial data encoded in Geography Mark-up Language (GML) from multiple Web Feature Services. The specification defines interfaces for data access and manipulation operations on geographic features. A user can combine, use and manage geodata from different sources.

Examples of ISO:

- ISO 19115: 2003 - Geographic Information – Metadata (possible content of metadata, minimum requirements and additional information, common format XML);
- ISO 19106: 2003 Spatial Schema;
- ISO 19110: 2005 Methodology for Feature Cataloguing;
- About 400 other standards;

Those two standardizations are not contrary but complementary, so if a system is compatible with one of them it will work with the other one too.

Strict standards simplify the process significantly especially when creating a database containing data from different sources.

On a European level the initiative INSPIRE (**In**frastructure for **Sp**atial **I**nfor**r**mation in **E**urope) aims to create a European geodata base with integrated spatial information services. This EU Guideline engages members to provide an interoperable geo database. It came into force in May 2007. In this collaboration the working group of the German state geodetic authority AdV should be mentioned for its contribution to INSPIRE (see links in chapter 10).

On a national level a consulting body for GIS is in development, which may define further standardizations.

The RGZ has adopted the Digital Topographic Key (DTK), which defines the rules for cartographic representation of the content of the digital geodetic plan (digital cadastral plan, digital topographic plan and the digital plan of the cadastre of lines) and the rules for the creation of libraries of topographic symbols. The Digital Topographic Key has entered into force on 09.08.2005.

Also this institution is discussing the topic of data transfer between institutions, so the results might become a national standard.

In the field of utilities the RGZ has published the "*Professional instructions for the creation and maintenance of the cadastre of lines digital base*", which entered into force on 17.05.2005. With this manual the contents, technical normative, way of making and archiving of the utilities cadastre digital database as well as data protection have been regulated.

Furthermore, any institution can define internal standardizations that make data exchange among departments easier.

People tend to consider software providers as a kind of standard, which generally is the wrong approach. Standards do not depend on the system, as common systems are compatible with many different standards. It is of great importance to define standards of feature types.

5.7 Flexible Presentation of GIS Data

The presentation analysis-derived results might impact its interpretation. Therefore, an appropriate presentation is of importance. So the scale and the colors should be adequate and make the map easily understandable.

Once geo objects are stored in a GIS its visualization or graphic presentation can be changed easily according to different needs. Graphic presentation in GIS systems is generated via its attributes. Completely different maps and thematic maps can be derived easily at the push of a button from the same GIS datasets. Depending on the purpose of the presentation, polygons with the same attributes can be shown separately or as one common parcel surface (see example in Fig. 5.10).

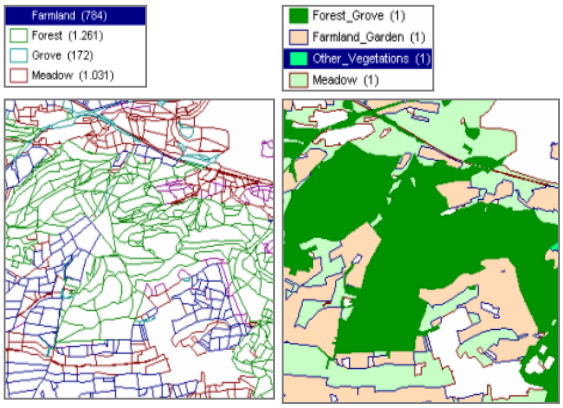


Figure 5.10: Flexible graphical presentation in GIS
Source: Specht-Mohl, 2006

6 Legal Demands on Local Self-Governmental GIS

The “Law on local self-governments” ("Official Herald of RS" Nr.129/07), (Zakon o lokalnoj samoupravi, (“Službeni glasnik RS", br. 129/07)) defines the responsibilities of self-governments. Based on the “Law on finance of local self-governments” ("Official Herald of RS" Nr. 62/06), (Zakon o finansiranju lokalne samouprave (“Službeni glasnik RS", br. 62/06)) property related taxes become the most important income of local authorities, which is collected directly by the self-governments. Of course, property tax is closely connected to accurate spatial data.

The “Law on planning and construction” ("Official Herald of RS", Nr. 47/03 and 34/06), (Zakon o planiranju i izgradnji, (“Službeni glasnik RS", br. 47/03 and 34/06)) defines the conditions and the kind of planning and space regulation, the use of land for building and the construction of objects. The law stipulates the main authorities for spatial planning, the main sorts of planning documents, spatial and urban plans. It also stipulates the responsibilities of state and local authorities in the planning process, construction, questions on land parcels, the use of building land, the legalization of objects built without a building permission.

The field of state survey and cadastre is regulated by the following laws:

- Law on land books, ("Official journal of the Kingdom of Yugoslavia", No.146 - L111 (July 1st 1930.), "Official journal of the Kingdom of Yugoslavia", No. 281 - HS (December 1st 1931.)),

  Zakon o zemljišnim knjigama, ("Službene novine Kraljevine Jugoslavije", br.146 - L111 (od 1. jula 1930.), "Službene novine Kraljevine Jugoslavije", br. 281 - HS (od 1. Decembra 1931.)),

- Law on State Survey, Cadastre and Registration of Real-estate Rights, ("Official Herald of RS", No. 83192, 53193, 67193, 48194, 12196, 15/96,34/2001 and 25/2002),

  Zakon o državnom premeru, katastru i upisima prava na nepokretnostima, ("Službeni glasnik RS", br. 83192, 53193, 67193, 48194, 12196, 15/96, 34/2001 i 25/2002).

List of regulations concerning the usage of data and services of the Republican Geodetic Authority:

- Decree on the keeping, usage and review of survey data and data from land cadastre, real estate cadastre and cadastre of lines ("Official Herald of RS" No. 47/03).

  Uredba o načinu čuvanja, korišćenja i razgledanja podataka premera, katastra zemljišta, katastra nepokretnosti i vodova, ("Službeni glasnik RS br. 47/03),

- Decree on the amounts charged for the use of survey and cadastre data and for services provided by the Republican Geodetic Authority ("Official Herald of RS", No. 45/02).

  Uredba o visini naknade za korišćenje podataka premera i katastra i pružanje usluga Republičkog geodetskog zavoda ("Službeni glasnik RS", br. 45/02).

These and other laws concerning the state survey, cadastre and other geodetic activities can be viewed and downloaded from the Internet site of the Republic Geodetic Authority.

6.1 Legal Frame of the GIS of a Local Self-Government Unit

Besides the existence of a national legal frame which is necessary for the realization of GIS in local self-governments and which is reflected in national laws on the field of activities of the RGZ, the field of activities of local self-governments as well as the information systems themselves, the existence of a local legal frame is necessary to define the legal frame and the relationships among the member organizations in creating GIS in local self-government. The legal framework given in the lower part of the text consists of three parts:

1. Memorandum of Understanding
2. Consent on Cooperation
3. Protocols of Cooperation

The Memorandum of Understanding is a general legal document in which the member organizations decide to take part in the GIS project in local self-governments on a high declarative level. The Agreement on Cooperation is a more direct legal document that defines the general rights and duties of the member organizations of the GIS project in the local self-government. The Protocols of Cooperation are not only one but a group of legal documents to regulate the relationships among the member organizations in all fields which are integral to a successful implementation of GIS in local self-governments. Some examples are “The Protocol on Exchange of Data of Local Self-Government Unit X”, plus “The Protocol on the Financing of GIS in the Local Self-Government X” and many more. It is important to note that the legal documents of the Memorandum and the Agreement are unique and unchangeable. There many documents of the protocols provided to all fields of member organizations considered important by the local self-governments to regulate their relationships. Furthermore, every protocol on cooperation mentions the documents of the Memorandum and the Agreement in the preamble as general and previous legal documents.
In the appendix general examples of the Memorandum of Understanding and the Agreement on Cooperation are given.

7 Communication Infrastructure of GIS

A successful implementation of GIS depends to a high degree on the willingness of those who are responsible for data availability and their acceptance of the importance of integration into such a system.

7.1 National Communication Infrastructure of GIS

Main data that are needed for work are:

- Orthophoto maps
- Streets and house numbers
- Digital cadastral maps or scanned maps including the positions of parcel numbers
- Data of the real estate cadastre
- Digital utility cadastre
- Urban documentation
- Statistical data

Institutions responsible for those data are:

- Institutions of the local self government units
- Public companies
- RGZ
- State institution for statistics
- Urban planning companies

There is a need to define the exchange formats for certain kinds of data, how to transfer them and the periodic updates of official databases. Besides the official data certain institutions are responsible for, it is possible to carry out a suitable collection of existing data from the terrain, which are not official but reflect the real situation and therefore contribute to the topicality of the databases.

The exchange of data can be done via Internet, or via an adequate medium (CD, DVD or similar).

The RGZ is the authority responsible for collecting and maintaining base data. Therefore, a successful application of GIS depends to a high degree on the relationship between local self-governments and the RGZ.

Minimal requirements for base data should be defined as follows:

- Orthophotos of the complete area of the local self-government units;
- Real estate cadastre containing the borders of parcels and buildings (presented as polygons), data on property (….);
- Address Codes for all buildings containing the street name, the number and the postal code;
- Infrastructural maps containing data on utilities (water, sewage, electricity, gas, heating…);
- Base data for urban planning containing the borders of planning units, land use data;

Furthermore, the RGZ should make sure that any kind of data gathered by the authority exists in digital form and is of high quality. Any maps should be object oriented and connected to an attribute table via a unique ID.

These are future-oriented requirements and not all of those quality features can be guaranteed at present. Especially digital data are not available for the whole area.

To ensure contemporary development and planning, it is integral for local self-governments to receive base data and their updates on demand at least twice a year. It is recommended to place a contract between single local self-governments or groups of self-government of the same region and the RGZ. The supply can happen via external storage media or with the development of high quality networks via Internet.

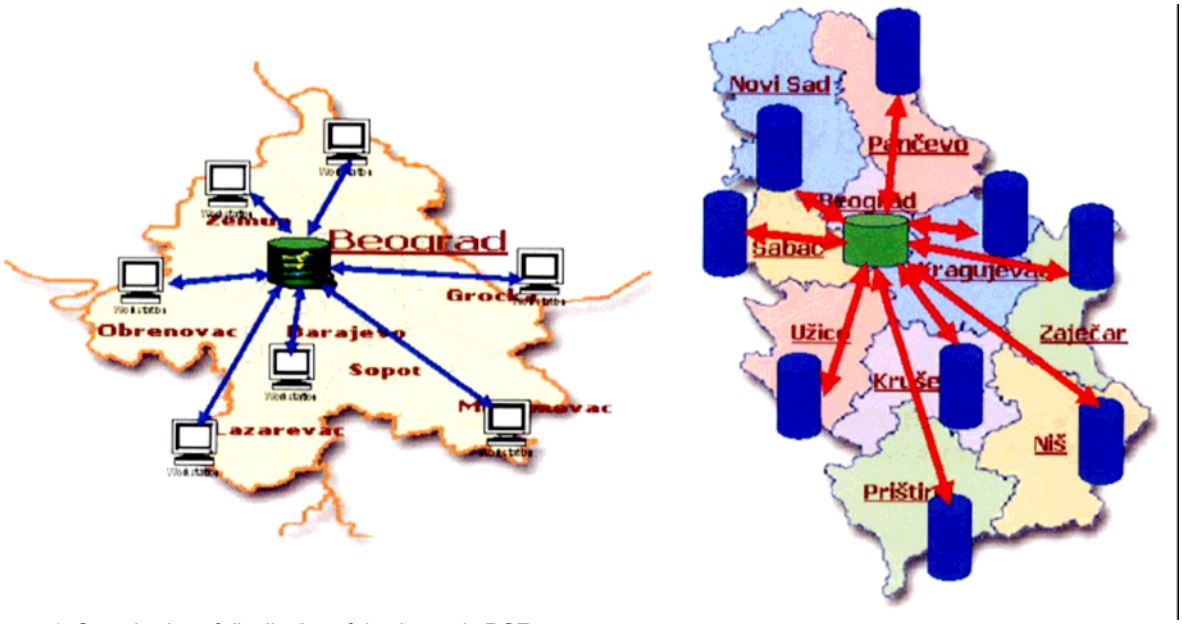


Figure 7.1: Organization of distribution of databases in RGZ
Source: RGZ, 2005

7.2 Local Communication Infrastructure of GIS

A communication infrastructure is one of the most important preconditions for the realization of GIS as a specific information system. This is of special importance for the GIS project of a local self-government because the member organizations of the GIS project are part of the local self-government, public and public-communal enterprises under the responsibility of the local self-government as well as republican public enterprises operating on the territory of the local self-government. It is well known that all contemporary GIS solutions include parallel viewing and/or exchange of a huge amount of data among a great number of users. Furthermore, while realizing a local communication infrastructure it cannot be expected that it will be used only for GIS purposes. For reasons of return on investment it is very probable that it will be used for many other purposes, for example classical data exchange, VoIP, video surveillance and others. Due to the offer of services to citizens and other clients via Internet there is a need for wide band access to the Internet as well as for a permanent Internet presence of the local self-government. Following conclusions can be drawn from the facts mentioned above:

- The communication infrastructure has to be of high quality.
- The communication infrastructure has to be robust and reliable.
- The communication infrastructure has to be set up with the highest possible bandwidth available on the market.

At the moment, on the national market the following possibilities for realization of a communication infrastructure are available to the local self-governments:

- Technology for the realization of a private optical net;
- Technology for the realization of a private wireless net;
- Technology for the realization of a private VPN net by rental from the provider;
- Technology for the realization of a wireless net by rental from the provider;
- Technology for the realization of an optical net by rental from the provider;

The most available and most used technologies on the national market are presented here, while others less available and so-called exotic technologies are not.

Private optical networks are the best way to realize a communication infrastructure, which is inevitable not only for a GIS project but also for other needs of a local self-government. Although the initial investments are higher than with other technologies the use and maintenance costs are approximately zero, therefore on a long-term scale this is convincingly the most economical technology for a local self-government. Many local self-government units have already started to build their private optical networks or are in the final phase of development (City of Niš, Self-government unit Valjevo, Self-government unit Mladenovac, City of Kragujevac, Self-government unit Subotica).

Private wireless networks are a good way to set up communication infrastructures quickly. The main reason not to recommend them in this guide is the fact that in their present state of development they do not fulfill any of the mentioned quality criteria (quality, robustness, reliability, band width). This technology will become acceptable through a fast development and acceptance of standards and the enlargement of the WiMax network as well as of other future products higher in standard.

Private VPN networks rented from the provider, specifically the so-called L2 and L3 VPN services of Telekom Srbija, are a qualitative, robust and reliable solution with a sufficiently wide band which is able to satisfy GIS needs but also other applications of local self-governments, above all at the locations of organizations which are so far away that the realization of an optical network would not make sense (at least during the first stage of GIS and other systems using the communication infrastructure before the return on investments starts). This way even very distant locations, for example water treatment plants with administration buildings of the public-municipal company for water utility can be connected effectively to the unique communication infrastructure even in the first stage of the project. Some local self-governments, for example the City of Niš are already using the L2 VPN service from Telekom Srbija for connecting far away locations, while others, for example the City of Kragujevac are in the final implementation phase.

Private optical networks as well as wireless

networks realized by rental from the provider are a good way for fast realization of communication infrastructure. The main reason not to recommend them in this guide is a very high annual usage fee. When an analysis of investments is done, it clearly shows that it is much more cost-effective to invest in the creation of a private communication infrastructure.

8 Complete Procedure of GIS Implementation in a Local Self-Government Unit

Mostly, the implementation of GIS in local self-governments is driven by the high motivation and commitment of some employees, who have recognized the benefit of GIS usage in their daily work. To make this engagement successful, political support is essential.

As GIS implementation always requires the integration of different departments and even exchange of data and knowledge to other organizations, it is an ambitious process. It depends to a large degree on the involved staff's communicative and social competence.

Within this process sometimes it may be necessary to reconsider the existing organizational structure and may require reorganization.

The implementation of GIS, the acquisition of data, the complete structuring and organization of this process is not trivial. So the implementation of GIS in local self-governments should be treated as a project with an adequate project management.

As this process is always individual, the proposed procedure presented in the following should be adapted to the specific situation.

What is all this effort for?

Without a systematic procedure or because some important aspects have been forgotten, the risk of a sub-optimal result or failure is high.

Here are some arguments for a planned approach (RT-GIS (2003)):

- As GIS implementation is a complex process, it can only be realized in steps. To do this all, necessary tasks have to be defined including setting priorities.
- It is not possible to evaluate the various software systems by demonstrations without having clear ideas of necessary features and defined requirements.
- The investment in a clear concept gives options to react on for future development and assures the selected system will stay for a long time. So it will save time and money.

On the other hand inadequate and overloaded phases of planning must be avoided, as this produces a long delay in implementation, causing motivation and engagement of the GIS-group to wane.

So, GIS implementation should aim for a good concept and structured approach that provides a viewable, timely success and preserves the essential motivation of all participants.

To ensure this, the following five steps for GIS in local self-governments may be helpful (Fig. 8.1)

These five steps should accompany GIS project implementation throughout. They should be used pragmatically and adapted to the special conditions.

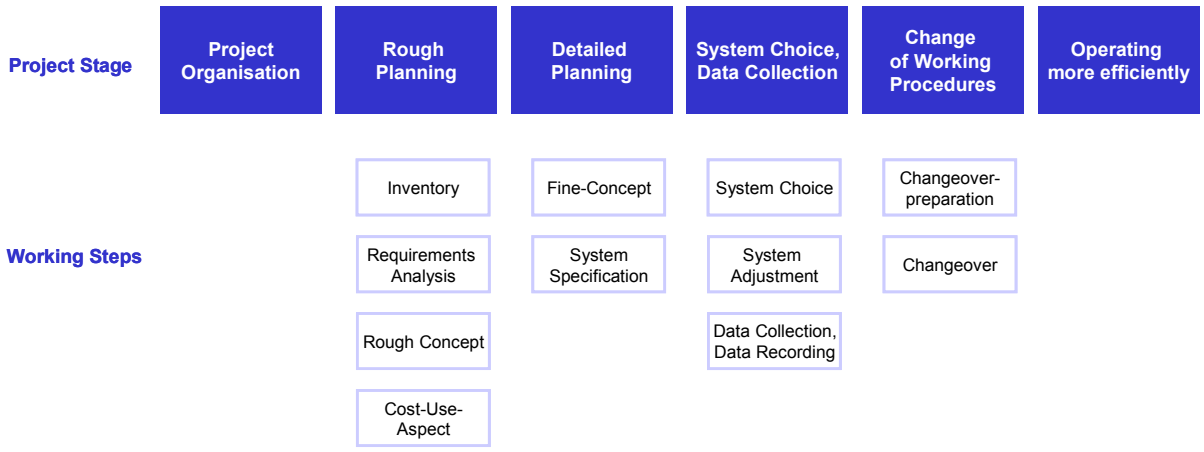


Figure 8.1: Five steps to GIS on local self-government level
Source: RT GIS, 2003

8.1 Project Organisation

Different aspects have to be clarified within the scope of project organization (Fig. 8.2) like:

- Determination of the project leader's competences;
- Clear assignment of tasks and field of responsibility to the project group;
- Who is responsible for decision-making?

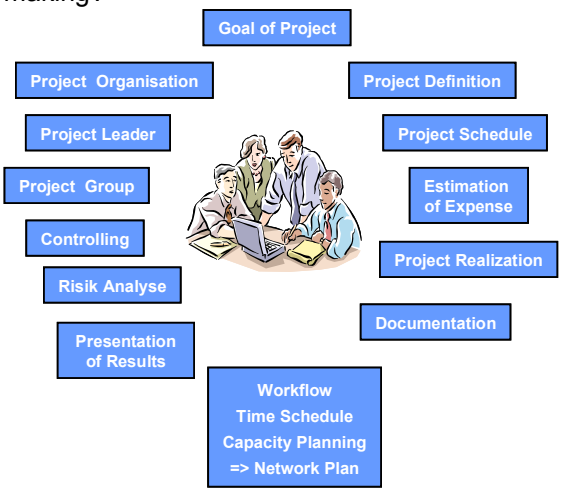


Figure 8.2: Aspects of project organization
Source: Schilcher, 2006

A well-defined description of decision-making processes (transparency), comprehension of reached decisions (permanent logging of processes), and fast, complete and correct transfer of important information to relevant persons is necessary.

The project organization should consist of at least the following main points:

- Project group,
- Project leader,
- Project definition,
- Project goals and justification,
- Definition project tasks,
- Determination of project duration and definition of benchmarks,
- Inner organization of self-government units.

8.1.1 Project Group

The project group should be composed of representatives from the most essential involved departments and institutions. Also they should have different educational backgrounds; the most important fields like informatics, urban planning, and geodesy should be represented. Each project member should be known by name and not have a substitute. The group formation should not change essentially during the project period.

Dependencies among the departments and institutions are inevitable and a GIS implementation always has far reaching effects on all involved. Therefore, the group should understand itself as a team working for the benefit of all.

There should be a clear assignment of tasks and field of responsibility for the project group.

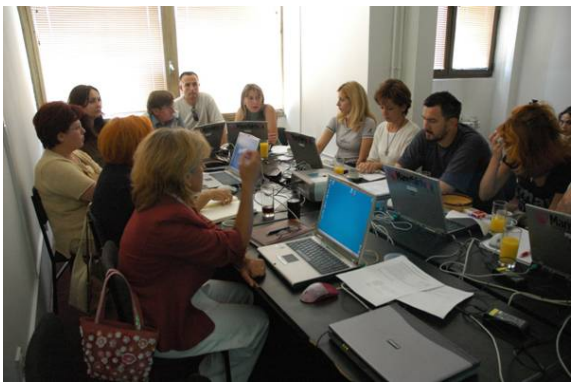


Figure 8.3: Training on GIS-use
Source: Local self-government of Subotica, 2007

8.1.2 Project Leader

In order to realize the GIS project successfully, the nomination of a project leader is essential. As key person for the implementing process the project leader should be initiative, cooperative, communicative and competent.

The project leader should also be well accepted by the group. Being the most important contact between the GIS project and the decision makers, a good relationship to them and a continuous presence of the GIS topic must be guaranteed, so decision makers can see the advantage and profit of the GIS project and be motivated for help.

The project leader has to be appointed officially in his function. Competencies that allow internal project decisions have to be assigned to him.

The project leader should be organizer of the project team and he should act as connector between administration and its head. He should be able to take the initiative, to cooperate, to communicate, to persuade and be objective. Furthermore, he should have an understanding of IT technology. He should not get lost in details but rather enable moving the project's progress.

The amount of time for heading up the project should not be underestimated and it must be assured that the project leader is free, as much as possible, of routine tasks to ensure his availability.

The project leader has the following tasks:

- Coordination of project staff,
- Coordination of different interests, demands and objectives,
- Determination of realistic goals, which ensure project success,
- Determination of measurable quality demands,
- Execution of realistic estimates,
- Development of work plans,
- Check results and steer intervention in case of deviations,
- Orientation of all involved persons towards the desired target.

8.1.3 Project Definition

The project leader and the project group have to first prepare a project definition for the project "GIS implementation". The project definition should consist of the following essential, measurable and reviewable contents:

- Exact definition of project goals and justification;

  Which target has to be reached?
  How can it be reached?
  How can the obtained targets be measured?
  On which regulations/laws is the project based?
  What will be the benefit and efficiency of the GIS project?

- Definition of tasks to be handled in the project, possibly definition of project tasks and impacts, which cannot be carried out within the project (e.g.: training of staff members, involvement of external consultant, etc.);
- Determination of project duration and intermediate project objectives;

The project definition has to be harmonized with decision-makers (mayor, council of the local self-government) and it should be valid without any changes during the complete project period. On the other hand, the project definition permanently has to be verified by comparing it with the existing general situation and conditions. It should be checked whether it makes sense or if it is plausible. If modifications are unavoidable, new agreements are necessary among all involved persons.

8.1.4 Additional Help

Finding supportive persons within or outside of the administration, who have influence or know how to promote the project, often has considerable influence on the process. If the idea of GIS implementation is born inside the administration, political representatives have to be persuaded of the idea. Often the best argument is a demonstration of GIS within other local self-governments. Also a cost – benefit – analysis may help at this point.

Assigning a controller to the project could provide effective support of the project leader's work and may have a neutral function.

As the implementation of GIS is inevitably associated to considerable additional costs in the local self-government, possibilities of financing have to be discussed in advance.

8.2 Coarse Planning

The next step of GIS implementation is the rough planning, followed by the detailed planning. This follows the concept of "top down" planning, which protects against too much detailed information in the beginning and helps to keep an overview. In practice the delineation between rough and detailed planning is diffuse. Having a rough plan that is highly elaborate may in easier cases help when it comes to the detailed planning.

The rough planning includes the following sub-steps:

- Inventory,
- Analysis of requirements,
- Rough concept/concept for a possible solution,
- Cost-benefit estimation.

A preliminary definition of basic goals will help in adjusting to these steps. Standard goals are: the improvement of information processing to get better efficiency and to provide the user with better geo information to increase the quality of decisions.

Four components will accompany the planning process (see fig. 8.3):

- What are the tasks?
- Who executes what tasks?
- What kind of information is available?

- What tools are available?

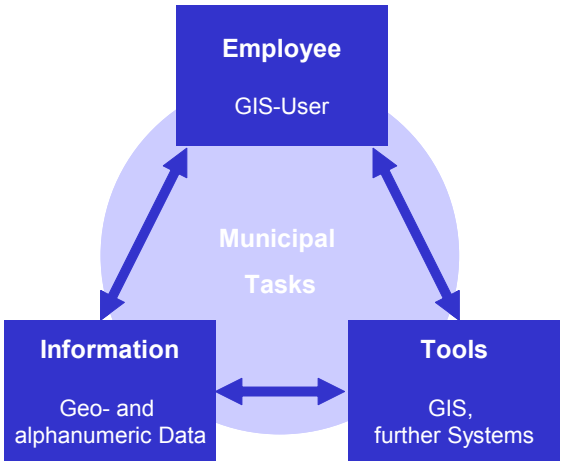


Figure 8.4: Components of GIS planning
Source: RT-GIS, 2003

These components are the starting point for the analysis of tasks and GIS application. For more complicated situations further aspects may be of importance to analyze workflow:

- Information and data transfer among tasks,
- Information and data transfer among employees,
- Sequence of tasks.

8.2.1 Inventory and Analysis of Requirements

All departments or companies involved in the GIS implementation project have to make an inventory of its data (graphic and alphanumeric) and working processes.

The intention of this step is to detect deficiencies in the working process that can be eliminated by use of GIS.

The following steps may be useful:

- To clear who is to be involved;
- To fix the procedure; how to inform participants, manner of questioning
- Clearing of evaluation process; systematizing of acquisition and analysis; manner of announcement of results;
- Determination of priorities.

It is important to distinguish between the real needs of a local self-government and possible wishes of individuals.

The objects of the ascertainment are the components shown in figure 8.4 - tasks, staff, tools and data. In the following, a list of important questions is given. The analysis of the inventory on the basis of these questions make clear what tasks (processes) have a high priority for GIS use and what data and functionalities are necessary.

For small local self-governments maybe one or two workshops are adequate. Other local self-governments will need a lot of separate workshops for departments and interviews of individuals.

Inventory and Analysis of Requirements - crucial questions:

Tasks

- What spatial relation tasks have to be done by the local self-government?
- What sorts of deficiencies are evident in present work system?
- For what tasks is GIS usage applicable?
- Are there tasks that are carried out simultaneously in different places?
- What is the main priority of the task which is to be carried out using GIS?

Employees

- Which employees are doing what tasks?
- Will another person do the tasks in future?
- What qualification should employees have?
- Who contributes information or data that are necessary for the task?
- Which employees or external persons shall see or use the task results and do they have the right quality?

Information/data

- Which information (data, maps …) are necessary to fulfill the task?
- Is this information digital or analogue?
- Is this information stored in multiple locations or updated several times?
- Is there separate information that can be integrated into one information pool?
- Are there information/data to be converted into another format?
- Can the conversion be done by the local self-government or is an external service provider necessary?
- Are there necessary data that can be used online?
- Are there data that must be collected?
- How shall these data be collected and who is responsible for updating?

-

Tools and GIS functionality

- Which software systems are in use?
- Shall new ones replace these systems?
- Are there interfaces to GIS?
- What IT standards have to be fulfilled?
- What amount of functionality is necessary for fulfilling the task (only viewing, editing, public internet service…)?
- What GIS functionalities are necessary for doing the task?

Source: RT-GIS, 2003

8.2.2 Rough Concept

The requirement analysis is the basis for the rough concept. This concept should contain the following aspects:

- Main objective of GIS application
- Results of inventory
- Application area of GIS
  - Priority
  - Expansion stage
- Requirements for
  - IT infrastructure
  - GIS data and data capturing
  - GIS functionality
  - Employees
  - Organization
- Cost/benefit analysis
- Concept of data acquisition
- Decision on what department holds the main responsibility for the GIS.

8.2.3 Aspects of Cost Benefit Relation

The calculation of the cost benefit relation is difficult and extensive. A manual for doing this could fill another guideline, so only some aspects are mentioned here.

The preoccupation with this theme may answer the question if GIS implementation is profitable or what method of operation (see Chapter 4.7) is to be chosen.

Studies show that during the implementation phases the costs/benefit relation mostly is negative and it becomes positive over the long-term. This depends on the complexity of the system and the data situation.

In general it is to be said that at first the greatest benefit of GIS implementation proves to be the increased efficiency of working processes and increased quality.

Criteria of costs are:

- Costs for system acquirement (hardware, software, network, …),
- Cost for maintenance,
- Personnel costs, cost for training,
- Geo data acquirement and updating.

Figure 3.8 shows a typical cost distribution.

In the following, it is shown, how the benefits of GIS may be outlined:

Quantitative benefit

- Cost reduction by automation of working processes;
- Cost reduction because tasks that can now be done on your own (analysis, maps);
- More effective work process;

Operational benefit

- Earlier and better decision making;
- Faster approval process (building permit);
- New possibilities for statistical analysis;

Strategic benefit

- Legal appointments are easier to consider; more transparency;
- Better image for administration;
- Optimized planning of land use;

External benefit

- Better and faster information for public;
- Service for geodata within internet;
- Further services possible;

8.3 Detailed Planning

The decision to develop detailed planning depends on the complexity of the situation and the level of detail of the rough concept.

Useful steps are:

- A detailed concept,
- A specification sheet for system selection,
- System selection,

Aspects to be considered are:

- Fine specifications,
- Detailed concept of benefits,
- Data update concept,
- Quality assurance concept,
- Cost analysis,
- Implementing concept,
- Data migration concept,
- Concept for training,
- Financing and promotion for implementation.

The following list will give some hints for necessary functionality and other aspects for system selection:

Basic functionality of GIS

- Support of raster, vector, attribute and meta data;
- Standard interfaces for data import and export (DXF, SHAPE, …);
- Layer structure or object structure for different thematic maps;
- Functions for layout, printing and plotter; cartographical functions;
- Query builder for querying attribute data, zooming to selected objects;
- Spatial query functions (find all objects within 1000 m, find all cadastral parcels cut by a water tube);
- Tools for measuring and dimensioning;
- Editing functions for geo and attribute data;
- Coupling to GPS, measuring instruments, tachymeter …;
- Geoprocessing functions like overlay, clip, buffer;
- Open architecture (extensions for application development, program language …);
- Scalability for data types, internet, application development, (OGC standards);

Further aspects for system selection:

- user friendliness;
- reliability;
- service;
- quality of documentation;

8.4 System Selection and Provisioning

For the system selection, the following steps are proposed:

- Creating an overview of technologies and systems;
- Working out a quote;
- System test and benchmark;
- System selection.

Information about available systems and providers should be gathered during the process to get an overview. Discussions with different providers based on the acquirement analysis and concept and attending fairs may help.

The rough concept and the fine specifications are the basis for discussions and for requesting a bid. The analysis of the bids reveals the most interesting provider. The evaluation table in the annex may help with this analysis.

To decide among them an extensive system test of at least two solutions should be carried out. Even if providers take some money for a system test, it is cheaper than a wrong decision. The aspects in the following list will help in carrying out the test:

- Dispatch software training for test participants by the provider;
- During the test phases there must be support by the software house;
- The test should be based on original data of the local self-government unit;
- The test should be carried out for several weeks;
- Ensure that there is time for the participants to carry out the test phases;
- After the test phases there ought to be no open questions;

8.5 System Implementation

After choosing a certain system the implementation has to be prepared carefully. First, a responsible person has to be available for the duration of the changeover as well as somebody (maybe a team) who will be in charge of later system administration and maintenance tasks.

As GIS will create new working procedures they have to be planned and described in advance. A reorganization of working stations and rooms has to be taken into consideration.

Among employees usually the first reaction to such changes is a negative one. It is important to motivate and reassure the employees who are going to work with GIS. If it is necessary to engage new staff members whose new requirements on their qualifications should be considered. Further training in different fields has to be organized, if possible within the institution and on internal computers.

The different steps of the system change have to be organized in a way in which they won't disturb the running workflow significantly. A possible extension of the existing GIS applications as well as the implementation of new ones should be considered early on.

During the change, two working flows in data retrieval might be inevitable, so certain data sets will exist in an analogue and a digital form. If gathering completely new data is

necessary it should fulfill the requirements of the new system.

Conclusion and recommendations

- The change of procedures must be planned and take place with a concept.
- Remember training for employees is necessary.
- Problems and delays are normal despite planning.
- Make sure that everyday procedures won't stop during the changeover.
- GIS applications should be implemented one by one.
- A critical analysis of the whole process and a comparison with the concept help to reveal mistakes.

8.6 Typical Problems and Possible Solutions

It is to be emphasized that the success of GIS implementation essentially depends on the people who are working on it. So the benefits derived by the implementation are influenced by motivation, technical know-how and the ability to "think GIS", in other words a way of thinking that conforms to the structure of GIS.

To make sure members of the working group are well prepared for such a project it is important to give them realistic information about the endeavor, the costs and the time needed for GIS implementation.

To preserve the motivation of the working group, normally existent early on in the implementation process, it is of greatest importance to generate viewable results at an early point. There is nothing more discouraging than a long planning phase, culminating in endless fine specifications or the interruption of the process by administrative or political handicaps. To produce early results it may be helpful to bring forward one easy application with limited data within a test region as well as to define milestones throughout the whole process.

For all involved people to acquire the necessary know-how, training is needed that provides knowledge about the fundamental structure of GIS, working with geoobjects with representational attributes and working with this mix of data and geometries. Examples in practice may show what new possibilities are contained in this application. That means that going deeper into scientific aspects of GIS should be avoided, but knowledge of basic GIS structure should be provided by easy examples.

An expert, either a member of the GIS group or by an external expert, must provide deeper knowledge in the field of GIS implementation.

Often the new organization of data and the processing of tasks make a reorganization of the municipal administrative structures necessary. New tasks in the field of system administration, technical maintenance and editing of digital data appear with GIS implementation. Sometimes it is possible to expand some of the existing departments of the local self-government, but in bigger municipalities it might be useful to establish a special department for GIS needs. Depending on the dimensions of the municipal GIS new jobs might be created.

As GIS is an integrative and interdisciplinary instrument, it forces the whole GIS group to work together. That means that everybody has to share his knowledge and his data with the others. Also it demands a great deal of flexible thinking, as GIS inevitably changes existing working procedures. The cooperative interaction of all involved persons in this ambitious project leads to synergy effects.

In the end, the process of GIS implementation requires unrestricted support from the side of the management of the local self-government. It is essential that management provides the working group with sufficient human resources, time, financial means as well as other decisive factors. The management has to be completely convinced of the future benefits of the GIS. Therefore, if the idea of GIS first comes up in the departments of the local self-government and not in the management itself, it might be necessary to provide the management with overall information on the structure of GIS, the costs and especially on the expected improvements in the efficiency of the work of the local self-government. Experience in the pilot local self-governments shows that the process of convincing might be strenuous and time-consuming but that it is of essential importance for the success of the GIS implementation.

9 Example of GIS Implementation in Local Self-Government

9.1 The Implementation Process in Kragujevac

History

The initiative for the development of GIS in Kragujevac started in the public company for urbanism board (Board) Kragujevac, the company which is responsible for spatial planning and therefore for the collection and standardization of all relevant data about the space.

In 2001 some personnel in the local self-government realized the interests of the city in this project so it gained the political support it deserved. From 2002 on the USAID appears as a member-consultant through the SLGRP project and the company DAI and in 2005 this role was taken over by the German Technical Cooperation GTZ.

The main aim of this project was the creation of a reliable common information system at the local self-government level to be used as a tool for more effective, economic and modern management of local resources for the very long procedures of giving building permissions and the lack of information on space kept at one place and available to all members of the development and management of the City of Kragujevac.

The idea is that all local and republic institutions on which the local self-government depends on to function are allowed to use this GIS. In cooperation with the Institution for Urbanism from Subotica and the Manufactura Company from Subotica the Board started with the development of software for GIS and for the giving of building permissions as modules that are to use the capacities of GIS.

At the start of 2002 the IO of the City of Kragujevac made a decision on the training of a coordination team for the creation of GIS. This team was renamed into working group in 2005 by a decision of the mayor of Kragujevac.

The tasks of the working group are:

- To define a concept of GIS;
- To maintain contact with relevant companies and institutions for the realization of the project;
- To define possibilities of financing the project;
- To form a GIS center with responsibilities in project realization;
- To define software and hardware platforms to be used for the collection of data for the GIS base;
- To formulate the cooperation of the Cadastral Unit and the local self-government on the transfer of surveying data and the further contribution to the realization of the project;
- To formulate the cooperation of the GIS-center and other local institutions on the realization of the GIS;
- To control the fulfillment of the tasks, to manage the means for the further development of GIS within the GIS center.

The concept of GIS for the local self-government of Kragujevac is made up of six components:

- Legal frame (the definition of the relationships between the member institutions)
- Spatial data (collection of data)
- System logistics (working group, GIS center)
- ITC net
- Software
- Adaptation of the local self-government and member institutions to a new way of working

Present state

The acquisition of equipment, hardware and software as well as the connection of the member institutions with the local self-government has taken place.

Software of the Manufactura Company from Subotica, which was developed in cooperation with the Board and the Institution for Urbanism, is used as an application for the internal and public portal. In addition, the acquisition of software for data editing for different needs of the member institutions has been finished.

A GIS center with its own responsibilities was created and is connected to the Board:

- Administration and maintenance of the system in functioning state;
- Preparation of data bases and applications to use within the system;

- Coordination of work on the creation of data bases of single member institutions;
- Training of the users of the system;
- And the permanent development of the system.

The following documents have been subscribed:

- Declaration of a partnership in the process of implementation, maintenance and use of GIS of the local self-government of Kragujevac, subscribed between the local self-government as the bearer of the project and 18 organizations and institutions;
- Consent to cooperation on the GIS of the local self-government of Kragujevac. It was subscribed by the local self-government as the bearer of the project and 17 organizations and institutions and is the legal act that defines all rights and obligations of the members of the GIS of the City of Kragujevac;
- Contract between the city of Kragujevac and the RGZ for the creation of a digital utility cadastre and furthermore between the City and the co financers/ owners of the networks;

Parallel to the legal frame the collection of data has started. By now following data are available:

- Orthophotos from the years 2005 and 2006;
- Statistical and census circles with the results of the census rolls from the years 1991 and 2002;
- Digital plan of streets and the positions of house numbers for the needs of queries by address;
- Urban plans (about 350 maps in PDF format);
- Scanned cadastral plans;
- Digital utility cadastre (about one half of the urban area);
- Geology map;
- Base of city rent;
- Digital base of the utility cadastre;
- And other.

Further development

The protocols on cooperation are in preparation. They define the procedures of the system e. g.:

- Protocol on data exchange;
- Protocol on data updating;
- Protocol on the insight of data by other persons;
- Protocol on the creation of new functions of the system.

The protocols have been defined by the working group GIS of Kragujevac and are subscribed by the member institutions and the local self-government of Kragujevac.

An idea for the development of the optical network has been created. Until then the services of Telekom will be used, that is to say the rental of networks.

Expected effects of the GIS of the local self-government unit of Kragujevac:

- A faster reaction of responsible institutions to client inquiries and the possibility of more detailed analysis and planning;
- Possibility of editing spatial data and their adaptation to the existing documentation;
- Possibility of easier planning, projecting and maintenance of all infrastructure networks;
- A decrease of the damages on utility networks by greater insight into data of other utility companies;
- An improvement of communication between all member institutions which are involved in the planning of the development of the local self-government unit;
- Stimulation of investment by the public GIS portal.

9.2 The Implementation Process in Niš

Introduction

While creating the GIS the organization of the City of Niš as a local self-government unit has turned from a city organization including two cadastral units, a self-contained city administration with secretaries and departments working as responsible organization units for certain fields into a city organization with five cadastral units with their own administrations and departments for certain fields of the local self-government.

At first the field of GIS as an information system was the responsibility of the Secretary of Development and Information Systems whereas today, according to the present city organization the appropriate authority is the

Administration of Information and Communication Technologies of the City of Niš (in the following called ICT administration of the City of Niš).

History

The idea of creating a GIS is several decades old, during which several trials to realize the project of GIS in the City of Niš at the level of single institutions have been started, in particular in the Directory for development of the City of Niš and the Institution for Urbanism of the City of Niš but also in cooperation with the academic sector.

For more than 15 years the Committee for Urbanism and the Directory for Development of the City of Niš are systematically using digitized geodetic data and orthophotos for work on urban-planning documentation while using Cad applications. Most of the public companies, for example Naisus (water and sewage), heating and others have been using geodata in their work for a long time. While forming documents for planning and building the responsible organization of the City Administration of Niš, specifically the Secretary for Urbanism and Communal Activities also started to use geodata in 2001. At this time a more consistent use of geodata in the sense of the creation of a specific GIS of the City of Niš was called for.

Preconditions for the creation of GIS

In March 2005 the City of Niš named a working group GIS for following tasks:

- Vision and concept,
- Analysis of present state,
- Analysis of compatibility with GIS standards,
- Analysis of logistics and system organization,
- Definition of the system profile,
- Definition of functional specifications of the system,
- System implementation.

In November 2007 the legal frame of the city of Nis consisting of the “Memorandum of Understanding” and the “Consent to Cooperation” was subscribed. The subscribers of this legal frame are the City of Niš itself, all public and public municipal companies under the supervision of the City of Niš as well as the republican public companies of the working group unit including the RGZ.

In 2002 the responsible Secretary for Development and information system, and today the responsible ICT administration of the City Niš, started creating the preconditions for the realization of GIS of the City of Niš. The mentioned preconditions are above all connected to the realization of communication capacities in the sense of a unique computing-telecommunication net of the local self-government that has been realized to a large extent as a private optical net and to a smaller extent as the telecommunication capacity of the national provider Telekom Srbija. Additionally, all the necessary informatics capacities and resources needed for the realization of GIS have been created, for example servers, working stations, additional software and such. Furthermore, every single member of the GIS working group has invested efforts in informatics as well as in communicational capacities of their own organizations. The step considered to be of particular importance not only for GIS but for e-government in general is the early realization of a wideband connection to the internet and to the government of the Republic of Serbia.

Present State

23 locations throughout the city area are connected on the unique computer-telecommunication net of the local self-government, 15 of them optically and 8 of them by using modern L2 VPN services (2Mbit/s) from Telekom Srbija. Professional Cisco equipment is used on this net. The net covers all departments of the local self-government and departments from a certain number of public and municipal-public companies, the local RGZ and Telekom Srbija (Note: although all those organizations are covered by the net, their connection to the net will take place after their subscription to the Protocol of Data Exchange or a similar document).

The operative systems at the working stations or clients are prevailingly Windows XP.

There is a noticeable development towards the use of open-source solutions, prevailingly to the OpenOffice application on Windows as well as on Linux platforms. The platforms of the server are Linux, Debian (last version), while the GIS server itself is an open-source MapServer (last version). The GIS Portal is to be found at the address http://gis.ni.sr.gov.yu . As part of the change to the new national domain .rs a new address of the GIS portal is planned: http://gis.ni.gov.rs.

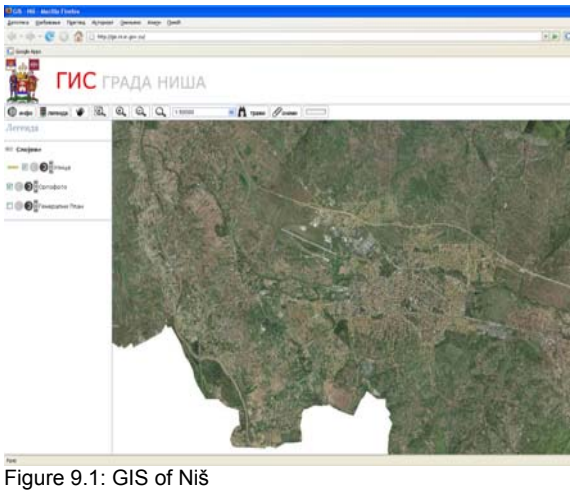


Figure 9.1: GIS of Niš
Source: Local self-government of Niš

Existing databases

- Orthophoto of the City of Niš from 2006;
- Digitized census and statistic circles;
- Last results of census roll (2002);
- Results of the last election;
- Street names and house numbers (including the query function);
- Master map of the City of Niš;
- Local development areas;
- Cadastre of local investing;
- Cadastre of pipes;

Further development

Further development should include a connection of the GIS portal with the applications in the member organizations of the GIS project as well as the public use of the portal. In this sense the GIS portal has its own protected intranet part that is meant for support of geodata between member organizations of the GIS project and the support of realization of tasks by using the following applications:

- Application for constructing permits and communal fee,
- Application for resolving licenses for illegal construction in process of legalization,
- Application for the work on inspection tasks,
- Application for the work on property tasks,
- Application for the work on tasks in the field of traffic, communal tasks and energy,
- Application for making theme maps on results of census rolls, elections, etc.

Furthermore, the already existing Internet part will be enlarged by new functions and services for the citizens. Of course both parts of the portal will be steadily supplemented by new geodata.

All data and applications are on the servers of the responsible ICT administration of the City of Niš which is carrying out the administration of the whole system.

9.3 The Implementation Process in Užice

Užice started a pilot project called “Baby GIS”. The functioning of the system was shown on a small scale based on a plan of detailed regulation containing about 7 % of the city’s territory. The goal of the project was to familiarize the staff of public companies with GIS and through this to create a base for the development of a GIS in a local self-government. The implementation was done with the help of external consultants from GISDATA – Bgd and can be viewed on the internet site of the local self-government (see Chap. 10).

Regarding this implementation, one point which causes criticism is the fact that professional staff of the local self-government as the main work carrier wasn’t involved from the beginning on with the consultants. A basic training has been carried out with employees of local self-government and republic companies before the coordination team was formed to collect data from other bearers.

A positive point is the fact that is it understood that there will be no progress without this team and without clearly defined procedures of data exchange.

A coordination team made up by representatives of the local self-government, municipal and republic public companies was formed. Their duties have been defined in a memorandum, which was signed by all the participants in the further development of GIS. Here are two important articles of this memorandum.

Article 6:

Duties of the coordination team:

- analysis of the spatial-planning documentation of the local self-government
- analysis of the data provided by all the undersigned of the Memorandum

- evaluation and definition of the level of detail of all data
- overview of possibilities for conversion of data from different formats to the ESRI-format (digitizing of maps and data which is not available in this form)
- familiarizing with future maps connected to the spatial map of the local self-government unit and the base map of Užice
- creation of conditions for formation of a central geobase data model and the integration of all data into this model
- definition of level of data in the central model depending on the degree of detail and the amount of information needed for tasks of the local self-government
- definition of rights and the level of restriction on the central server
- creation of conditions for a linkage of all the undersigned of the Memorandum with the data base

After having fulfilled each item of point 1 of this article the coordination team is to write a report on the realization for the needs of all the undersigned to verify the specified activities and to define the further ones.

Article 7

Based upon this Memorandum after having fulfilled the duties defined by article 6 the undersigned will declare further activities for realization of a GIS for the local self-government of Užice in more detail in a special contract.

At the moment the coordination team is working on an analysis of the state of all GIS development participants to make a proposal for the next steps to be taken by the local self-government.

One point which is sure to be recommended is the forming of a “central team” in the local self-government and further teams in each public company which are going to work on the digitizing of the available data to make conversion and exchange easier. We are going to propose a GIS architecture in local self-government which makes it possible to keep and maintain the resources which make up a GIS in the companies which are responsible for them.

This ensures a more effective processing of the data and product delivery or services for the final users.

9.4 The Implementation Process in Subotica

(A detailed description of the implementation process is available on CD)

History

The idea of creating a communal geographical information system (GIS) of Subotica is 18 years old, when City Planning Institute (CPI), the public company for Aqueduct and Sewerage and Construction faculty in Subotica brought Arc-info (DOS version) with combined funds to a few AT 286 machines.

The City Planning Institute started the systematic digitalization of geodetic maps in 1990 and a creation of an urban planning documentation on CAD. An external demand for a collective use of those vector databases emerged by the end of 1997 especially from Electro distribution Subotica and KDS Subotica.

On the initiative of CPI the realization of Communal Info Network started in November 1998 by accepting a common program for creating it.

After accepting the concept for the Communal Info Network its realization was started. The realization ran until March 1998 when a physical level of the net was achieved as well as a software part of the Internet including FTP services. In the middle of 1999 the realization of the project continued but slowly. The CPI was the only one to continue development with the help of Electro distribution. The CPI bought a GIS tool (Autodesk MapGuide R5 with 10 Authors) and started the first real GIS in Subotica. Names of streets, house numbers and cadastre numbers of parcels are connected with graphical data – geodetic maps.

In 2001-2002 this tool was used for the presentation of the scheme of the General Plan of Subotica. Because of the difficulty of acquiring upgrades for MapGuide at the end of 2002 City Planning Institute stopped using it and started developing its own GIS tool with programmers who had experience in Intranet/Internet programming.

Since mid-2003 the GIS is in service and used in CPI, partly on the Internet for public use, partly used by the construction department of local self-government of Subotica and partly by P.S. “Aqueduct and Sewerage”.

In September 2004 the Executive Committee of Congress of Subotica named a Working group for the organization of developing GIS with following tasks:

- Definition of complete project,
- Establishment of project goals,
- Establishment of the definition of project,
- Determination of timetable for the project,
- Other jobs in organization for developing GIS.

In May 2006 a memorandum on the organization of the creation and implementation of a Geographic Information System for the Local self-government of Subotica was subscribed. The subscribers of this Memorandum are the local self-government unit Subotica, all public companies and some of the public municipal companies.

Present state

The connections (rented lines of 2Mbit/s over Zyxel and Cisco equipment) are used for data exchange and the use of GIS applications.

Operating systems on working places

On work places clients are mostly Windows operating systems, Win98, Win ME, Win2000 and WinXp. On a few workstations the operating system is Linux including a graphical interface.

Operating systems on server

On servers the operating system is Linux**,** Debian 3.1. (sarge). The GIS server is an Open Source MapServer 5.0.0.

Databases

Existing databases:

- Orthophoto of Subotica and Palić from the year 1999;
- Digital plans of Subotica (Digitalization was completed over a period of 10 years so some of the data are outdated and of various quality);
- Digitized census and statistic circles;
- Results of census roll in 1991 and 2002;
- Results of the last election;
- Results of air quality measuring for the last 5 years.

GIS application is a group of applications written for data exchange and fulfilling special tasks. Specifically, applications are

- GIS application for exchanging and viewing data
- Application for constructing permits and communal fee
- Application for resolving licenses for illegal construction in process of legalization
- Application for making theme maps on results of census rolls, elections, etc.

The data and application are held on servers within the directory. An extern service provider does the administration of the servers.

At the moment:

- Creation and updating of the database of over- and underground energetic infrastructure and objects
- Working on the acquisition of data while a GPS equipment is bought for the field work for GIS data

Further development

The GIS of the local self-government unit Subotica is running but is limited due to the lack of adequate connections of the single units to the intra-/extranet. Therefore, the creation of an optical net is planned, which could connect all the members of the system.

The local self-government unit Subotica is the owner of the GIS, while the Development Magistry is responsible for the implementation. Therefore, a GIS Center is to be formed in the Development Ministry. The functions of the center are the administration and maintenance of the functioning state, preparation of databases and applications for use in systems, coordination of the jobs in creation and maintenance databases of members, training of the users and permanent development of the system.

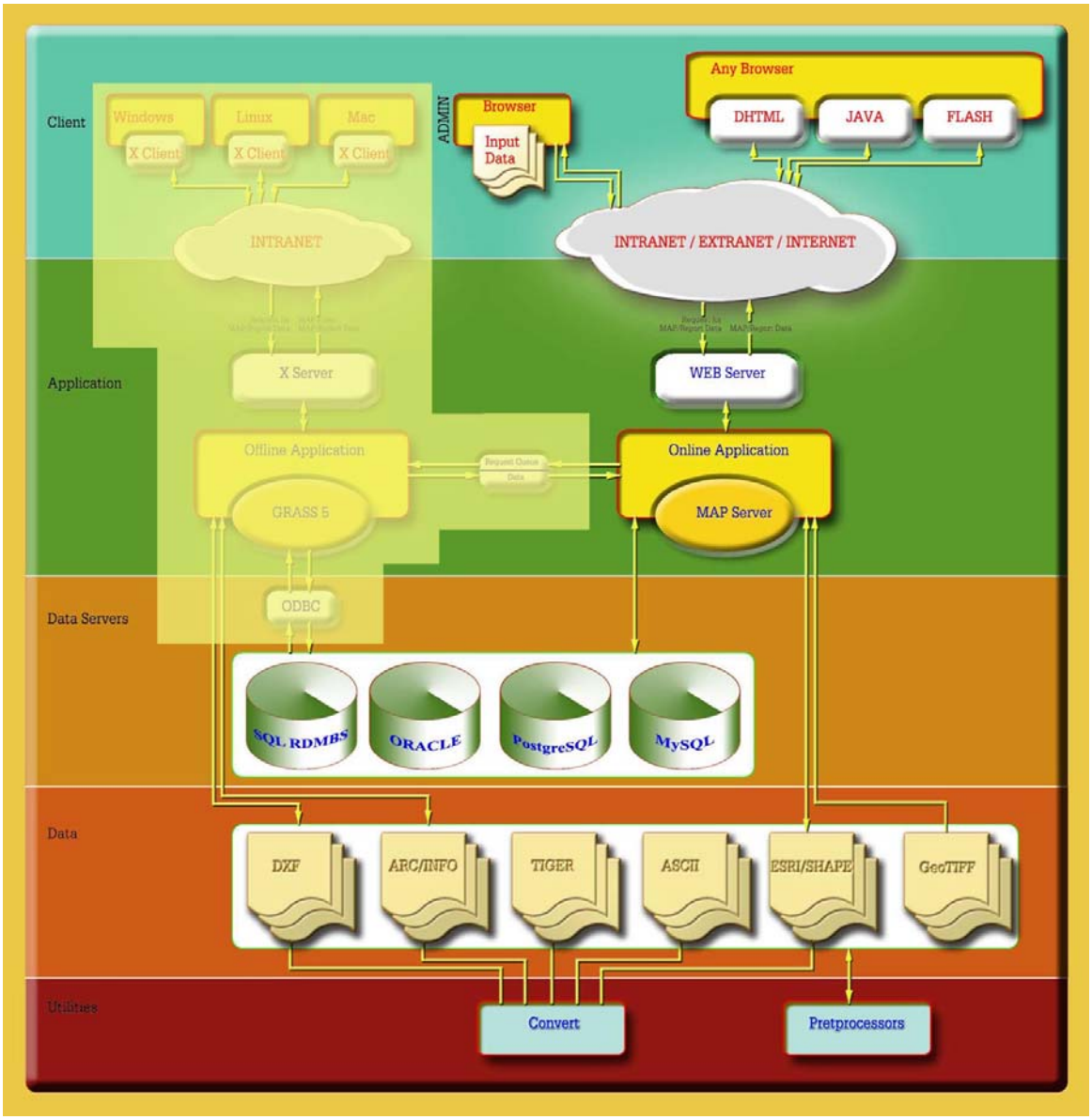


Figure 9.2: Complete GIS architecture in Subotica
Source: Local self-government of Subotica, 2007

10 Links

- Public GIS-portal of the local self-government of Kragujevac:
  http://gis.kragujevac.org.yu
- Public GIS-portal of the local self-government of Niš:
  http://gis.ni.rs
- Public GIS-portal of the local self-government of Subotica:
  http://suboticagis.rs
  http://map.subotica.co.yu
- Public GIS-portal of the local self-government of Šabac:
  http://sabac.org
- Public GIS-portal of the local self-government of Užice:
  http://opstinauzice.org.yu
- Website of the Standing Conference of Towns and Municipalities:
  http://skgo.org
- Website of the Republic Geodetic Authority:
  http://rgz.sr.gov.yu
- Central mortgage record (Centralna evidencija hipoteka – CEH):
  http://rgz.sr.gov.yu/ceh
- Download of OGC-Standardization documents (for free):
  http://opengeospatial.org/standards
- Runder Tisch GIS e. V., (round table GIS c/o Technical University of Munich):
  http://rtg.bv.tum.de/
- INSPIRE:
  http://eu-geoportal.jrc.it/; http://inspire.jrc.it/
  http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML
- ETRS89:
  http://de.wikipedia.org/wiki/ETRS89; http://en.wikipedia.org/wiki/ETRS89
- AdV :
  http://adv-online.de/extdeu/nav/eb3/broker.jsp?uMen=0a170f15-8e71-3c01-e1f3-351ec0023010
- AGROS:
  http://gpsweb.ns.ac.yu/

11 List of Figures

12 Sources

- Bill, R. & Fritsch, D. (1991): Grundlagen der Geoinformationssysteme, Wichmann Verlag, Karlsruhe.
- ETHZ (2007): Swiss Federal Institute of Technology, Institute of Geodesy and Photogrammetry, Geographic Information Systems and Theory of Errors, at URL: http://www.ethz.gis.ch. (July 2007).
- RGZ (2005): written comment delivered in December 2007.
- RT GIS (2003), Runder Tisch GIS e. V. c/o Technical University of Munich, Institute for Geodesy, GIS and Land management (Edt.): Geoinformationssysteme – Leitfaden für kommunale GIS-Einsteiger (Geoinformation Systems – Guideline for Municipal GIS-Starters), several authors, Munich.
- RT GIS (2005), Runder Tisch GIS e.V. c/o Technical University of Munich, Institute for Geodesy, GIS and Land management (Edt.): Geoinformationssysteme – Leitfaden zur Datenqualität für Planungsbüros und Behörden (Guideline on Data Quality for Planning Offices and Authorities), several authors, Munich.
- RT GIS (2006), Runder Tisch GIS e.V. c/o Technical University of Munich, Institute for Geodesy, GIS and Landmanagement (Edt.): Wirtschaftlichkeit von GIS – Leitfaden für das kommunale eGovernment. (Profitability of GIS – Guideline for the municipal e-Government), several authors, Sig Media GmbH & Co. KG, Köln, Germany.
- Schilcher, M., (2004): Technical University of Munich, Research project: „GeoPortal“– Managementreport.
- Schilcher, M. & Voerkelius, U., (2006): Technical University of Munich, lecture „Basics in GIS“.
- Specht-Mohl, C., (2004): Stuttgart University of Cooperative Education, lecture “Geoinformatics”.
- Specht-Mohl, C., (2006): Intergeo East: Orthophoto, a profitable map substitute or more? “True” alternatives and practical benefits.
- Specht-Mohl, C. & Gauly (2006): GIS-Guideline, first draft.

13 Abbreviations

AGROS	Active Geodetic Referent Network
CAD	Computer Aided Design
CPI	City Planning Institute
DBF	Digital Base File
DEM	Digital Elevation Model
DGPS	Differential Global Positioning System
DTK	Digital Topographic Key
FDI	Foreign Direct Investments
FTP	File Transfer Protocol
GIS	Geographic Information System
GSD	Ground Sampled Distance
ICT	Information and Communication Technology
INSPIRE	Infrastructure for Spatial Information in Europe
ISO	International Organization on Standardization
KDS	Kablovsko Distributivni Sistem (cable distributive system)
MEGA	Municipal Economic Growth Activity
MSP	Municipal Support Programme
OGC	Open Geospatial Consortium
PALGO	Public Administration and Local Government
PDA	Personal Digital Assistant
REC	Real Estate Cadastre
RGZ	Republički Geodetski Zavod (State Geodetic Authority)
SCTM	Standing Conference of Towns and Municipalities (SKGO)
TIN	Triangulated Irregular Grid
UNHABITAT	United Nations Human Settlements Programme
VPN	Virtual Private Network
WiMax	Worldwide Interoperability for Microwave Access
WMS	Web Map Service
WFS	Web Feature Service
XML	Extensible Mark-up Language

14 Annex

14.1 Work Tools

Forms for:

- Project definition
- Fine specifications

All the following forms are a translation from the German GIS Guideline (RT-GIS (2003)).

Rough planning GIS-implementation **Model of a** **Data entry form for an inventory/analysis of requirements**	Form Nr.	
	Department:	
	Person:	
	Date:	

A. Tasks

Tasks

1. Tasks of local self-governments:
Which task is being inquired?

Nr.	Name	Responsible

2. Detailed tasks: activities, persons:
Which steps are necessary to fulfil the task*? Persons involved?*

Nr.	Name	Official in charge/department	Externals involved

B. Inventory fulfilling of tasks

Inventory fulfilling of tasks

3. Tools in use at the time:
What kind of software is used now to fulfil the tasks?

4. Used information / data:
Which information/data/maps are needed to fulfil the task in the moment?

Kind	Source	analogue/digital	Quality

5. Result of work:
What kind of results is established while fulfilling the task (e. g. information/data)?

Kind	Used by	analogue/digital	Quality

6. Deficiencies:
Which deficiencies in the flow of work/working material exist in the moment? Where are possibilities of improvement?

6.1. Deficiency fulfilment of task	**Possibilities of improvement**

6.2 Deficiency information/data material	**Possibilities of improvement**

Data entry form for an inventory/analysis of requirements

C. Requirements on GIS application

Requirements GIS application

7. Suitability of tasks for GIS use:
Are the tasks/parts of tasks suitable for GIS application?
Which degree of priority should be given to the fulfilment of this task with GIS?

Suitability	Priority	Explanations

8. Functionality with GIS application
Which functions should GIS fulfil considering the mentioned tasks?

9. Digital data needed for GIS application:
Which data from nr. 4 is needed in digital form? Is this data already available?

Kind	Source	Availability	Accuracy	Data exchange from/to

10. Further comments/explanations

Rough planning GIS-implementation

Model of a listing

Analysis of requirements: part tasks/GIS-functionality

Part of tasks Nr.	Name	Priority for GIS	Part of task	User	Function graphic	Function thematic data	Data required

Rough planning GIS-implementation

Model of a listing

Analysis of requirements: part of tasks data

Available information (planning, data, maps)								Requirements on GIS data					Use planned by (staff member, department, externals)		
Nr.	Name	Scale 1:____	analogue/ digital	Data type	Form at	Precisi on	Accuracy	Available data usable?	Improve ment of quality necessar y?	Digitizing necessar y?	Gathering of new data necessary?	Change of format necessary? Data-type/ format	Gatheri ng by	Updatin g by	Access
Part 1: graphic information (e. g. planning, geo data)															
Part 2: alphanumeric information (e. g. text, data bases)															

Sample for the evaluation of the fine specifications for the implementation of a GIS in a local self-government				
	Function	Degree of performance 1-10 points		Weighing [%]
		System A	System B	Examples
1.	**Characteristics of provider: Profile of company**	7,4	6	2,50%
	Experience and establishment of software provider	5	6	30%
	References of software provider in the field of application of the user	10	5	40%
	Evaluation of competence and willingness to assist	7	9	20%
	Cooperation of software provider with data service providers	7	0	5%
	Geographic closeness	3	8	5%
2.	**Characteristics of provider: Profile of software**			2,50%
	Future orientation of GIS basic technology			
	Market share in the planned field of application			
	Licences in the field of application			
3.	**System platform/system requirements**			
	Backing of server operating system			
	Backing of client operating system			
	Backing of open-source operating systems (e. g. Linux)			
	Backing of Microsoft operating systems (Windows)			
	Flexibility in regard to			
	Hardware requirements server			
	Hardware requirements client			
	Requirements network technology			
4.	**GIS-Architecture**			
	Connection of working stations for editing (clients)			
	Connection of working stations for request (clients)			
	Connection of working stations in the intranet via internet technology (browser technology)			
	Internet connection for citizen requests			
5.	**Data storage/database**			
	Data base integrated into GIS base software			
	Keeping of data geometry data (possibility, functionality)			
	Keeping of data alphanumerical data (possibility, functionality)			
	Integration of data (possibility, functionality)			
	Keeping of data without redundancies			
	Database technology			
	Concept of transactions (data sets can only be proceeded at one working station)			
6.	**Data model**			
	Spatial and alphanumerical data can be managed and edited together			
	Object structured data model			
	Usability of 3D, multimedia data			
	Presentation of own functional requirements is possible in the data model			
	Documentation of data model			

	Adaptation, upgrading, openness of data model			
7.	**Software compatibility/interoperability**			
	Compatibility to GIS software products			
	Possibility of connection of further programs			
	Compatibility to Office products			
	Integration of OpenGIS standards			
	Backing of standards data bases (SQL, ODBC, JDBC…)			
	Backing of standard program interfaces (e. g. XML)			
	Adoption of standard programming languages			
8.	**Data interfaces**			
	Backing of standard GIS interfaces (DXF, TIFF, Shape, SQD)			
	Backing of interfaces for data updating			
	Backing of standard interfaces for Office products			
9.	**Basic functionality of the base software**			
	Basic functionality for processing of vector data			
	Basic functionality for processing of raster data			
	Basic functionality for combined processing of vector and raster data			
	Management of several projects possible			
	Functionality for data import, input and gathering			
	Graphical interface			
	Viewing functionality (zoom, scale…)			
	Cartographic presentation possible			
	Output and print possible			
	Writing or reports possible within standard software			
	Selection of single objects			
	Readouts of information to objects			
	Selection and attribute queries			
	Further proceeding and export of data			
	Topological evaluations			
	Data interfaces			
	Export of parts of datasets			
	System performance			
10.	**User friendliness**			
	self-explanatory user interface			
	Clarity			
	Documentation basic software			
	Documentation thematic applications			
	Online help			
11.	**Data security and data protection**			
	Functionality for regular data backup			
	Administration of user rights			
	Limited access to personal data			
12.	**Thematic applications and upgradeability of the system**			
	Availability of various thematic applications			
	Modular upgradeability of thematic applications			
	Thematic applications adapted to own requirements			
	Functionality of thematic applications			

	Possibility of integration of 3D data			
	Possibility of Integration of multimedia data			
	Creation of macros			
	Programming within the system by the user himself possible			
13.	**Functionality of thematic applications (depending on theme)**			
	Example: Geo base data			
	Property request			
	parcel request			
	Address request			
	Import of orthophotos possible			
	Import of further thematic data possible			
14.	**Functionality of a general request working station**			
	Access to all thematic applications			
	Zoom, scale, …			
	Fade in/out of thematic applications			
	Overlapping of different thematic applications			
	Queries of thematic data			
	Printing functions			
15.	**System support**			
	Contract for maintenance			
	Hotline			
	Training			
	Sum			100%

Prevention of project risks with the implementation of GIS		
	Project risk	**Prevention by**
Time	• System implementation takes significantly more time than expected • Time lag in data retrieval	• Project management • Planning with milestones • Provide sufficient human resources • Limit of project duration max. 1 year
Costs	• Increase of costs with software adaptation due to dependency of system provider • Too high costs of data retrieval	• Consider possibilities of upgrading when choosing a system • Limit data retrieval to the most important sets, proceed in steps
Data	• Quality doesn't match the requirements • Level of detail and data model do not cover the expected functionality • Data updating is not ensured, invalid data	• Order data only from original provider (authorities) • Detailed planning of data retrieval, consider quality aspects • Own gathering of data only if update possible
System	• Functionality doesn't match the expectations • System is not upgradeable • Solution complexity too high	• Analysis of requirements • Testing of system • Fine specifications • consider upgradeability of system • Choose priorities, do not implement all the applications at once
Staff	• Insufficient acceptance by employees • Overestimation of own capacity	• Early involvement of employees • Cooperation • Involve service providers

14.2 Model Contracts and Agreements

14.2.1 Example of the Memorandum of Understanding on GIS in Local Self-governments (Serb.)

Grb Lokalne Samouprave

Memorandum o razumevanju o Geografskom Informacionom Sistemu *Lokalne Samouprave*

Član 1

U cilju planiranja integralnog razvoja *Lokalne Samouprave*, modernizacija usluga koje *Lokalna Samouprava*, zajedno sa organizacijama potpisnicama Memoranduma, pruža svim zainteresovanim stranama, jedna je od najvažnijih aktivnosti koju zajedno sprovode *Lokalna Samouprava* i organizacije potpisnice. *Lokalna Samouprava* uvodi Geografski Informacioni Sistem, kao alat za efikasno pružanje usluga zainteresovanim stranama. U ovom poslu neophodna je saradnja među organizacijama koje pružaju svoje usluge zainteresovanim stranama na teritoriji *Lokalne Samouprave*.

Član 2

Lokalna Samouprava i organizacije potpisnice izražavaju svoju nameru da uvedu Geografski Informacioni Sistem *Lokalne Samouprave*.

Član 3

U ovom poslu *Lokalna Samouprava* i organizacije potpisnice će sarađivati u okviru zakona i dobre poslovne prakse.

Član 4

Lokalna Samouprava i organizacije potpisnice zapažaju korist od postojanja Geografskog Informacionog Sistema i zato će staviti na raspolaganje svoje resurse za sprovođenje ovog projekta.

Član 5

Lokalna Samouprava i organizacije potpisnice će urediti svoje međusobne odnose u uvođenju, održavanju i korišćenju Geografskog Informacionog Sistema *Lokalne Samouprave* Sporazumom o saradnji i Protokolima o saradnji.

Član 6

Usklađivanje rada *Lokalne Samouprave* i organizacije potpisnice vršiće se preko člana svake institucije u Radnoj grupi za Geografski Informacioni Sistem *Lokalne Samouprave*.

Član 7

Lokalna Samouprava i organizacije potpisnice su saglasni da je Memorandum otvoren za pristupanje drugih organizacija od zajedničkog interesa uz saglasnost Radne Grupe za Geografski Informacioni Sistem *Lokalne Samouprave*.

Član 8

Ovaj Memorandum je zaključen u __ (slovima: _____) istovetna primerka, od kojih svaka strana zadržava po 3 (tri) primerka.

RGGIS
Organizacija 1
odgovorno lice

_____
potpis odgovornog lica, funkcija

RGGIS
Organizacija 2
odgovorno lice

_____
potpis odgovornog lica, funkcija

... dodati još RGGIS organizacija prema potrebi ...

Lokalna Samouprava
funkcija (Predsednik Opštine / Gradonačelnik)

_____
ime i prezime

14.2.2 Example of the Agreements on Cooperation on GIS in Local Self-governments (serb.)

Grb Lokalne Samouprave

Sporazum o saradnji na Geografskom Informacionom Sistemu *Lokalne Samouprave*

OPŠTI DEO

Član 1

U smislu Geografskog Informacionomg Sistema *Lokalne Samouprave* (u daljem tekstu GIS *Lokalne Samouprave*) Učesnikom se smatraju *Lokalna Samouprava* i organizacije potpisnice Memoranduma o razumevanju o GIS-u *Lokalne Samouprave*. Korisnicima GIS-a *Lokalne Samouprave* se smatraju treća lica, organizacije ili pojedinci, zainteresovani za korišćenje usluga GIS-a *Lokalne Samouprave*.

Član 2

Sporazumom o saradnji na GIS-u *Lokalne Samouprave* (u daljem tekstu Sporazum) definišu se prava i obaveze *Lokalne Samouprave*, Učesnika i Korisnika u GIS-u *Lokalne Samouprave*.

Član 3

Lokalna Samouprava i Učesnici u GIS-u *Lokalne Samouprave* saglasni su da je GIS *Lokalne Samouprave* od presudne važnosti za buduće kvalitetno upravljanje gradskim resursima.

Član 4

Svi poslovi vezani za GIS *Lokalne Samouprave*, uključujući uvođenje, korišćenje, dalji razvoj i unapređenje GIS-a *Lokalne Samouprave*, definišu se kroz Radnu grupu za GIS *Lokalne Samouprave*, formiranu od strane *Predsednika/Gradonačelnika Lokalne Samouprave* rešenjem broj _____ od __.__.200_. godine.

Član 5

Cilj Radne grupe za GIS *Lokalne Samouprave* je izrada vizije i koncepta GIS-a *Lokalne Samouprave*, analiza postojećeg stanja, analiza usaglašenosti sa GIS standardima, analiza logistike neophodne da podrži uvođenje GIS-a *Lokalne Samouprave*, def-ja profila korisnika sistema, def-ja skupova i kvaliteta neophodnih prostornih podataka, def-ja funkcionalnih specifikacija sistema i uvođenje sistema u operativnu upotrebu.

Član 6

Logistika neophodna za uvođenje GIS-a *Lokalne Samouprave*, njegovo korišćenje, dalji razvoj i unapređenje GIS-a *Lokalne Samouprave*, definiše se kroz Protokole o saradnji za svaku oblast logistike pojedinačno. Protokole o saradnji definiše i predlaže Radna Grupa za GIS *Lokalne Samouprave* a usvajaju *Lokalna Samouprava* i organizacije Učesnika.

Član 7

Finansiranje GIS-a *Lokalne Samouprave* vrši se iz namenski određenih sredstava Budžeta *Lokalne Samouprave*, budžeta Učesnika, donacija, i od pružanja usluga Korisnicima što će se utvrditi posebnim Protokolom o saradnji u ovoj oblasti.

PRAVA I OBAVEZA POTPISNIKA

Član 8

Svi Učesnici GIS-a *Lokalne Samouprave* imaju pravo i obavezu da koriste GIS *Lokalne Samouprave* u svom svakodnevnom radu u cilju unapređenja usluga krajnjim Korisnicima.

Član 9

Pravo i obaveza *Lokalne Samouprave* i Učesnika je da preko imenovanog člana Radne grupe za GIS predlaže inicijative u okviru uvođenja GIS-a *Lokalne Samouprave*, njegovog korišćenja, daljeg razvoja i unapređenja u skladu sa odgovarajućim Protokolima o saradnji.

Član 10

Pravo i obaveza *Lokalne Samouprave* i Učesnika GIS-a *Lokalne Samouprave* je da prikupljaju, objedinjavaju, obrađuju, vrše analizu i održavaju prostorne podatke u skladu sa odgovarajućim Protokolima o saradnji.

ZAVRŠNE ODREDBE

Član 11

Vlasništvo *Lokalne Samouprave* i Učesnika GIS-a *Lokalne Samouprave* nad podacima i uslugama koji su u njihovim direktnim nadležnostima je neotuđivo.

Član 12

Podaci i usluge koji čine GIS *Lokalne Samouprave* mogu se davati, ustupati, preuzimati ili distribuirati van GIS-a *Lokalne Samouprave* samo na osnovu definisanih odgovarajućih Protokola o saradnji. Svaka zloupotreba podataka je strogo zabranjena.

Član 13

Učešće *Lokalne Samouprave* i Učesnika GIS-a *Lokalne Samouprave* kod uvođenja, korišćenja, daljeg razvoja i unapređenja GIS-a *Lokalne Samouprave* ne ograničava Učesnike da samostalno uvedu, koriste, razvijaju i unapređuju sopstvene GIS sisteme.

Član 14

U slučaju spora *Lokalna Samouprava* i Učesnici će pokušati da sve moguće sporove reše u duhu dobre poslovne prakse. U slučaju spora koji *Lokalna Samouprava* i Učesnici ne mogu rešiti sporazumno, spor će se rešavati pred stvarno nadležnim sudom u *Lokalnoj Samoupravi*.

Član 15

Ovaj Sporazum je zaključen u __ (slovima: _____) istovetna primerka, od kojih svaka strana zadržava po 3 (tri) primerka.

RGGIS
Organizacija 1
odgovorno lice

_____
potpis odgovornog lica, funkcija

RGGIS
Organizacija 2
odgovorno lice

_____
potpis odgovornog lica, funkcija

... dodati još RGGIS organizacija prema potrebi ...

Lokalna Samouprava
funkcija (Predsednik Opštine / Gradonačelnik)

_____
ime i prezime

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn
T: +49 6196 79-0
F: +49 6196 79-1115
E: **info@gtz.de**
I: www.gtz@de

Project Land management / Cadastre in Serbia
Kralja Vukašina no. 2
11000 Belgrade
T: +381 11 3693436
F: +381 11 3693439
E: gtz.lamacad@eunet.rs

Standing Conference of Towns and Municipalities
Makedonska 22/VIII
11000 Belgrade
T: +381 11 3223446
F: +381 11 3221215
E: secretariat@skgo.org

Republic Geodethic Authority
Bulevar vojvode Mišića 39
11000 Belgrade
T: +381 11 2650886
F: +381 11 2651076
E: office@rgz.sr.gov.yu