

THE IMPORTANCE OF INTRODUCING GIS AND ITS APPLICATION ON A LOCAL GOVERNMENTAL LEVEL – AN EXPERIENCE FROM SERBIA

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Abstract: *The application of information technology gets growing number of activities, which are under the jurisdiction of local government, partially or fully automatized due to fact that nearly 80 percent of all the decisions and information, made are directly or indirectly related to spatial data. This paper presents the importance of geographic information system applications in local governments as an effective tool that should provide support for the upcoming decisions through the analysis of spatial and other data, including support planning. It is also indicated the importance of using GIS software solutions, which implementation can be achieved interoperability in local government. Today, around thirty cities in Serbia have began with the implementation or significant progress in the development of the local GIS. The experiences of the local governments in the municipalities of Serbia emphasize that GIS has developed gradually with more or less success, quite often with the support of the funding projects as well as using personal resources.*

Keywords: *Geographic Information System (GIS), local government, spatial data*

INTRODUCTION

With the development of information and communication technologies, geographic information systems (GIS) have been increasingly developing on a technological level, and considering the place and time in which something is situated, based on spatial and non-spatial information, a successful implementation in different areas of business is provided. Goodchild (2010) emphasizes that GIS is one of the technologically developed systems that has provided and promoted the understanding of information and

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display of spatial data in the last 20 years. GIS displays that data in a visual, simple form that the user can relate to (Seferović, 2006).

A wide use of GIS in the last couple of years represents the result of progress in other technologies and areas that are correlated and supportive of the GIS system, such as geography and cartography, geovisualization, computer science, data base theory, mathematics, etc. Ron Alber defines GIS as „not a singular, but a gathering of simultaneous technological revolutions“ (Clarke, 2003). The fact that GIS does not undermine other applications, but itself represents an essential and inovative application concerned with spreadsheets, systems for data base managing and processing, it could be defined ad a powerful set of tools for gathering, storing, accessing, transforming, searching and displaying of spatial data from the real world for specific purposes (Burrough et al, 2000).

Beginning with geographic location, GIS provides a systematic gathering and managing of spatial data, as well as connecting different data of crucial importance to the local government. When it comes to spatial planing, the logic of applying GIS is unquestionable. Thus the ability to transform the spatial data into relevant information represents its basic value and advantage (Đorđević J., Đorđević D.,1996) .

During the last decade an increasing number of local governments in Europe has stood out as choosing to introduce and apply the geographic information system (Voerkelius et al., 2008). Since GIS is used for organizing and managins resources that are related to space and spatial planning, a great possibility of its application on a local governmental level emerges. Its application today relies on Real Estate Cadastre (REC) and Utilities Cadastre, due tu which these two cadastres are under the jurisdiction of the Republic Geodetic Authority (RGA) (Voerkelius et al., 2008). GIS technology provides a vital support to almost everything that a local government deals with.

Well defined geospatial programs help the jurisdiction in providing quality services to citizens, in a payable manner. The areas within which the local government can apply GIS are numerous, ranging from urban planning, tourism, protecting the environment, traffic, managins property, tax collection, agriculture, etc.

The subject of this paper is concerned with the development and the bases of applying GIS in local governments in Serbia. The essential problem in the work of local governments and public firms being the lack of cohesive information, caused by yet another lack of a unified data base – which leads to difficulties and inability of efficient operatins, the purpose of the paper is to represent the advantages of introducing GIS to local governments, where the main features to be emphasizes may be a better and faster process of decision making, an increasing efficiancy and decreasing administrative expenses, as well as a better connection with the citizens.

The structure of the paper is organized precisely on the theoretical basis of GIS, which is related to development and possibilities of its application in municipalities. A special attention has been given to the benefits provided by the system, whereby a project of applying GIS in the municipality of Pirot has been presented, with the goal of supporting the local government and all interested parties in the process off collecting information about its home country.

INTRODUCTION AND APPLICATION OF GIS IN LOCAL GOVERNMENT

Numerous businesses related to planning and administrative tasks in local governments mostly rely on spatial data. With the process of decentralization, the local governments have been increasingly transforming into certain service and administrative enterprises of their own, and are at the service of their users. Generally speaking, the users could be divided into those who manage the spatial data and keep track of it, and to those who simply use the data provided. The classification of users can as well be made on the basis of data usage frequency, where we distinguish those who use the data frequently with the goal of performing their activities, and those users who occasionally access the spatial data (Piro, 2006).

In order for the spatial data to be used, firstly all of the objects and phenomena of interest should be spatially represented, together with a complex analysis and processing of data when required. In that case the local government has two possibilities: to increase administration or to apply the GIS technology. Considering the fact that the appliance of GIS as an organized set of computer hardware, software, data, staff and networking provides recording, editing, managing, handling, analyzing, modeling, displaying of data with a spatial reference, as well as storing on a single location (Jovanović et al., 2012), its introducing is seen as a more appropriate solution.

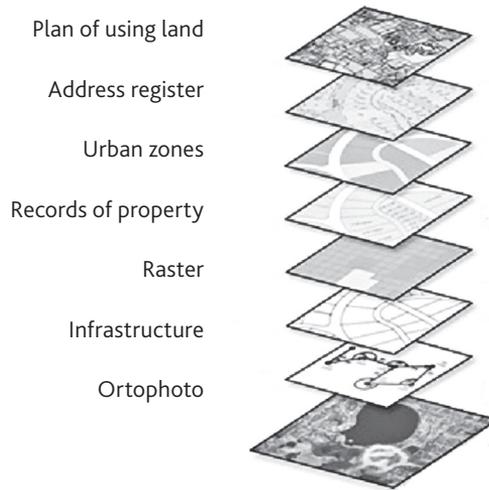
On the other hand, the process of gathering spatial data itself requires great expenses, but if they exist in a digital form they can easily be reproduced and distributed since they are given values, whereby they are easy to merge and combine with other information.

Appart from that, updating can be done with a considerably less amount of effort (Pick, 2005). Yet, before introducing and applying GIS, the people in charge and the local government as the „head“ institution must find the answers to questions dealing with the nature of data being used, how to reach them, do they already exist in the organization, what are the expenses of gathering and updating, etc.

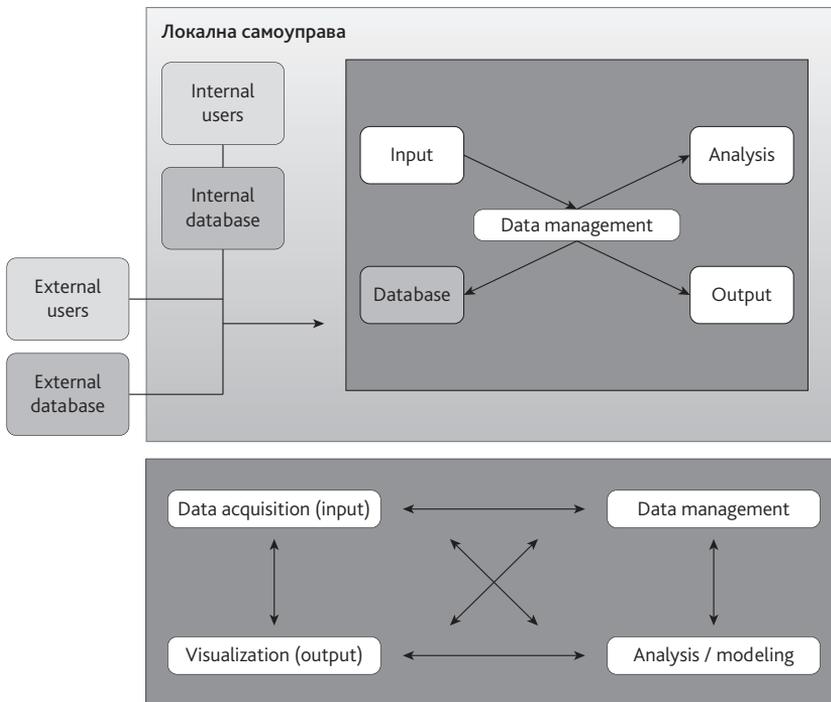
Observing any of the GIS projects it is possible to note that it consists of several layers or types of features. Depending on what is to be represented on them, the layers can be stacked in any order (Image 1), whereby they are connected by a table of attributes. Furthermore, the attributes of the alphanumeric data connect the objects and locations, whereby the data becomes visible and prone to analysis with the choice of any object (Žužić, 2012).

Since GIS represents a simulation of a real environment, it is mostly illustrated by different layers within which the data is organized into appropriate criteria. Some of the GIS layers are the address register, city zones, cadastral maps, orthophoto recordings, etc. (Pančev, 2012).

What defines GIS as a special tool is the fact that a large number of data on a local level can be georeferenced, i.e. it is possible to determine its spatial component. Since GIS is of use to every institution working with spatial data, among which the emerging ones are agriculture, tourism, forestry, utility companies, transport, etc., its development itself represents a perennial work to be developed in stages that are well planned and coordinated by the local government.



Picture 1. Overview of possible layers in GIS
 (Source: The project "Improving the GIS in Pančevo", 2012)



Scheme 1. GIS as an integrated software system that supports the above processes and their interactions
 (Source: Author based on Lennox, Nasrin, 2012)

Spatial information that are of significance to the local government are mostly situated in various public institutions and utility services, due to which numerous property data are outdated, and some only available in an analog form, thus being convertible. Considering the fact that GIS can provide a more simple storing, saving, and exchange of data in a standardized manner, its appliance in this case can represent a significant solution. By connecting the local government with other local and republic organs and institutions, GIS can contribute to a better usage of resources, faster exchange, analysis, and processing of information among different institutions, or within an institution itself, as well as to a syncing of businesses in planning, managing, and maintenance of local systems.

IMPORTANCE OF GIS FOR LOCAL GOVERNMENT

There are numerous benefits and advantages of using GIS. Through the main applications of GIS: mapping, measuring, monitoring, modeling, and managing (Stankov et al., 2012) various analyses can be performed, depending on the requests and expectations, and the results provided can further be sold to interested clients. GIS, as well as the programs based on the appliance of geospatial data in a local government, support a wide range of local and regional functions and provide an opportunity to minimize the expenses and maximize the benefit of the authorities in charge when it comes to investing (<https://www.fgdc.gov>).

A typical use of GIS related to everyday actions in a local government is viewed in an easier search through the parcels, of data related to the parcels, appliance of different resources, sustainable management, programs for protecting the environment, promoting the economic development, urban planning, projecting, decision making, etc (Žužić, 2012).

Besides, its basic purpose and significance is viewed in the visualization of data with the goal of a more precise, easier, and a more complex managing of resources of the local government and public institutions on its territory. The appliance of GIS in a local government provides an opportunity to completely redefine the action of communicating with the population, all with a purpose to improve the services given to citizens, potential investors, than to speed up the communication among different services and other interested parties.

In the area of providing services, a well developed GIS can be applied to the area of tourism, where networks of paths and routes can be worked out, while the famous tourist sights can be dealt with more successfully. Also, it is possible to check the road networks, their development and maintenance in order to prevent traffic jams (Voerkelius et al, 2008).

Thus, the importance of GIS to the local governments can be spotted through following aspects:

- lessening the administrative expenses and efficient business making
- better quality and faster decision making process
- improved connection with the citizens

GIS technology plays a crucial role in generating timely and confident information for planning and decision making on all levels of the local government (Bariar et al., 2004). According to this, it could be pointed out that an important goal of promoting the information support of the spatial development of a local government is creation and development of GIS as a supporting instrument for planning, executing and tracking the spatial and territorial development, with acknowledging the key directives of the general plan.

Table 1. Key directive for the strategic directions of GIS in local government

Directorate	Key Directives
CORPORATE SERVICES	<ul style="list-style-type: none"> • Local Government has a need to improve governance around data and information management • Aerial photography is a key information source for Council in supporting decision making capability • Inspection and valuation processes need to be aligned and supported by GIS • A critical business driver is to move away from multiple sources of similar data or data that shares strong relationships • Local Government needs to do more in terms of risk assessment and management strategies, particularly in regards to corporate systems and data • Local Government needs to ensure that future systems support the business needs of the organization • Improved access to data and information in the field for out of office workers • Reduce the risk of providing wrong information to customers
PLANNING AND ENVIRONMENT	<ul style="list-style-type: none"> • Improved integration between corporate systems such as GIS, Planning and Buildings data and information sources • Improved access to facilities and community owned assets such as open spaces, boat ramps • Training provided to be increased to support staff knowledge and awareness regarding GIS • Initiatives such as provision for environmental analytical data and functionality (i.e. mapping coastal historical information) • Improve the capability of the system to support business analysis and decision making capabilities of staff • Support strategies to analyse rural land use for farming, tourism and agribusiness • Provide mobile mapping technologies for activities such as emergency management and weed control • Improve customer service through better use of GIS
COMMUNITY AND ECONOMIC DEVELOPMENT	<ul style="list-style-type: none"> • Improved integration to corporate systems such as TRIM CIC (Customer Service System) • Ability to clearly define KPIs through GIS and asset management processes • Improved support for Community and Economic Development business requirements such as more vegetation mapping, septic tank management, emergency management support...

Directorate	Key Directives
INFRASTRUCTURE	<ul style="list-style-type: none"> • Ensure seamless integration between core corporate systems such as customer service, asset management and GIS • Provide the tools and expertise to be able to analyse data and information more effectively • Improve confidence in Council data and information • Support field work through mobile computing technologies, such as inspections, reactive and planned maintenance, condition reporting • Provide more effective OH&S and maintenance process support • Raising awareness of staff for more accountability regarding business processes and data management • Reduce the risk of litigation • Provide tools to support future planning needs (i.e. should a pre-school be built in this particular area?) • Understanding growth pressures more effectively

Source: Lennox, Nasrin, 2012.

The array of jobs that GIS will be used for by the local government depends on the knowledge of the employees, training of personnel, technical equipment, the data available, but also on the inventiveness of the people the system is developed and used by.

DEVELOPMENT OF GIS IN LOCAL GOVERNMENT IN SERBIA

Introducing GIS on a level of local government includes grouping together several different sections, as well as data and knowledge exchange among them and other organizations. The beginnings of introducing GIS are related to the Institute for Urban Planning of the city of Subotica, which conducted an initiative for creating a communal GIS 18 years ago, and since 1990 it begins working on a systematic digitalization of geodetic surveys, as well as on creating an urban planning documentation (Voerkelius et al., 2008).

In the last 10 years, in collaboration with the Directorate of Urban Planning in Kragujevac, and a programming company *Manufaktura d.o.o.* from Subotica, a decision has been made that for such a task a WEB GIS access with an appliance of an Open Source software should be used (Žužić, 2012). Apart from a local network of infrastructure, digitalized surfaces and other data, there existed a need for a unique system that will systematize and unify data, and that will altogether be at disposal to everyone in the Institute for Urban Planning, with the possibility of expanding to the local government and beyond (Žužić, 2012).

After the popularization and getting to know the system through a series of meetings, presentations within conferences and special forums, an implementation of the project was conducted in 2003, and the sources of financing from that period on have been various, from the German Society for Technical Cooperation (GTZ), DAI Company, EXCHANGE 3 Programm, etc.

The Exchange 3 Program has a purpose of contributing to the strengthening of capacities of the local governments in Serbia for the future participation in the process of decentralization, in accordance with the European Union standards. A direct user of the pro-

gram is *Stalna konferencija gradova i opština (SKGO)* which, with the goal of supporting the development of the local GIS, organizes network meetings of cities and municipalities. Thus, a possibility would be made for the representatives of the local governments to exchange experiences with their co-workers and gather information about current subjects. On the other hand, the ultimate users of this program are cities and municipalities in Serbia and their citizens. However, a lot of cases have shown that the local governments directed onto making and introducing the municipality GIS are developing their own information system without a concept of coordination and harmonization with other departments. Because of that, unfortunately, they often do not get the opportunity to use the experiences of others. Today, approximately 30 cities and municipalities in Serbia have made a considerable progress in the development of their local GIS, or began to use it. The ones that stand out among the local governments that have gone far with their GIS development are Subotica, Indjija, Nis, Kragujevac, and increasingly more the municipality of Pirot, where the introduction of this system is being dealt with more details further in the paper. The Exchange 3 Program approved financing of projects for introducing or further developing of GIS in the following cities and municipalities: Barajevo, Bujanovac, Kruševac, Kuršumljia, Zvezdara, Zrenjanin, Koceljeva, Novi Sad, Kraljevo, Pančevo, Pirot, Trstenik, Senta, and Čajetina (<http://www.exchange.org.rs>).

THE PROCEDURE OF INTRODUCING GIS IN PIROT

The GIS project of the municipality of Pirot was realized within the range of the Exchange 3 Program and it covers a larger number of work stages in the local government, the Directory of Construction of the municipality of Pirot and the utility companies *JP „Komunalac“* and *JP „Parking servis“*. The main purpose of the project was the development and implementation of the GIS in the municipality of Pirot and creating an infrastructure of geospatial data on a municipality level, based on the *GIS Development Strategy of Pirot Municipality* sustained in 2005 (www.mapsoft.rs). The strategy was presented with the architecture of the municipality GIS that was based on web technology, which includes the usage of Internet and distributed data bases. Such architecture implies that most of the data will be kept and saved within services, institutions, and establishments in charge for it.

On the other hand, through a web GIS server, as well as the approach to central or local GIS data bases, their distribution to users is provided (Pirot, 2005).

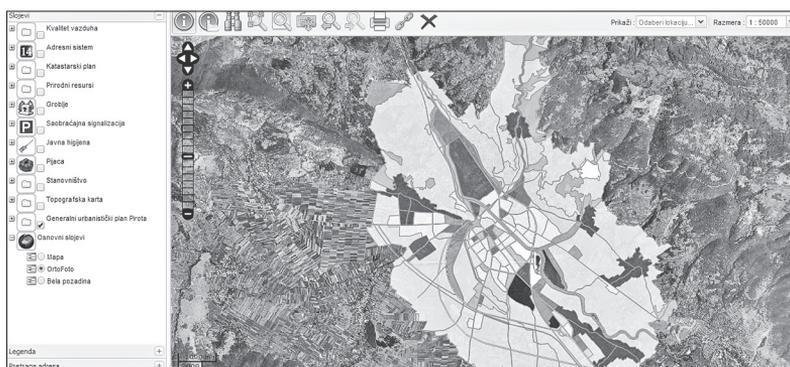
One of the goals of the project was to redesign the municipal web geoportal within which all of the geospatial data, geoinformation and services of the municipal GIS were systematized. This geoportal is a key spot for accessing the municipal GIS for a large number of users, both those from public companies and municipal administration, and citizens and other interested parties.

The ultimate goal of the project is to improve the services that the local government together with public companies provides for the users, both in terms of quality and efficiency equally.

Four main components of the municipal GIS were developed within the project:

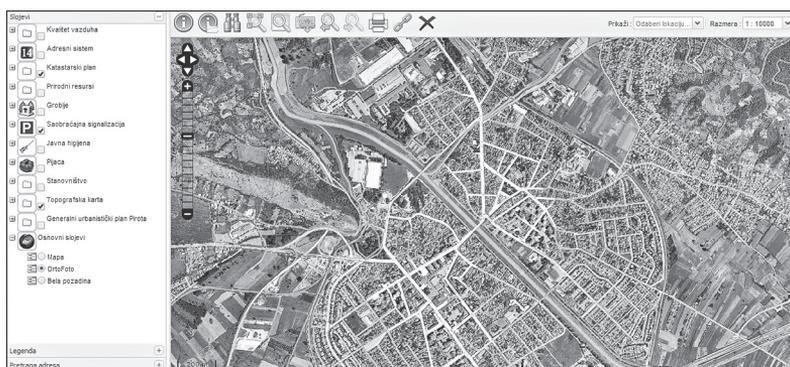
- GIS for the maintenance of public lighting
- GIS for the maintenance of roads, streets, and traffic signalization
- GIS for the maintenance of communal objects
- GIS based on a thematic whole of natural resources (<http://gis.pirots.rs>)

With the appliince of the web GIS geoportal the citizens of Pirot, and everybody else interested, were given an insight into official municipal data with the ability of sending suggestions and complaints to the municipal institutions. GIS in Pirot contains a public section available to all citizens and a professional section based on which it is possible to access additional data and additional functionality, depending on the rights of access. Public access provides a preview of a range of information, such as natural resources, public transportation lines. A search of parcels is provided, as well as addresses, useful locations, then a preview of the General Urban Plan, etc.



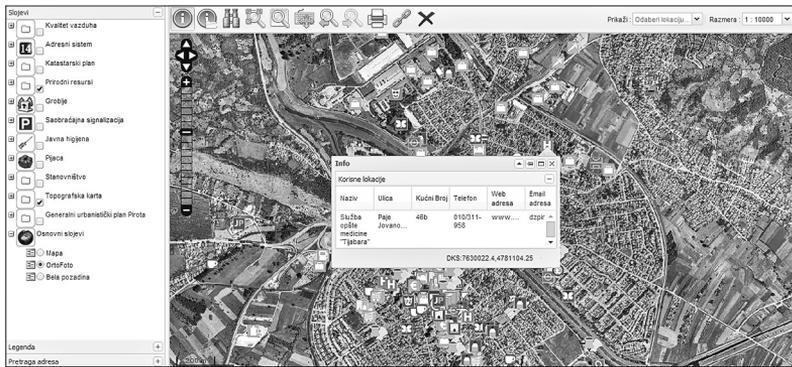
Picture 2. The municipality GIS with the presented urban plan of Pirot

(Source: <http://gis.pirots.rs>)



Picture 3. Municipality GIS with the presented cadastral maps, traffic signalization, roads, streets and hydrography

(Source: <http://gis.pirots.rs>)



Picture 4. Representation of significant location in the municipality of Pirot, with the possibility of obtaining detailed information on the selected object

(Source: <http://gis.pirot.rs>)

As represented in the *GIS Development Strategy of Pirot Municipality*, the effects of introducing GIS are related to:

- timely reaction of the authorities in charge to the requests of citizens, investors, and other clients,
- more efficient long-term planning in different areas (urban planning, demography, agriculture, forestry, communal infrastructure, etc),
- possibility of a better quality of data organization,
- better management of existing resources in order to achieve savings and stop the negative influences on the surrounding,
- analysis of the spatial and other data, as well as easier planning,
- speeding up the process of legalization,
- more efficient work of municipal section, etc.

CONCLUSION

The importance of GIS in the modern society is increasing, first of all because of the development and appliance of information and communication technologies which contribute to its efficient usage, and its future development as well. GIS industry includes a wide range of possible applications. It will increase in time through innovations in technology, with the raising awareness about its advantages as a powerful means of supporting decision making, but also its greater availability of spatially represented data and software. The strength of GIS lies not only in the ability to visualize spatial relations, but also in creating a holistic view of the world that emerges from its interconnected components and complex relations.

Introduction and appliance of GIS are an important precondition for the efficiency in the work of local governments. Applying GIS in the local governments during the last decade has impacted the means of functioning of certain municipalities. Complex business processes that required an overview of the scanned geodetic surfaces are already

in the past. A saving of resources of people and technique is also present, which justifies the introduction of this system. GIS provides a possibility to storage and save data, maps, and alphanumeric data in a digital form, and in such a way the parties in charge conduct the exchange of data much faster and easier. What is of crucial importance to the development of GIS is a strategic guidance in order to use all of the advantages this system has to offer. One should not neglect the fact that the appliance of this system is never finished, considering that it is a process that implies gathering, entering, usage of data and its constant updating.

It is important to emphasize that success in the implementation of GIS in a great matter depends on the people working on it. A great role is played by motivation, skills, technical knowledge, but also the ability of thinking within the frames of this system. In order to escape certain limitations in the development it is important that the management of the local government provides a working group in means of workforce, time, financial means, etc.

In Serbia, approximately 30 municipalities and cities have made significant progress in promoting their local GIS, and the data of RGA are essential for its future development. Also, as a support in the development of the local GIS in Serbia, an important role is given to the Stalna konferencija gradova i opština (SKGO) which, for that purposes, organizes network meeting of cities and municipalities, as well as the Exchange 3 Program directed towards introducing an EU model into the functioning and promoting the efficiency of the local governments.

REFERENCES

- Bariar, A., Gupta, R. D., & Prasad, S. C. (2004). Development Of Gis Based Spatial Data Infrastructure For Micro-Level Planning. Map World Forum. Hyderabad, India: GIS Development
- Burrough, P, McDonnell, R, (2000) "*Principles of Geographical Information Systems*", Oxford University Press Inc., New York
- Voerkelius, U, Glavina, J., Specht-Mohl, C., Schilcher, M., (2008) "*Upravljanje zemljištem/katastar u Srbiji - GIS priručnik za Lokalne samouprave u Srbiji*", Stalna konferencija gradova i opština (SKGO), Republički geodetski zavod, Nemačka tehnička saradnja (GTZ), Kancelarija za upravljanje zemljištem/katastar u Srbiji, Beograd
- Goodchild, M. (2010), "Twenty years of progress: GIScience in 2010". *Journal of Spatial Information Science* 1, 3-20.
- Đorđević J, i Đorđević D., Primena GIS-a u prostornom planiranju, SANU, Beograd, Jaroslav Černi, 1996., 213.
- Žužić, J., (2012) "*Uvođenje i primena GIS-a kao tehnološke inovacije u JP*" *Direkcija za izgradnju Grada Subotice*", Seminarski rad, Doba Fakultet, Maribor
- Jovanović, V., Đurđev, B., Stankov, U., Srđić, Z. (2012): *Geografski informacioni sistemi*. Univerzitet u Novom Sadu, Univerzitet Singidunum, Beograd
- K.C. Clarke, *Getting Started with GIS*, Prentice Hall, 2003.

Lennox, P., Nasrin, S., (2012): GIS as an important tool for local government, Geospatial World, <http://www.geospatialworld.net/Paper/Application/ArticleView.aspx?aid=30280>

Opština Pirot (2006): Strategija razvoja GIS opštine Pirot, Pirot.

Pick, B. J. (2005): Geographic Information Systems in Business, University of Redlands, USA.

Projekat "Unapređenje GIS-a u Pančevu" – Čemu služi GIS, Pančevo, 2012.

Сеферовић, С., (2006): Дигитална физичко-географска карта Фрушке горе у размери 1:25000, Дипломски рад, Природно математички факултет, Нови Сад

Stankov, U., Đurđev, B., Arsenović, D., Marković, V. (2012). Understanding the Importance of GIS among Students of Tourism Management. Geographica Technica, No. 2, 68-74.



<https://www.fgdc.gov/ngac/ngac-local-gov-gis-best-practices-paper.pdf>

<http://www.mapsoft.rs/index.php/sr/opstinski-gis-pirot>

<http://gis.pirot.rs>

http://www3.exchange.org.rs/upload/Document/File/2013_02/Exchange_3_zavrсна_brosura_feb_2013.pdf