Geosector Status Overview in the Republic of Serbia

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Abstract. Organizations operating in geosector in the Republic of Serbia are gathered around a common goal – the establishment of geodata infrastructure at the national level. State of play was done as one of the tasks in order to conduct proper planning and establishment. Questionnaire included 80 organizations from all levels of government, public enterprises, academic institutions, and other entities doing business with geodata. Results were statistically presented and the expert analysis was conducted with recommendations for further development. Basic technical and staff capacity of the geosector organizations in general are on satisfactory level, while a few leading authorities are significantly stands out and they are also major holders of production and distribution of the geodata. Existing production is a solid base for the further development as most of geodata sets have digital form, state coordinate system, and to a great extent already participating in the exchange. Elimination of the production overlapping and improvement of sharing are the main fields to be addressed. Defining, introduction and implementation of the standards, as well as more intensive activities on implementation of metadata are key factors of the improvement of geosector conditions. Referent data defining with corresponding national sources and stabile financing will additionally introduce favorable conditions for the geosector development. Stated results and recommendations are only part of the comprehensive examination, which is presented in this paper.

Key words: National Spatial Data Infrastructure, INSPIRE, geodata, geosector

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1 Introduction

Directive 2007/2/EC on establishing the INfrastructure for SPatial InfoRmation in the European Community – INSPIRE came into force on May 15th, 2007. The INSPIRE Directive has the objective to establish spatial data infrastructure in the European Union, for the purposes of policies and activities which may influence the environment [1]. Spatial data infrastructure refers to establishing conditions for exchange, access and use of interoperable spatial data and spatial data services across various levels of state administration and throughout various sectors, with emphasis on environment protection sector [1].

The Republic of Serbia is candidate state for European Union accession, based on the decision of European Council dated March 1st, 2012. The INSPIRE Directive is on the list of European legislation to be fully transposed to Serbian legislation prior to the accession, which directly refers to geosector. Although there had been initiatives for connecting and integration of spatial data in the Republic of Serbia in the past, initial activities on the National Spatial Data Infrastructure (NSDI) establishing had been started in 2008, in the Republic Geodetic Authority, through cooperation with the Norwegian Cadastral and Mapping Agency (Statens Kartverk). The goal was to adjust to the European legislation, and beyond that, to improve the existing spatial data for quality and wider use.

The Republic Geodetic Authority, being the central institution of geosector with the coordination role [3], had initiated firmer links between the geosector participants through the NSDI structure establishing. Legal foundation for both organizational structure and NSDI establishing is the 2009 Law on State Survey and Cadastre. This Law directly transposes some of the INSPIRE Directive provisions into Serbian legislation. Pursuant to the Law, organizational structure of the NSDI consists of the following organs: NSDI Council and NSDI Working Groups [2]. The NSDI Council manages creation of institutional and technical framework for geoinformation infrastructure establishing at the national level, with the Working Groups being operative organs. Currently, NSDI organs cover 62 representatives from 32 organizations [6], ranging from state administration, over scientific institutions, down to local government. General overview of stakeholders participating in the organizational structure is given in the Table 1 [6].

Joint work in geosector, coordinated by the Republic Geodetic Authority, had yielded substantial results in the NSDI development: the initial national portal “GeoSRBIJA” had been launched in 2009 (www.geosrbija.rs), complete organizational structure had been established in 2010 – 2011, the NSDI establishing strategy for the period 2010 – 2012 had been adopted, Mid-term program of works on the NSDI establishing and maintenance for the period 2011 – 2015 had been promulgated, overview of legislation in the field of geodata had been produced, geosector status had been analyzed, the NSDI law drafting had been initiated for the purpose of full transposition of the INSPIRE Directive in the national legislation, drafting the agreement between the NSDI participant organizations had been initiated, and issues of standardization and other items had been initiated [5].

### Table 1: NSDI organizational structure composition

<table>
<thead>
<tr>
<th>Organization type</th>
<th>NSDI Council</th>
<th>Working Group for Cooperation</th>
<th>Working Group for legal framework</th>
<th>Working Group for technical framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>State administration</td>
<td>10</td>
<td>15</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Ministries</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Special organizations</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Public companies</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Other public organizations</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Province organs</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Local government</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Municipal administration</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Public companies</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Scientific institutions</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Scientific institutions</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Scientific-educational</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Institutions</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Private companies</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>19</strong></td>
<td><strong>10</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

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Comprehensive analysis of geosector status had
been implemented for the purpose of determination of current state and needs for further development in the geosector. Complete results and conclusions of the analysis performed by the NSDI organs can be found in the document “Detailed Overview and Analysis of the Results of Questionnaire on Geosector Status 2013”, with short overview presented here.

2 Methodology

Mid-2012, the NSDI Working Groups’ members had decided that it was necessary to analyze current state in geosector. For those purposes, a comprehensive questionnaire had been designed, consisting of 33 questions in 5 themes:

1. Details on organization;
2. Spatial data production;
3. Cooperation between spatial data producers and users;
4. Standardization in the spatial data field;
5. Miscellaneous.

The questionnaire had been sent by the Republic Geodetic Authority on August 24th, 2012, to the broad range of organizations, which are assumed to have some links with spatial data regarding collecting, storing, processing and use. Apart from that, Permanent Conference of Cities and Municipalities had forwarded the questionnaire to the local government units. Answers had been collected by the end of 2012, through web form (based on the open source application LimeSurvey), electronic in doc format or in paper form. A total of 80 organizations had responding, with 78 filling out the questionnaire, and two noting that they do not produce or use spatial data, i.e. they do not have organizational unit working with spatial data.

Working team had been established to analyze status of geosector, consisting of representatives from various NSDI Working Groups and different organizations of governmental and local administration.

All answers had been inputted and presented in a single database. Source answers were changed only for the purpose of clear presentation of results (homogenized regarding scripture, introduced abbreviations of names, etc). The first step in results processing was to clearly present summary answers from the questionnaire. Simple descriptive statistics had been used, represented with short descriptions, tables and graphs. Answers statistics was given for each question, against the total number of organizations. Questions with predefined answers had covered prevalence of answers, while the descriptive questions had gotten answer categorizing, for the purpose of easier presentation.

The second step was the key part on work on overview of state in geosector – professional analysis of results obtained from the questionnaire. Puisent to the analysis of results obtain, the working team had created common conclusions and recommendations regarding the state of geosector in the Republic of Serbia.

3 Results

Results of the answers will be presented per questionnaire themes, so the introductory considerations of this chapter will cover overview of data on organizations: type, level of operation, financing, employees working with spatial data and technical capacities. Further on, the results on spatial data production will be presented, such as production against the INSPIRE themes, product description, issues of exchange and needs for spatial data. Next, the description of cooperation regarding spatial data will be given, with pricing policy, proposals for NSDI financing and data sharing possibilities. Final considerations of the present chapter refer to the issue of spatial data standardization, both for implementation and familiarity with standards, utilization of services, existence of metadata, etc.

3.1 Overview of Data on Organizations

Overview of organizations responding to the questionnaire on the state in geosector per type is shown in Table 2. Regarding territorial level of operation, there is uniform representation of organizations from the national and local level (44 % each). As for the financing, the respondents are predominantly users of the budget funds (state budget 27.5, autonomous province or local budget 26 %, budget combination 4 %), with only 15 % of organizations being financed from their own revenues. The majority of spatial data producers and users (84 %) are the budget funds users – exclusively or combined with own revenues.

<table>
<thead>
<tr>
<th>Organization type</th>
<th>Prevalence</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration organs</td>
<td>48</td>
<td>62%</td>
</tr>
<tr>
<td>Public company</td>
<td>15</td>
<td>19%</td>
</tr>
<tr>
<td>Scientific-educational institution</td>
<td>5</td>
<td>6%</td>
</tr>
<tr>
<td>Private company</td>
<td>3</td>
<td>4%</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>9%</td>
</tr>
</tbody>
</table>

Organizations in general do not have significant number of employees primarily tasked with collecting, processing or use of spatial information. More than 40 % of organizations have up to 5 employees in this field, while 12 % has none employees tasked with these duties. Figure 1 shows in more detail the number of organizations per number of employees tasked with spatial information. The small number of employees in
this field is congruent with the fact that 72 % responding organizations does not have organizational unit for spatial information.

Regarding technical capacities of organizations linking their operation with spatial information, the situation is acceptable. 90 % of organizations have broadband internet access, 93 % have computer network (nearly 60 % of them both LAN and WAN), and 88 % of organizations have database. Databases used are shown in the Figure 2. Nearly all responding organizations believe that spatial data use in their operation is useful, essential, and very useful.

Number of utilized applications for spatial data use and processing is low. The majority use one or 2 – 5 applications. As for the GIS platforms, the most commonly used is Desktop GIS, followed by Desktop GIS combined with Server GIS, and somewhat rare Desktop GIS combined with Server GIS and RDBMS. Internal capacity of organizations for developing spatial data management applications is shown in the Figure 3.

3.2 Spatial Data Production

Responding organizations had mostly noted that they are spatial data producers (68 %). Additionally, they had noted production per all INSPERE themes (with the exception of themes 15 and 16 from the Annex III, which refer to the oceans and seas). Descriptions of datasets produced in general provide satisfactory image of spatial data production. Said datasets are in 91 % of cases in digital format, linked to the national coordinate system in 84 % of cases, and are externally available with high degree (69 %). On the other hand, metadata exist for mere 25 % of listed datasets, and their availability via web services is rather low (22 %), due to the previous fact. Figure 4 shows percentages of organizations working with spatial data per number of products.

Elaboration of spatial data production in the Republic of Serbia inevitably leads to the issue of production overlapping. Examination of organizations having interest in the spatial data field clearly depicts the existence of this issue. Some of the overlapping categories, according to the questionnaire results, are data on addresses, utilities, topography, transport networks, urban and spatial planning data, as well as orthophoto and satellite images. When considering overlaps, the INSPIRE Directive (Article 4, Paragraph 2) is to be considered, stipulating that if several identical copies of the same dataset exist, it only covers reference, i.e. source version [1]. Additionally, covered territory has the significant role in analyzing overlaps.
Figure 4. Percentage of organizations per number of products

Availability of spatial datasets produced extends to the fact that organizations mostly (80%) note that they procure certain products for their daily activities from the other organizations. The most common products procured from other organizations are topographic maps, orthophoto, cadastral maps, cadastral parcels and address data, followed by the real estate sheets, consent conditions and spatial plans. This indicates the fact that the Republic Geodetic Authority is predominantly noted as the data distributor or producer. At the same time, the Republic Geodetic Authority is the very organization noting the greatest number of data procured from other organizations for its own operations. Dependency was also noted in the group of spatial data producers, with the central position being in fact held by the Republic Geodetic Authority.

Methods of spatial data distribution indicate predominance of the models which are not congruent to the modern IT trends, nor with the INSPIRE Directive, which highlights use of network services for spatial data sharing [1]. Exceptionally high percentage of organizations distributes data directly in digital medium or paper form (72%). That is by far the most common method of distribution, but by no means the only method for a given organization. Nevertheless, nearly 40% or organizations had noted mail only distribution, or combination of mail and direct distribution. Table 3 shows prevalence of individual methods of spatial data distribution in 66 organizations providing answer to this question.

Certain percentage of organizations (44%) has experience with spatial data sharing via web services (WMS, WFS, WCS, CSW and other). All organizations, without exception, having the experience in use of these services note that those are positive experiences and that spatial data access, viewing and sharing should be developed in this manner.

<table>
<thead>
<tr>
<th>Distribution method</th>
<th>Prevalence among 66 organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downloading via internet (download: HTTP and FTP)</td>
<td>26</td>
</tr>
<tr>
<td>Via e-mail</td>
<td>25</td>
</tr>
<tr>
<td>Postal/mail service</td>
<td>24</td>
</tr>
<tr>
<td>Direct (digital media, paper)</td>
<td>56</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
</tr>
</tbody>
</table>

Demand for unavailable spatial data mostly refers to cadastral data, infrastructure, orthophoto and satellite images and address data. List of unavailable, yet necessary data indicates major similarity with the list of datasets being produced, even with the list of spatial data with existing overlaps in the production. The noted fact indicates one of the anomalies in the spatial data production and use, to be analyzed in the next chapter. The Republic Geodetic Authority had been noted as primary producer of necessary, yet unavailable spatial data. The most important reasons of spatial data unavailability are high price, non-existence, outdated and unavailability on the internet.

3.3 Cooperation in Geosector

The existing cooperation in the geosector is being performed on demand, pursuant to the law or contract i.e. agreement. On the other hand, for use of spatial data produced 35% or organizations notes that they produce data for their own needs. Significant users are also citizens, organs of local and central government, followed by the public companies. Pricing policy of spatial data producers is different, with predominant charging for data i.e. services (45% of organizations). The rest of organizations, with nearly the same percentage, distribute the data for free, or according to the combined model (28% and 27% respectively). When charging for spatial data, organizations calculate the prices according to the production costs, with seldom use of spatial data market price.

As for the NSDI financing model, organizations mostly agree that the model should be implemented so that the production costs for the key data are being covered from the budget, with the exchange between the participants being performed without a fee. There is a widely present opinion in the geosector that the key role of the national geoportal is spatial data sharing, with an additional important role being spatial data integration. Additionally, exchange of spatial data via web portal with e-payment is receiving support from the majority of organizations (85%).
When evaluating issues in spatial data procurement, the first ones refer to non-existence of data in digital format, old/outdated data, data incompleteness and high prices.

3.4 Standards

Implementation of standards, such as INSPIRE, ISO and CEN, OGC, W3C and others is very low. Use of the INSPIRE standard is noted by only 6 organizations (with additional 5 organizations having partial use). The similar situation is shown for all other standards. The most implemented are GIS software producers’ standards and national standards. Other standards are mostly unknown or it is noted that they are needed.

Metadata use is also critical, since only 8 organizations note that they have metadata in line with the standards. Detailed percentages of metadata existence are shown in the Figure 5.

Figure 5. Metadata existence

Geosector organizations have the perception that the most necessary services for daily activities performing are spatial data viewing and vector and/or raster download, followed by WMS services and metadata search. Status of GIS analyses use for spatial data is such that attributive and spatial queries over vector data are being widely used, with the remaining GIS analyses, such as spatial queries over raster data, spatial-temporal queries over vector or raster data, analyses over digital terrain model and network analysis are being less used.

The impression is being formed that data use and protection does not receive necessary relevance, since more than half responding organizations did not answer this question. According to the organizations responding, use is regulated by access authorization, with the predominant protection being back-up with access authorization. Figure 6 shows detailed distribution of answers covering this topic.

Figure 6. Data use and protection

Nearly all organizations in geosector note that additional professional education is necessary, especially in the field of standardization, metadata and web services.

4 Analysis

Organizations responding to the survey on state in geosector, per number and per geographic coverage, are in fact representative sample of the geosector in the Republic of Serbia, therefore being valid for estimation of status.

The majority of organizations have the employees working on spatial information, but being minority. The users are dominant in numbers, using spatial data without adjusting them to their needs. Technical capacities are no longer beyond the reach of any serious organization or local government, which is indicated by domination of necessary foundation – broadband internet access. As for databases, Microsoft and Oracle are dominant. However, major percentage of the MS Access database use, which is not true multiuser database, indicates dominance of databases created earlier. The very diversity of databases should not be a problem, as long as there is a common standard for communication and format of data shared (web services and XML).

Few organizations have advanced capabilities regarding applications used and developed, such as regarding the work process and requirements. Only specialized organizations, i.e. their departments have advanced possibilities. At the local level, there is a major diversity of approaches for spatial information use. In general, all levels have established awareness of spatial data significance, which is partially conflicted with the low allocation of human resources for tasks referring to spatial data.

Clear indicator of specializing in several organizations for spatial data production and distribution is rather sharp division to two groups of organizations operating in geosector:
1. Spatial data producers and users; and
2. Exclusive spatial data users.

First group consists of 5 organizations, all being on national level.

The existing datasets have the good property, being mostly in digital format and in national coordinate system. There is a lack of unique standards regarding scales, resolutions and data quality and updating interval in general. Negative aspect of the existing spatial dataset is that the percentage of metadata existence is extremely low, which significantly hinders modern data exchange and development of spatial applications using the existing data. Due to this, there is appropriately small percentage of spatial data available over the web services.

Existence of overlapping in spatial data production is notable, namely for addresses, orthophoto, topographic dataset, data on transportation, hydrography, and other items. On the other hand, list of necessary, yet unavailable data mostly coincides with the list of data being produced. Such situation indicates insufficient communication and data sharing, but it may also be the consequence of insufficient territorial coverage of certain spatial data.

For the existing and available data, price is being seen as the leading obstacle for sharing. Data prices are being determined by organizations themselves, with the objective of cost recovery, updating and production improvement. If we consider the fact that budget financing is being predominant in the geosector, national strategy of geosector development must be established, to appropriately resolve the issue of financing. In fact, it is necessary to provide stable funds for geosector financing, regardless if they fully originate from the budget or from fees collected from users, as well as to assure clear definitions of establishing and updating processes, with the emphasis on cost efficiency. Most of organizations consider that production costs for the key data must be covered from the budget, with the exchange between the stakeholders being free. Even today, some of the spatial data are being shared without fee, if the legislation prescribes so.

Furthermore, cooperation and data sharing in geosector exists, has high intensity, being defined by the usual procedures: agreements, legislation or individual requirements. The issues yet to be tackled refer to data sharing methods. Today’s data exchange is prevalent using digital media or in paper form; directly or by mail. Positive experiences in web services using note justification and must be the example for the delivery channels to switch to this model.

There is a prominent opinion that data exchange holds key importance for geosector, but there is well noted need for spatial data integration and transparency. Sharing, integration and provision of transparency are the basic tasks of the national geoportal. Previously noted issue of missing metadata reemerges here. This issue is directly linked with non-adherence or unfamiliarity with standards, which is general state in the majority of geosector organization. This is, yet, reflection of lack of unique strategy at national level for spatial information implementation. Furthermore, inexistence of overall electronic payment processor using debit cards, certificates and full Republic Key infrastructure is the obstacle for data sharing over web portal from the financial point of view. Resolving issues listed is necessary for establishing electronic sharing and payment.

The problems occurring in data procurement, in the manner it is being performed today, does not entail a prevalent issue, instead there are several, equally present (updating, quality, high price, etc). Yet, the problem being hardest to solve, considering necessary financial resources and time, are old, outdated data. However, if we consider the multiple positive effects of spatial data updating, any investment in updating has multiple cost efficiency. For that purpose, national strategy is necessary to provide for key data updating.

Regarding GIS analyses, attribute and spatial queries over vector data are most frequently used. Very few organizations use more GIS analyses in their work. Services noted as necessary (“vector and/or raster download” and “spatial data viewing”) clearly indicate which services need to be developed. However, such answers are the consequence of undeveloped system of work with common server. Organizations predominantly use desktop applications.

In the field of regulated use and protection of spatial data, there is a low level of response, followed by access authorization, partially with backup. Access authorization is the initial level of protection, with the backup being simple protection against data loss, excluding unauthorized access and copying. Therefore, the existing spatial data protection is mostly not appropriate.

Positive and encouraging fact is that organizations operating in geosector are aware that they require additional professional educations, with appropriate fields of education selected.

5 Conclusions

Conclusions are conceptualized in the form of recommendations, to improve the status in geosector. Pursuant to the current state in geosector in the Republic of Serbia, it is necessary to:

- Work on technical education, as well as on business application of spatial data. Trainings should be directed towards the possibilities offered by the spatial data, by using the GIS tools;
- Access databases and accompanying applications need to be migrated to the appropriate server databases (SQL Server,
Additional work should be done on services standardization and classification, as well as services description, to provide recognition by all users;

Initiate the activities on complete digitalization, establishing updating and quality of all existing spatial data;

For spatial data production and distribution, it is necessary to define central point, common standards for use and quality of spatial data collected;

To resolve the issue of overlapping in production, thus duplicating work and resources, it is necessary to:

- Define key/reference data on the national level and strive for full territorial coverage and updating. That requires provision of financing from the budget, which are being motivated by the high degree of cost efficiency;

- Assign competences to the organizations for key data, which implies revoking duplicated competences. Additionally, impose obligation to use key/reference data from the national producers;

- Improve method of data distribution and sharing by increasing web services use (public internet network, protected internet channels or leased lines) in data sharing and communication between the applications. In this manner, efficiency will be increased, with decrease of data prices, thus data will become more available to all users;

- Pricing policy should regulate greater spatial data availability, and open data would remove the majority of reasons for unavailability. Additional reason for open data access is that the general standpoint is that the NSDI financing model should be such that the production costs for the key data are being covered from the budget and data exchange among the subject should be without fee, as presently budget financing dominates among the primary spatial data users;

- Further work on development of the national portal and the NSDI should follow the required roles: spatial data integration and sharing;

- At national level, define standard(s) in geosector and work on their implementation. Particularly, encourage improvements in standardization and metadata implementation, since the lack thereof hinders spatial data sharing and use.

Gratitude

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