

Sonja Dimova

PhD, State advisor for geomatics
Agency for Real Estate Cadastre-Skopje,
Republic of North Macedonia
s.dimova@katastar.gov.mk

Suzana Ivanovska Kirandziska

MSc, Head of NSDI department
Agency for Real Estate Cadastre-Skopje,
Republic of North Macedonia
s.kirandziska@katastar.gov.mk

Luka Jovicic

MSc, Project manager
GDİ DOOEL Skopje, Republic of North
Macedonia
luka.jovicic@gdi.net

ANALYSIS OF DATA SETS AND SERVICES ON THE NSDI GEOPORTAL

The paper analyzes the data sets and services published on the new NSDI geoportal. The Agency for Real Estate Cadastre as the institution which according to law is responsible for establishing, maintaining and enabling public access to the NSDI geoportal, started to modernize the existing NSDI geoportal in order to upgrade it and increase the number of data and services.

The new NSDI geoportal was launched in November 2020 and, as a cutting-edge software solution based on the ESRI platform, enables viewing and using the spatial data through web-oriented services and interoperable infrastructure. Several aspects were in focus during the creation of the geoportal, such as the products, users, administrative aspects, business aspects, strategic goals, but also certain visions and concepts about the way the system should function in the future

Keywords: NSDI, geoportal, data set, web service, INSPIRE, harmonization

1. INTRODUCTION

The establishment of the National Spatial Data Infrastructure (NSDI) in the Republic of North Macedonia is regulated by the Law on the National Spatial Data Infrastructure of the Republic of Macedonia (*Official Gazette of the Republic of Macedonia* no.38/14 and 106/16). The law transposes the European directive INSPIRE (2007/2/EC) which regulates the establishment of spatial data infrastructure in the European Community.

The objective of the establishment of the NSDI is to facilitate the access, sharing, use and distribution of standardized spatial data and services in an efficient, effective and synchronized manner.

According to the Law on NSDI, 20 institutions are the NSDI subjects/stakeholders: Ministry of Justice, Ministry of Defense, Ministry of Interior affairs, Ministry of Economy, Ministry of Agriculture Forestry and Water Economy, Ministry of Local Self-Government, Ministry of Culture, Ministry of Transport and Communications, Ministry of Environment and

Physical Planning, Ministry of Information Society and Administration, Ministry of Political System and Inter-Community Relations, State Statistical Office, Agency for Real Estate Cadastre, Agency for Spatial Planning, Central Registry of the Republic of North Macedonia, Crisis Management Center, City of Skopje, Economic Chamber of the Republic of North Macedonia, Geological Survey of the Republic of North Macedonia and Association of Economic Chambers of the Republic of North Macedonia.

In order to facilitate the data sharing between state institutions, an Agreement for sharing of spatial data sets and services has been prepared and already signed by fifteen stakeholders. The agreement sets a legal framework which regulates the sharing of data within the NSDI geoportal.

Currently, 161 metadata, 79 web services and 82 geospatial data sets are published and available for using on the NSDI geoportal, demonstrating expansion in modern way of sharing and using data sets through web services (Figure 1).

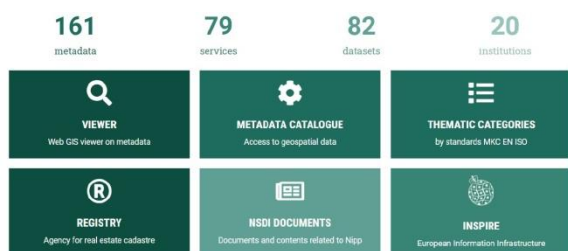


Figure 1. Number of data sets and services on the NSDI geoportal (<http://nipp.katastar.gov.mk>)

2. ARCHITECTURE AND FUNCTIONALITY OF THE NSDI GEOPORTAL

The NSDI geoportal integrates spatial data sets from the NSDI subjects. It is based on ISO and OGC standards and the INSPIRE directive implementing rules, with the focus on the web network services architecture.

The geoportal is user-oriented and contains many of information and data that users need. The data sets from the NSDI geoportal can be used by the state institutions, private sector and citizens. With one click on the NSDI geoportal users can access requested information, see all data published on the portal (hydrographic network, road network, cadastral parcels, land use, buildings, geographical names, elevation model, orthophoto map and other). The geoportal contains several functionalities: search application, metadata catalogue with a tool for metadata creation, map viewing application /GIS browser, registries, administrative module and module for e-commerce services.

The portal enables connection of spatial data sets and services between the NSDI subjects, as well as with third parties interested. The NSDI geoportal is used to manage the NSDI through facilitation of access, exchange, sharing, searching and using of standardized spatial data and services. Its main components are: geospatial data sets, metadata, network services (discovery, view, download) and interoperability of data sets and spatial data services.

The architecture of the NSDI geoportal (Figure 2) is in the line with the architecture on the INSPIRE geoportal.

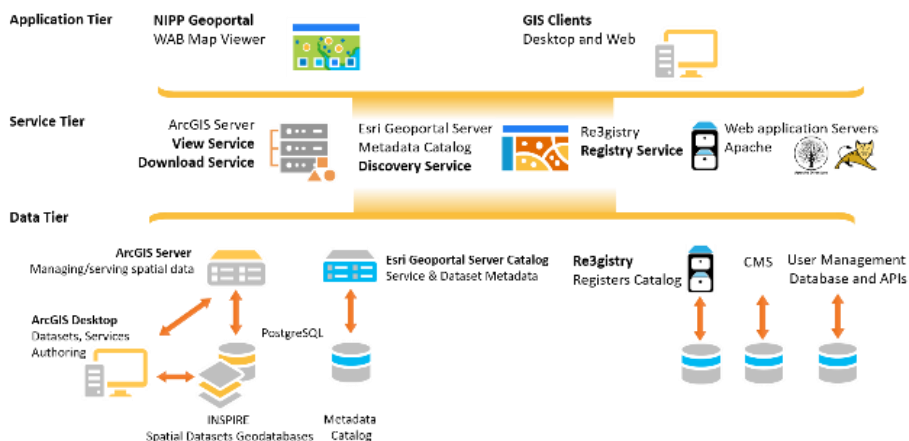


Figure 2. Architecture of the NSDI geoportal

A central functionality of the NSDI geoportal is the metadata catalogue. Metadata is presented with xml files which provide information on the content, owner, quality, type, accuracy, spatial information and updates of data set or service. This is essential information that other individuals or organizations need to know before they can use the data or service. A Metadata Catalogue Service is a mechanism for storing and accessing descriptive metadata and allows users to query data items based on desired attribute the catalogue service. NSDI geoportal contain a metadata editor (tool for creation of metadata for data set and service creation). All metadata on the NSDI geoportal are created according the Regulation of standards of metadata ("Official Gazette of the Republic of North Macedonia" no. 123/19) and Commission regulation (EC) no 1205/2008 implementing directive 2007/2/EC of the European parliament and of the Council as regards metadata.

Overview of architecture and functionality of the NSDI geoportal shows that geoportal fulfills following conditions: keeps the data where it can be maintained most effectively, the ISO and OGC standards are implemented, has the possibility to combine seamless spatial information from different NSDI subjects and share it with many users and applications, information for data set and services, transparency and availability of data and services.

3. ANALYSIS OF THE DATA SETS ON THE NSDI GEOPORTAL

Themes of data sets are described within the article 5 of the NSDI law. The NSDI law defines 32 themes of data sets: coordinate reference systems, geographic network systems (grid systems), geographic names, administrative units, addresses, cadastre parcels, traffic networks, hydrography, protected areas, elevation/height terrain model, earth surface, ortho-photogrammetry, geology, statistical units, buildings, soil, land use, human health and protection, services of public interest, environment monitoring systems, Production and industrial capacities, agricultural and aqua - cultural capacities, population density - demography, areas for management, limitation and regulation and reporting units, natural risk zones, atmospheric conditions, meteorological geographical characteristics, bio - geographic regions, habitats and biotopes, density of the species, energy sources and mineral resources. In comparison with the INSPIRE themes, Macedonian NSDI lacks two themes: oceanographic geographical feature and sea regions, since these are not applicable. The number of 67 published national data sets on the NSDI geoportal belong to 19 themes of data sets is presented in Figure 3.

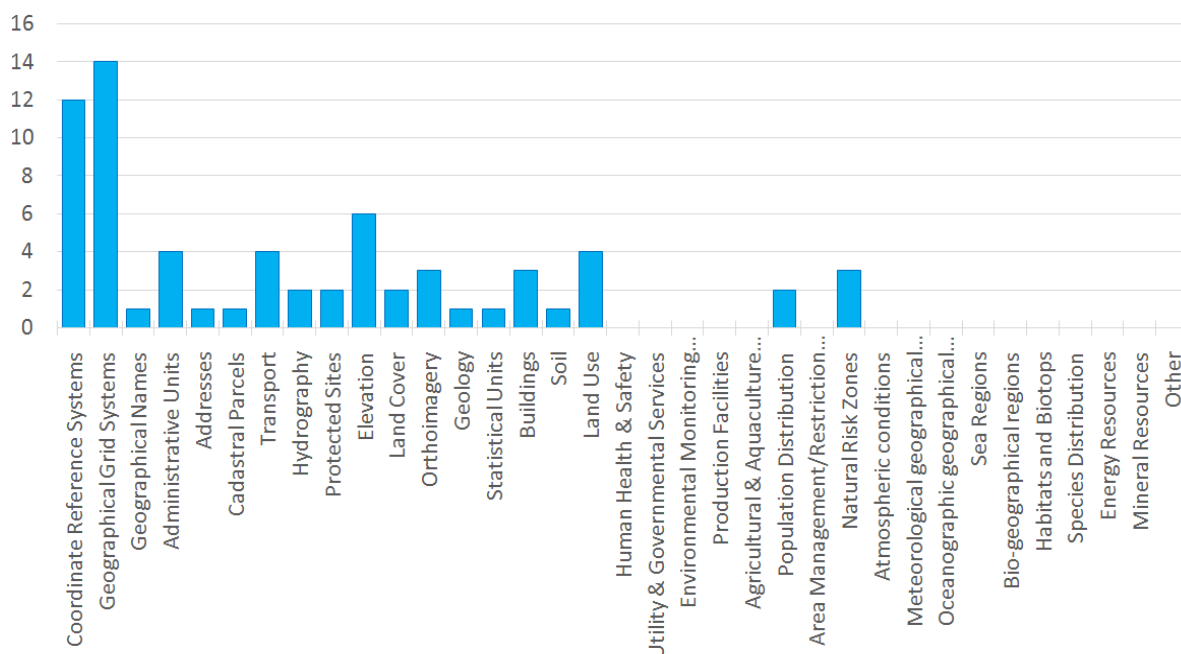


Figure 3. Number of spatial data sets per themes published on the NSDI geoportal

All of the published data sets on the NSDI geoportal are: transparent (data for governing should be easily found and available), accessible (disparate data sources can be easily combined, no matter what their origin is), scalable (data is structured so that it can be used across different scopes), reliable (data is collected only once and is maintained regularly) and accountable (metadata is formalized and set to a standard).

Having in mind that the NSDI initiative is directly related to the European INSPIRE Directive, the data from the Agency for Real Estate Cadastre are a step ahead of the data from the other NSDI subjects. They are harmonized in accordance with the relevant INSPIRE data specifications (technical guidance) and are interoperable with data sets from European countries. The number of 15 national data sets which are harmonized with INSPIRE data specifications are shown in Figure 4.

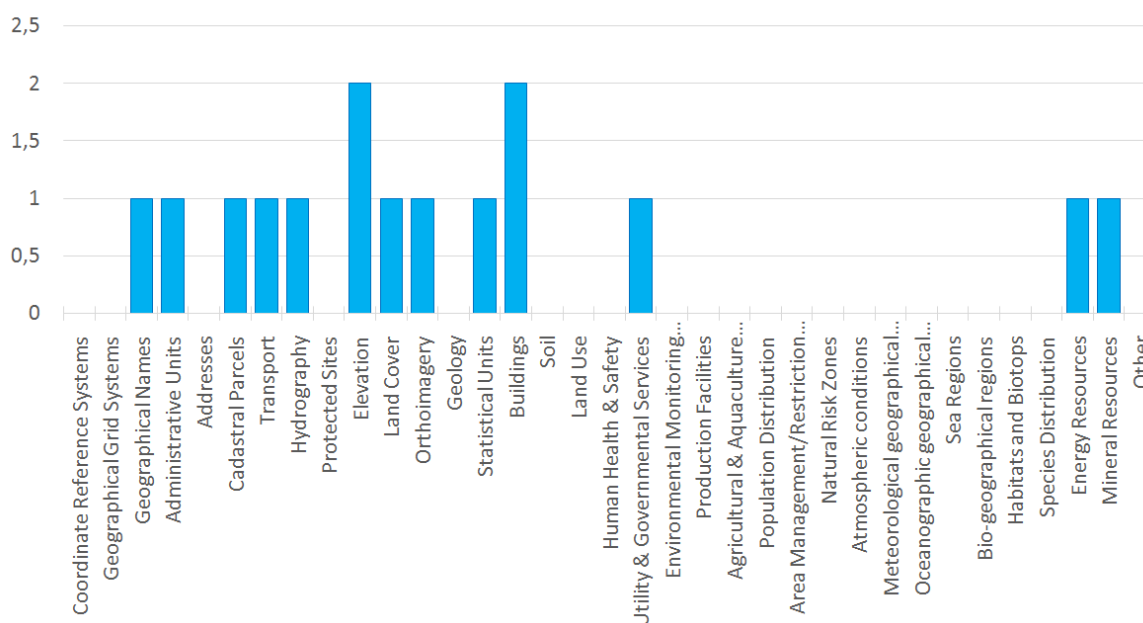


Figure 4. Spatial data sets harmonized with INSPIRE data specifications

4. ANALYSIS OF THE WEB SERVICES AT THE NSDI GEOPORTAL

Following services are available for data sets published on the NSDI geoportal: discovery, view, and download, through following protocols:

- URL address (Get Capabilities) for OGC services (OWS, WMS, WMTS, WCS, WFS, WPS, SOS, SPS, CSW, KML)
- Open Archive Initiative
- Get Capabilities URL for CS-W Discovery
- URL address (WAF HTTP/FTP)
- URL address for JSON data format DCAT
- ATOM Feed
- URL for metadata XML document
- OpenSearch XML

The term web service describes a standardized way of integrating web-based applications using OGC (Open Geospatial Consortium) and ISO (International Organization for Standardization) standards via Internet Protocol. The service allows the user to search, view and download spatial data. The analysis of the services published on the geoportal gives the following results:

WMS is the most widely accepted and popular web mapping service, which describes the communication mechanisms and allows software products to request and provide pre-assembled map images ("composite" map images, which can contain both vector and raster data) to the requesting client. Web Map Service interface standard (WMS) provides a simple HTTP interface for requesting ge-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response

to the request is one or more geo-registered map images (returned as JPEG, PNG, etc.) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not.

Web Feature Service (WFS) interface standard provides an interface allowing requests for geographical features across the web using platform-independent calls. One can think of geographical features as the "source code" behind a map, whereas the WMS interface or online tiled mapping portals like Google Maps return only an image, which end-users cannot edit or spatially analyze. The Web Feature Service (WFS) represents a change in the way geographic information is created, modified and exchanged on the Internet. Rather than sharing geographic information at the file level using File Transfer Protocol (FTP), for example, the WFS offers direct fine-grained access to geographic information at the feature and feature property level.

Download service offer transmission of a file from NSDI geoportal to the computer system using Internet point-of-view, to download a requested file and to receive it. Those services can be realized using File Transfer Protocol (FTP) which is the Internet protocol for downloading and uploading files and a number of special applications.

In relation to the web services published on the NSDI geoportal, 55% of them are view services what enable viewing the data sets using Web Map Services (WMS) and 45% is download services which include web feature service (WFS), Atom and web cover services (WCS) (Figure 5).

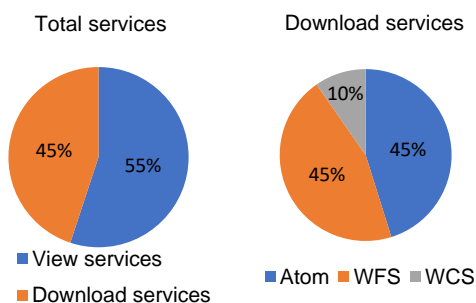


Figure 5. Graphical presentation of the coverage of the web services on the NSDI geoportal (Left: Ratio between view and download services; Right: Ratio of types of download services)

The comparison of data sets and services on the NSDI geoportal indicates that only 34%

data sets are available for use by the view services, and 24% are available for use by the download services. The statistic also to point out that a lot of data sets don't have a web services, they only have metadata (Figure 6).

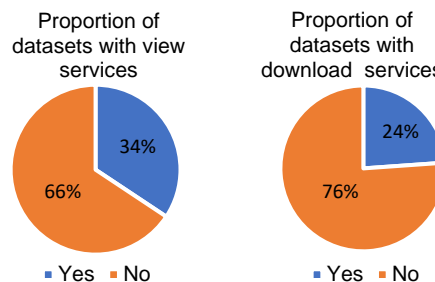


Figure 6. Percentage of representation of data sets through web services

The users of the NSDI geoportal can use 10% view services free of charge, but the download services at the moment may not be used free of charge (Figure 7). Further geoportal development considers the implementation of open data initiative which will allow part of the download services to be used free of charge.

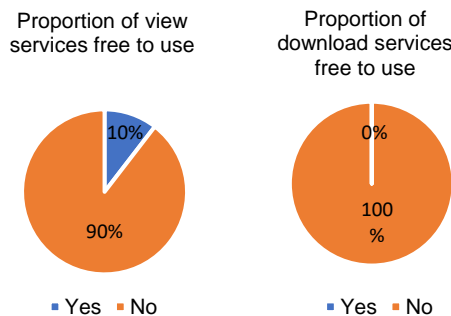


Figure 7. Percentage of web services use free of charge

5. CONCLUSION

Analysis of data sets and services published on the NSDI geoportal illustrate that the structure of the NSDI geoportal, data sets and services are well structured and they are harmonized with INSPIRE directive. At the moment the number of published data sets and web services is good, but not enough, because it is necessary to publish data sets for all themes. This means that the NSDI stakeholders are needed to take activities to enlarge the number of published data sets and services on the NSDI geoportal. More data sets and services published on the geoportal will contribute to

better future on NSDI and will have positive impact to the society.

The development of NSDI geoportal contributes to significant progress in NSDI area in recent years. One major goal in this area is cooperation and support of the NSDI subjects with reference data, which are needed in their daily work. However, one of the challenges in the future is to take activities for wider promotion of the NSDI geoportal in order to increase using available data sets through web services and motivate state institutions to share datasets via NSDI geoportal.

REFERENCES

- [1] Annoni, A. (2006), JRC and INSPIRE Interoperability, GIM International, Vol. 20, No. 3.
- [2] Annoni, A. and Craglia, M.(2005). Towards a Directive Establishing an Infrastructure for Spatial Information in Europe (INSPIRE), FIG Working Week, Italy.
- [3] Dimova, S. (2018), The legal component one of the key segments for NSDI development in Republic of Macedonia, Land Governance in an Interconnected World, Annual World Bank Conference on Land and Poverty, Washington D.C.
- [4] Dimova, S. (2010), The role of the Agency for Real Estate Cadastre in the establishment of the National Spatial Data Infrastructure, International Conference SDI, Skopje, Macedonia.
- [5] European Commission (2010), Commission Regulation (EU) No 1089/2010 of 23 November 2010 Implementing Directive 2007/2/EC the European Parliament and of the Council as regards interoperability of spatial data sets and services
- [6] European Commission (2011), Commission Regulation (EU) No 102/2011 of 04 February amending Regulation (EU) No 1089/2010 Implementing Directive 2007/2/EC the European Parliament and of the Council as regards interoperability of spatial data sets and services
- [7] European Commission (2009), Commission Regulation of 5 June 2009 Implementing Directive 2007/2/EC of the European Parliament and of the Council as regards monitoring and reporting.
- [8] Groot, R. and McLaughlin, J. (2000), Geospatial Data Infrastructure: Concepts, cases and good practice, Oxford University Press, Oxford.
- [9] Johan Sandberg (2011), Challenges within Geographical Data Sharing Using OGC Standards Regarding the INSPIRE Directive, School of Architecture and the Built Environment Royal Institute of Technology (KTH) Stockholm, Sweden.
- [10] Jovicic, L. (2018), Spatial Data Harmonisation in Regional Context in Accordance with INSPIRE Implementing Rules, GISM01 20182, Master Thesis in Geographical Information Science, Dept of Physical Geography and Ecosystem Science, Lund University, Sweden.
- [11] Mijić, N., Preradović, D., Šestić, M. (2016), Strategic development of infrastructure for spatial information based on European INSPIRE directive, Conference Researching Economic Development and Entrepreneurship in Transition Economies, Belgrade, Serbia.