SDI DAYS 2013

Šibenik, 26/27 September

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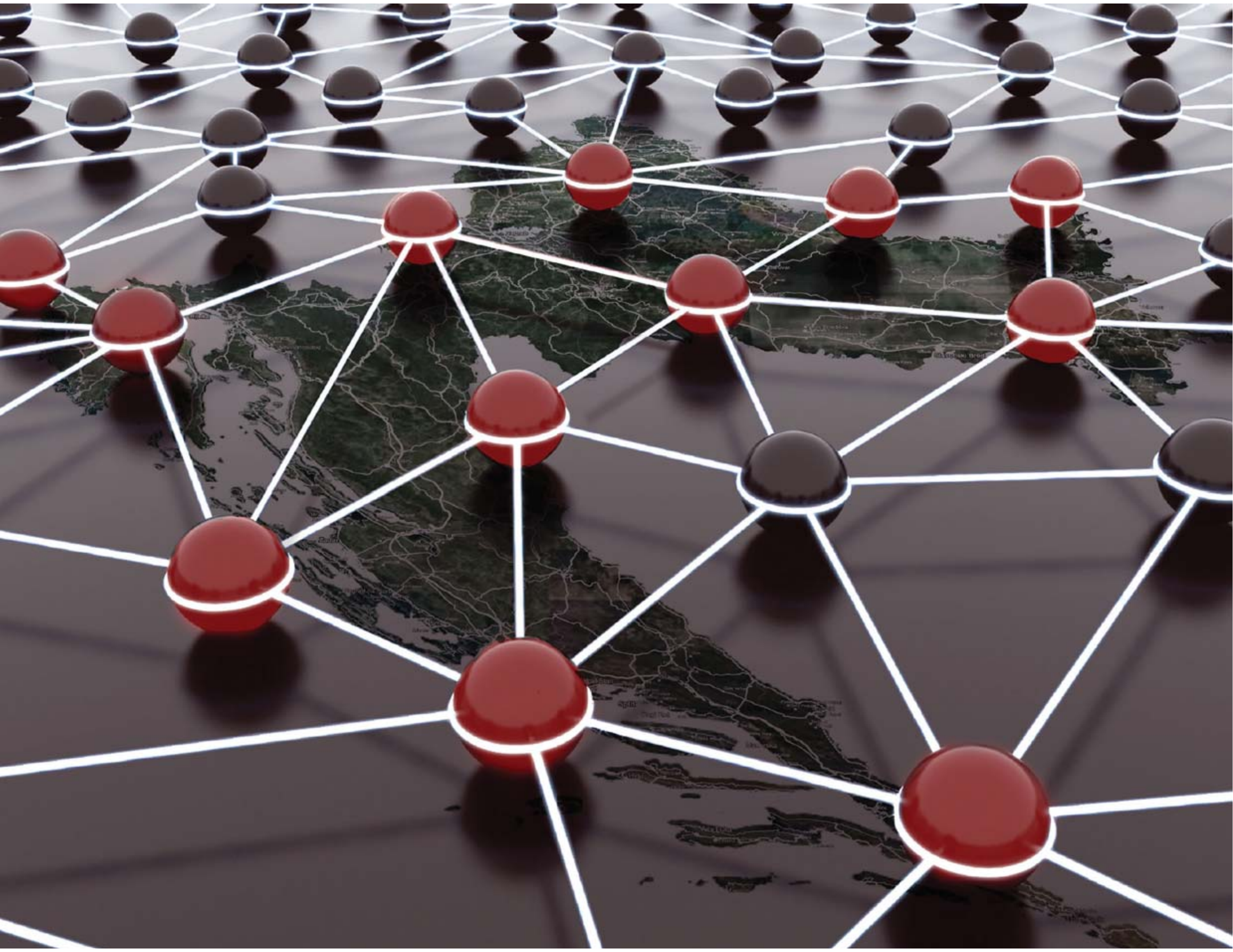
·INSPIRE and integrated land & water management scientific workshop

·5th NSDI and INSPIRE day

PROCEEDINGS



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DGU REPUBLIC of CROATIA State Geodetic Administration

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Ministry of Construction and Physical Planning

NIPP
NSDI Council of the Government of Republic of Croatia

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5th Croatian NSDI and INSPIRE Day

Organizers preface

The importance of spatial data, their products and services have long been recognized as the infrastructural foundation for the development of society. State Geodetic Administration (SGA) is giving its spatial data and services to ministries, institutions, private sector and citizens. SGA fundamental spatial data are serving as the basis for further development in many sectors. Spatial data services and products create the basis for new development cycle, as a basis for investment and economic development.

SGA have obligation to implement EU INSPIRE Directive. The National Spatial Data Infrastructure Act is one of the mail stones on this path. Making NSDI Act, SGA fulfilled one of the obligations Republic of Croatia had considering EU pre accession obligations. It is making Croatian legislative compatible with EU in the field of spatial data. SGA also have the role of INSPIRE National Contact Point, and it is serving as the link between Croatian and EU spatial data infrastructures. SGA will farther develop cooperation and partnership on national and international level as one of the essential prerequisites for the development of society, economy and the NSDI.

SGA is traditionally organizing SDI Days and this year they have a special importance because Croatian membership in EU. Organizing SDI Days, State Geodetic Administration is contributing to development of spatially enabled society.

SGA Director general
Danko Markovinović, PhD

Preface

A question "Where?" is one of the fundamental questions in everyday life. Decisions made in everyday life are strongly under influence of spatial data. About 80% of the information that surround us has a spatial component. Without spatial thinking and spatial reasoning abilities, we would not be able to function as individuals in everyday life, but neither as a society. We are often not even aware, when we are solving some problem that we are thinking and reasoning spatially. Without the abilities of spatial thinking and reasoning, we would be lost in the space. Spatial data support everyday decision-making processes that can vary from everyday routine to emergency decisions, from saving lives to saving money. It is hard to find a governmental or non-governmental sector that does not use spatial data.

In order to make a transition from a subjective spatial reasoning to a collective one, and to allow economy and industry to develop more efficiently, a standardization of spatial data and services, processes and relations linked to spatial data should be performed. International standardization and data harmonization are essential to make a background for streaming spatial data sets and an interaction between services, making spatial data more interoperable. Spatial data interoperability is one of the main focuses of the INfrastructure for SPatial Information (INSPIRE) and National Spatial Data Infrastructures (NSDI).

The spatial industry is around us. In our mobile phones, Global Positioning System, Geographic Information Systems, road and sea navigation systems, maps and plans and many other everyday-used tools. Due to a massive usage of spatial tools, spatial literacy became a necessity in everyday life. SDI has been rapidly expanding in the fields of development of information society and knowledge economy. INSPIRE and NSDI are initiatives striving to raise the use of spatial data to a higher interoperable level facilitating a faster economic growth.

The organization of SDI Days 2013 was based on the annual Croatian NSDI and INSPIRES Days. Until now four NSDI and INSPIRE Days were organized in: Varaždin (2009), Opatija (2010), Split (2011) and Zagreb (2012). SDI Days 2013 were organized from 26th to 27th September in the city of Šibenik. Šibenik is worldwide known for its UNESCO World Heritage Site - the Cathedral of St. James from $15^{th}/16^{th}$ ct.

SDI Days 2013 included events:

- INSPIRE and integrated land & water management scientific workshop,
- 5th NSDI and INSPIRE day.

The organizers of SDI Days 2013 were: State Geodetic Administration (Croatia), European Commission Joint Research Centre (Italy) and Chamber of Chartered Geodetic Engineers (Croatia). The main auspices were Ministry of Construction and Physical Planning of the Republic of Croatia and NSDI Council of the Government of the Republic of Croatia.

The European Commission Joint Research Centre (JRC) coordinates the scientific and technical development of the European INSPIRE Directive, supports its implementation and leads research towards the next generation of environmental information infrastructures at European and global levels. Through the Enlargement & Integration action, JRC also gives support to countries on the road towards EU membership by contributing to the INSPIRE implementation and facilitating scientific and technical exchange. As a part of SDI Days, JRC organized a scientific workshop on INSPIRE and an integrated land & water management.

This year SDI Days have a special importance because this year Croatia joined the EU and INSPIRE became part but also a legal obligation of the Croatian NSDI program. The INSPIRE Directive is implemented into the Croatian legislature by the NSDI Act.

SDI Days 2013 promote knowledge and sharing of ideas and information about SDI. The main topics were:

- INSPIRE implementation
- legislation in the functioning of NSDI
- INSPIRE and integrated land & water management
- implementing NSDI
- NSDI stakeholders and data
- connecting NSDI and Digital Agenda
- marine and coastal environment
- natural disasters
- environmental Protection and Impacts
- integrated spatial assessments
- eGovernment services
- other SDI and INSPIRE topics.

An intention of the SDI Days 2013 organizers was to contribute to a development of spatially enabled society and a rise of spatial literacy. A wide range of topics and distinguished national and international speakers granted interesting lectures and a state-of-the-art approach. SDI Days 2013 promoted sharing of ideas and an international spirit of collaboration. An International Scientific Committee peer-reviewed the papers. Topics of the papers of SDI Days 2013 combine international, regional, national and local aspects of SDI. Considering an interdisciplinary character of spatial data infrastructure, SDI Days 2013 tried to contribute to the development of geoinformatics, cartography, geography, ecology, hydrography, spatial planning, cadastre and other fields.

We would like to thank all the contributors for building and sharing the spirit of SDI Days 2013.

Prof. Željko Hećimović, PhD
Prof. Vlado Cetl, PhD

Invited speakers

INSPIRE maintenance and implementation
Vlado Cetl, Vanda Nunes de Lima, Michael Lutz

GeoServer, the Open Source server for interoperable spatial data handling
Simone Giannecchini, Andrea Aime

Discovery of Geospatial Information Resources on the Web
Tomáš Kliment, Vlado Cetl, Martin Tuchyňa

INSPIRE maintenance and implementation

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Abstract

INSPIRE implementation process started in 2009 with the programme that spans to 2020. Some important milestones that were set in the implementation roadmap are already achieved and many components and services of infrastructure are in place e.g. transposition of Directive into national legislation, documentation of all the datasets that fall under the 34 themes, provision of network services, provision of newly collected Annex I spatial data sets under harmonized conditions etc. However most of the data harmonisation effort has yet to be undertaken. Specifications for the data themes in Annex II and III are expected to be adopted by the end of 2013 and after that they will be implemented over the next 7 years. Therefore, in general we are just on the half way through the implementation of INSPIRE. The implementation process is now entering a new phase oriented towards the member states. This process will be supported by the European Commission (EC) through setting up of the INSPIRE maintenance and implementation framework (MIF).

Keywords: INSPIRE, maintenance, implementation, MIF.

1 Introduction

The implementation of INSPIRE Directive is now entering a new phase. The Directive has been transposed in national legislation of the member states (MS) and most of the implementing rules have already been approved [1].

According to monitoring reports from 2010 [2] and State of Play reports from 2011 [3] in every European country National Spatial Data Infrastructure (NSDI) is developing according to the principles, rules and guidelines defined in the INSPIRE Directive and its implementing rules (IRs) and technical guidance (TG). Many components and services of infrastructure are already in place. However most of the data harmonisation effort has yet to be undertaken. Also it must be mentioned that despite the fact that all countries make progress there are still lot of challenges ahead [4] and significant differences in NSDI status and practice between MS. Some countries are making rapid progress while some are standing behind.

On 8 April 2013, the INSPIRE committee unanimously approved the IR regarding the themes of annex II and III. This important event is a milestone for interoperability in the EU, primarily for environmentally related spatial data, but also for other communities who will benefit from and build upon the INSPIRE experience. The formal adoption is expected by the end of 2013 and after that they will be implemented over the next 7 years.

The implementation process is now entering a new phase oriented towards the MS. This process will be supported by the EC through setting up of the INSPIRE maintenance and implementation framework (MIF) that is presented and discussed in this paper.

The INSPIRE Directive also envisaged a mid-term review by May 2014 that will be based on monitoring and reporting on implementation [5] prepared every 3 years by the MS and an assessment by the EC.

2 INSPIRE Implementation Roadmap

INSPIRE implementation process started in 2009 with the programme that spans to 2020 (figure 1).

Figure 1: INSPIRE Roadmap [5].

What	When
Metadata available for Annex I+II spatial data	Dec 2010
Discovery and view services IOC	May 2011
Discovery and View Services operational	Nov 2011
Download and Transformation Services IOC	June 2012
Download and Transformation Services operational	end 2012
Access to (newly collected / all) Annex I spatial data sets under harmonised conditions	end 2012 / 2017
Metadata available for Annex III spatial data	Dec 2013
Access to (newly collected / all) Annex II+III spatial data sets under harmonised conditions	around Oct 2015 / 2020

By December 2013, the MS are expected to have:

- documented all the datasets that fall under the 34 themes of INSPIRE with harmonised metadata
- provided discovery, view, download and transformation services
- provided newly collected data under Annex I according to the harmonised INSPIRE specifications
- established harmonised conditions for access and use of the data by public administrations in each country, with the same rules also available to any other public administration in the EU
- implemented harmonised conditions for access and use of the data by the institutions and bodies of the Community
- transposed the INSPIRE Directive into their national legislation and established appropriate structures and mechanisms for coordinating, across the different levels of government, the contributions of all those with an interest in their infrastructures for spatial information.

Data Specifications for the data themes in Annex II and III will be adopted by the end of 2013, and implemented over the next 7 years. Many components and services are already supposed to be in place but most of the data harmonisation effort has yet to be undertaken. Figure 2 clearly shows roadmap towards harmonised downloadable data sets through download services.

Figure 2. Download services roadmap

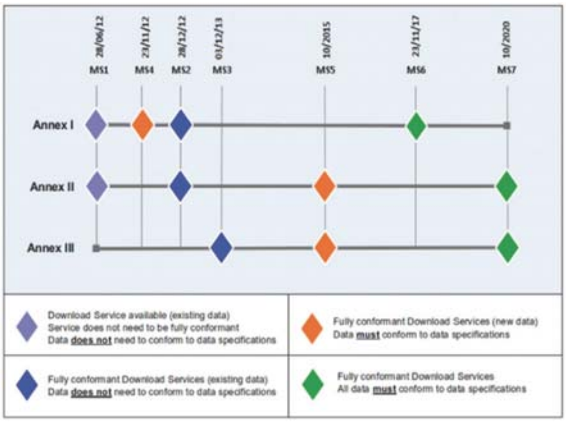


Diagram by Ian James, Ordnance Survey

Fully conformant all data regarding Annex I must be available by the end of 2017 and for Annex II and III by the end of 2020. Therefore, in general we are just on the beginning of data harmonisation and half way through the overall implementation of INSPIRE.

3 Maintenance and Implementation

Like any major infrastructure in an ever-changing world, INSPIRE requires maintenance [6].

Setting up a framework for such maintenance, further implementation and evolution of INSPIRE is therefore a logical initiative for which the rationale is also underpinned by rights and obligations laid down in the INSPIRE Directive [7]. For example:

- Article 1.2: »INSPIRE shall build upon infrastructures for spatial information established and operated by the Member States.«
- Article 18.1: »Member States shall ensure that appropriate structures and mechanisms are designated for coordinating, across the different levels of government, the contributions of all those with an interest in their infrastructures for spatial information. These structures shall coordinate the contributions of, inter alia, users, producers, added-value service providers and coordinating bodies, concerning the identification of relevant data sets, user needs, the provision of information on existing practices and the provision of feedback on the implementation of this Directive.«
- Article 19.1: »The Commission shall be responsible for coordinating Inspire at Community level and shall be assisted for that purpose by relevant organisations and, in particular, by the European Environment Agency«
- Article 7.5: »Representatives of Member States at national, regional and local level as well as other natural or legal persons with an interest in the spatial data concerned by virtue of their role in the infrastructure for spatial information, including users, producers, added value service providers or any coordinating body shall be given the opportunity to participate in preparatory discussions on the content of the implementing rules referred to in paragraph 1, prior to consideration by the Committee referred to in Article 22(1).
- Implementing Rules shall be adopted "in accordance with the regulatory procedure referred to in Article 22".

On this basis the EC and MS agreed to develop and adopt the IRs through a governance process based on the principles of open, transparent and inclusive participation of all stakeholders.

Progress along the roadmap for the development and implementation of the IRs as laid down in the Directive has resulted in a situation, in which a number of IRs either already have to be implemented in the MS, entered into force and are being implemented, or are still in the phase of development on their way to adoption and entry into force.

To support INSPIRE evolution, EC proposed the INSPIRE MIF as a main driver.

The MIF will address the following main challenges:

- be fully aligned with and interfaced to the ongoing development of the remaining IRs
- be support to the further implementation of the IRs in the MS
- be responsive to lessons learned from the implementation (which may require modifications to the IRs, TG documents and associated registers and tools)
- be comprehensive to ensure the cross-cutting coherence of the components of the infrastructure – some of the issues resulting from implementation of the IRs may affect more than one INSPIRE component, e.g. data specifications and network services, and it is crucial that these are resolved and applied in a consistent manner
- be flexible for taking into account requirements emerging from environmental policies and policies or activities which may have an impact on the environment
- be adequately resourced and organized for dealing with event-driven requests and needs for maintenance and evolution.

The MIF will provide support to the implementation regards being responsive to questions and requests for technical assistance from the stakeholders having to implement the technical components of the IRs in their organization.

Regarding maintenance the MIF acknowledges two types of them [6]: corrective maintenance, aimed at resolving errors or inconsistencies in the IRs or TGs, and evolutive maintenance, which addresses emerging requirements. An example of corrective maintenance is the alignment of the metadata regulation and TGs with the regulation on the interoperability of spatial datasets and services. An activity that would qualify as a form of evolutive maintenance would be the formal recognition by the MIG of the Sensor Observation Service (SOS) specification as a valid INSPIRE Download Service specification, resulting in an update of the Download Service TG documents.

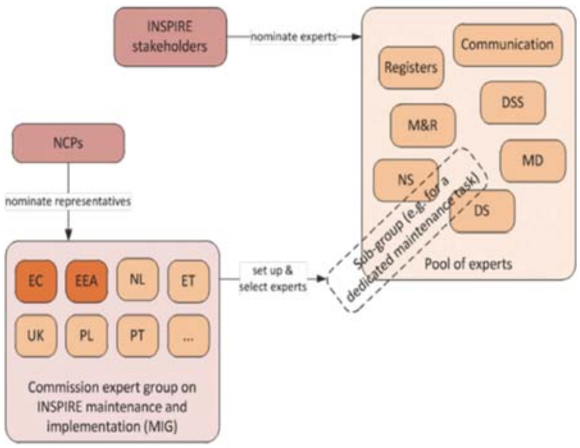
Setting up of MIF consists of a set of processes and procedures agreed with, and involving, the MS representatives in what is called the Maintenance and Implementation Group (MIG). The formal representation of the MS experts through the INSPIRE national contact points (NCP) in the MIG will be complemented by a pool of experts drawn from the stakeholder community, following a call for expression of interest.

The tasks of the INSPIRE MIG are:

- to bring about an exchange of experience and good practice related to the implementation of the INSPIRE Directive and the IRs
- to identify and give advice about the priority issues to be addressed in the maintenance of the INSPIRE Directive, IRs and/or TG documents
- to identify issues related to INSPIRE implementation (including, but not limited to: technologies, standards, methods, coherence across INSPIRE chapters and communication measures to be adopted) and advise the EC on how to address them.

Figure 3 illustrates the relationships between the MIG, its sub-groups and the pool of experts described in the »Proposal for INSPIRE Maintenance and Implementation« [8].

Figure 3. Setting up the MIG, the pool of experts and sub-groups



The experts in the pool will be called upon when MIG sub-groups are formed to address specific implementation or maintenance issues, but will also provide the opportunity to reach out to experts involved or interested in particular aspects of INSPIRE implementation or maintenance.

In order for the experts to plan and quantify their efforts, the EC will issue and update regularly the planning and organization of the maintenance task through a rolling work programme based on change requests and raised issues and discussed with the INSPIRE Committee. The work programme will be revised regularly (e.g. once every 3 months) to reflect newly identified issues and priorities.

Figure 4 shows an overview of the maintenance workflow, which incorporates the INSPIRE MIG and its responsibilities (shown in green) as well as possible MIG sub-groups (shown in dark blue).

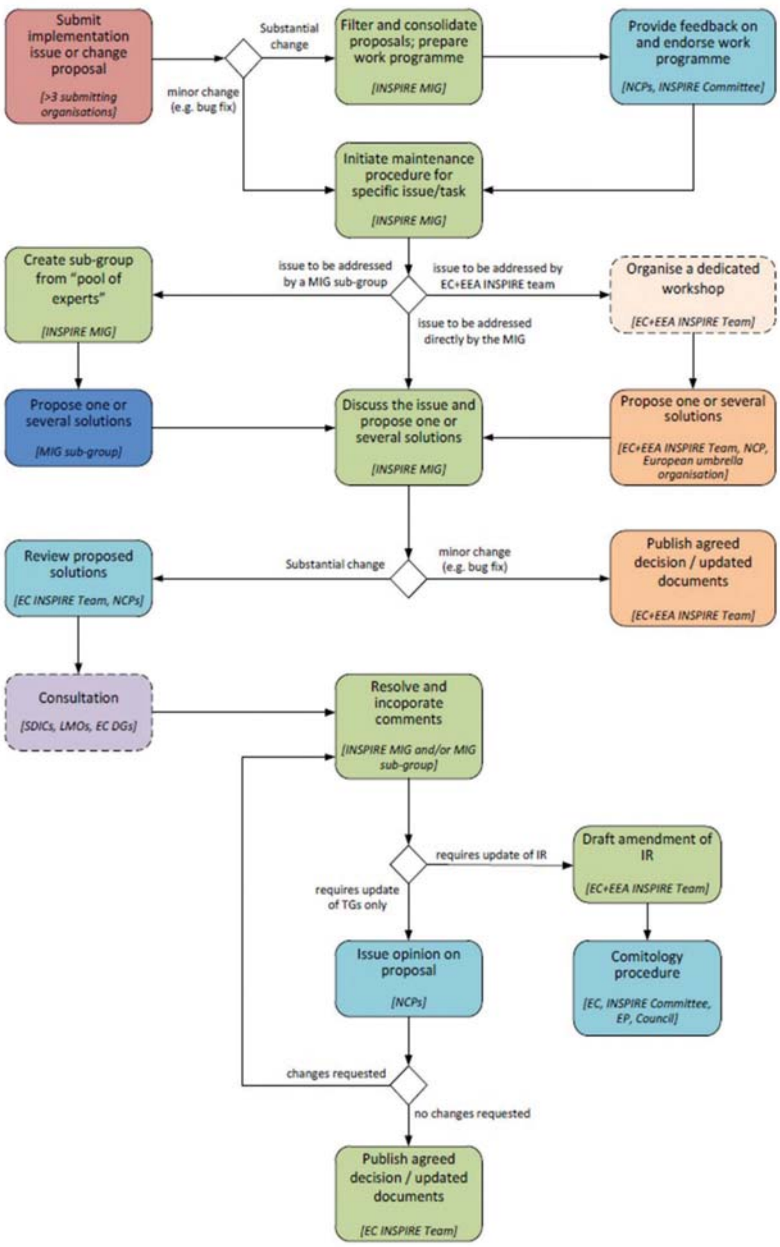
Issues can be raised by one of the following submitting organizations: a NCP, the EC INSPIRE Team, an active Drafting Team (DT), Thematic Working Group (TWG), and the Initial Operating Capability Task Force (IOC-TF) to the EC INSPIRE Team.

Each issue should be supported (seconded) by at least two other submitting organisations. For minor changes (e.g. the correction of an error or bug), the EC INSPIRE Team will activate one or several appropriate experts from the INSPIRE expert group (ideally the editor of the document to be updated) to make the required change and then publish the updated document.

For all other change requests and issues, the EC INSPIRE Team will filter and consolidate the received proposals and will regularly update the work programme, on which the NCPs are then invited to provide feedback.

Based on the work programme, the EC INSPIRE Team will initiate the maintenance procedure for a specific issue. To deal with an issue, the EC INSPIRE Team can either:

Figure 4. Workflow for INSPIRE maintenance [8]



- propose itself a solution for the issue, or
- organise a dedicated workshop to address the issue with relevant experts selected from the INSPIRE expert group and when appropriate additional ones, or
- create a dedicated maintenance WG to develop a solution. To set up this group, the EC INSPIRE Team will propose experts from the pool of experts. If necessary (e.g. because a specific area of expertise is lacking), the EC INSPIRE Team may also decide to propose additional experts from outside the pool.

The NCPs will be kept informed about how the specific issues are being addressed. The proposed solution is provided to the NCPs and EC INSPIRE Team for review. On critical issues and where required by the INSPIRE Directive (e.g. in Art. 7(5) for the IRs), the EC INSPIRE Team will also launch a Spatial Data Interest Community (SDIC)/ Legally Mandated Organisations (LMO) consultation.

The maintenance WG/EC INSPIRE Team will adapt the proposal based on the comments received. If the issue requires only an update of a TG document, the NCPs will be asked to issue an opinion on the proposal. If the NCPs request no further changes, the agreed proposal will be published by the EC INSPIRE Team.

If an update of an IR is required, the EC INSPIRE Team will draft an amendment of the IR based on the elaborated proposal, and this proposal will enter the comitology procedure.

4 Conclusion

INSPIRE process started officially some 6 years ago with the formal adoption of INSPIRE Directive and continued with transposition into EU MS. Today already some clear results and benefits can be seen through increasing availability of spatial data and services in the EU. However harmonisation of data sets according to INSPIRE data models have just been started and is foreseen to be finished by 2020.

To help MS in INSPIRE implementation but also to support maintenance and evolution, EC proposed establishment of INSPIRE MIF. MIF will be focused on the IRs, TGs and framework documents, and components implemented at EU level such as the geoportal and the registries. It can be seen as a fundamental component in the evolution of INSPIRE. Also it will be the common platform and tool for both MS and EC in monitoring and controlling the implementation of INSPIRE.

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GeoServer, the Open Source server for interoperable spatial data handling

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Abstract

GeoServer is an open source geospatial server written in Java, implemented following the best Java Enterprise practices. It allows to disseminate, manage and analyze data using the most widely used OGC standards (WMS, WFS, WCS and WPS) as well as specific extensions for a transparent interaction with clients such as Google Earth or other commercial and Open Source software. It also provides support for de-fact standard protocols like REST and formats like GeoJSON.

This paper will provide the audience with an extensive overview on GeoServer functionalities for the creation of interoperable Spatial Data Infrastructures with particular focus on the latest functionalities such as the WPS spatial data analysis capabilities.

Keywords: GeoServer, Open Source, OGC Standards, SDI

1 Introduction

GeoServer is an Open Source application distributed under GPL license[6] for the handling and dissemination of geospatial data. GeoServer provides the basic functionalities to create interoperable Spatial Data Infrastructures (SDI) according to standards edited by Open Geospatial Consortium (OGC) and ISO Technical Committee 211 (ISO TC 211).

GeoServer has been created to ingest, manage and serve geospatial data both vector (called *feature* by OGC) and raster (called *gridcoverage* by OGC) as well as to create and disseminate georeferenced maps obtained by overlaying rendered versions of the above mentioned data according to styling rules coded following specific standards.

This paper will provide the audience with an exhaustive introduction to the functionalities of GeoServer emphasizing its support to interoperability through the implementation of standard protocols. Moreover it will provide information about the internal working of GeoServer as well as all general information about the Open Source project behind it, which will cover who is managing and promoting it.

In the following sections the most important features of GeoServer will be introduced and described such as supported protocols, provided functionalities and supported input and output data formats. Moreover additional information about the GeoServer infrastructure will be provided.

2 Supported Protocols and Formats

2.1 Supported Protocols

GeoServer has been developed to provide support for standard protocols to consitute a valid tool for the creation of distributed interoperable spatial data infrastructures (SDI).

GeoServer natively supports a wide range of standards both edited by internally renowned bodies like OGC and ISO TC 211 as well as de facto like WMS-C, the protocol for the tile oriented access of Web Map Service or WMS.

The most important supported standards are:

- OGC Web Map Service (WMS) 1.1.1[2] with support for OGC Styled Layer Descriptor (SLD) 1.0.0[17] OGC Web Map Service (WMS) 1.3[3] with support for OGC Symbology Encoding (SE) 1.1[18] for the generation and dissemination of georeferenced maps from both raster and vector data. Moreover GeoServer supports a wide range of proprietary rendering directives some of which will be discussed in the sections below.

- OGC Web Coverage Service (WCS) 1.1.0[24], Web Coverage Service (WCS) 1.0.0[5] and Web Coverage Service (WCS) 2.0.0[1] for the management and the dissemination of raster data in native format. This service accounts for the possibility of accessing to subareas, reprojecting, resempling as well as changing the format of raster data. It is important to note that the WCS differs from WMS because in the processing chain of the raster data there are no rendering directives.
- OGC Web Feature Service (WFS) 1.0.[21], 1.1.0[22] and 2.0[23]. These services allow the management and dissemination of vector data . The parallel with the WCS service for raster data is clear: through WFS the user has direct access to the original vector data or to a reprocessed version according to the received indications. It is worth to point out that GeoServer supports the Geography Markup Language (GML) together with other wide used formats such as Shapefile[4] and GeoJSON[8].
- Excellent support OGC Keyhole Markup Language (KML)[24], the XML dialect which allows GeoServer to interact with Google Earth and Google Maps with advanced characteristics which will be discuessed in the following sections.
- WMS-C, OGC WMS-T, TMS through its extension GeoWebCache.
- OGC Web Processing Service (WPS) 1.0[19] in order to provide support for the interoperable publication of geoprocesses to the web.
- GeoRSS[10] the de facto standard to extend the transport format Remote Syndication Standard (RSS) in order to add support for specifying georeferenced topologies. It can be used to transfer vector data.

In the following table (see Table 2) the various versions of the OGC protocols implemented by GeoServer are summarized with particular reference to all those for which GeoServer is Reference Implementation (a *Reference Implementation* is an implementation of an OGC specification which has been verified and validated as fully correct and respondent to the specification. The reference implementation is made available by using Open Source and free software so that other implementations both Open Source and proprietary can use it as reference).

Table 1 OGC protocols supported by GeoServer

Protocol	Version	Reference Implementation
WCS	1.0.0	
	1.1.0	X
	2.0.1	
WFS	1.0.0	X
	1.1.0	X
	2.0.0	
WMS	1.1.1	
	1.3.0	
WPS	1.0.0	

2.2 Supported Formats

The list of the input and output supported formats by GeoServer is wide thanks to a wide number of available extensions which contribute to increase the extension, and new formats are added continuously by the members of the developer community.

Table 2 Data Formats supported by GeoServer

Format	Input	Output
Geotiff	x	x
Image+world file	x	x
GTOPO30	x	x
Ascii grid	x	x
Image mosaic	x	-
Image pyramid	x	-
ArcSDE raster	x	-
Erdas Image	x	-
ECW	x	-
MrSID	x	-
JPEG2000	x	-
DTED	x	-
NITF	x	-
CADRG	x	-
Grass Binary Grid	x	-
netCDf-CF	x	x
Oracle GeoRaster	x	-
BigTiff	x	x
ShapeFile	x	-
Postgis	x	-
ArcSDE feature	x	-
Oracle	x	-
MySQL	x	-
SQL Server	x	-
OGR supported formats	x	-
Cascading WFS	x	-
Cascading WMS	x	-
SpatiaLite	x*	-
Teradata	x*	-

3 Enterprise Infrastructure

GeoServer has been developed leveraging on the Java Enteprise *Spring*[26] framework which is currently the most widely used Java framework in web environment. It is worth to now point out some of the most important characteristics of GeoServer which are inherited from the Spring framework itself.

Modularity. GeoServer consists in a wide range of modules: core and extensions. The core modules are necessary to the correct operation of the base platform, while the extension modules add new functionalities to the platform beside the basic ones both *vertical* and *horizontal*. The vertical modules provide services to the final user while the horizontal modules add functionalities both to the platform as well as to the users.

For instance, one of the core module of GeoServer is the module handling the internal configuration of the server while the WPS module is an extension providing support to the WPS protocol: following the above explanation, the first described module is horizontal and the second described module is vertical. The modularity of GeoServer allows a largely independent between the modules and this is a fundamental aspect for such framework.

Extensibility. GeoServer makes available for those who want to add new functionalities a wide range of extension points both in the form of Java interfaces to implement and in the form of extension points available via the Spring framework.

Configurability. GeoServer is fully configurable through its graphic interface, but it is important to point out that all the modules, by following the Spring standard, are configurable through XML file in order to create advanced customized versions of the server.

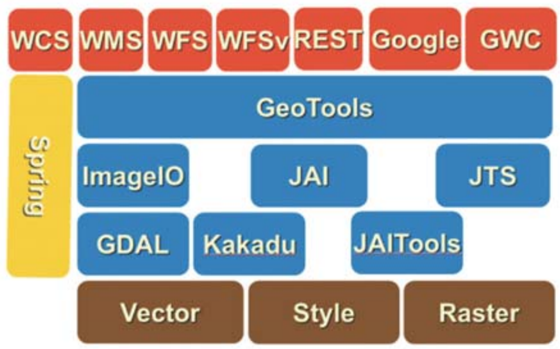
Multi-tier architecture. in GeoServer there is a net separation between the different levels of the infrastructure: data, service logic and interface.

As illustrated in Figure 1, GeoServer is based, besides Spring, on a wide range of well-known Open Source libraries among which we would like to mention:

- **GeoTools[11]** geospatial Open Source toolkit developed in Java allowing the management, processing and rendering of raster and vector data. This is the core component which GeoServer use to manage geospatial data.
- **ImageIO[14]**, **ImageIO-Ext[12]** low-level input/output libraries of geospatial raster data
- **Java Topology Suite (JTS)[16]** geospatial Open Source library developed in Java for the management of geometries
- **GDAL[7]** Open Source library for accessing raster geospatial data
- **Java Advanced (JAI)[13]**, **JAITools[15]** Open Source libraries written in Java for processing high-performance raster data

GeoServer has been successfully used with a wide range of server application such as Tomcat Jetty, WebLogic, JBoss, etc., moreover since it is based on Spring it has been developed in order to be able to use server-side managed resources such as database connection pools.

Figure 1. Basic infrastructure of the GeoServer



4 Web Administration Interface

One of the most appreciated features of GeoServer is that it provides an administration interface fully operable via web browser which allows to manage all the configuration aspects for both services and data. GeoServer is cross-browser and does not require installation of any plug-ins (see Figure 2)

In particular, through this interface, the following actions are possible:

- Adding and configuring new data sources and various OGC services deployed
- Configuring the raster data management engine
- Checking the GeoServer status (log visualization, check the resources use)
- Users' management and access policies configuration to services and resources
- Preview of the configured data via web client

It is important to point out that, thanks to the technology used for building such user interface, it is possible to easily extend at runtime the graphic interface of GeoServer by deploying new components which will be integrated with the default structure. This allow to add new features in a user-friendly way without changing the basic user interface.

5 Advanced Support for Maps Creation

GeoServer provides advanced support for maps creation via the WMS service for both raster and vector data leveraging on styles created with SLD files (SLD stands for Styled Layer Descriptor, a standard for specifying styles for WMS services used by GeoServer) supporting also a wide range of specific extensions.

Figure 2. The Admin GUI of GeoServer

Let us now briefly introduce the usage of SLD files for styling. An SLD is an XML file which can be used for specifying rendering directives both for raster and vector data.

Figure 3. Simple SLD file to render one layer at points

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<StyledLayerDescriptor version="1.0.0"
 xsi:schemaLocation="http://www.opengis.net/sld StyledLayerDescriptor.xsd"
 xmlns="http://www.opengis.net/sld"
 xmlns:ogc="http://www.opengis.net/ogc"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <NamedLayer>
    <Name>Simple Point</Name>
    <UserStyle>
      <Title>Simple Point</Title>
      <FeatureTypeStyle>
        <Rule>
          <PointSymbolizer>
            <Graphic>
              <Mark>
                <WellKnownName>circle</WellKnownName>
                <Fill>
                  <CssParameter name="fill">#FF0000</CssParameter>
                </Fill>
              </Mark>
              <Size>6</Size>
            </Graphic>
          </PointSymbolizer>
        </Rule>
      </FeatureTypeStyle>
    </UserStyle>
  </NamedLayer>
</StyledLayerDescriptor>
```

As of vector data, taking into account the parallelism between a feature (in the OGC jargon) and a row in a spatial database an SLD file allows users to specify a set of rules to control rendering of the geometry in relation to the values of the attributes of the individual alphanumeric features (see Figure 3).

Concerning raster data, SLD provide a relatively limited support since it allows the application of color maps with customized colors to native unrendered data) e.g. a DEM) as well as the application of simple contrast enhancement function for data with intrinsic rendering (e.g. RGB data like colored orthophotos).

In the following sections some of the most interesting rendering directives will be described. Both standard as well as specific GeoServer's extensions will be taken into consideration.

5.1 Support for Raster Symbolizer

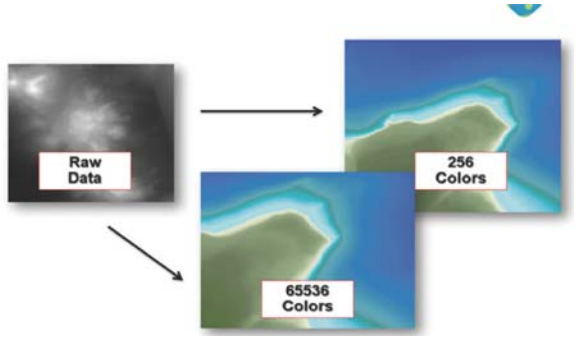
GeoServer supports the creation of artificial rendering from raster data containing geophysical values (e.g. measured temperature on the surface of the sea or DEM) through the mechanism provided by the SLD specification, introduced above called *RasterSymbolizer*.

Through this mechanism it is possible to instruct the GeoServer WMS service via an SLD document to perform operations on a raster such as selection and merge of channel, *contrast stretch* and also the application of custom *colormap* (with 256 or 65536 colors) through linear interpolation (*piecewise)* between values contained in the raster (e.g. elevations) and the specified colors (see Figure 4 and Figure 5).

Figure 4. Example of a Raster Symbolizer.

```
<RasterSymbolizer>
 <ColorMap>
  <ColorMapEntry color="#000000" quantity="0.0"  opacity="1.0"/>
  <ColorMapEntry color="#ff0000" quantity="2.0"  opacity="1.0"/>
  <ColorMapEntry color="#ffff00" quantity="10.0" opacity="1.0"/>
  <ColorMapEntry color="#00ff00" quantity="15.0" opacity="1.0"/>
  <ColorMapEntry color="#00ffff" quantity="20.0" opacity="1.0"/>
  <ColorMapEntry color="#0000ff" quantity="25.0" opacity="1.0"/>
  <ColorMapEntry color="#ff00ff" quantity="30.0" opacity="1.0"/>
  <ColorMapEntry color="#ffffff" quantity="100.0" opacity="1.0"/>
 </ColorMap >
 <Opacity>1.0</Opacity>
 <ChannelSelection>
  <GrayChannel>
   <SourceChannelName>1</SourceChannelName>
    <ContrastEnhancement>
     <Normalize/>
    </ContrastEnhancement>
  </GrayChannel>
 </ChannelSelection>
 <ContrastEnhancement>
  <GammaValue>1</GammaValue>
 </ContrastEnhancement>
</RasterSymbolizer>
```

Figure 5. Raster Symbolizer in action to create the rendering of a raster DEM



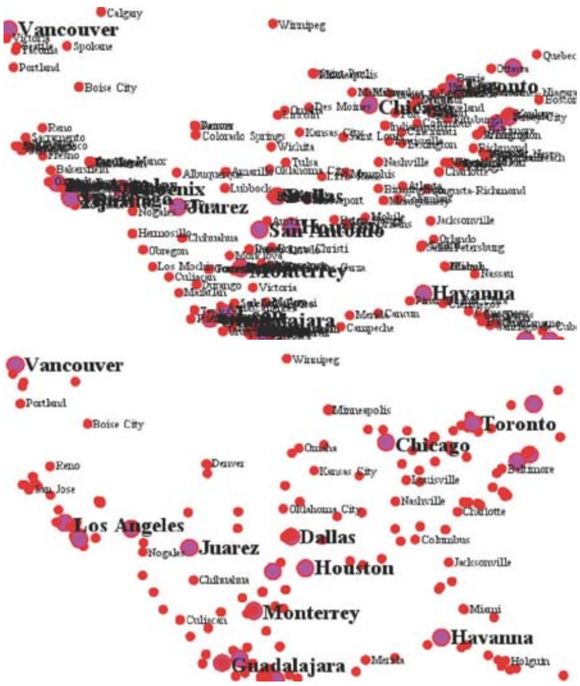
As mentioned above GeoServer allows us to create not only simple colormaps with 256 colors but also high quality (but slower) colormaps with 65536 colors.

5.2 Advanced Labeling

Thanks to several extensions of SLD standard, GeoServer allows fine grain control over the label placement for vector data taking also into account alphanumeric attributes associated with their geometries. It is worth to introduce briefly some of the proprietary options (extensions to the standard SLD specification) available:

- Priority Labeling: allows to control the order of preference between labels in relation to the value of the alphanumeric attributes of a feature. For example (see Figure 6) it is possible to ask the server to highlight the labels of the cities with a number of inhabitants higher than a certain value.
- Overlapping and Separating Labels: allows to control if and how the labels can overlap

Figure 6. Rendering of US major Cities, first without any rules, then with priority on population



5.3 Geometry Transformations

The Geometry Transformation mechanism allows to extend the design mechanism for the geometries for the vector data make available from the SLD specification in order to perform manipulations on the geometries themselves before applying the design directives: with this mechanism is possible to build complex manipulation as shown in Figure 7.

Figure 7. Using Geometry Transformations to add a shadow to the buildings

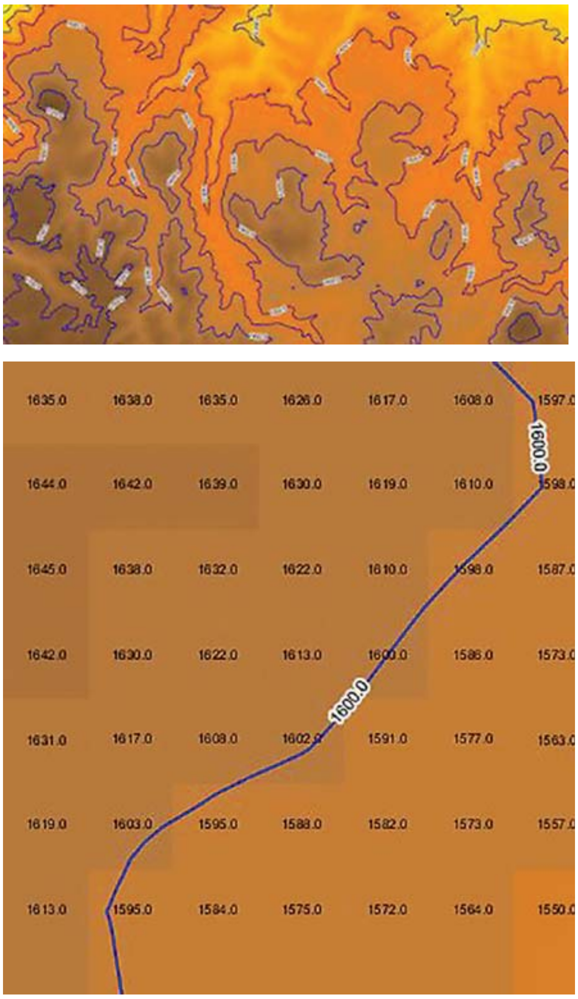
5.4 Rendering Transformations

The rendering transformation mechanism can be seen as a natural extension of the mechanism of the geometry transformation because it allows to apply generic transformations on a GeoServer layer before it is passed to the rendering engine and can be applied both to vector and raster data.

This mechanism is based on geoprocesses available through the WPS service; this means that the geoprocesses installed in a single installation of GeoServer through the installation of the WPS extension can be used as rendering transformations if they adhere to certain rules.

Thanks to this mechanism for example is possible to create a style using geoprocesses for the extraction of contour lines or polygons from raster data and at the same time it is possible to specify the rendering guidelines for the generated geometries, as shown in Figure 8. All this can be done on the fly, with no pre-generation of vector data.

Figure 8. Extraction of contours from DEM, polygonalization DEM and their vector drawing on-the-fly



6 KML/KMZ Support

GeoServer integrates natively with Google Earth by supporting out-of-the-box a lot of interesting features concerning KML/KMZ production as explained below.

SuperOverlays: they are useful in those cases where large quantities of data must be transferred to the client. They are a specific form of KML in which the represented data is divided in regions to allow Google Earth to update each particular region of the map only when this is visualized.

Both raster super-overlays and vector super-overlays are supported. Raster super-overlays produces optimized images for the current zoom level of the map while new images are provided when the zoom changes. With the super-overlays the vector data are shown in a progressive way, as you get closer to the earth surface, for not overloading Google Earth with too much data.

Heights and Time templates: in GeoServer it is possible to define templates to visualize the data in Google Earth using the time and elevation dimensions (by default Google Earth represents the data in two dimensions). It is possible to build an elevation template by choosing a layer's attribute to be used as the elevation for extruding geometries in Google Earth for individual features (it is worth noticing that this is not a 3D rendering but rather a 2.d rendering). When building a time template a temporal attribute must be available in the dataset to be used by Google Earth during the visualization for the generation of time series.

Placemark templates: templates can be also used in GeoServer to customize Google Earth placemarks for vector data. Two different files can be defined whose content, taking into account one or more attributes of the vector data to render, will provide the information for creating the customized of placemarks.

Regionation and scoring: the super-overlay vector mode can use the KML regionation to organize the features hierarchically. This needs the specification of a Regionation Attribute, which determines how the features shall be visible at a specific zoom level. GeoServer can also render the KML data in raster or vector format depending on the zoom level to reduce the amount of data transferred.

6.1 Qos Management

The control flow module is an extension for GeoServer which provides to the administrator the means to control the number of concurrent queries which the server can manage as well as the Quality of Service (QoS) reserved to each single request in terms of used resources and maximum response times. This kind of check is important for the following reasons:

- **Performance**: our tests have shown that the limitation of the number of the concurrent WMS queries to a maximum of the double of the number of the available CPU cores allows to increase significantly the throughput of the maps requests limiting the risk of *resource* (memory, disk, CPU) *thrashing*.
- **Resource control**: queries of data extraction or map creation can exploit large quantities of computing resources such as cache and CPU. The possibility of imposing limits on requests allows the administrators to control the amount of hardware resources allocated to each request. Through the **Resource control** parameters is possible to control also the total number of requests served at the same time by controlling indirectly the maximum amount of memory used by GeoServer
- **Fairness**: a single user should not overload the server with too many requests cannibalizing the server resources at the expenses of other users.

The control flow module normally does not reject the exceeding requests but it queues them in order to satisfy them later. It is possible to configure the module in order to reject the requests after that they have been in the queue for a certain amount of time.

7 Authentication & Authorization

GeoServer provides support for the HTTP Basic Authentication by default. HTTP Basic Authentication is a widespread authentication system supported by all the OGC clients. Other authentication systems can be integrated thanks to the *Spring Security* functionalities (it is worth to remind the reader that GeoServer is based on the *Spring* Java Enterprise framework), which is the security module used by GeoServer.

Integrating other authentication systems in GeoServer it is possible but particular care should be taken to evaluate which clients will be able to benefit from the use of new protocols. For example, Central Authentication Service (CAS), a widespread *Single Sign On* system which is supported via a GeoServer extension will allow an easy integration with web-based applications, but it will prevent the access to most of the desktop clients.

GeoServer also integrates a fine grained access control subsystem based as well on *Spring Security* which allows the users to define authorization and roles both at *service level* (e.g. roles which can be applied only to the WMS requests) and single *data level*.

The security system can be divided in two components:

- A recently developed security engine which allows to apply complex security roles filtering on the single record and hiding single data columns as well as cutting raster data and cascaded WMS layer on specific areas of interest.
- A configuration interface which allows to apply easier roles at the level of single layer or single service.
- The security engine allows to write a customized security subsystem integrated with the management of the authorization, while the base interface allows to apply simple security roles for non-enterprise installations.

8 GeoWebCache Integration

GeoServer provides a transparent integration with the Open Source geospatial framework GeoWebCache for tile caching and acceleration of maps dissemination to tile-oriented clients such as Google Maps or Bing Maps. GeoWebCache can be compared to a proxy server sitting between the map client and the WMS server: it performs tile caching by saving individual tiles on disk in an appropriate directory structure avoiding the rendering overhead introduced by multiple requests for the same exact tiles on the same exact layers.

With GeoWebCache in action the requested tiles will be saved and retrieved from the cache according to the parameters specified in the WMS requests paying the rendering penalty only once, greatly improving maps dissemination performances, especially for large datasets and/or complex styling.

9 WPS Protocol Support

The WPS protocol (Web Processing Service) has been designed to allow the publication of spatial operations in an interoperable way. A WPS service can use vector or raster data, local on the server or remote, to produce a wide range of geospatial operations such as intersection, buffering, statistics, raster algebra, format conversion and more. The WPS standard imposes the processes description, the operations (e.g. *GetCapabilities*, *DescribePRocess*, *Execute*) as well as the syntax for calling such operations but it does not impose the implementation of specific spatial analysis functions which are at the discretion of those will implement the WPS server. GeoServer by default provides an extensive set of ready-to-use geoprocesses:

- Many simple processes for geometries such as clipping, buffering, vector overlay and so on.
- Statistical analysis on raster data, raster versus classified raster or raster versus polygonal, clip of a raster on a polygon.

- Georeferencing/Georectification of a raster given the ground control points.
- Various conversion processes between raster and vector, included the extraction of contour-lines.

It is also possible to write new processes with an easy-to-use Java API, moreover there exists support to creating processes in scripting languages such as Jython, JavaScript, Scala, JRuby and Groovy.

It is eventually worth to point out the deep integration of the WPS service with the rest of the functionalities provided by the server, like with the rendering engine via the *Rendering Transformations* or with the security subsystem.

10 GeoServer Facts and Numbers

GeoServer is supported by a large and active community of supporters and developers. Commercial support for GeoServer is available by numerous companies between which we can cite the main ones:

- **GeoSolutions** is an Italian company composed by geospatial Information & Communication Technology (ICT) consultants with the mission of providing professional support services and innovative cost-effective solutions based on the best Open Source technologies. GeoSolutionss associates are PMC members for GeoTools, PSC members for GeoServer and PSC members for GeoNetwork [9].
- **OpenGeo**, is a company based in the US which has recently spun off from the original creators of GeoServer, The Open Planning Project.

10.1 Project Steering Committee

The Open Source project behind the GeoServer product is governed by a Project Steering Committee (PSC), which is a body composed by individuals in charge for representing the developers as well as the power users of GeoServer in the most complete and diverse way. The turnover of people sitting in the PSC is accepted and desirable to ensure that we give voice to the greatest possible number of people. The primary role of a PSC member is to take decisions concerning the operative and strategic management of the GeoServer project.

10.2 Diffusion

Being GeoServer an Open Source project freely downloadable, a good source of information to represent its popularity and degree of diffusion is represented by the download statistics on the distribution site (i.e. *SourceForge*). During the period September 2009 – September 2010 the average of download per month has been 20000. Moreover GeoServer is currently used in several environments which are private companies as well as big international bodies like FAO, IFAD, WHO, World Bank.

11 Conclusions

In this paper the GeoServer Open Source server for the management and dissemination of geospatial data has been introduced and presented.

General information about the Open Source project that controls and develops the GeoServer has been provided in order to allow the reader to understand how a community-driven project is structured. Number and facts about its diffusion has also been provided.

Moreover, a detailed introduction to the most important features and characteristics of the GeoServer has been provided with special focus on the support for standard protocols both when mandated from international renowned standardization bodies like OGC or ISO TC 211 as well as de-facto standards like GeoJSON that emerged from the community of geospatial developers.

Eventually it is worth to point out that we strived to provide the reader with information to employ the GeoServer Open Source server efficiently and effectively for building interoperable Spatial Data Infrastructures (SDI) based on OGC and ISO TC 211 standards at different scales.

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Discovery of Geospatial Information Resources on the Web

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Abstract

Nowadays, the web provides different methods for discovery and retrieval of geospatial information (GI) resources. For an ordinary internet user, the most used information systems to retrieve GI resources are so called spatial browsing systems such as Google Maps. Spatial Data Infrastructure (SDI) provides more detailed information on specific spatial data themes with advanced levels of searching facilities based on a detailed documentation - metadata. Current research activities have reported that so called mainstream web provides many valuable GI resources of several types (e.g. OGC Services, KML data, etc.). They can be discovered using web search engines (SE) such as Google, Yahoo or Bing. The paper describes individual steps of a workflow for an automatic metadata extraction from the information provided by OGC web services and further extensions in order to fulfil the INSPIRE legislation requirements and related standardization for digital geographic information. Additionally a workflow for searching GI resources provided by OGC services on the mainstream web represented by Google SEs is elucidated.

Keywords: SDI, mainstream web, metadata, OGC services

1 Introduction

Nowadays many ways exist to search and retrieve GI resources on the Web. For an ordinary internet user, the most used information systems to retrieve GI are so called spatial browsing systems such as Google Maps. These systems provide an easy and user-friendly way to discover and use GI resources as addresses, points of interest (POI), routes among POI, etc.

(SDI provides more detailed information on specific spatial data themes (e.g. protected sites, natural hazard risk zones, energy resources, geology, etc.) with advanced levels of searching facilities based on a detailed documentation - metadata. SDIs are aimed to address the issue of data availability by promoting and enabling data sharing and access [1]. However, every data provider needs to create and publish metadata in a predefined structure describing GI resources in order to make them discoverable through an SDI. This fact may decrease the final amount of GI resources available through current geoportal applications on a global (e.g. GEOPortal [11]), European (INSPIRE Geoportal [12]), National (e.g. Geoportál NIPI [13]), or domain specific (e.g. Geoportál ÚGKK SR [14]) level. An added value for the data producer would be to provide an automated way of metadata creation and update in order to unburden their workload and let them focus on the actual data sources (e.g. OGC Web Services)[2,3]. This assumption is still an open question for most of the current systems used within SDI implementatio**ns.**

Additionally, current research activities [4,5,6,7] have reported that so called mainstream web provides many valuable GI resources of several types (e.g. OGC Services, KML data, etc.). They can be discovered using web search engines (SE) such as Google, Yahoo or Bing. The benefit of web SE in comparison to SDI engines (geocatalogues) is that the former automatically crawls the web in order to discover information resources of several types. Therefore no additional work is required, besides publishing URL addresses of available resources on a web page or on a portal, obviously if a data provider wishes to promote and make his resources discoverable on the Web. GI resources discovered within SEs may extend significantly the information richness of the current SDI portals, and may be used to develop SDI portal of specific data domain orientation also with combination of social media, voluntary geographic information etc.

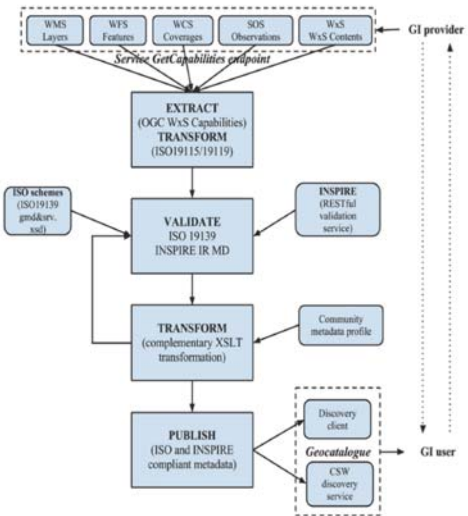
The paper addresses 2 research questions and is organised in the following sections: Section 2 describes two methodologies designed for an automatic ISO/INSPIRE metadata creation based on OGC services metadata models and national/domain/community metadata profiles as well as for a workflow applied to discover OGC services using the Google Search engine (SE), extract relevant metadata into the required structure and provide CSW services for further usage in SDIs; Section 3 summarizes the results and provides figures reporting the analyses performed; Section 4 draws conclusions and outlines the future work.

2 Material and Methodology

2.1 Automatic creation, validation and publication of ISO/INSPIRE metadata

The methodology proposed in the paper is based on a scenario, in which a data provider from a certain domain (e.g. environmental agency) has already been providing GI resources via OGC services (e.g. WMS, or WFS) and needs to register and provide them within the INSPIRE, or national SDI. In order to do this, he/she needs to create a metadata records for individual datasets, series and services (types of GI resources defined by INSPIRE [10]). The methodology was tested on GI resources administered by the Geodesy, Cartography and Cadastre Authority of the Slovak Republic (GCCA SR).

Figure 1 Methodology – workflow overview [2]



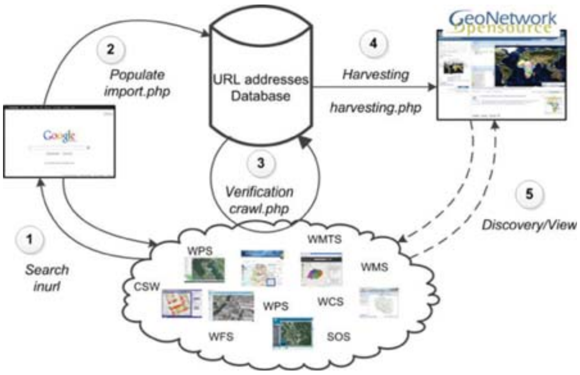
The methodology, which is schematically depicted on figure 1, proposes a workflow to accomplish the scenario described above. The workflow consists of the following steps [2]:

1. Extract and transform – in order to create metadata structure defined by ISO19119/19139, the content of OGC service GetCapabilities response was extracted and transformed using XSLT transformations implemented in Geonetwork opensource catalogue [15]. Individual metadata records were created for both service (WMS) and its contents (WMS layers).
2. Validate – to verify the compliancy of the information extracted from the OGC GetCapabilities response, two types of metadata validation were performed. The first was to validate the metadata against the ISO schemas [9] using Altova XMLSpy editor [16]. The second one was to validate the compliancy defined by INSPIRE implementing rules for metadata [10] using MDValidator tool developed in (Kliment, 2012). MDValidator uses RESTFul INSPIRE metadata validation service [17].
3. Complementary transformation – since the OGC models do not contain all the information required by ISO and INSPIRE, which was also confirmed by validation results, the complementary transformation was designed and implemented. Community metadata profiles defined for datasets and services publishing GI resources from the ZB GIS (database of reference spatial data on national level) were used to define the missing information in the transformation model. Altova MapForce software [18] was used to define the mappings and to generate XSLT code to be used for the implementation. The XSLT code was used to perform a batch transformation of the metadata gained initially from the OGC to the INSPIRE model in Altova XMLSpy. To verify the quality of the transformation, the metadata were validated again as described in the previous step. If needed, the mapping was modified according to the validation results.
4. Publish metadata – ISO/INSPIRE compliant metadata for both service and datasets were published in GeoNetwork geocatalogue in order to provide searching interfaces for direct GI users with a discovery web based client as well as for remote catalogues (e.g. INSPIRE Geoportal, or National Geoportal) through the CSW discovery service. Metadata update is ensured by periodical harvesting of the OGC service GetCapabilities endpoints, thus should reflect the actual status of the described GI resources.

2.2 Publishing metadata of GI resources provided by OGC services discovered on Google

In this section we describe the methodology for publishing OGC services discovered on the Web in a CSW-compliant geospatial catalogue [7]. Figure 1 illustrates five main steps of a workflow that allow us to keep a wide range of geospatial services updated and accessible through a CSW catalogue. In order to support the steps proposed in the workflow, we make use of the available tools and applications such as Google Search Client [19], OutWit Hub [20], GeoNetwork opensource [15], MySQL DBMS (database management system) [21] and Apache HTTP Server [22] used to run developed PHP (Hypertext Preprocessor) [23] scripts.

Figure 2 Methodology overview [7]



In particular, the individual steps shown in figure 2 are summarized in the following paragraphs [2,7].

1. Search in Google SE to discover URL addresses pointing to OGC services - Google search client was used as a search interface to discover available OGC services endpoints. An advanced search operator ***inurl*** was used for a query definition in order to restrict the search to predefined query strings in the URLs of records stored in the Google databases. An example of a query definition used to discover WMS services GetCapabilities URLs was as follows:

   inurl:service=WMS inurl:request=GetCapabilities

   Information such as Title, Description and URL were extracted from the HTML representation of a Google result list and converted into comma separated value (csv) files per each service type (i.e., wms.csv, wfs.csv, sos.csv etc.).
2. Populate a database with discovered URL addresses - a MySQL database was created as a central storage of the discovered OGC services GetCapabilities endpoints. In order to populate the database with the results retrieved from Google, a PHP script *import.php* was developed [2]. The script retrieves URL addresses from the csv files created in step 1 and populates the predefined columns in the database with the parsed URL addresses and related information as title and description.
3. Verify OGC services endpoints - the objective of this step was to verify whether the services found are available to be used. In order to implement this step, another PHP script ***crawl.php*** was developed [2]. The script fetches a GetCapabilities URL stored in the database, triggers it and verifies the service availability. If the service is available, the script extracts relevant information (e.g. version) to update the corresponding columns in database and sets the *status* column as “available”. Otherwise, the *status* column is flagged as “unavailable” and *version* remains empty.
4. Create and run metadata harvesting tasks in GeoNetwork for OGC services endpoints - GeoNetwork opensource catalogue was used as a central repository for ISO 19115/19119 metadata created for the discovered OGC services and the contents they publish. Harvesting tasks were created and run for all the OGC services endpoints stored and verified in the previous step 3 in order to collect metadata for both services and the contents they provide. Harvesting XML services [24] provided by the GeoNetwork API were used to manage harvesting task in a programmatic way with a third developed PHP script *harvesting.php [2]*. The script looks for services for which the version was detected and creates harvesting tasks in GeoNetwork. Two types of harvesting tasks were defined: the first one for catalogue services - csw and the second one for other OGC services such as WMS, WFS, etc. – ogcwxs. Associated categories for each OGC service type and its content were created in the GeoNetwork database in order to enable distinct searches as described below.
5. Provide discovery/viewer web interface - GeoNetwork opensource was used as a client application to provide a web-based search interface on the metadata harvested in the previous step, as well as a map client to portray layers from the discovered WMS services. Finally, another GeoNetwork feature called Virtual CSW was used in order to provide several CSW interfaces for individual OGC services and their contents to be discoverable with remote SDI clients.

3 Results and Discussions

The pilot implementation of the methodology for automatic creation, validation and publication of ISO/INSPIRE metadata retrieved from the OGC GetCapabilities model applied on GI resources of GCCA SR gave the following preliminary results and outputs [2]:

- 46 metadata records were created for the datasets and one for the view service (WMS) by extracting and transforming information provided by WMS GetCapabilities response into the ISO metadata models.
- Mapping to the ZB GIS community metadata profiles was designed and implemented using XSLT technology.
- Complementary transformation gave the following results: all 46 metadata records were compliant to the ISO schemes; four metadata records were compliant also with the INSPIRE requirements regarding the metadata and 42 metadata records reported 2 INSPIRE validation errors. The first error was a missing value for the element 2.1 Topic category and the second was a missing keyword from the general environmental multilingual thesaurus (GEMET) describing the relevant spatial data theme as defined in Annex I, II or III to INSPIRE Directive. The reason was that those 42 metadata records were created for the layers, which did not contain features from the Hydrography data theme, whereas the mapping was designed initially only for Hydrography theme.

In order to apply the experiment in practice with a higher level of efficiency the following assumptions should be taken into considered by the data producer:

- Data are published through OGC services.
- Names, or identifiers of individual objects (e.g. WMS layers, WFS Features) are standardized. For instance the WMS layers names correspond to the names of the feature classes defined in the feature catalogue. This assumption is important for the determination of the dataset related data theme, which is used to decide what type of information is assigned within the automatic metadata creation process.
- For the datasets published by the OGC services contents are all descriptive information defined in the OGC models (e.g. abstract, keywords, spatial and thematic extent, etc.) provided and updated. This guarantee that most of the information can be reused in the transformation process as well as the metadata naturally reflects the actual status of the data due to their creation by data producers.
- All the information defined as mandatory by the legislation (e.g. INSPIRE) as well as by further specific users requirements are incorporated in the community metadata profiles. The community profiles are used to transform the metadata into a structure, which fulfils these requirements.

The following part illustrates the results gained after the pilot implementation of the methodology for publishing the metadata of GI resources provided by OGC services discovered on Google. Table 1 shows the numbers of URL addresses discovered for individual OGC services in different periods. The last column contains a summary of all URL addresses imported into the database. The numbers after the slashes defines quantity of services gained after the verification procedures (OGC services availability tests).

Table 1. Discovered OGC WxS GetCapabilities URLs

OGC SERVICE TYPE	JUNE 2012	JULY 2012	AUGUST 2012	NOVEMBER 2012	JANUARY 2013	DATABASE 28/01/2013
WMS	554 / 541	540 / 527	725 / 711	699 / 686	752 / 738	1536 / 1433
WFS	530 / 517	520 / 509	636 / 620	619 / 604	591 / 575	1282 / 1115
WCS	169 / 162	176 / 171	251 / 245	356 / 347	231 / 226	632 / 589
WPS	86 / 77	86 / 78	94 / 88	90 / 87	95 / 91	136 / 112
SOS	71 / 56	71 / 55	76 / 65	72 / 58	74 / 58	100 / 85
CSW	178 / 169	142 / 132	177 / 166	164 / 160	178 / 175	281 / 244
WMTS	157 / 156	169 / 168	151 / 149	190 / 190	198 / 198	361 / 277

The total number of functioning OGC services stored in the database after a verification procedure performed on the 28th of January 2013 was 3855 out of 4328 total amount of the discovered URL addresses (89.07%). A percentage increase of an amount of the stored functioning services was for WMS 123.70%, WFS 97.35%, WCS 155.86%, WPS 33.02%, SOS 45.55%, CSW 52.12% and WMTS 60.86%. For instance, the average number of WMS services discovered after 5 searches was 640.6 and the number of the functioning stored in the database was 1433. Therefore an increase of WMS services stored was 792.42, which means that on average 158.48 new WMS services were found in each search.

The following figures show the quantity of metadata records created in GeoNetwork after the individual harvesting tasks for discovered OGC were completed. Figure 3 summarizes the results gained from the harvesting tasks type ogcwxs, thus for all OGC services and their content except CSW (which has a particular harvesting task) and WMTS (which is not supported yet). Figure 4 provides an overview of the amount of metadata records generated after the harvesting tasks of type ogccsw that were created and executed for the discovered CSW services.

Figure 3 Numbers and categories of metadata collected from *ogcwxs* harvesting tasks

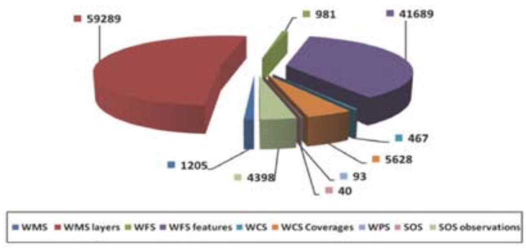
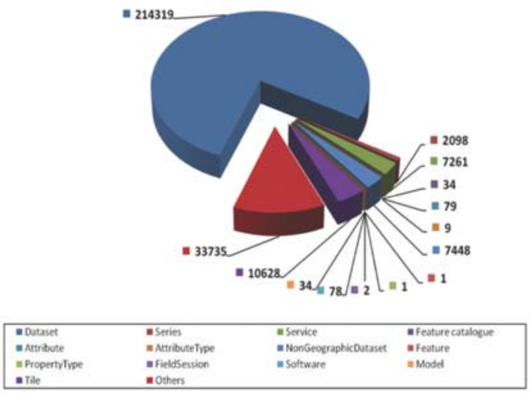


Figure 4 Numbers and categories of metadata collected from ogccsw harvesting tasks



4 Conclusions

The resort of geodesy, cartography and cadastre in the Slovak republic administrates big amount of data with national extent, which needs to be described by metadata of appropriate quality in order to ensure their sharing in an effective way. The preliminary results gained from the application of the methodology for automatic creation, validation and publication of ISO/INSPIRE metadata showed possible enhancements in the process of metadata creation in the real implementations on the national level. The preliminary results are based on a small ZB GIS datasets sample (46 feature classes) and the mapping was designed only for Hydrography INSPIRE spatial data theme. However, the mapping can be complemented with the rules applied for other themes applicable to the ZB GIS database (i.e. Administrative units, Geographical grid systems, Geographical names and Transport networks).

The approach presented in the second methodology for publishing the metadata of GI resources provided by OGC services discovered on Google enhances discoverability (or visibility) of OGC services through SDI mechanisms on a global scale. By visibility is meant the ability to discover OGC services through CSW services, as a standard discovery mechanism to SDI users. However, not all OGC services are registered and hereby reachable via CSW services, or some are registered in individual CSW nodes that are not interlinked. For that reason, many provided information may not be discoverable through the common discovery interface. On one hand, the gained results indicate that service providers and organizations use extensively OGC services, as already point out in recent surveys [6]. However, on the other hand, it seems that service providers do not pay attention to enhance their discoverability, i.e., such services remain hidden to the SDI community, either due to a lack of skilled personnel or of easy-to-use publishing tools that would automate the registration of access, download and view services into catalogues [8].

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[15] GeoNetwork opensource - http://geonetworkopensource.org/
[16] Altova XMLSpy XML editor - http://www.altova.com/xmlspy.html
[17] INSPIRE metadata validation service - http://inspire-geoportal.ec.europa.eu/GeoportalProxyWebServices/resources/INSPIREResourceTester
[18] Altova MapForce - http://www.altova.com/mapforce.html
[19] Google Search Client - https://www.google.com
[20] OutWit Hub - http://www.outwit.com/
[21] MySQL DBMS - http://www.mysql.com/
[22] Apache HTTP Server - http://httpd.apache.org/
[23] PHP - http://php.net/
[24] Geonetwork harvesting services - http://www.geonetworkopensource.org/manuals/trunk/developer/xml_services/services_harvesting.html

INSPIRE and integrated land and water management scientific workshop

Spatial intelligence, spatial reasoning and SDI

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Abstract

After theory of multiple intelligences proposed by Howard Gardner in 1983, spatial intelligence is one of the more recognized intelligences (bodily-kinesthetic, linguistic, logical-mathematical, musical, interpersonal, intrapersonal, naturalistic and spatial intelligence). The most common description of spatial intelligence is the ability to be able to recreate experience and reasoning about shape, measurement and orientation in the space. Spatial intelligence is basically the biological capacity that focuses on spatial judgment. There are many spatially related concepts in use: spatial ability, spatial reasoning, spatial cognition, spatial perception, environmental cognition, cognitive mapping and other. Future on, spatial thinking is a combination of cognitive skills: concepts of space, tools of representation and processes of reasoning. There are more forms of thinking: mathematical, verbal, logical, metaphorical, hypothetical, and other. Ability to use space as a framework for understanding, to define problems and give solutions is based on spatial thinking. Spatial thinking is an essential competence in a lot of branches like surveying, cartography, architecture and other. The conceptualization of the spatial relations is based on semantics and ontological approaches of spatial data, and they are defining theoretical background of spatial intelligence from geoinformation point of view.

In the past, before maps era, geographical names were the main tool to make spatial relations and spatial reasoning. Spatial reasoning using geographical names can be seen as the ability to extract position and orientation from geographical names in everyday life. The spatial intelligence since beginning of the life on the Earth is evaluating. Animals and humans have elements of spatial intelligence. For example spatial intelligence and reasoning was not the same before maps era and today. Historical evaluations of spatial intelligences and reasoning can be ultimately divided in: times before humans, time before languages, maps era, GIS era, spatial DB era and SDI era. Geographical names, maps, GIS, spatial DB and SDI are spatial thinking tools that are strongly influencing our spatial reasoning and intelligence. Each generation of geospatial tools is more developed and is influencing spatial intelligence and spatial reasoning. SDIs are giving new opportunities considering influencing development of spatial intelligence and spatial reasoning.

Keywords: SDI, spatial intelligence, spatial reasoning, semantic.

1 Introduction

To develop a spatial data systems, spatial data should be »specialized«, extract from real world in to the system of idealized world that includes everything of interest; e.g. universe of discourse. How this process is going to be done, its shape and scope depend on the base of knowledge used in the process (surveyor’s knowledge’s, cartographer’s knowledge’s, architect’s knowledge’s...), the goal of the idealized system, used technologies as well need of the main user.

Today’s developments of spatial systems and Spatial Data Infrastructures (SDI) are strongly based on the International Organization for Standardization (ISO), Open Geospatial Consortium (OGC) and other standardization systems. They are using as the basis conceptual model on the level of Unified Modelling Language (UML) object oriented semantics. It is defining theoretical background of spatial intelligence from geoinformation point of view.

Ontological approach to spatial data is making a new basis for building spatial systems. It is giving new possibilities in building spatial systems joining more bases of knowledge what would be hard or impossible to release in the sematic approach. Ontological approach is still not widely used. Today, hybrid conceptualization of the spatial relations using semantic and ontological approaches could be found.

Using spatial intelligence, spatial thinking and spatial reasoning is a new approach. It is using more fundamental point of view on spatial data and systems. It is making connection with other scientific branches on more fundamental basis. SDI is using bases of knowledge of more scientific branches. SDI is basically a tool in the processes of spatial thinking and spatial reasoning.

Theory of multiple intelligences was introduced in 1983 by Howard Gardner and in 2007 he introduced eight intelligences [3]. There were not claiming that this is a complete list of intelligences [14]. Spatial intelligence is one of the basic intelligence. Spatial relations are important for every day activities and almost in all scientific fields (e. g. from 3D spatial modeling humans DNK and molecules, artistic presentations to every movement in space). It is essential for many professions, and it is essential for cartography, spatial planning, surveying, architecture and other.

The intelligence is most studied in humans. But, intelligence can also be articulated in animals. Beside bio intelligences also artificial intelligence of machines can be articulated [12].

The historical traces of human's spatial intelligence could be found from spoken usage of geographical names, maps, GIS, spatial databases to Spatial Data Infrastructure (SDI). SDI is usually build using bases of knowledge of more branches. It has complex structure that is built on more approaches to spatial intelligences. SDI is used by more branches and will serve as basis for spatial thinking and reasoning.

2 Spatial intelligence

There are different definitions of intelligence. But, they are including abstract thought, understanding, communication, reasoning, learning, planning and problem solving. Spatial intelligence is only one of the multiple intelligences:

- Spatial intelligence - deals with spatial judgment and the ability to visualize with the mind's eye.
- Logical-mathematical intelligence - deals with logic, abstractions, reasoning and numbers. While it is often assumed that those with this intelligence naturally excel in mathematics, chess, computer programming and other logical or numerical activities, a more accurate definition places less emphasis on traditional mathematical ability and more on reasoning capabilities, recognizing abstract patterns, scientific thinking and investigation and the ability to perform complex calculations.
- Linguistic intelligence - deals with words, spoken or written.
- Bodily-kinesthetic intelligence - deals with control of one's bodily motions and the capacity to handle objects.
- Musical intelligence - deals with sensitivity to sounds, rhythms, tones, and music. People with a high musical intelligence normally have good pitch, and are good in ability to sing, play musical instruments, and compose music.
- Interpersonal intelligence - deals with interaction with others. In theory, people who have a high interpersonal intelligence tend to be extroverts, characterized by their sensitivity to others' moods, feelings, temperaments and motivations, and their ability to cooperate in order to work as part of a group.
- Naturalistic intelligence - deals with nurturing and relating information to one's natural surroundings.
- Existential intelligence - deals with ability to contemplate phenomena or questions beyond sensory data, such as the infinite and infinitesimal.

3 Spatial thinking and spatial reasoning

There are more forms of thinking: mathematical, verbal, logical, metaphorical, hypothetical, and other. We are learning to think spatially since we are born. Spatial thinking is a part of everyday living. It is a combination of cognitive skills: concepts of space, tools of representation and processes of reasoning.

There is no final scientific definition of spatial thinking [11]. The main definition disagreements are about the scale, dimensions, the nature of cognitive processes, the number of major components and the relationships. The mostly used definition is that spatial thinking is ability to use space as a framework for understanding, to define problems and give solutions.

Spatial thinking is involved in all manner of science. Spatial relations and thinking can scales from the nanoscale to the astronomical scales. It is an essential competence in a lot of branches like urban planning, surveying, cartography, architecture and other [1].

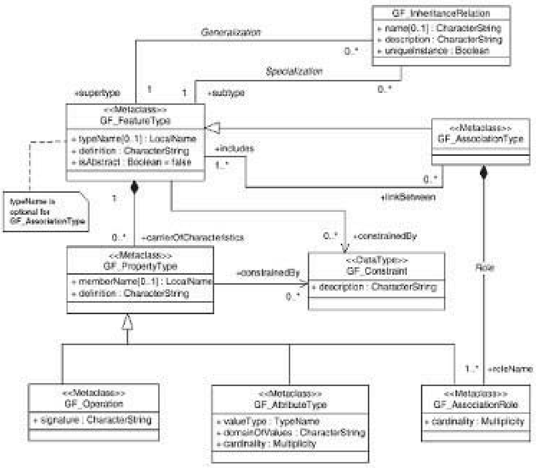
Logical and mathematical intelligences are in school system and culture used as dominant intelligences and they are influencing interpretations of spatial and other intelligences [2], [13].

In the school systems and in our evaluations of individuals, logical-mathematical intelligence is the scored the highest. Quotient of intelligence is mainly checking logical-mathematical abilities. Spatial intelligences and abilities are not so high scored. In the U.S.A. the problem is recognized and in the schools systems are introduced new educational approaches to strongly introduce spatial intelligence as well spatial thinking and spatial reasoning [1].

4 Semantic and ontological approach

Spatial Data Infrastructure (SDI) development is based on the ISO and OGC standardization systems. As the basis is used conceptual model on the level of UML object oriented semantics. Semantics as the study of meanings is used as the background in establishing relationship between spatial data. One of the examples of this approach is General Feature Model in INSPIRE Generic Conceptual Model [6] (Figure 1).

Figure 1: General Feature Model.



Source: General Feature Model [6].

Semantically approach in development of the spatial data systems and SDI is classical approach [7].

Ontology, as relatively new approach, is giving possibility to connect different views of the real or hypothetical world that includes everything of interest; e.g. universe of discourse. Because idealization of real world, in the information-communication technology (ICT) more ontologies about the same part of reality can be developed. Scalability of ontological models is allowing integration of new bases of knowledge in an existing ontological domain [10]. ISO/TC211 geoinformation standardization of ontology approach is intended to provide General Feature Model that can be used to join ontologies [8], [9].

5 SDI as spatial thinking tools

Spatial thinking and spatial reasoning are based on the spatial intelligence. Elements of spatial intelligence could be found at animals and humans. But, artificial intelligences can be developed as well.

Spatial thinking and reasoning is changing during the time. It was not the same before maps era and today. Historical evaluations of spatial thinking and reasoning can be ultimately articulated as: times before languages, spoken spatial information, maps era, GIS era, spatial database, and SDI era. Each epoch have new generation geospatial tools used as basis in spatial thinking and reasoning. Each generation of geospatial tools is more developed and more complex. SDI as tool of spatial thinking and reasoning is giving new opportunities in solving problems of different branches.

But, spatial thinking is changing considering spatial systems used to prepare spatial information in thinking and decision making processes.

Considering development of the SDI, the problem is still how to use different bases of knowledge and how to implement intelligences in SDI system. As good this task is going to be solved, SDI is going to be more useful for spatial thinking, spatial reasoning and solving problems.

SDI is developed to build basic spatial data infrastructure. It is not adapted to particular spatial thinking or reasoning and users needs. It should be used to develop specific spatial thinking and reasoning users' needs.

With development of SDI's, also are rising demands on the knowledge used in the geoinformation industry that is making spatial products and services. One of the main purposes of development of spatial products and services is to help user in spatial thinking and reasoning processes and to make decision.

An example of widely used spatial intelligence, spatial thinking and spatial reasoning are car navigation devices. They are using, as the main components, spatial information system inside transportable device and satellite navigation systems. Instructions to car drivers about driving direction are results of artificial intelligence system and spatial reasoning of the navigation system. During driving the car drivers have specific needs on navigation and route detection. These needs can be clearly articulated and car navigation systems reasoning is developed as support of the driver's needs. Driver needs during the driving are clearly articulated. But, in other decision making processes, it is not always easy to articulate processes and roles of the spatial reasoning system that can help or completely remove humans.

Basic concept of SDI is not to develop artificial reasoning systems and devices as need for particular user groups (as drivers). But, SDI is making platform for development of spatial reasoning systems. In this way development of SDI's is making support of spatial thinking and spatial reasoning.

6 SDI and spatiotemporal thinking

Temporal component is very important in spatial relations and in everyday decisions. Spatial temporal data and SDI systems are building more complex, but also more realistic, basic for spatiotemporal thinking and reasoning. SDI's temporal scales are from real time data to geological eras. Infrastructure for Spatial Information in the Europe (INSPIRE) and National Spatial Data Infrastructure (NSDI), developed considering INSPIRE, are using information about temporal life span of the spatial data. That is making basis for spatiotemporal thinking and reasoning.

Real time data from different sensor systems as: hydrological water level sensors, seismometers and earthquakes measuring systems, traffic intensity monitoring sensors, air pollution sensors and other sensor's systems are critical to make spatiotemporal reasoning of different kinds. For example, real time traffic data are critical to drivers to make proper spatiotemporal reasoning considering traffic routes.

With development of SDI's, higher and higher requests are made on spatial literacy of the developers and users of spatial products and services. Spatial literacy can be defined as a normative statement of what members of a culture should know and be able to do with the spatial knowledge [1].

7 Geographical names as specific spatial thinking and reasoning tool

Geographical names are developed and used for centuries. They are assigned to features to articulate the space around us. But, they are also serving as a strong tool in everyday communication. They reflect historical and cultural development of area and they are defining not only features, but also individuals, groups and nations that are using them. Geographical names are one of the most widely used tools in recognition of the spatial relations. They have complex structure containing information about space, feature, language, time and other features.

Geographical names are important spatial thinking and spatial reasoning tools used in everyday life. Geographical names do not fitting completely in present theories of spatial intelligence and spatial thinking. They can be interpreted as spatial and linguistic intelligence tool. They do not support concept that spatial intelligence is strongly connecting with visualization using the mind's eye. Even Gardner observed this problem in definition of spatial intelligence claiming that the blind people also have spatial intelligence.

Spatial reasoning using geographical names is the ability to extract position and orientation from geographical names. In the past, before maps era, geographical names were the main tool to make spatial relations and spatial reasoning. Geographical names are interdisciplinary problem that is joining geography, surveying, cartography, linguistics and other branches.

Geographical names can be given in spoken or written way, and that is making them part of linguistic intelligence. But, geographical names contain strong spatial information, and are used for spatial georeferencing in everyday communication. They are widely used in spatial thinking and spatial reasoning [2], [5], [6].

To be a unique identifier of the feature/objects geographical names should contain at least proper noun, defined feature and georeferenced geometry of the feature. Using only noun, what is usually done in everyday communication, can easily lead to error in spatial reasoning. For example, the statement: »I am going to Berlin.« does not tell if I am going to capital of Germany, settlement in Norway or region in France that are all called Berlin. Incomplete or not fully defined data are regularly leading to errors in spatial thinking, spatial reasoning and decision making.

8 Conclusion

Semantics and ontological approaches are defining today theoretical background of spatial intelligence from geoinformation point of view. Spatial intelligence, spatial thinking and spatial reasoning are making new approach to spatial data systems and SDI.

SDI is a spatial thinking tool that is going to be used in development of spatial reasoning supporting system. It is going to be the basis for development of geoinformation industries.

SDI as spatial thinking tool is developed on previous spatial thinking and spatial reasoning tools as spoken geographical names, maps, GIS and spatial databases.

Geographical names, maps, GIS and SDI are spatial thinking tools that are representing historical development steps. Geographical names have been used as spatial thinking tool before maps and GIS and SDI are next development steps. Each generation of tools is more developed and giving more possibilities. Spatial intelligence, that is relatively new approach, is opening huge area in research on the basis of studying development of spatial thinking tools.

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Water management & INSPIRE

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Abstract

The Directive 2007/2/EC of the EU adopted in 2007 aims at establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) for environmental policies and policies or activities which may have an impact on the environment.. It cover spatial data sets related to one or more of the 34 themes listed in the INSPIRE annexes. Hydrography theme (HY) provides four application schemas that deliver a water spatial framework for mapping, reporting, modelling and spatial analysis purposes. An Oceanographic Geographical Features theme (OF) describes the physical and chemical characteristics of the sea and Sea Regions theme (SR) define marine areas of common features. Pool of the HY, OF and SR spatial data, makes an information system that integrates interoperable data on inland and coastal waters and provides core spatial data models that can support resolving water thematic issues. It can be applied on the national level, but as well as on the regional or European level. The data specifications for these themes are part of the Regulation on interoperability implementing INSPIRE Directive and further described in the INSPIRE Technical Guidelines.

1 Introduction

The Directive 2007/2/EC of the European Union (EU) adopted in 2007 aims at establishing an Infrastructure for Spatial Information in the European Union (INSPIRE) for environmental policies or policies and activities that have an impact on the environment [1]. INSPIRE is based on the infrastructures for spatial information that are created and maintained by the Member States (MS). The Directive does not require collection of new data, but MS' existing spatial datasets, should be publicly accessible, harmonized and interoperable through network services, within established implementation roadmap [2]. To ensure that the spatial data infrastructures of the MS are compatible and usable, the common Implementing Rules (Commission Regulations) on metadata, monitoring and reporting, network services, data services and sharing, interoperability of spatial data sets were developed as a INSPIRE legislation.

Data interoperability means the possibility to combine spatial data sets and services from different sources across the European Union, without involving specific human or machine efforts.

MS have two interoperability options:

1. Interoperability could be achieved transforming existing data sets
2. Storing the existing (unchanged) data set and transforming them via services for publication in the INSPIRE infrastructure

With Interoperability it is expected that users will spent less time and efforts on understanding and to integrating data, building their applications based on spatial information delivered within INSPIRE.

To prove this, various studies were developed, analysing the cost efficiency related to the spatial data infrastructures, applied for the local administration [3,4,5].

The required information that should be publicly available and interoperable is related to the 34 INSPIRE data themes listed in the three Annexes of the INSPIRE Directive [6]. Data themes and core data models are defined in Commission Regulation No 1089/2010 (CR) regards interoperability of spatial data sets and services [7]. Together with this CR were developed data specification documents [8] as detailed technical guidelines with the objective to help MS implementation.

Hydrography, Oceanographic geographical features and Sea regions are INSPIRE themes that directly deal with water spatial objects.

This paper describes “water” themes, related spatial data models and how they can be applied for resolving water related applications.

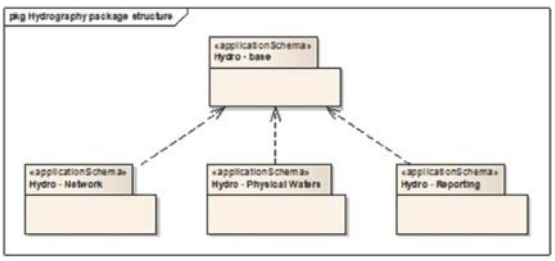
1.1 Hydrography (HY) theme data models

Within hydrography theme are described sea, lakes, rivers and other waters. This theme involves all inland surface waters as coastal waters that should be considered as defined in the Water Framework Directive 2000/60/EC (WFD) [9].

The hydrography theme and data models are covering the network of water bodies and relating structures and physical objects. It provides solid framework for the mapping, reporting and modelling purposes. If there are more specific user requirements, the provided models could be extended to cover required specific needs.

The hydrography application schema is divided into three separate application schemas that describe: physical waters for mapping; network model for spatial analysis; reporting and management units that are used primary for WFD reporting. The fourth application schema ”**Hydro-base”** enables that single real world feature represented in a “view” of mapping, network and reporting, share common base class (“relatedHydroObject” within name or/and identifier). This allows implicit association between spatial objects (and related data and information) for a single feature modelled with different application schemas [10].

Figure 1: Package structure of the Hydrography application schemas



Source: INSPIRE Data specification on Hydrography – Technical Guidelines v.3.0.1.

Representing hydrography elements in terms of mapping is one of the most habitual use case that provides background for location and to understand relations in the represented space.

The **Physical Waters application schema** is primarily used for creating base maps that are related to hydrography. Application schema distinguishes physical water objects, objects that delineate the water bodies, drainage areas, natural points in the network that influence on the flow and manmade objects related to the network. Physical waters application schema distinguish water bodies; water body’s delineation (land water boundary); natural or artificial points of interest (that have an influence on the flow as ditch, creek…) in the hydrography network and finally drainage areas. The drainage areas are referred on the river basin (physical catchment area) and not to River Basin District (RBD) as defined in the WFD. River basin district is excluded form that data model because it is an administrative unit that have no direct relation to the physical catchment.

Hydro-network application schema is defined on the Generic Network Model (package of Generic Conceptual Model [11] that provides fundamental baseline for interoperability). It is a schematic and basic view of the hydrography network with simple geometrical representations (links and nodes) where centreline is an “alternative representation” of the watercourse and a spatial object in itself. The nodes do not only connect the various centrelines but can also represent ‘constrictions’ in the network such as hydrography points of interest or man-made objects

The Hydro–Network application schema is providing four hydrography-specific spatial object types:

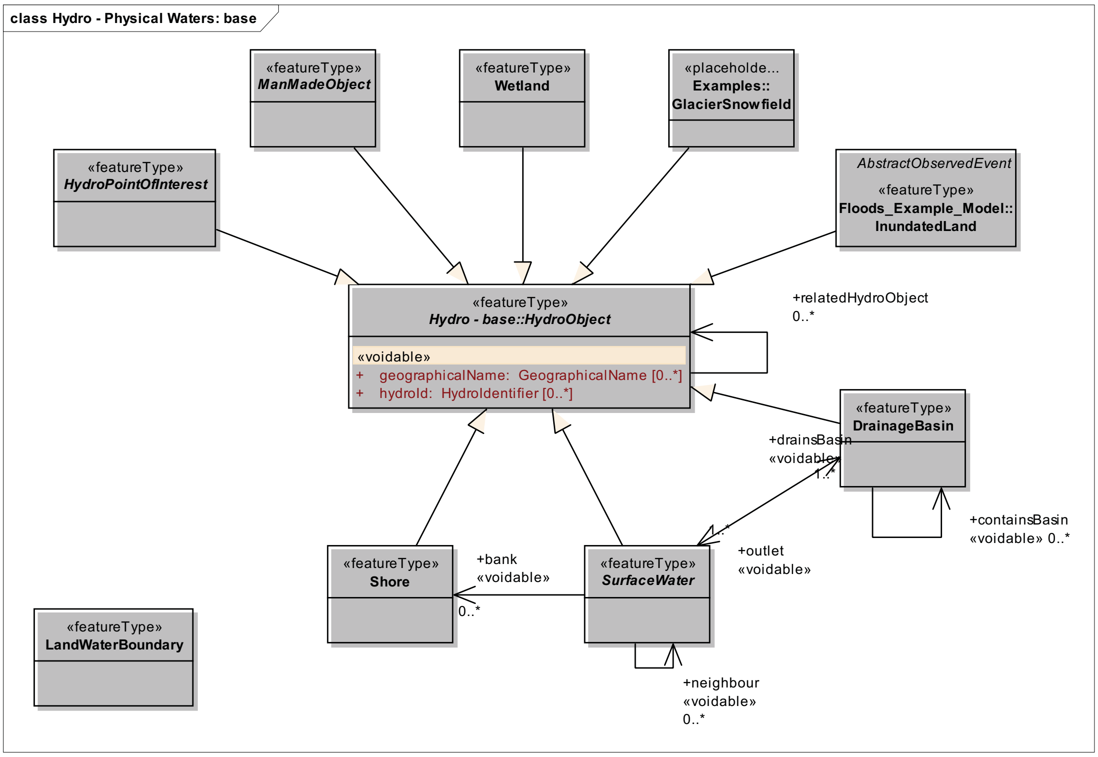
- WatercourseLink, network core links
- HydroNode, network core nodes
- WatercourseLinkSequence,identifying an aggregated sequence of connected links
- WatercourseSeparatedCrossing, non-interacting link crossings

Hydro-reporting application schema provides important ability to relate WFD reporting objects to hydrography objects modelled with Hydro-network or Physical-waters application schemas. For development of Hydro-reporting application schema the use case has been WFD itself. Due that classification of WFDWaterBody can be derived on more specific reporting spatial objects:

- WFDGroundWaterBody: for WFD groundwater bodies
- WFDCoastalWater: for WFD coastal water bodies
- WFDTransitionalWater: for WFD transitional waters
- WFDRiver: for WFD rivers
- WFDLake: for WFD lakes

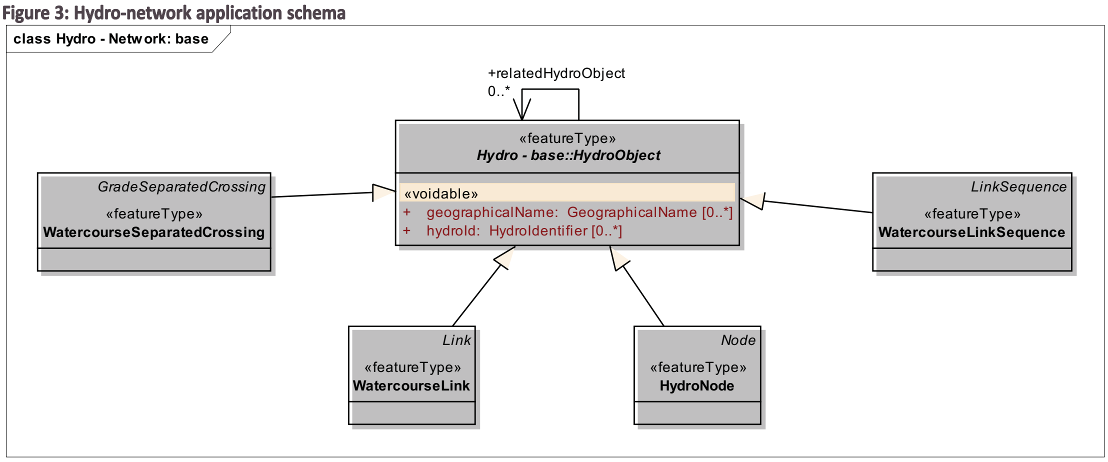
Geometry of WFDWaterBodies and ID should be the same that is used for the WFD reporting. As well, this application schema may be extended to the requirement of the WFD reporting.

Figure 2: Physical Waters application schema



Source: INSPIRE Data specification on Hydrography – Technical Guidelines v.3.0.1.

Figure 3: Hydro-network application schema



Source: INSPIRE Data specification on Hydrography –Technical Guidelines v.3.0.1.

1.2 Oceanographic geographical features (OF)

The Oceanographic geographical features theme describes the physical and chemical characteristics of the sea. This type of information is essentially a coverage describing the ocean and could be presented as a set of point data, gridded data, but as well, vertical profiles through ocean depths and trajectories along the ocean surface [12].

From Generic Conceptual Model are used six "core" types of observations:

- Point observation
- Point time series observation
- Multi point observation
- Grid observation
- Grid series observation
- Point observation collection

Additionally, two other types can be used to represent oceanographic data:

- Profile observation
- Trajectory observation

The Ocean Features theme employs the ISO 19156 Observations and Measurements standard for consistent encoding of measured, modelled or simulated data. Model based on the ISO is a quite generic (guidelines on how to be used within INSPIRE [13]), possible to apply in many different oceanographic thematic domains (temperature, salinity, water level, ocean color, etc.).

The model covers all requirements of the current state of art research in oceanography, as it can integrate and gather data obtained in-situ (water sampler, glider…), sampled remotely (data obtained by airplane, satellite..) or even done by simulation. As well the data model should be used for the data modelling in the environmental and engineering projects as for the assessment of coastal flood hazard or water quality.

1.3 Sea Regions (SR)

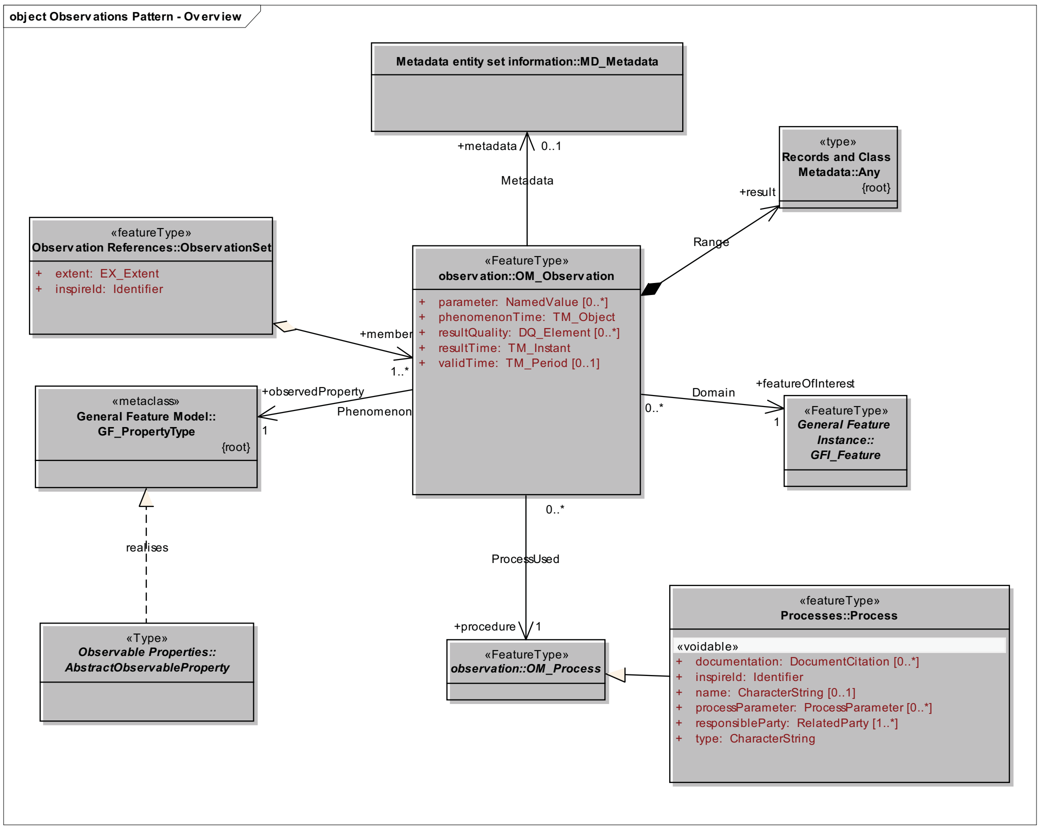
Sea Region is a 2D geometry of an area that is covered by an ocean, sea or similar salt water body and is defined as area of common physical and/or chemical characteristics. INSPIRE data model allows the concept of the named seas e.g. "Mediterranean Sea", but as well it is possible to describe areas of sea surface and sea bed with common characteristics. A Sea Region will typically be represented as a vector data set, not as coverage [14].

The spatial objects – features modelled with other INSPIRE theme (e.g. transport network, aquaculture facility) can be located in a Sea Region or (features with same geometry as a Sea Region) can represent it specialization (e.g. protected area as NATURA 2000). Finally, property of other INSPIRE theme could represent features that are properties of the Sea Region in some respect (e.g. OF chemical and physical characteristic, HY tidal water level values….)

The primary class in the Sea Regions data model is the SeaArea which is an area defined with common chemical or physical characteristic and can be type of Hydrography HydroObject. Due the variation of tidal states, SeaArea supports multiple geometries what is modelled by MarineExtent data type.

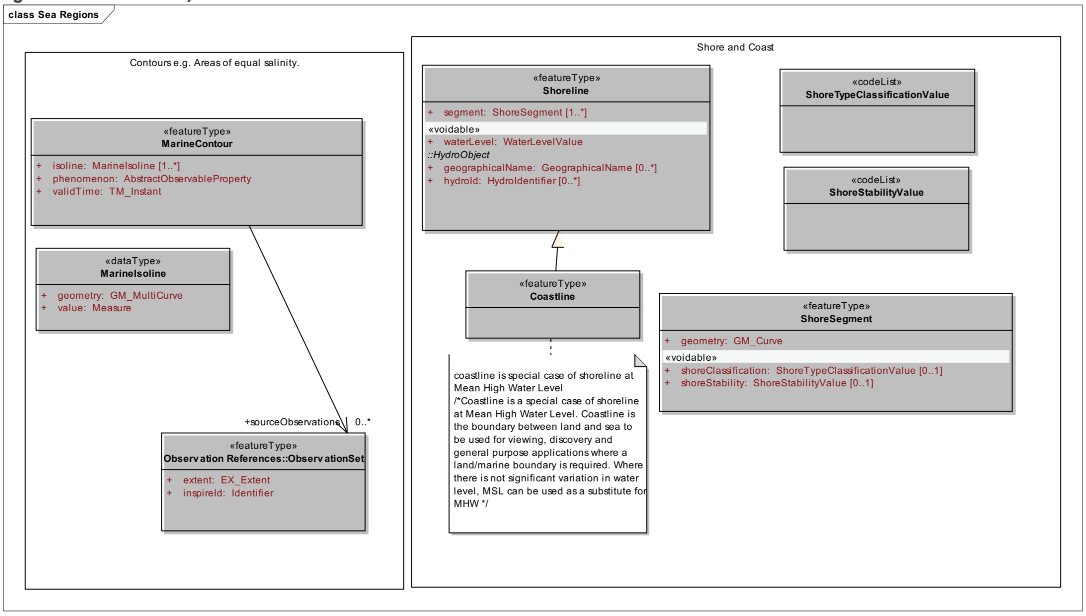
SeaArea can be classified using open codelist SeaAreaTypeClassificationValue (as an estuary, delta, open ocean etc.) or can be used Sea (named sea) or MarineCirculationZone specializations. Inter tidal zones, areas of

Figure 4: Overview of ISO 19156 OM_Observation



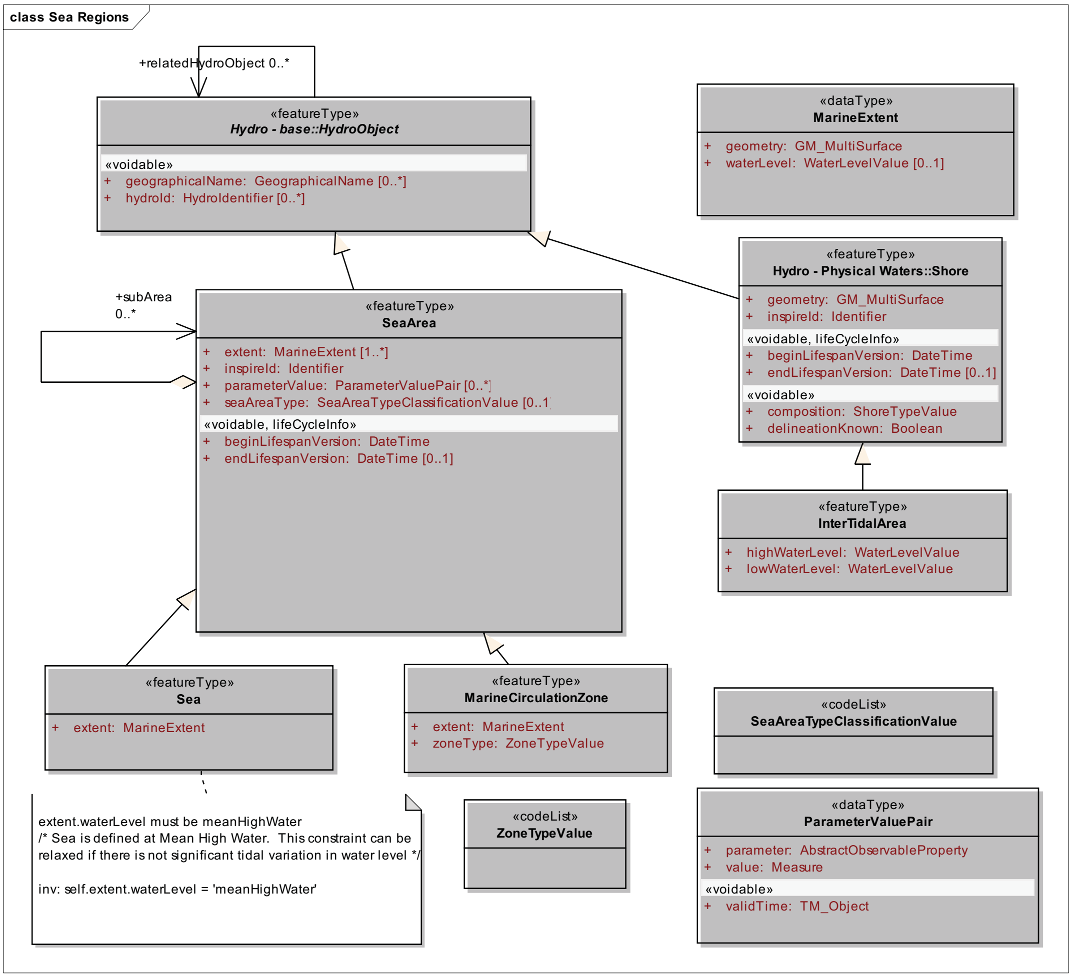
Source: INSPIRE Data specification on Oceanographic geographical features – Technical Guidelines v.3.0rc3

Figure 5:Marine contour, Shore and Coast overview



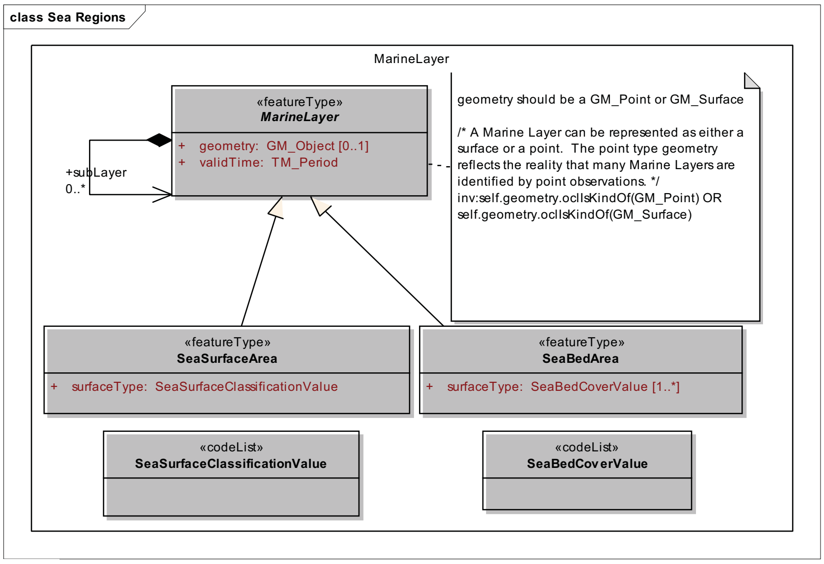
Source: INSPIRE Data specification on Sea regions – Technical Guidelines v.3.0rc3

Figure 6: Sea areas overview



Source: INSPIRE Data specification on Sea regions – Technical Guidelines v.3.0rc3

Figure 7: Marine layer overview



Source: INSPIRE Data specification on Sea regions – Technical Guidelines v.3.0rc3

significant ecology interest can be modelled by specialization of Shore type in Hydrography.

Boundaries where SeaArea meets land as well can be modelled as a Shoreline that can be divided on the ShoreSegment and Coastline that is determinate by Mean High Water Level.

Isolines presenting some phenomenon (temperature contours, waveclimate etc...) at a particular time can be modelled by MarineContour spatial object type.

Finally, Marine Layer is a generic class for modelling areas of interest as sea surface (e.g. oil spills) or sea bed areas (rock, sand...). Both specializations have an extendible classification code lists.

2 Application

Data delivered conform with the INSPIRE data models developed for HY, OF and SR can be used for mapping, reporting, modelling, spatial analysis, research and other applications that deal with environmental or engineering "water" issues. Data models do not deliver direct solution, but provide management for information and data, required for resolving an environmental/engineering issue.

For a development of the river basin information system that integrates inland and coastal waters, should be involved data provided by at least the three theme data models. Data provided by HY (table 1), describe the continental waters network (as physical waters, schematic network and WFD water bodies), river drainage basin, WFD coastal waters, shoreline and possible morphological pressures.

Table 1: data provided by HY models

Hydrography		
Hydro-physical waters	**Hydro-network**	**Hydro-reporting**
River and drainage basin		
Physical water objects that form part of hydrological network (watercourse, lakes…)	Network data model that sink directly to coastal waters	WFD water bodies included (coastal , transitional, river, lake and ground)
Manmade point of interest (seep, spring, pumping station, lock, dams, weir, shoreline construction…)		Water bodies identified impacts&pressures
Shorline		Water bodies related ecological status

OF provides results of coastal/marine waters environmental monitoring (table 2) and SR subdivisions and aggregation of coastal areas according to common (physical, chemical...) properties (table 2).

Table 2: data provided by OF and SR models

	Sea regions
Oceanographic geographical features	Assessment area
Inshore, offshore sampling results of physical and/or chemical indicators	Sea bed areas (rock, mud, gravel, coral…)
Remote sensing ocean color results (trophic state of coastal waters)	Areas with common physical, chemical, biological characteristics (bathymetry, phosphorus concentrations, salinity, trophic state…)
	Shoreline

This river basin information system becomes a tool for river basin district management, which should be applied due WFD requirement. This spatial data model should be used for water management, environmental reporting, impact and pressure assessment and other applications where water data is relevant. INSPIRE interoperability requirement, provide support in using environmental data at the national river basin, but as well in the cross-border situation (Neretva river basin), as on the regional (Danube river basin) and European level.

Including the data provided by other INSPIRE themes (Land use, Land cover, Geology, Environmental monitoring facilities...) that are directly or indirectly all related to the water, the river basin management system become even more complete and populated by environmental information and facilitate holistic approach in resolving any water issue.

3 References

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The Hydrographic Dimension of Marine SDI

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Abstract

The knowledge of spatial data is necessary for a large number of human activities. A Spatial Data Infrastructure (SDI) is a data infrastructure implementing a framework of geographic data, metadata, users and tools that are interactively connected. In Croatia much has already been written about SDI, but primarily from land-based perspective. In this paper marine dimension of SDI (MSDI) that encompasses marine geographic and business information in its widest sense is described. It is pointed out that hydrography, as modern applied science, plays very important role in measurements and description of oceans and seas. Hydrographic spatial data forms the key base reference layer for the sea space in MSDI data. There are a large number of MSDI stakeholders, but International Hydrographic Organization (IHO) recommends Hydrographic Office to play a central role in the development of the marine component of NSDI. It is concluded that MSDI in Croatia should be established according global, regional and national conventions and policies because Croatian internal waters, territorial sea and protected ecological and fishery zone (ZERP) area is 55 349 km^2, what is 97.9% of Croatian land area.

Keywords: hydrography, marine cadastre, MSDI.

1 Introduction

Development of modern society has enforced the usage of spatial data in many human activities. In last decades rapid application development of information and communication technologies considerably improved tracking of spatial data changes.

Spatial data is defined as the data or information that identifies the geographic location of features or objects, usually stored by geographic coordinates which is often accessed, manipulated or analysed through Geographic Information System - GIS [7].

A Spatial Data Infrastructure (SDI) is a data infrastructure implementing a framework of geographic data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way. Another definition is the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data.

The wider use of national Spatial Data Infrastructures (NSDI) has long been held back by difficulties in sharing data between different technologies, different organisations and even between different functions within the same organisation.

The current interoperability capabilities are reflected in the European Unions' (EU) initiative to create a regional SDI – INSPIRE (INfrastructure for SPatial Information in Europe, Directive 2007/2/EC). INSPIRE sets out a framework and timetable that will oblige public sector organisations to publish key spatial data sets in ways that support the discovery of the data and provide access to these resources via product-neutral visualisation and downloading services.

Much has already been written about SDI, but primarily from land-based perspective [4]. This statement is valid for Croatia as well. In 2008, Croatian State Geodetic Administration (SGA) published study titled National infrastructure of spatial data in Croatia [15]. In this document the marine dimension of Croatian NSDI is only mentioned, although the total area of Croatian internal waters, territorial sea and protected ecological and fishery zone (ZERP) area is 55349 km2, what is 97.9% of Croatian land area [9]. Moreover, coastline of the Republic of Croatia consists of a mainland part 1880 km in length and an island part 4398 km in length, amounting to 6278 km [3]. It is the second best indented coast in the Mediterranean. The Republic of Croatia is committed to defining spatially its land and marine territory. Recently Croatia issued National Spatial Data Infrastructure Act [12].

The aim of this paper is to present importance of hydrography and Hydrographic Office (HO) in a process of definition and implementation of Marine Cadastre and Marine Spatial Data Infrastructure (MSDI).

2 Hydrography

Literally translated, hydrography means water mapping and has different meanings depending on the scientific discipline to which it refers. Oceanographers use the term to describe and map the physical characteristics of water such as temperature, salinity, and chemical content. Geographers and geologists use hydrography to define the water surface and volume. Hydrography, as used in nautical charting, is focused on identifying hazards to safe navigation.

Hydrographic discipline is composed of parts of several sciences. Hydrographers use physical oceanography to characterize the properties of the water column, which directly impact ocean acoustics, and to analyse survey area tidal characteristics. Modern surveys use acoustic soundings to determine the water depth. Marine geology is useful in characterizing the seafloor. Determination of the geoid and other vertical reference levels requires geophysical data, primarily gravity. Collected data are presented on nautical chart. Thus, hydrography is a multi-disciplinary science.

Hydrography provides the fundamental backdrop for almost everything that happens in, on or under the sea. It is becoming increasingly significant factor for spatial data and supports: safety of navigation, protection of marine environment, national infrastructure development, coastal zone management, marine exploration, resource exploitation - minerals, fishing, maritime boundary delimitation (UNCLOS, others), maritime defence and security and disaster management.

The International Hydrographic Organization (IHO) in Hydrographic dictionary [7]. defines hydrography as the branch of applied science which deals with the measurement and description of the physical features of the navigable portion of the earth's surface [seas] and adjoining coastal areas, with special reference to their use for the purpose of navigation.

Recent technological changes have caused sudden and substantial changes in hydrography, and thereby changes of definition. On 4th Extraordinary IHO Conference [7] the new definition was adopted, which said that hydrography is the branch of applied sciences which deals with the measurement and description of the physical features of oceans, seas, coastal areas, lakes and rivers, as well as with the prediction of their change over time, for the primary purpose of safety of navigation and in support of all other marine activities, including economic development, security and defence, scientific research, and environmental protection.

The result of a hydrographic survey is a nautical chart which shows the seafloor and other features related to navigation. Thus every hydrographic survey has four major components.

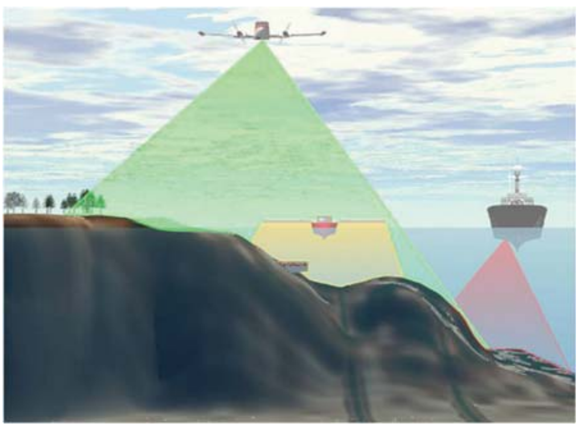
1. Positioning or location of the survey data;
2. Water depth (bathymetry) measured from a vertical reference surface (mean lower low water – chart datum) to the seafloor;
3. Features which may be hazards to navigation (wrecks, shoals, reefs…);
4. Seafloor characteristics refer primarily to the bottom type (mud, sand, bedrock, coral reef) necessary to determine anchorages or the seabed obstacles.

Hydrographic surveys for nautical charting usually meet standards defined by the IHO and consist of three main parts:

- Bathymetric surveys, the measurement of the depths of water bodies from the water surface. Recently bathymetric survey is carried out by multibeam and LIDAR instruments which delivered terabyte of spatial data, shown in Fig. 1.;
- Oceanographic surveys collect information in the water column zone including water chemistry (salinity, dissolved oxygen, etc), biological data and physical data (sea heights, currents, etc);
- Geophysical surveys characterize the structure and composition of the earth beneath the sea floor (gravity, magnetism, seismic surveys, sediments and rocks beneath the seafloor).

Hydrography, with its subset of data themes, forms the key base reference or core geographical or geospatial layer for the sea space in global, national or regional MSDI data.

Figure 1:Hydrographic survey



Source: Banic & Cunningham [1, 13]

3 Marine Spatial Data Infrastructure (MSDI)

Following global trends, IHO established Marine Spatial Data Infrastructure Working Group (MSDIWG) in 2008 to identify the hydrographic community inputs to National Spatial Data Infrastructures (NSDI).

MSDI usually include physical and chemical datasets of marine water column, marine infrastructure (wreck, offshore installations, pipelines and cables), administrative and legal boundaries, areas of conservation, biological features of marine water column and habitats types. All that data form spatial data base of marine component of national spatial data infrastructure.

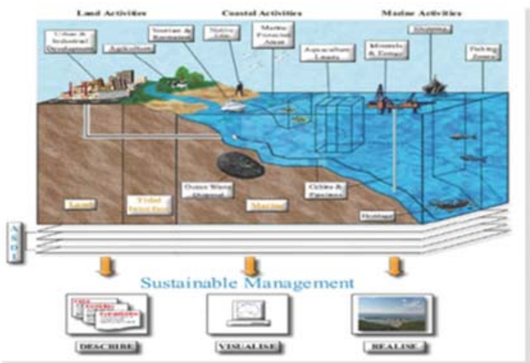
According to IHO, Hydrographic Office (HO) is uniquely placed to play a central role in the development of the marine component of all SDI's [7]. HO is official source for bathymetric data, seabed and sea-level informations. National Croatian HO - Hydrographic Institute of the Republic of Croatia (HIRC) is official provider of national hydrographic informations for the Eastern part of Adriatic Sea waters.

Marine Spatial Data Infrastructure (MSDI) is the component of an SDI that encompasses marine geographic and business information in its widest sense. This would typically include seabed topography (bathymetry), geology, marine infrastructure (e.g. wrecks, offshore installations, pipelines and cables), administrative and legal boundaries, and areas of conservation, marine habitats and oceanography [7].

It must be pointed out that for every maritime country marine administration has a very important role for implementation of MSDI, especially at highest political level.

Schematic presentation of the MSDI as "the marine dimension" of SDI is shown in Fig. 2.

Figure2: MSDI as marine dimension of SDI



Source Binns et al. [2]

MSDI must follow global, regional and national conventions and policies, thus Croatian MSDI follow:

Global:

- UN Convention on the Law of the Sea – UNCLOS
- SOLAS
- IHO/IMO Strategy and Convention
- Regional (EU):
- INSPIRE Directive 2007/2/EC
- EU Integrated Maritime Policy (IMP)
- Marine Strategy Framework Directive (MSFD)
- Barcelona Convention for Protection of the Mediterranean Sea Against Pollution
- Mediterranean Action Plan (MAP)

National:

- Maritime law
- Law on hydrographic activity
- Marine Register and seaport law

Each maritime country need to develop MSDI mapping website (Web GIS tools services) established for collect, archive and distribute reference maps and other marine data sets especially spatial datasets produced by Hydrographic Offices.

3.1 Hydrographic data in MSDI

MSDI usually include data which present characteristics of marine waters [14]:

Physical and chemical datasets:

- Seabed topography, Bathymetry
- Sea Temperature
- Ice cover
- Current velocity
- Upwelling
- Wave exposure
- Mixing characteristics
- Turbidity
- Residence time
- Salinity
- Nutrients, Oxygen.

Biological features:

- Phytoplankton, Zooplankton
- Benthic flora and fauna
- Fish populations
- Marine mammals
- Seabirds

Habitats types:

- Predominant seabed and water column habitats
- Special habitats

Metadata normalized:

- ISO 19115 and 19139 standards compliant
- OGC standard – Catalogue Services Web (CSW 2.0.2)

3.2 Marine Cadastre

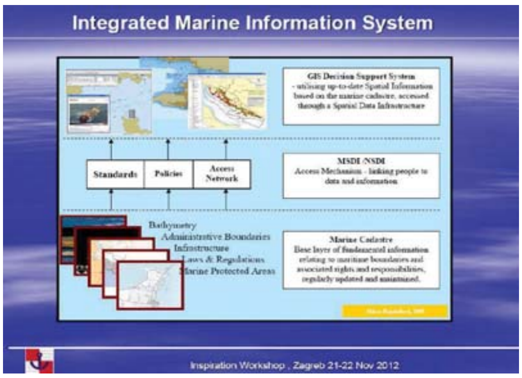
Hydrographic Institute of the Republic of Croatia (HIRC), as official HO, recognized the importance of the MSDI concept. In article 15 of the Law on hydrographic activity [11] it is defined as Marine Cadastre as follows: *Marine Cadastre shall keep records of the data on the sea, seabed and submarine area, relevant for the safety of navigation, except the data of interest to Defence*.

Marine Register shall include the data of the users, the way and proportions of exploitation of the sea, seabed and submarine area, as well as the records of objects, works and occurrences relevant for the safety of navigation, for each area of local self-governing unit and units of local government and self-government."

HIRC shall carry out, among others: Describing and drawing of a geodetically defined border of sovereignty of the Republic of Croatia on sea, taking into consideration other acts which regulate the border, keeping up to date and managing the database of the official data on sea, in the following fields: navigation, hydrography (objects on sea and in the submarine area), cartography, geology, geophysics and oceanography (sea level oscillations, waves, currents, thermohaline, hydroacoustic and optical properties of the sea, hydrometeorology, etc.), as well as organizing and conducting the Marine Cadastre.

Marine Cadastre is part of MSDI as described in Fig. 3.

Figure 3. Marine Cadastre as a part of MSDI



Source, Gržetić at al. [6]

3.3 MSDI Stakeholders

MSDI portal manage, share and retrieve geographical marine information in order to support multidisciplinary studies (share of geographical information across disciplines environmental, socio-economical, regulations, geosciences) and support of decision making (management of usages and resources of coastal zone and fisheries, risk assessment, renewable marine energies).

There is a large diversity of interests, ranging from tourism and recreational activities such as diving and swimming to disposal of waste such as jarosite and chemical dumps. Marine cadaster, administrative and legal boundaries, rights and restrictions data have been very important part of MSDI. Table 1 shows the range of stakeholders and activities that occur within the marine environment. All that stakeholders are the potential MSDI user.

Table 1. Activities in marine environment

ACTIVITY	INCLUDES
Tourism & Recreation	Diving, Swimming, Boating, Fishing
Marine protected areas	Marine National Parks Marine Sanctuaries
Shipping	Commercial Shipping Freight Haulage Passenger Ferries
Heritage	Shipwreck Indigenous Artifacts
Cables & Pipelines	Oil and Gas pipelines Telecommunications Electricity cables
Aquaculture Leases	Mussle Farms Abalone Farms Spat Gathering Areas Oysters Farms
Mineral & Energy	Mineral, Oil & Gas Exploration Resource Extraction
Native Title	Non-excusive access to the sea and sea-bed
Ocean Waste Disposal	Ammunition, Chemical & Jarosite Dumps Scuttled Vessels Land-based sources
Coastal engineering	Coastal structures Water front development Sediment transport & morphology Shoreline management Coastal flooding and erosion Dredging and spill management Cooling water recirculation Survey and monitoring

3.4 Integration of land and marine spatial data on the coastline

The problem of implementation of MSDI in NSDI is consequence of different presentation of spatial data in coastal zone. Land data (State Geodetic Administration) and marine data (Hydrographic offices) are usually represented by means of different coordinate systems, different projections, different datums (horizontal and vertical), and different scales, to show different contents. As a result, users are not able to refer to the required object in the coastal area in a simple and consistent way [5, 8].

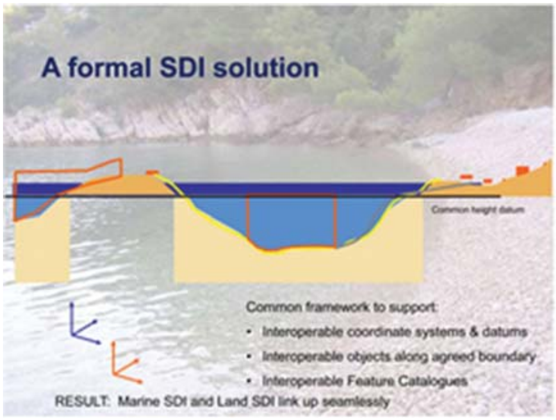
An example of activities on implementation MSDI (legal boundaries) is shown in Fig. 4.

Integration of the land and marine data is becoming a serious problem for many countries, and just a few of them have solved it [9], each in its own way.

It must be pointed out that for every maritime country marine administration has a very important role for implementation of MSDI, especially at highest political level. Marine administration requires definition of MSDI and then access and information about MSDI.

Role of Hydrographic Offices (HO) in SDI is official source for bathymetric data, seabed and water level information. HIRC is enhancing its role as an organization recognized as the official provider of national hydrographic informations. To realize this goal, the HIRC is realigning its activities towards data accessibility and the integration of marine information in support of the safe and efficient use of our waterways, the sustainable development of Eastern part of Adriatic Sea and national sovereignty and security.

Figure 4: Coastline spatial data integration



Source Murray [10]

4 Conclusion

Hydrography is the branch of applied sciences composed of several scientific disciplines. Recent technological changes (GPS, multibeam and LIDAR instruments which delivered terabyte of spatial date) have caused sudden and substantial changes in hydrography, and thereby IHO changed the definition of hydrography.

Marine Spatial Data Infrastructure (MSDI) is the component of an SDI that encompasses marine geographic and business information in its widest sense.

Hydrographic spatial data forms the key base reference layer for the sea space in MSDI data.

MSDI usually include physical and chemical datasets of marine water column, marine infrastructure, sea boundaries and biological features and habitats types of marine water column. All that data form base spatial data of marine component of national SDI.

MSDI should be established according global, regional and national conventions and policies of each maritime country. There are a large number of MSDI stakeholders. Hydrographic Offices are official providers of hydrographic data in MSDI. Therefore IHO recommends Hydrographic Office to play a central role in the development of the marine component of NSDI.

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Developing automatic line for geospatial analyses on assessment of small hydro power plants

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Abstract

The main goal of the paper is to show the established line for geospatial analyses for assessment of small hydro power plants (SHP). The focus is put on analysis of the hydrologic parameters of surface water resources using Geographic Information System – GIS. The method is implemented at a study area which is located east of the Prespa lake watershed in the south-west part of Macedonia which covers around 280km2 with elevation difference from 840m to 2560m a.s.l. A preliminary screening of sites for small hydropower in the hilly region is a difficult task by the conventional methods. The overall aim of the research presented is to use GIS technology, geospatial analyses and hydrological modeling to arrive at various suitable sites for SHP construction. For the analysis are used historic numerical data for rainfall and runoff of one gauging station in table format and digitized map in scale 1:25000. Using interpolation methods is obtained a digital elevation model-DEM which is used further for GIS-based watershed analysis as well as for analysis of hydrological parameters. Maps with rainfall and runoff values are determined using an empirical quadratic equation for relationship between elevation and rainfall. Using maps of rainfall values at pixel level and elevation drop along stream segments, a method for assessment of small hydropower potential was developed. The proposed methodology allows preliminary and efficient decision making considering small hydropower plant projects development. The methodology showed that small watersheds in hilly regions in Macedonia have huge possibilities for exploitation of SHP plants. Same method of research can be used also to other similar watershed areas.

Keywords—Geospatial analysis, Hydrologic modeling, Small hydropower, Watershed.

1 Introduction

A preliminary screening of sites for small hydropower in the hilly regions is a difficult task by the conventional methods. The research in the paper focuses on the implementation of GIS-based methodology approach for determination of surface water potential and especially stream flow. The amount of achievable hydropower at any given site is a function of hydraulic head(elevation drop) and flow rate. Thus, harnessing hydro energy requires assessment of the water resource as described in [1].

A good estimation of runoff can be obtained by using the U.S. natural Resource Conservation Services (NRCS) method for estimating direct runoff from rainfall as discussed in [2] as well as with well known conventional methods such as: rational method, area proportion method SCS-CN method and others.

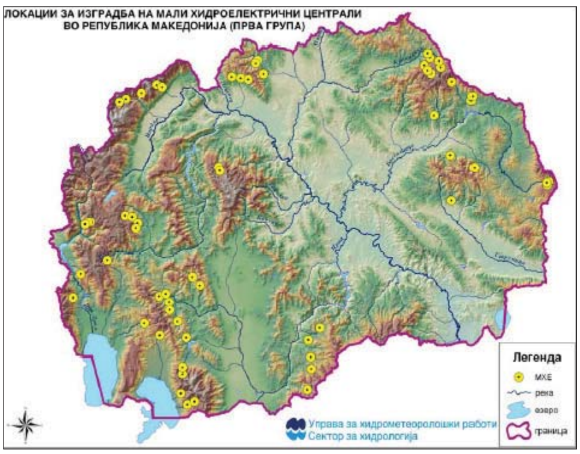
In a small watershed areas usually there are just few gauging stations or even one. Therefore, the determination of rainfall values at annual and monthly level can not be done using standard methods for rainfall calculation such as: arithmetic mean method or Thiessen polygon method. Having on disposal isohyetal map can be employed different interpolation methods in GIS environment for determining of rainfall values at pixel level in raster format. In such cases, the isohyetal map should be enough precise and with satisfactory density of isohyetal contour lines in order the rainfall map to be determined more accurately. Because of lack of precious isohyetal maps in small watersheds in the mountainous areas, a different methodological approach should be developed. Thus, in the research in the study area is employed an empirical quadratic equation for relationships between the rainfall values and elevations. With determination of rainfall map at pixel level in GIS platform, can be easily determined also map with runoff values at pixel level.

The realistic representation of terrain surface (digital elevation model, hillshade model) and complex hydrological phenomena are now possible through spatial tools and modeling techniques with GIS. Moreover, the geospatial analysis of hydropower potential of small streams in GIS platform is an efficient way toward the preliminary screening of suitable sites for small hydropower project development.

2 Study area and source data

The study area is a part of the Prespa lake watershed located in the south-west region of Republic of Macedonia as shown in Fig.1. The watershed area is mainly covered with miscelaneous forest, pastures, agricultural land, rocky surfaces and rural built up areas. The main river in the area is Brajcinska river with total length of 14.720m. The total watershed area of the Brajchinska river is about 64,5 km2. The geology structure of the study area mainly consists of alcaline granite, quartz-chlorite shales and alluvium-fluvial glacial sediments at the lower elevation surfaces. The extent of the area is 210- 210 15'(west-east) and 400 52' 30'' – 410 (south-north). The river has many tributaries that flow into it from left and right side of its downflow direction.

Fig.1 East watershed area of Prespa lake



As input data are used numerical data of historic hydrologic measurements at one gauging station for runoff and rainfall values for the period 1961-2000. These data are in Excel tabular format. There are also used topographic maps with different thematic layers in vector format in scale 1:25000. Each map covers an area of about 140 km2. For the research study were used the layers of point grid, contours and digitized stream network . All of the data in these maps are projected using the state coordinate system (Bessel) based on the Gauss-Krueger projection.

3 Methodology

3.1 Preparing Digital Elevation Model - DEM

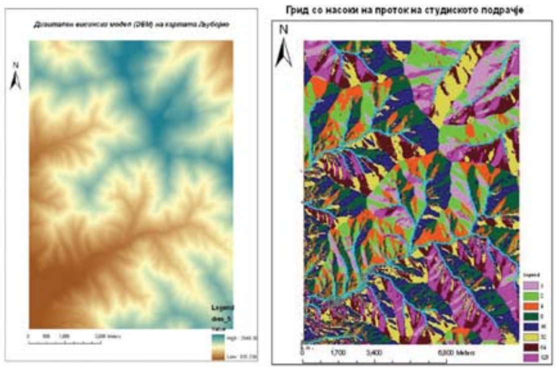
The main and initial input data for obtaining of a hydrological model is the digital elevation model – DEM. The DEM of the study area is created using the ArcGIS with support of its Spatial analyst and 3D analyst extension tools. Using the interpolation tool Topo to raster, with combination of the point grid shapefile and contour shapefile is created a DEM with cell resolution of 20 m. The DEM was hidrologically corrected with filling sinks in order to be suitable for hydrological analysis. DEMs were used furthermore to determine the needed hydrologic parameters such as: slope, flow direction, flow accumulation, stream network delineation, watershed delineation, pour points and others. The triangulated irregular network as well as a hillshade map were also generated by ArcGIS 3D analyst for better visualization of the surface.

3.2 Watershed analysis and stream network delineation

The ArcGIS Spatial analyst and 3D analyst extension tools were used for the watershed analysis. The flow direction raster map was obtained from the hydrologicaly corrected DEM as input raster, using the tool Flow direction in the meny Hydrology in the Spatial analyst tools. Water in a given cell can flow to one or more of its neighbouring cells according to to the slopes of drainage paths [4]. This concept is based on the 8-direction pour point model. The resulting flow direction grid is encoded with codes of 1,2,4,8,16,32,64 and 128 for each direction of flow at a given cell.

The Flow accumulation grid was determined using the flow direction grid as input raster. The flow accumulation grid from the physical point of view is the drainage area at each cell in unit of cells and means, how many upstream cells contribute with flow to a given cell in the raster map [5]. The DEM and flow direction are shown in Fig.2.

Fig.2 DEM of the study area a.) & flow direction map b.)



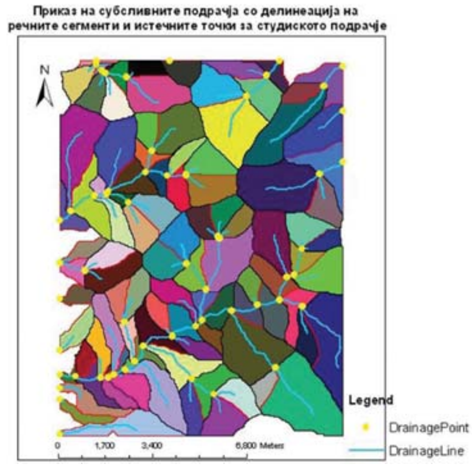
a. b.

The product of the number of upstream cells and the area of a single cell determines the watershed area of each cell. In this case the area of one cell is 20x20 = 400 m2. Using the cell with the highest flow accumulation value can be determined the outlet point(pour point) of the watershed which is analysed. The watershed area upstream of the determined pour point at gauging station is shown in Fig.3.

Fig.3 Layout of the outlet point at the gauging station with the upstream watershed area.

The outlet is a point at which water flows out of the area. This point may be a gauging station and usually is located in the lowest area that intersects with the river stream Fig 3. Flow accumulations are important because they allow us to locate cells with high cumulative flow. Using the watershed tool in the meny hydrology in the Spatial analyst, can be determined the total watershed area at the outlet point. With setting of a treshold value in the flow accumulation tool it can be easily delineated the stream network in raster format. It can be also manually created a pour point shape file with location of many pour points along a given stream. Each pour point then represent a sub watershed for each stream segment of the main river Fig.4. Using the conversion tools each obtained raster map can be converted also in shape format accompanied with an attribute table.

Fig.4 Map of subwatersheds with their pour pounts



4 Hydrology analysis

Considering the hydrology analysis, the initial step is the determination of rainfall values at each raster cell. Here an empirical quadratic equation (Eq.1) for relationship between the annual rainfall values and elevations was employed [3].

$$R = 166{,}93 + 100{,}42H - 2{,}80H^2 \quad (1)$$

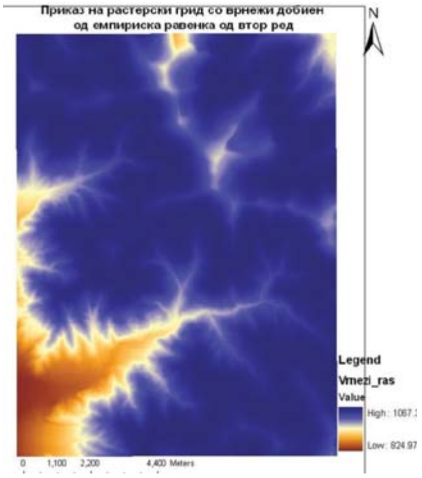
where: R is annual rainfall and H is the elevation in hecto meters. This equation is valid for the south-west part of the country and hence also for the study area.

For calculation of the rainfall raster map in GIS, as input data was used the point shape file with X,Y, Z coordinates. A new column(field) in the atribute table with calculated elevations in hectometers for each point was created. It is also added a new column for calculation of annual rainfall values, and using the equation 1 with the raster calculator tool in Spatial analyst are calculated annual rainfall values for each grid point [8].

Using the feature to raster conversion tool, the rainfall point shape file was then converted into raster map with rainfall values at pixel level, Fig.5.

For the determination of flow at each cell location were used few methods, such as: Rational method, Area-proportion method and SCS-CN method. Using the

Fig.5 Raster map with rainfall values at pixel level.



annual rainfall map and flow accumulation map, is obtained annual rainfall accumulation map or so called precipitation-area product map which represents the average annual flow at each cell assuming no losses. The range values in the annual rainfall accumulation grid is 0 – 1,723 m3/sec. With the annual flow values and annual rainfall values at the gauging station, using the equation 2 the runoff coefficient C at the gauging station was obtained.

$$Q = C * R * A \qquad (2)$$

The product R*A was determined using again the raster calculator tool in Spatial analyst , where the raster map of rainfall values was multiplayed with the raster map of watershed area values at pixel level. Because it is going for relatively small watershed area upstream of the gauging station, the calculated runoff coefficient C is used for calculation of annual flows at ungauged locations in each cell along the Brajcinska river. For more accurate values of runoff coefficient should be taken into consideration also the land cover, soil type and climatic factors in the study area. The determined annual average runoff coefficient for the gauging station was : C = 0,809.

Using the value for the runoff coefficient and the precipitation-area product raster map, at each location can be easily determined the average annual runoff(discharge) Q .

For determination of raster map with Q values at ungauged locations, it was also employed the s.c. Area-proportion method using the equation 3 below,

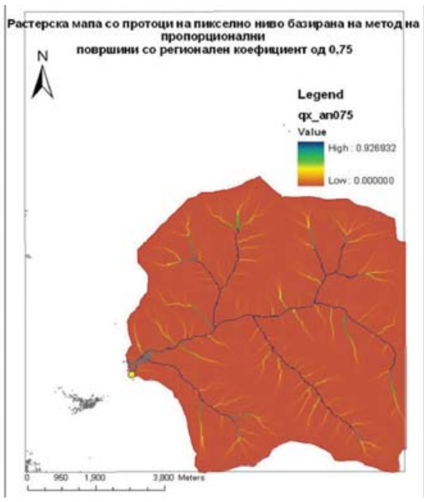
$$Q_x = Q_0 \cdot \left(\frac{A_x}{A_o} \right)^{\alpha} \qquad (3)$$

where Qx is the discharge at the ungauged cell, Q0 discharge at the outlet point , A0 watershed area at the outlet point , and Ax is the watershed area at the ungauged location. α is the regional coefficient with range values between 0.5 and 1, and depends on regional factors: climate, landcover, soiltype, and temperature. In the study area has been taken empirical value of 0.75 which gives most accurate results. The watershed area raster map Ax was determined with the raster calculator tool by multiplaying the flow accumulation map with the area of a single cell which is 20 x 20=400 m^2. In this way the equation 3 can be also written as:

$$Q_x = \left(\frac{Q_0}{A_0^{\alpha}} \right) \cdot A_x^{\alpha} \qquad (4)$$

where the expression in parentheses is quotient between the discharge value and watershed area at the gauging station, and is a constant value. The watershed area raster map A_x^{α} was determined again employing the raster calculator tool [9]. With multiplication of the constant value in parentheses with watershed area map, it was determined the final map of discharge values at pixel level, Fig.6.

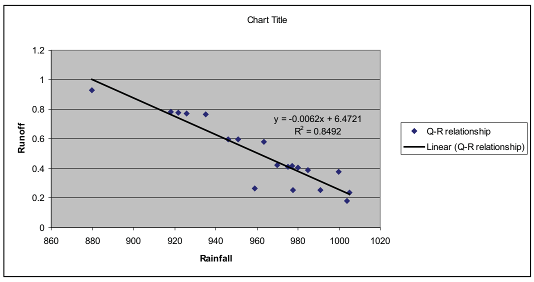
Fig.6 Raster map with runoff values obtained using the Area-Proportion method.

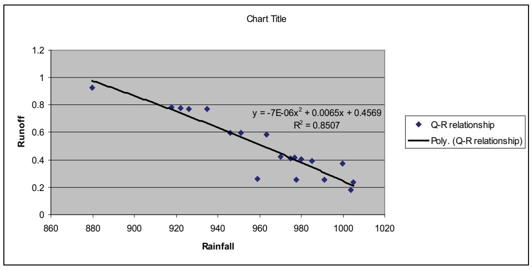


It is also performed a Regression analysis for determining the relationship between the discharge Q and rainfall R where the rainfall is independent(predictor) variable and discharge is dependent variable. The regresion lines(linear and polynomial) are shown in Fig.7 below.

The coefficient of correlation R2 is higher than 0.84 which means, that there is a quite strong relationship between the Q and R. All results of discharge values at the ungauged locations that were calculated with the above methods were compared and calibrated.

Fig.7 Regression relationship between runoff(Q) and rainfall(R).





5 Assessment of SHP potentials

For assessment small hydropower potentials it is necessary to determine the hydraulic head and runoff values at each segment along a stream. The product of hydraulic head(elevation drop) H and runoff Q gives the power output at each potential location using the equation 5:

$$P = \rho g \eta_t Q_i H_n (kW) \qquad (5)$$

where P is the power in kW, η_t is the efficiency coefficient, g is the gravity acceleration, H_n is the net elevation drop and Q_i the runoff(discharge) at the certain location. In the study area, the regional empirical value of 0,901 for the efficiency coefficient is taken.

In the calculation of the power at each particular site, always is taken the runoff value at the intake location (upper vertice of a stream segment) , and as elevation drop or hydraulic head is taken the total elevation difference between the intake and the location of the small hydropower plant [9].

6 Results and discussion

Integrated GIS interface is very usefull and convenient tool for watershed and hydrological parameters analysis. The automatically delineated stream network, watershed and subwatershed areas as well as pour points in GIS platform give a quite accurate, quick and efficient results for needed hydrologic parameters in small basins.

The determination of rainfall and runoff values in GIS environment gives relatively accurate results for analyses of preliminary screening of suitable sites for small hydropower project development.

From the results of the GIS analysis as explained above, the potential sites for SHP development are located by using engineering criteria. In the stydy area have been found more than 10 suitable locations for SHP exploatation, and 2 of them seems to be most convenient regarding the power output values. The results of the calculation of all important parameters for decision making regarding the suitable location for SHP development are shown in Table 1.

The minimum power output is obtained from the second location named Brajc_192 mostly due to the low

TABLE 1.Suitable locations for SHP project development

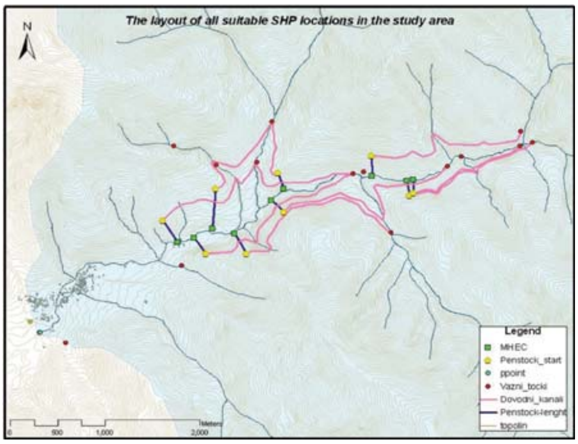
	Location	Intake Elevation (m)	SHP Elevation (m)	Watershed Area (km²)	Elevation Drop(m)	Qav(m3/s)	Qin(m3/s)	P (kW)
1	K_kob_319	1321	1202	8.969	119	0.239	0.3585	341.3
2	Brac_192	1317	1224	6.953	93	0.178	0.267	198.65
3	Brajc_330	1302	1225	16.278	77	0.375	0.5625	346.5
4	Brajc_340	1248	1133	18.112	115	0.406	0.609	560.3
5	Rzans_337	1268	1103	9.664	165	0.253	0.3795	500.95
6	Brajc_343	1187	1071	29.384	116	0.583	0.8745	811.53
7	Stanis_341r	1226	1146	9.737	80	0.255	0.3825	244.8
8	Stanis_341l	1226	1082	9.737	144	0.255	0.3825	440.65
9	Stanis_int	1176	1062	10,102	114	0.262	0.393	358.42
10	Brajc_343+ Stanis_int	1178	1062	39,486	114	0.845	1.2675	1155.96
11	Brajc_340+ Rzans_337	1248	1133	27,776	115	0.659	0.9885	1004.77

discharge at the upper elevations and small elevation drop between the intake and SHP site location.

The maximum power output is obtained from the location 10 named Brajc_343+Stanis_int mainly due to the combination of two intakes where the discharge amount at the first intake with value of 0.583 is added to the second intake flow with value of 0.262 so that is obtained a total discharge amount of 0.845 m3/sec. In this case both inlet chanels have to be combined from the first intake Brajc_343 with elevation of 1178 m.a.s.l. toward the second intake location named Stanis_int with elevation of 1176 m.a.s.l. and from there to the forebay tank and starting point of the penstock with elevation drop of 114 metres.

The graphical layout of the suitable sites is shown in the Fig.8. The intake locations are drawn with red circle, the starting points of penstocks with yellow and the SHP sites with a green sign.

Fig.8 Graphical layout of suitable sites for SHP



The disposition of the small hydropower locations is in elevation range from 1062 m.a.s.l. of the lowest to 1225 m.a.s.l. of the SHP plant in the highest location. All small hydropower sites are located along the Brajchinska river as the main river stream in the study area.

As can be seen from Table I, the location No.6 in combination with the location No. 9 gives the maximum power output of 1.155,96 kW. Also the location No.4 in combination with the location No. 5 gives the second maximum power output with the value of 1004.77 kW.

For the final decision making should be made also some classical hydrology measurements and analyses at a particular site, in order to be calibrated with the determined results with the geospatial analysis in GIS environment as described above.

7 Conclusions

The objective of this paper was to propose a GIS based methodological approach for analysis of main hydrologic parameters for identify the suitable sites for SHP projects developing, mainly based on engineering criteria using geospatial analysis. The focus of the analysis was set to satisfy the criteria regarding the sufficient amount of stream flow for SHP development.

The analysis was performed based on two criteria: 1)Topographic analysis of the suitable sites in GIS taking into consideration the elevation drops along one or more adjacent stream segments and 2) Hydrology analysis of discharge at intake points performed also with GIS tools.

The proposed methodology offers an efficient way to examine also any other similar or larger watershed mountainous areas rich with water resources. The results can be used for decision making regarding the investigation and comparison of the suitability of various SHP potential sites. Further analysis is foreseen considering the economic, social and environmental criteria of SHP potential sites. For the future work, more accurate input data (DEMs) with finer cell resolution, LIDAR, as well as more gauging stations with measured data should be taken into consideration for the analysis

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Hydrological modeling by the Land Surface Schemes of the Global Climate Models

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Abstract

Estimation of the components of the water cycle as runoff and groundwater recharge at country scale is very important in water management. It becomes especially important in forecasting these phenomena during expected climate changes. The only way to achieve this is the application of adequate to the task scale mathematical models.

Land Surface Schemes of the Global Climate Models (LSs GCM) are universal hydrological models and are appropriate for solution of the problem.

The paper presents research performed by the mathematical model CLM (Community Land Model 3.0). Different hydrological assessments are made and the model results are compared with real measurements. The good enough for the purpose approximation brings to the conclusion that CLM model is reliable tool for hydrological forecasting at country scale, aiming at practical assessments in water management in Bulgaria.

Keywords: land surface model, runoff, groundwater recharge.

1 General notes

An averaged assessment of the components of the water cycle as runoff, groundwater recharge and evaporation on vast territories like whole river basins or the entire country territory is important for the country water management. While the run off could be measured directly the other two components are not susceptible to reliable measurement. Most suitable tool for quantitative assessment of the water cycle components in such case are the mathematical models estimating them as a result of the land surface atmospheric effects. Worldwide there are developed several rather sophisticated such models capable to give detailed estimate of the hydrological elements in function of the atmospheric forcing on the terrain surface. With such models it is possible the simulation of daily even hourly flow at fixed points from catchments and time intervals of any size. They are good for detailed water cycle components evaluation. However these models have a very serious disadvantage consisting in the necessity of collecting huge number of phisico-geographical data and consequently calibrating and validating the model for the concrete catchment. Obviously the implementation of such a task in a country scale in the Bulgarian conditions will be a tremendous job making it practically not feasible.

An appropriate solution of the problem can be found in the employment of the Land Surface Schemes of the Global Climate Models. Thanks to the joint research of scientists from all over the world created were the global research models, known as Global Land Components of the Global Climate Models. They are their lower boundary condition and give the moisture and energy exchange in the coupled system land – atmosphere. Such a model is CLM3 [3]. It contains rather precise submodels for the tree main water cycle processes: surface water runoff, infiltration and moisture transport through the soil profile, evaporation and evapotranspiration from the land surface. In the same time it has built-in all necessary input land surface information – topography, land cover, soil profiles texture and hydraulic properties, etc. At the same time the model resolution is rather large, which makes the model appropriate for more generalized, averaged assessments of the water cycle components – over large scale catchments and better for longer periods as months and years.

The model is run for the whole territory of Bulgaria. The goal is to be prepared information related to different hydrological components, analyze it and create friendly digital maps to serve the authority, the experts and the public.

In the presented paper discussed are the CLM3 model results from evaluation of the runoff from the watershed filling the "Topolnitza" reservoir and the watershed feeding the groundwater body "Belene".

2 Model application data

To drive the model data of different sorts were used: geographical coordinate mesh 2° x 2°, 6-hours time step, near surface meteorological data including convective precipitation, air temperature, air pressure, specific humidity, shortwave and long wave radiation and wind speed. This is taken from the data sets of the National Centers for Environmental Prediction (NCEP), which is the NASA database. Soil and vegetation information with spatial resolution 0.5° X 0.5° was taken by the IGBP dataset (International Geosphere – Biosphere Program

The precipitation is portioned by the model into evapotranspiration, surface runoff and infiltration. In our study we will discuss and use the data obtained for the surface runoff and the infiltration.

3 Runoff calculation

The runoff from a river basin can be calculated for time period an hour, a day, a month. The longer the period the more accurate is the calculated runoff volume. The CLM3 model was applied for the catchment of Topolnitza river before entering the „Topolnitza" reservoir. During the severe floods in August (03.08.-10.08.) it was flown over and enormous water quantities flew downstream and destroyed large rural and urban areas (Figure 1). For that reason CLM model has been applied for reservoir inflow monthly forecast aiming at its good management by permanent control of the reservoir volume.

In detailed research carried out earlier the monthly runoff volumes were calculated and by comparing the simulation results with observation data it was proved the applicability of the CLM model for producing reliable estimations for runoff from the watershed of Topolnitza river [2]. Here the results from modeling are provided for the first 5 months of the year 2013. That is the period

Figure 1. Picture of the overflowing Topolnitza dam during the severe flood in August of 2005

when there is highest feeding of the water resources for the whole year. They are shown on the Table 1 and can be used for current runoff monitoring.

Table 1. Hydrological assessments

	January 2013	February 2013	March 2013	April 2013	May 2013
Runoff, mm/day	0.37	2.38	0.42	0.28	0.37
Groundwater recharge, mm/day	0.17	0.56	0.26	0.15	-0.21

4 Infiltration calculation

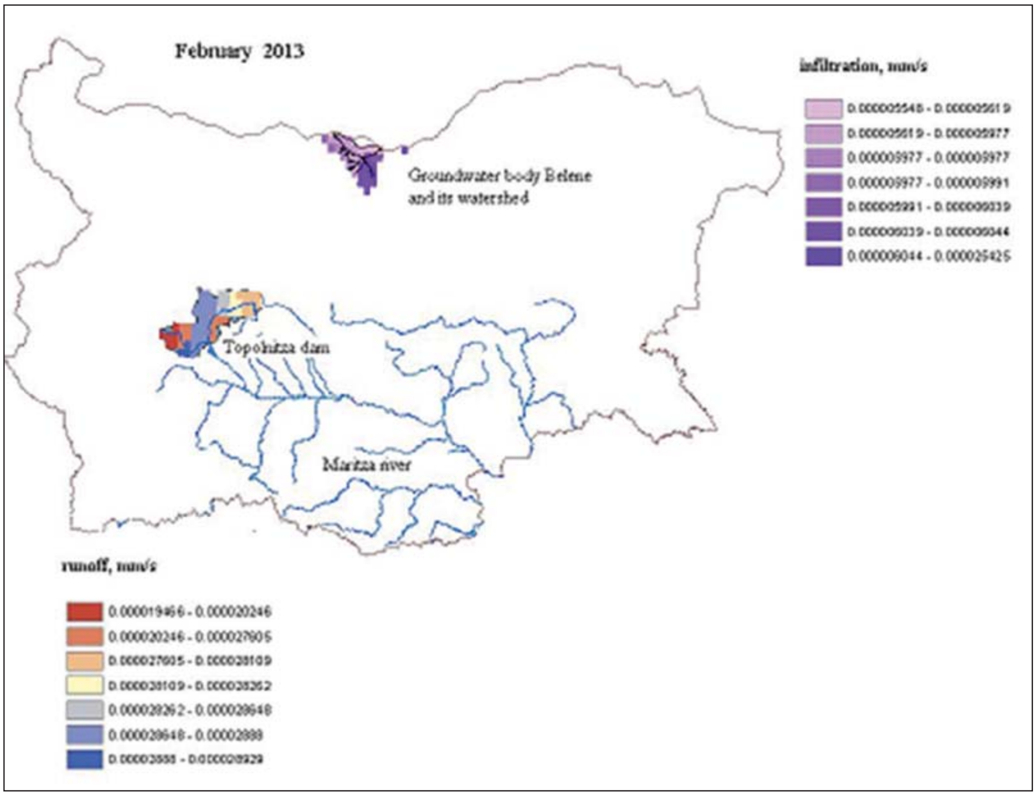
In this report considered is the groundwater body „Belene (area 210 km2), recharged from a catchment with area of 870 km2, which directly outflows into Danube. It is unconfined two layered, with depth of 18 m. The first layer is clay-sand and the second layer is gravel- sand. The lower boundary, has a depth of 20 m, bellow the ground surface. The groundwater body is being fed by precipitation. In detailed research carried out earlier [1] by comparing the simulation recharge with the observation data it was shown the model reliability for groundwater recharge estimation. Here provided are the model results for 2013 year (Table 1).

5 Conclusions

For the first 5 months the runoff and recharge peaks occurred during February 2013 which is shown on Figure 2.

From the Table it is seen that during the May 2013 the groundwater recharge changed its direction. It is from the groundwater to the atmosphere.

Figure 2. Hydrological assessments for February 2013



The model enables the quick estimation of the regarded hydrology components the second one (the groundwater recharge) being very difficult for assessment.

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Turkey's SDI with respect to Settlements and Buildings at Risk in light of the INSPIRE Framework

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Abstract

Turkey is a country prone to various devastating natural disasters. Especially, after two perilous earthquakes in 1999 (Izmit & Duzce), Turkey learned significant lessons. These lessons learnt gave rise to reviewing the entire disaster mitigation system. Nevertheless, the recent earthquake in the City of Van (24.10.2011) revealed some deficiencies in the process of implementing disaster mitigation measures. To remedy these deficiencies, the Ministry of Environment and Urbanization (MoEU) prepared a new law on "Transformation of Areas under the Disaster Risks" (Law No. 6306). The law sets out principles and standards of disaster mitigation and recovery process and procedures with respect to areas prone to disaster risks as well as buildings at risks in and out of disaster prone areas.

In view of the large number of transformation areas and risky buildings in Turkey, the spatial data infrastructure needs to be built for managing the relevant process and procedures by the authority in charge (DG of Infrastructure and Urban Transformation Services of MoEU). At present, the General Directorate collects and registers various spatial data. Annexes I, II, and III of the INSPIRE Directive provide a reference base for such data. This paper portrays the efforts of the General Directorate to collect and manage the aforementioned data in accordance with INSPIRE standards. The paper furthermore extends to other features of spatial data infrastructure with a view to reflecting the total capacity of the General Directorate in transforming risky areas into sustainable settlements. Finally, the paper designates some topics of cooperation in the frame of INSPIRE activities.

Keywords: Natural disasters, buildings and areas at risk, spatial data infrastructure

1 Introduction

On account of its geologic, topographic and climatic attributes, Turkey has frequently been confronted with many different types of natural disasters, namely earthquakes, floods, landslides, avalanches. Among these natural disasters, earthquakes have the most detrimental effects on the settlements in Turkey **[5].**

Especially since 1950s, urban settlements in Turkey are the main centers of increasing population and construction. Urban settlements in Turkey are also at high risk of natural disasters due to dense construction parallel with the population increase. The extensive natural disaster experience of Turkey over many centuries invigorated efforts to develop disaster mitigation capacities. Especially, after two perilous earthquakes in 1999 (Izmit & Duzce), Turkey had remarkable lessons learnt. These lessons learnt gave rise to reviewing the entire disaster mitigation system. Many initiatives and ongoing studies on legislation, institution-building, insurance, and quality control look promising for disaster resilient settlements. Nevertheless, the recent earthquake in the city of Van (24.10.2011) designated some deficiencies in the implementation process. To find out an effective method to surmount on these deficiencies, the Ministry of Environment and Urbanization prepared a new law namely, Transformation of Areas Under the Disaster Risks (Law No. 6306). The law entered into force on 31.5.2012. The scope of the law is to determine principles and standards of disaster mitigation and recovery process and procedures in the areas prone to disaster risks as well as buildings at risks in and out of disaster prone areas. Since urban settlements are densely populated and constructed areas in such an increasing population country like Turkey, the main focus of implementation is on urban settlements in the frame of aforementioned law.

In this respect, it is expected to design a road map to execute the transformation process priory in urban settlements. The road map requires setting relevant principles and standards for the urban transformation process and procedures as well as capacity development for technical staff and key executives. Consequently, the Ministry of Environment and Urbanization expects to achieve the following goals:

- To transfer the knowledge and experience attained from the road map into a regulation to guide local authorities how to implement the urban transformation process.
- To lessen urban environmental degradation
- To create awareness on how to build sustainable urban settlements

The urban transformation process is multi-dimensional. It does not only cover the process of reconstruction of the risky buildings but also integrated spatial planning approach to serve sustainable development, financial models to facilitate the payments of middle and low income group home owners, environmental friendly methods to prevent environmental degradation in and around urban areas. In this respect, the Ministry of Environment and Urbanization aims at enact comprehensive legislation to guide for better implementations. Thus, the Ministry is going to organize various workshops, seminars, and local meetings to invite relevant public central and local authorities, private company representatives, academics, scientists, researchers, NGOs and other citizen groups, media members to create a common mind. It is believe that all these valuable inputs will have valuable contribution to draw an effective road map for the urban transformation process.

2 The Pertinent Legislation

The process and procedures of the transformation activities are performed by the Ministry of Environment & Urbanization/DG Infrastructure and Urban Transformation Services in accordance with the following documents of the legislation:

- **Decree Law No.644, Article 11-** The Decree Law on Foundation and Organization of the Ministry of Environment and Urbanization: According to the law, the Ministry has two main responsibilities with respect to the objectives of the transformation process:
  - To prepare the legislation on spatial planning, environment, building, and construction as well as monitoring and controlling the relevant implementations.
  - To fulfill and exercise the projects and implementations of transformation areas which are not planned and built up in accordance with planning standards, building codes, and earthquake risks.
- **Law No.6306-** Transformation of Areas under the Disaster Risks: The Ministry is in charge of determining principles and standards of disaster mitigation and recovery process and procedures in the areas prone to disaster risks as well as buildings at risks in and out of disaster prone areas. In the implementation process of the law, the following supplementary legislation are used [3]:
  - The Regulation on the Implementation of Law of Transformation of Areas under the Disaster Risks
  - The Communication on Methods and Principles of Declaring Urban Transformation and Development Areas in Publicly Properties or Publicly Used Areas
  - The Regulation on the Revenue, Expenditure of the Special Account of Transformation Projects, the Transfer of Loan and Financial Resource
  - The Circular on Rental Subsidy
  - The Circular on Detection of Risky Buildings
  - The Circular on The Process and Monitoring of Risky Building Demolition
- **National Earthquake Strategy and Action Plan 2012-2023-** The Prime Ministry, Directorate of Emergency and Disaster Management prepared a national strategy and action plan by assigning tasks to relevant institutions and authorities. According to that Strategy Document, the Ministry is responsible for preparing mitigation plans and performing micro-zoning activities [5].
- **Integrated Strategy of Urban Development and Action Plan (KENTGES) -** The Ministry has a national strategy on urban development document which addresses various responsibilities to itself as well as other relevant authorities and institutions. The main objectives of the document are determining the principles, strategies, and actions for solving the structural problems of urbanization as well as maintaining healthy, balanced and livable urban development. It has a prospective view for urbanization to get efficient results through the year 2023 which intersects the 100. Anniversary of the Republic of Turkey [4].

In the frame of the aforementioned legislation, the Ministry of Environment and Urbanization/ General Directorate of Infrastructure and Urban Transformation Services (DGI&UT) has been working since May 2012 when the Law No. 6306 came into force. It aims at performing the transformation/ regeneration of settlements with a view to upgrading living standards, designing eco-settlements, and creating brand cities for Turkey.

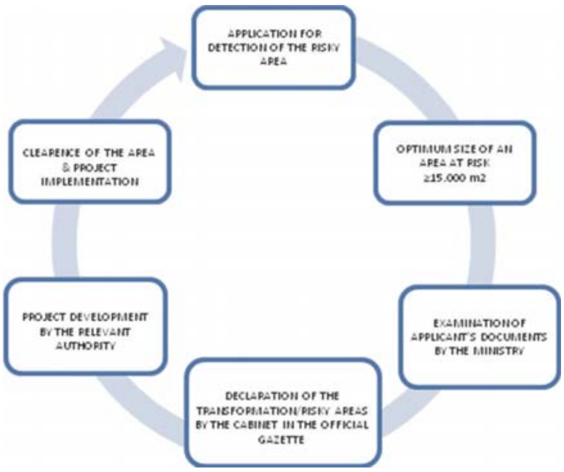
The DGI&UT is aware of some deficiencies in the existing legislation by considering a very dynamic process of transformation activities. Thus, DGI&UT still works on development of legislation while it is open to technical cooperation with relevant institutions, universities, professionals as well as Turkish and international funding/donor organizations.

3 The Main Topics of Implementation Through the Area Transformation Process

In the context of the area transformation activities, DGI&UT executes two main activities, namely risky areas and buildings. As it is defined in the Law No. 6306, a risky area is an area that has risks of loss of life and property stemming from the unstable ground conditions or unsafe constructions. The risky area process constitutes with detection of the area, preparation of the proposal of the given area, examination of the proposal documents, declaration of the risky area, project development, and implementation (see fig. 1).

The detection and proposal preparation procedures can be initiated by the Ministry, the nearest municipality to the risky area, the Prime Ministry Mass Housing Authority or the citizens living in that area. The proposal preparation process requires a technical report and an attached folder containing the relevant documents prepared in accordance with the Regulation on the Implementation of Law of Transformation of Areas under the Disaster Risks [3].

Figure 1: The Process & Procedures of an Area at Risk.



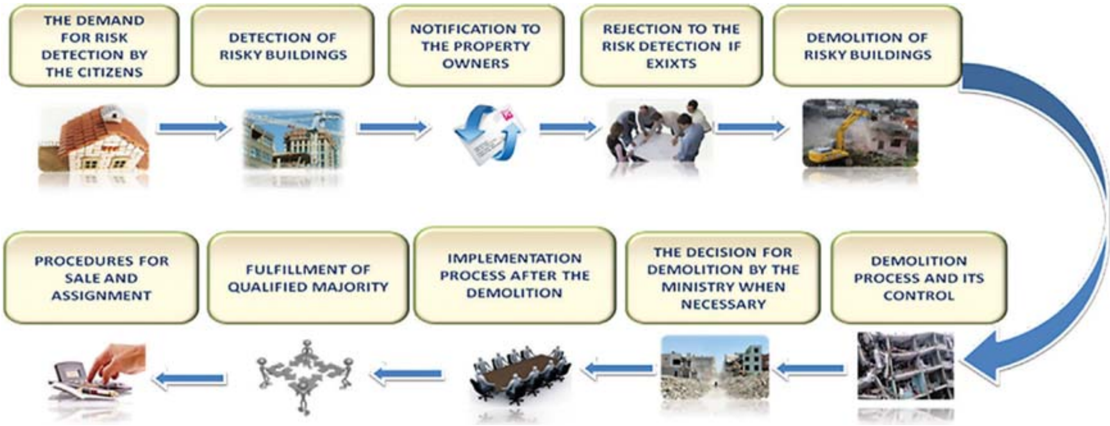
Source: **www.kentseldonusum.gov.tr**

After the technical report and the attached documents are examined by the DGI&UT, the technical view of the Prime Ministry, Directorate of Emergency and Disaster Management is asked. Subsequently, the expediently prepared proposal's folder is sent to the Cabinet. In accordance with Law No. 6306, the declaration of a risky area is performed by the Cabinet. After the declaration, the project development process is initiated by the authority who applied for the risk detection. In the frame of the Law No.6306, the project design is performed in the original area. If the risk of the area is unbearable due to the inconvenient ground conditions such as fault lines and high liquefaction features, the project is developed on a proposed area by the relevant municipality or the Ministry. Those areas called "reserve areas" and defined by the Ministry [3]. The project of the area is developed after the completion of some relevant analyses such as analysis of existing land use, analysis of land tenure and property ownership, and feasibility analysis of demolition and area clearance process. To support the process of transformation, the Ministry has some subsidies, namely rental subsidies and user friendly loans.

As one of the main transformation activities, the process of risky buildings constitutes with risk detection, evacuation and demolition, and project development (see fig.2). According to the Law No. 6306, the risk detection of buildings is not compulsory but the Ministry encouraged the citizens and local authorities by creating awareness of high disaster risks in Turkey. The DGI&UT gave licences to the institutions and companies to detect the building's risk. To detect the risk of the building, those licensed institutions and companies are only allowed officially.

The risk detection process is started by the application of the minimum one property owner. After the detection of the risk, it is notified to the relevant directory of deed. The directory of deed informs to the all property owners in that risky building for evacuation. In case of rejection to the risk notification from other property owners, an official letter of rejection should be sent to the Ministry in 15 days following to the information of the directory of the deed. The letters of rejection are examined by the committee constitutes with 7 members (4 academics and 3 experts from the Ministry). The committee prepares a report to assess the risk of the given building. If the building risk is confirmed, the demolition process will start. If not, the risk notifi-

Figure 2: The Process and Procedures of a Building at Risk



Source: www.kentseldonusum.gov.tr

cation in the directory of deed will be revealed. After the risk detection and the notification to the relevant directory of deed, utilities of the building such as water, gas, electricity can be interrupted in accordance with Law No. 6306 [3]. After the demolition of the building, the implementation process starts. The new project of the building is developed and finalized by the consensus of minimum 2/3 of the property owners. Similar to the process of risky areas, the Ministry provides rental subsidies and user friendly loans to the dwelling unit owners in the risky buildings.

Turkey has 81 provinces. Since 2012, many risky areas are declared in 26 provinces and many risky buildings were detected in 68 provinces. According to the figures and records of the DGI&UT in September 2013, approximately 40,000 risky dwelling units and offices were detected and 105 risky areas are declared.

4 The State of Play for Spatial Data Infrastructure in the Ministry & DGI&UT

Efforts to build SDI in Turkey started in the mid-1980s. In 1990s, data on altitudes, administrative boundaries, centra of settlements, and a data bank for geology were initial milestones of SDI in Turkey. Since 2003, the State Planning Organization (SPO) which reported to the Prime Ministry coordinated some successive Action Plans (Action 36, 47, and 75) for the "Turkey e-Transformation Project" with a view to creating an information society. In this context, many initiatives were taken to develop components of the NSDI (http://www.bilgitoplumu.gov.tr/Documents/5/Documents/Action_Plan.pdf). By considering the capacity of some spatial data producer institutions, the establishment of a national geo-portal was one of the sub-actions of the Project. The SPO assigned the task of establishment of the national geo-portal infrastructure to the Ministry of Public Works & Settlement (MPW&S) in 2006. According to the terms of reference of the SPO, the establishment of the national geo-portal infrastructure covers the feasibility study, preparation of the relevant legislation, and relevant institutional organization. The preparatory studies proceeded till 2008. Thereafter, as a preliminary study, the feasibility report on building the infrastructure for the national geo-portal was completed in 2010 [2]. As another milestone in this period, the Department of Informatics and GIS was created in 2009 in the MPW&S to build and operate the Turkish Geographical Information System as well as to support and motivate public institutions for wider use of the System. In 2011, the Ministry of Environment & Urbanization was established as a result of the reorganization of the former MPW&S and Ministry of Environment and Forestry. In the meantime, the DG GIS which is in charge of building and developing national SDI was launched.

The NSDI scene in Turkey had been scattered for a long time. While until recently various institutions have been producing spatial data (see fig.3), only some of them contribute to the spatial data infrastructure in Turkey. Over the past years, several initiatives were taken to develop components of the NSDI and to implement INSPIRE [2]. Since 2011, the Ministry of Environment and Urbanization began coordinating the implementation of the INSPIRE Directive & SDI at the national level. Within this context, the Ministry runs some key projects through building NSDI according to the INSPIRE principles and standards. These projects are not yet completed. The detailed information of those projects can be taken via contacting the website of the General Directorate of GIS: http://www.csb.gov.tr/gm/cbs/index.php?Sayfa=sayfa&Tur=webmenu&Id=10087.

After its establishment in 2012, the DGI&UT has been collecting and managing the bundles of data related to the risky areas and buildings, notably on property, geological features, land-use, spatial plans, and risk profile issues. Those data are collected via 81 provincial directorates of the Ministry as well as 3 regional directorates of the DGI&UT, namely Istanbul, Izmir, and Bursa. The DGI&UT has also several inner departments to process those data. They are the department of transformation areas, department of risky buildings, department of communication, coordination & finance, department of monitoring & assessment, department of resource development, department of mapping & real estate management, department of infrastructure, and department of administrative services.

Figure 3: Key Stakeholders of SDI in Turkey.

Source: Own source.

5 The Analysis of SDI of the DGI&UT in the Framework of INSPIRE

The spatial data infrastructure (SDI) can be described as an infrastructure to enable the interoperability among various stakeholders as well as to provide the easy and quick access to data and services for the users. Interoperability requires communication and interaction among various systems having different hardware and software installations. Stakeholders can be grouped into data suppliers and users. Services of SDI are main procedures for process, analysis, and provision of spatial data. SDIs can be managed by various sets of spatial data at the local and national levels. Each set represents an individual SDI which covers sub SDIs. All stakeholders are responsible for generating and updating their own relevant data and services as well as providing them via national spatial data structure (NSDI) [6].

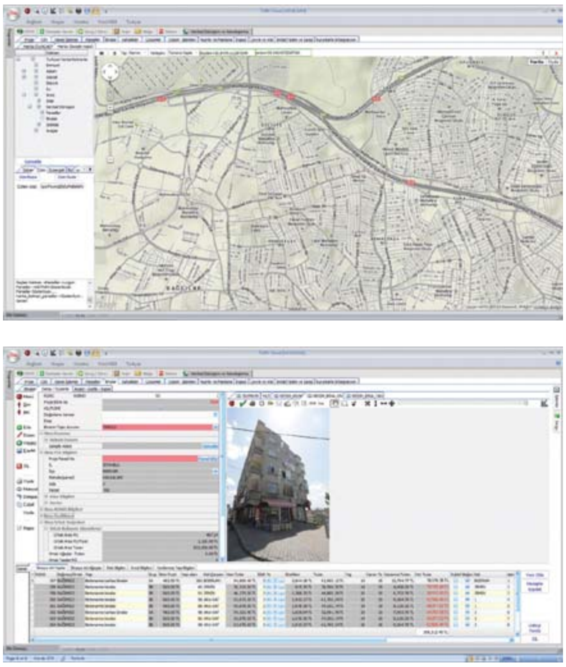
In modern cities, SDI is inevitable for sustainable urban development to serve economic, social, and environmental objectives, in addition to mitigating disaster risks. To design a spatial data infrastructure for an urban settlement requires elaboration of various issues in urbanization. These issues can be grouped such as demographic, social, economic, environmental, political, administrative, physical, technical-technological issues. Although all these issues covered the urban risk topics, a special attention is required to design a SDI for risks with a view to developing disaster resilient settlements.

After this brief introduction, the existing SDI of the DGI&UT will be examined in the light of aforementioned components of SDI. In the mean time, a comparative analysis between the existing SDI of the DGI&UT and the relevant INSPIRE standards and activities will be performed.

The DGI&UT has an open source software program to collect and manage the relevant data. The software program called “A.R.A.A.D.NET” is developed for the management system of urban transformation processes and procedures. The program is aimed at processing the data by using 42 different modules. The modified version of the NexsusDB data base engine is being used in the A.R.A.A.D.NET The GIS interface of the program provides the connection to Google Maps (see fig.4). The DGI&UT has been using 8 components of the A.R.A.A.D.NET relevant to its key tasks since 2012. These are, management of risky areas, management of reserved areas, management of risky buildings, management of licensed institutions, management system of property ownerships and tenants, loan management and financing, monitoring and surveillance, and management of notification to the directories and declaratory clause procedures. Various users such as public institutions, enterprises, individuals can access to the program by downloading the application of “Turk_yonet” and asking for the user account. The further information and support can be asked via the following link: *http://www.turkyaz.com/amenu1turkyazilimsistemi/mdunyaveturkyaz*

The A.R.A.A.D.NET serves mainly non-graphic data and very limited graphic data. This is the main handicap of the program. The DGI&UT aims at developing the software program to cover graphic and non-graphic data in terms of fulfilling the INSPIRE standards. In the program, the data are collected into three main groups, namely project data, parcel/lot data, building data. The project data covers the data on name, budget, actors, legislation, and the monitoring committee. The parcel/lot data covers the data on address, area, property, and litigation issues. The building data covers name, address, coordinates, parcel, building code number (from the national data base of addresses), area, measures of the building, number of units in the building, details of the construction, ground conditions, earthquake hazard zone information, and the level of safety of life.

Figure 4: GIS Interfaces of Risky Areas and Buildings



Source: www.turkyaz.com

In addition to the aforementioned data collected by the DGI&UT, some data are borrowed from other public institutions. In accordance with the Annexes I, II, and III of the INSPIRE Directive, the following data are borrowed and used in the DGI&UT:

Annex I: administrative units, addresses, cadastral parcels, hydrography
Annex II: land cover and geology
Annex III: statistical units, buildings, land use, utility and governmental services, natural risk zones

The stakeholders of the SDI are other general directorates and 81 provincial directorates of the Ministry, 3 regional directorate of the DGI&UT, other ministries and central institutions, governorates, municipalities, licensed risk detection institutions and companies, citizens, real estate agencies, construction companies, insurance firms, researchers and academics, and the media.

6 Final Assessments & Sugestions for the Future

A significant milestone in Turkey is the establishment of the General Directorate of Infrastructure & Urban Transformation Services in accordance with the Law No.6306 entered into force in May 2012. It is a remarkable initiative to mitigate natural disasters in Turkey. As already mentioned, the DGI&UT has been collecting and managing various data in the processes of buildings and areas at risk. Thus, the development of the SDI is inevitable in terms of efficiency and effectiveness in its activities.

To build and develop a SDI for the DGI&UT requires a reliable network, useful software, efficient data modelling, cooperation with stakeholders, and the concept of interoperability. The DGI&UT has a sufficient network to collect data from other general directorates and 81 provincial directorates of the Ministry as well as its 3 regional directorates. Nevertheless, it needs to develop better contacts with other stakeholders of the national spatial data infrastructure in Turkey. In terms of software capabilities, the DGI&UT has the recently developed, open source software program. It mostly covers non-graphic data. In the frame of aforementioned issues, the DGI&UT need to develop cooperation with INSPIRE working groups to comply with INSPIRE standards. The relevant standards and studies of the INSPIRE will facilitate the transformation activities of the DGI&UT.

The main objectives of the INSPIRE Directive are facilitating data exchange, sharing and reusing of the data for the purposes of effective governance and policy making, and developing the capacity of share and use interoperable spatial data [1]. In this context, the relevant activities and the recent performance of the DGI&UT look promising. To support those activities and performance of the DGI&UT, two studies will be very helpful, namely “Draft Guidelines of Data Specification on Natural Risk Zones” and “Plan4All Project”. These studies will especially create inspiration and provide guidance to develop meta data, data modelling, principles of sharing and exchanging data as well as give clues to enhance interoperability. The scope of the Draft Guidelines of Data Specification on Natural Risk Zones covers floods, landslides, forest fires, and earthquakes. The scope f the Law No. 6306 is almost similar to those natural risk zones except forest fires [7].

The outputs and findings of the Plan4all Project provide valuable guidance to develop SDI of the DGI&UT. The key support of the Plan4all Project will be about the interoperability issues. Since the DGI&UT works with various data sets and collaborates with many stakeholders, the recommendations and findings of the Plan4all Projects will be very valuable for the successful transformation area operations. In addition to its guidance about interoperability issues, the useful outputs on data modelling and spatial data themes of the Plan4all Project will provide further support to the DGI&UT [6]. In case of collaboration on the aforementioned issues, the lessons learnt of the DGI&UT might make some meaningful contributions to the relevant INSPIRE studies.

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The enhancement of interoperability between the Transport Corridors and Ports for integrated land use and water management in Albanian coastal areas

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Abstract

Albania is a maritime nation with regional interests. Albania has a favorable maritime position linked with the Adriatic and Ionian Seas and the Central Mediterranean Sea. The Albanian geographical position has been and will be important factor for the economical development and prosperity in the premises of the Balkans countries. Length of Albania coastline is about 28.9 % of its land territory size. Space Marine, the coastal region of Albania is 220 miles stretch of Buna River (North) spill until Stillos Cape (South).

Political changes occurred in Albania in the beginning of 90', and what follows in Balkan region, have dramatically changed the regional policies in main economic sectors. In the new Western Balkan reality, need a new cooperative, ambitious and engagement Albanian National Strategy to comply with the regional development. Population and maritime factors must shape Albanian national strategy objectives. The coastal area of Albania is one of the hot spots for biodiversity in the Mediterranean Sea. This fact needs to be more emphasized, especially through use of its national maritime strength.

The development of a new Albanian National Maritime Security Strategy (NMSS), must take into account the most strengthen national factors; Albanian population and maritime position. Re-dimensioning of the Albanian maritime factor, request also a new NSS with more ambitious objectives toward its more active role on regional security environment.

Following the paper, we will introduce you with the measures and solutions provided in the framework of the actions taken to various areas of Albanian coastline relying on the different data collected sources, as well as the analysis done in the matters of integrated land and water management in Albania.

Keywords: National maritime Strategy, Coastal development, Ports and transport corridors, Territory Planning

1 Coastal &Tourism Development

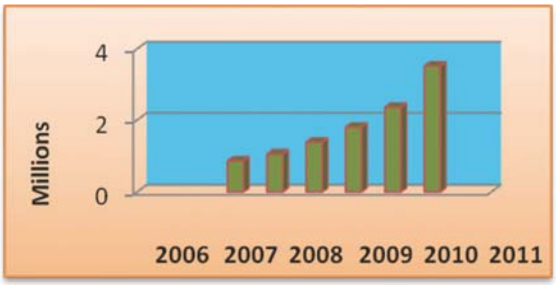
The geographical position of Albania in the Mediterranean basin, and the extensive coastline in the Adriatic and Ionian Sea, has created opportunity for the development of tourism in Albania.

The coastline is its own asset for tourism development. The Albanian coastline offers a pure natural, and healthy environment, with clean waters, away from the influence of urban pollution, noise etc.

Approximately 60% of the Albanian population is living in the coastal areas. Point source pollution of coastal waters has significantly diminished, due to the fact that most of the industries are closed down, but there has been an increase of urban pollution in the coastal area caused by the tourism development mainly in the Adriatic coast and by the increasing number of inhabitants in the main Albanian cities like Tirana and Durres (waste water and solid waste discharge on rivers and then into the sea).

The impacts of coastal development, particularly from tourism and urbanization have intensified over the last few years.

Table 1: Number of Tourists visiting Albania



Source: INSTAT, Albania

Albania's coastline has exceptional sights and splendid vistas that highlight the Albanian Riviera and attracts the attention of both local and foreign tourists. The majority of tourists' reason for selecting Albania as a tourist destination is linked directly to the natural coastal environment. According to MTCYS, 80% of arrivals/visitors are from neighboring countries (Kosovo, Macedonia, Bosnia Herzegovina, etc) and ethnic Albanians, who are resident abroad. In the future, the Albanian coast could become preferred destinations in Mediterranean region.

Figure 1: Albanian Coast views

foreign owners, who use their vessels to visit other destinations. Interaction with, and use of, tourist facilities in the neighbourhood will be relatively limited.

2. Landing and **short term stay of pleasure vessels visiting a Tourist Destination**. Interaction and use of local tourist facilities has significant economic potential.

Review shows that neighbouring coastal countries, such as Croatia, with 500 km coast line, and Montenegro, with 100 km coast, are host to 10 and 3 major marinas respectively. This would indicate that an initial marina capacity of 6 to 8 locations along the 350 kilometre of the Albanian coast would suffice. Consequently, in addition to the four proposed Green Ports in the Traditional City Ports, it is considered prudent to proceed only with the Marina Concessions already considered at Bishti I Pallas (Km 60), and Kalaja e Turres (Km 120), which are both located near beach sections already developed for holiday makers.

It is strongly recommended to limit further marine concessions to development of Full Resort Facilities, which may be offered by international resort companies, and will comprise of complete tourist destination developments, such as large (1000 room) Hotel Resort, Golf Course and other Entertainment and Tourist Attractions, and adjacent Marina and Yacht Club facilities. Locations for such developments may be at the presently undeveloped Palermo Bay (Km 300) and the Laguna North of Vlore (Km 200).

The Consultants recommend waiting with any other developments till the completion of the Coastal Management Master Plan, which will present a full study of the tourism development potential, marina and yacht harbour requirements in relation with coastal zoning and land use definitions.

2 The Need for a National Maritime Security Strategy

The situation analysis indicates that Albanian marine and coastal ecosystems contribute to sustaining human health, lifestyle, and the food production needed for the economic development and well-being of the coastal population. However, Albanian marine and coastal ecosystems are under increasing pressure from a rapid increase in coastal urban development and the resulting increase in human use of coastal and marine ecosystems.

The changes and what is expected to be changed in regional and national security environment must be reflected in new Albanian NSS. The lock-landed Albanian neighboring states, such as Serbia, Macedonia and Kosovo, in the new promising economic security environment, progressively will try to increase their accessibility to maritime trade, as long as it remains the less expensive one. It estimates that global maritime trade, travel, and commerce will double in the next twenty years.

The objectives of national security strategy are focused and defined to secure the national interests. Economic development and prosperity of the nation is the end-state of any security strategy. The nowadays Albanian geopolitical advantages must be converted into trade and economical advantages of tomorrow. Achievement of those objectives requires a more ambitious Albania engagement in regional security through an active cooperative security strategy and a protagonist role in regional trade. The actual regional corridors through Balkan, east-west, and north-south and vice versa, in the new geopolitical environment need to be enhanced and improved. The activation of the 8th Corridor, as well as a potential corridor in the future north-south, parallel to the coast of the Adriatic-Ionian coastline, will emphasize the maritime strength of Albania and its role on regional strategy. The new role of Albania in regional trade, economic development and security needs a new dimension of its maritime domain; regional dimension.

2.1 Strategic Plan for Marine and Coastal Protected Areas (SPMCPAs)

New phenomena occurred in Albania during the transition period after 1990 until 2013, by the population migration from north and mountains areas throughout the coastal area at a distance of not more than 10 km from coastline.

Marine and Coastal Protected Areas (MCPAs) are globally recognized as one of the most effective tools for managing the marine and coastal environment where the threats to that environment are geographic (spatial) in nature and where the threats can be managed geographically (spatially).

A "Strategic Plan for Marine and Coastal Protected Areas (SPMCPA)" is central to the "Improving Coverage and management effectiveness of marine and coastal protected areas".

The MCPAs Network in Albania

The overall goal of the SP of MCPA network is:
"To take an ecosystem-based management approach to the protection of biodiversity, natural, landscape, historic, cultural, and archaeological resources of the Albanian marine and coastal environment to ensure that the natural, economic and aesthetic values are conserved for now and future generations".

The specific objectives:

- Identification of the problems and assessment
- he coastal areas Management Plan design, the strategies and objectives to be achieved.
- The amendment of the legal and institutional framework to achieve the objectives of the strategy.
- Implementation of the law in force, the education, the awareness and other forms of activities to attract the attention of the population to work and protect for the environment.
- Ongoing evaluation process to establish and regulate equilibrium between economic development and environmental protection.

2.2 Shaping the future for SPMCPA

The Development of Coastal Port Strategy Concept in Albania is based on the principle that Albania requires in the short and medium term a strategic and sustainable development of Tourism Hubs which are recommended to be located in the Coastal Cities, through the transformation of the Traditional City Ports into **Green Ports, which are Environmental Friendly and People Oriented**. This can be accomplished by the development of one **New, Modern and Efficient Sea Port** to provide a **Gateway to the Balkans**, as an Excellent Entry to the European Transport Corridor VIII while further providing an Economic Gateway for the Import and Export requirements for Balkan region. Consequently the Traditional City Port of Durres, as well as the three other City Ports of Shengjin, Vlore and Saranda, can then be developed as **Green Ports - environment and people oriented social and tourist centers.**

2.3 International cooperation for sustainable land and water management

The increasing competition over natural resources as a result of population and economic growth, climate change is magnifying the challenges of natural resource management. The international community and government of Albania have responded to the deteriorating status of marine and coastal areas through international and national legal measures.

In addition Albania is a party to the Barcelona Convention: Integration Coastal Zone Management (ICZM) for the protection of the marine environment of the Mediterranean and its Protocols. The Barcelona Convention and its Protocols provide a framework for a series of cooperative, coordinative and mutual assisted processes aimed at protecting the Mediterranean marine environment, conserving its biological diversity and combating pollution.

To ensure the success of ICZM, Albania should adherence to the principles that define sustainability and act in different ways to achieve integration, creating optimal balance between environmental protection and development of the economic and social sectors.

On the aim to achieve the objectives settled in the Strategic Plan for Marine and Coastal Protected Areas in Albania, ICZM would take into considerations all the appropriate measures to be implemented in the land within the planning area, in particular the touristic land will be determined through a systematic analytical process, which is based on national, regional and local objectives regarding with:

1. Sustainable Development of the territories
2. Optimal use of the key economic assets; the responsible management of the natural environment
3. Ensuring public safety, the protection of public utility storage and other elements of local infrastructure, including expansion of new roads, the right of way for local and inter-national roads as well as permanent waste deposits processing in plants according to the capacity of the solid waste system.
4. The protection of national parks with high-value landscape and active entertainment villages.
5. Rationalization of potential areas development.
6. Environmental Impact Assessment through the development of environmental systems and natural resources to improve decisions for their management.

Expanding participation in this Convention shall engage Mediterranean countries to better management of their coastal areas, as well as deal with the new challenges of the coastal environment to **combine their efforts to reverse the degradation trends** in the marine and coastal environment.

3 Ports and the Transport corridors

To analyze the interoperation between Ports and Transport Corridors for an integrated land use and water management we have analyzed to main ports in Albania.

Durres Port

The Durres Port is the main port of Albania and located on the sea front of the city of Durres, where it has historically developed as a city port. In recent years the port has been handling over 75 % of the country's imports and exports of commercial cargo, of a total of about 3-4 million ton per year. In 2008 a Port Master Plan was developed, which foresees handling of a maximum throughput of around 9 million ton per year, which, depending on the estimated scenario, will be reached sometime between 2020 and 2030.

Figure 2: Durres Beach

Vlora Port

The Vlora Port is considered the second largest port of Albania, but handles a substantial smaller volume of cargo (around 15 % of country total), mainly consisting at present of importing cement and other building materials.

Nowadays Albanian ports processing is not in the expected figures, while their total annual processing capacities goes up to 5-6 million tons per year. The expecting flow of goods, through 8th and 10th Corridors will require the increasing ports processing capacities up to about 16 million tons per year. It will be a requirement for inhabitants of Albania, Kosovo, Serbia, Macedonia and transiting parts of Bulgaria and Rumania.

Albania is set to become a major entry point into the European Transport Corridor VIII, which is considered vital for the economic growth of the South Eastern European region. Furthermore the landlocked neighbor countries, Kosovo and Macedonia, will largely rely on a maritime entry point for their import and export flows.

However, the development of adequate Infrastructures, which connects the Coastal Ports of Durres and Vlora to the Albanian Road Transport Corridors including an Efficient Railway System for Cargo Transport, is a vital condition to develop the Strategy. Any Coastal Port is only as Strong as its Weakest Infrastructure Link.

The referred Infrastructure Link, of which the road system is at present already under construction, is of course imperative for the continued growth of this Transport Corridor including the Traditional Port Cities. These existing City Ports will not lose business, but they will WIN the development and income of the Green Port tourism development.

The Albanian Transport Corridors of Integration are:

- Corridor West – East; part of Trans-European Corridor VIII, links Italy – Albania – Macedonia – Bulgaria (Bari, Brindisi - Durres, Vlore – Tirane – Sofje – Burgas, Varna)
- Corridor North – Central, links Montenegro – Albania-Greece, (Hani i Hotit – Shkoder – Gjirokaster – Kakavije (Greece)
- Corridor Durres – Kukes – Morini, links Albania – Kosovo – Nish, Serbia)

Figure 3: Corridor VIII and Durres-Morine (Kosovo) Road

Once substantial Economic Growth is realized, eventually as part of the EU, and the advantages of the Economies of Scale allow, the development of a second Entry Corridor, possibly at the Vlore Bay, may have to be considered in the Long Term (30 – 50 years).

However, to achieve optimum economic benefits for these corridors, as well as for the developing Albanian Costal areas, full use must be made with the interoperation of Ports and Transport Corridors linking the territories for trade and economy in interregional and European scale.

Considering the relative short, 350 km, Albanian coast line, developing modern ports and land transport arteries will be effective. Such “Balkanport” can be the “Europort” for South- East Europe

In Conclusion of the Strategy Concept, it must be recognized that the proposed Strategy Concept is of particular significance for the recommended Short and Medium Term future (10 – 20 years) of Albania’s economic development.

Therefore it is to consider the Rail&Road Corridors as an Integrated Development of this Strategy

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Prospects for the development of Web Geo-Services between Bulgaria and FYROM by applying the INSPIRE directive

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Abstract

In this paper the process of Inspire Directive implementation and establishing the national Spatial Data Infrastructure (SDI) in Bulgaria and the Former Yugoslav Republic of Macedonia (FYROM) is considered. One of the prerequisites for cross-border compliant Geo-services is the practical fulfilment of Directive recommendations, which can provide interoperable resources of spatial information. An overview of several completed and ongoing projects in the framework of the international and national programs is presented. The most recent project for creating a Geo-portal in Bulgaria is described. Important issues related to the SDI establishing on a regional level are discussed and problems in this area are marked. Some proposals to overcome obstacles for following the INSPIRE directive road map in both countries, which can support the cross-border cooperation are given. Sustainable development of the region could be achieved by promoting the public access to Geoportals and their tools by developing SDI and new Web Geo-Services.

Keywords: Web Geo-Service, INSPIRE Directive, cross-border co-operation, economic development

1 Introduction

Nowadays, the geospatial information becomes an increasingly necessary resource for resolving a wide range of scientific and applied tasks related to the sustainable planning and development of the national economics of each country. The development of advanced Web services and Geoportals as intelligent platforms for the geospatial information (GI) usage plays an increasingly important role on the social-economic and natural environmental policies of Europe. Spatial information data that related to local, regional or global size have to be standardized and harmonized to simplify the integration of individual datasets and to help resolving real problems. Web Geo-Services and Geoportals could provide automatically coordination and full exploiting functionality of the GI for user specific applications [e.g., 2, 9, 12, 14]. Through INfrastructure for SPatial InfoRmation (INSPIRE) adopted by the European Commission (EC) a main framework of developing a National Spatial Data Infrastructure (NSDI) that support the economic development, social life, and environmental sustainability of a country or region has been set [5].

This article presents major problems in coordination and consultation efforts of various institutions for the establishing a national platform for geospatial information in Bulgaria and the FYROM. The issues discussed in [8] are represented in more details. An overview of national and international projects involving the use of geospatial information in Bulgaria is done. Important subjects for the effective utilization of resources for building of SDI, the possibilities for geodata base integration into a robust platform and providing web services by Geoportals are discussed. Based on the analysis of current situation, a conceptual scheme for new organization structure in Bulgaria to fulfill the INSPIRE Directive implementation rules is proposed, which differs from the now existing given in last monitoring reports [15, 16]. Recommendations to tackle delays that can help to accelerate the process of building the NSDI of Bulgaria and the FYROM and to strength the collaboration between governing bodies, scientific community, NGOs and end users of geospatial data through supplying Web Geo-Services, are given.

2 Geospatial information systems for the national and EU policies in Bulgaria

The history of the creation of digital spatial data in Bulgaria started back in 1995 with the adoption of a regulation for developing the cadastral plans of the settlements [7, 14]. Later during the applying of the restitution laws many settlements have been fully covered by the maps in digital form. Only with the adoption of the Law on Cadastre and Property Register (LCPR) in 2001 the sources, accuracy, structure and format of the cadastral data have been formally regulated. Since then, numerous problems arose due to differences in precision, structure and format of the geospatial data for the settlements and rural areas created under the regulatory frames of different laws. Several conflicts with overlapping areas have emerged from the different status and own property.

The deepening of the negative trends in the chaos of geospatial data was also supported by the inconsistency of the Bulgarian legislation. The LCPR and other related laws (Law on Territory Planning, the Water Act, etc.) have been repeatedly repaired and updated. As a result, the coverage of the country territory with harmonized geospatial data (cadastral maps) is only 30% according to formal information of the Agency of Geodesy, Cartography and Cadastre (AGCC) [14]. As concerns as the rural areas, the institution responsible for elaboration of the digital maps and registries of these areas, is the Ministry of agriculture and food. The coordination of activities related to geospatial data integration between these two governmental institutions is difficult and still not enough efficient.

The accession of Bulgaria to the European Union was accompanied with numerous GIS projects, which directly or indirectly are related to the infrastructure for spatial data in European context. There are several completed projects related to the development of SDI and usage of geospatial data for different purposes and end-users funded by EU Programmes or other donors in which Bulgaria took part. EC supports INSPIRE implementation by different programmes and projects as most of the initiatives concern the geodata use within the field of environmental policy. Bulgarian governmental institutions, academia, universities, NGO and other public institutions participated in the implementation of the projects such as CORINE, NATURA 2000, NATURE-SDIplus, BalkanGEONet, PASODOBLE, DACEA, Plan4all, EnvPlus ESDIN, OBSERVE, etc. The AGCC provides and maintains data on projects EuroBoundaryMap, EuroGlobalMap, EuroRegionalMap, containing respectively the administrative and statistical data at a scale of 1:100 000 topographic database at scale 1:100 000 topographic data at a scale of 1:250 000 for business use and spatial analysis [14]. Several reports and papers [e.g., 1, 6, 10, 11, 13, 14] describing these projects and results achieved are published.

On national level GIS projects in various sectors of the economy and administration have been realized [6, 13, 14], some of which are: ALIS (Agricultural Land Information System); CALIS (Cadaster Land Information System); the project National Health Card supports the reform of the Ministry of Health; the project GIS in education supports the reform in the Bulgarian education; Integration System for Electronic Government of Bulgaria is used by the state administration and the community for providing and using electronic geo services; environmental protection' projects for the management plans of the National Parks »Rila«, »Central Balkan«, Strandja«; and others.

GIS projects for the local or regional municipalities' government, which should be mentioned with applications in various areas are: SOFKAR - to build a GIS, including data on cadastral regulation plans and their amendments; GIS for the objects of concession; GIS for spatial planning; GIS for forecasting and warning of floods in the river basins; GIS for Environmental Monitoring; Geo-based applications for regional and Urban Planning and municipal property; GIS of the real demographics of the population of Sofia Municipality, etc. [6, 13].

At present, with relatively slow steps several corporate GIS projects were initiated mainly for the needs of the National Electric Company and other corporations in the energy sector. Some state institutions and agencies began to build own Geoportal and to provide web geo-services. For that purpose, they exploit the funds under the EU Operational Programmes and additional government co-funding. Since the beginning of 2013, e.g., the AGCC starts a project named »Upgrading of existing systems and development of e-services by AGCC for better service delivery«. The project aim is to establish the register of geographical names and to bring the available geodata in accordance with the requirements of the INSPIRE Directive and the access to spatial data. The Military Geographic Service at the Bulgarian Army also began implementation of a project titled "Developing an information system for providing public access to spatial data and services to the Department of Defense" funded by the EU Operational Program "Administrative Capacity". The project aims to improve the quality of administrative services to citizens and businesses by building an information system for public access to spatial data. The implemented system will lead to harmonization of spatial data and will ensured interoperability of the electronic exchange between the project gateway and the National Geoportal.

The National Company »Railway Infrastructure« at the Ministry of Transport, Information Technology and Communications implemented the project »Expanding the functional scope of GIS to the State Enterprise« National Company Railway Infrastructure », which is set to build module(s) for the provision of geographic informa-

Table 1: List of some projects related to the INSPIRE Directive with Bulgarian participation

Type of project	Title	URL address
International/Regional	enviroGRIDS - Building Capacity for a Black Sea Catchment Observation and Assessment System supporting Sustainable Development	http://envirogrids.net http://portal.envirogrids.net
	OBSERVE - Strengthening and development of Earth Observation activities for the environment in the Balkan area	http://www.observe-fp7.eu
	NATURE-SDIplus: Best Practice Network for SDI for Nature Conservation	http://www.nature-sdi.eu http://www.ursit.com/nasdi.php
	Promote Air Quality Services integrating Observations – Development Of Basic Localised Information for Europe; Regional AQ service for Bulgaria	http://www.myair.eu http://www.niggg.bas.bg/cw3/index.php http://data.geophys.bas.bg/ozone_surf/index.html
	DACEA - Danube Cross-border System for Earthquakes Alert	http://www.quakeinfo.eu/en/about-us/about-the-project.html
	Plan4all - Geoportal for spatial planning	http://www.plan4all.eu/simplecms/?menuID=1&action=article&presenter=Article
	BalkanGeoNet	http://www.balkangeo.net
National	Technical assistance, upgrade of existing systems and development of e-services by the AGCC to improve services in Bulgaria	http://icadastre.bg http://www.cadastre.bg/GeocartFond-Portal
	Register of protected areas in Bulgaria of the Executive Environment Agency at the MEW	http://eea.government.bg/zpo/en/index.jsp
	GIS of the Ministry of Regional Development and Public Works - sharing geospatial data on TCP/IP	http://212.122.182.101/MRRB/#
	CORINE Land cover	http://eea.government.bg/en/projects/index.html http://bsdi.asde-bg.org/lccs.php
	Project "Preparation of the Bulgarian Natura 2000 network of protected zones"	http://www.natura2000bg.org/natura/eng/index1.php
	Elaboration of a National Information and Communication Strategy for the Natura 2000 Network	http://gis.mrrb.government.bg/pmapper/map_separate-legend.phtml?winsize=small&language=bg&config=natura2000
	GIS for Environmental Monitoring	http://eea.government.bg/bg/output/inf-systems/index.html
	Integration System for Electronic Government of Bulgaria	http://www.egov.bg www.identity.egov.bg
Local	SOFKAR	http://www.gis-sofia.bg/index.php?id=42&lang=en
	Montana Spatial Data Infrastructure	http://geoinfo.montanastatelibrary.org/data/msdi/cadastral/ http://giscoordination.mt.gov/default.asp
	Integrated Plan for Urban Regeneration and Development of Burgas	http://bggis.com/Default.aspx?alias=bggis.com/burgas&

tion to other systems in accordance with EU and national legislation. The Ministry of Health has developed thematic and regional portals provide services to spatial data.

All mentioned international and national projects aim to share knowledge and to build interoperable applications on issues related to geospatial data, forming a position and balanced public policy that defends the interests of Bulgarian and EU countries citizens. A list of some completed and ongoing GIS SDI projects on a European, national or local level are presented in Table 1.

They provide significant input to the national framework to elaborate a strategy of all activities in the field of GI usage, which is a fundamental prerequisite to successful construction of the Bulgarian NSDI. But, in most cases, in the realization of these projects the INSPIRE requirements and recommendations are not known, not followed or are undervalued. There are various reasons for that situation. Part of these problems concern to the clearly prescribed rights and responsibilities of the Bulgarian institutions, weak interoperability among the state organizations involved in SDI related activities, low institutional and/or public awareness about NSDI activities, lack of consistent legislation, fairness, clarity, state revenue, investments for the SDI construction. Other issues are related to the security of spatial data. The issues that concern the necessary upgrading of educational programs, the life long-term training of GI professionals and improving the competence of all decision makers in the field of SDI policy deserve much broader acceptance and higher priority as mentioned by Boes and Pavlova [1].

3 INSPIRE Directive implementation in Bulgaria and FYROM

Bulgaria. The building of infrastructure for spatial information in Bulgaria is quite slowly as compared to the other EU countries. The legal frameworks are placed, there is some progress in national legislation that was harmonized with the European, but the realization of plans is still at management level. Strategic document for the Republic of Bulgaria, reflecting the harmonization of the Directive in national legislation for building the elements of NSDI is the Law on access to spatial data, adopt in 2010 (State Gazette, N.19, 2010). An important element of the NSDI is the national Geoportal, which has to link with the EU INSPIRE geo-portal. According to the national legislation, the Ministry of transport, information technology and communications defines and coordinates the national policy for building the infrastructure for spatial information. The Executive Agency »Electronic communication networks and information systems" (EAECNIS) at this Ministry is the responsible coordinating structure for building a national Geoportal and its maintenance. The European road map for INSPIRE Directive implementation and all related documents are uploaded on the EAECNIS website [15]. At present, an experimental Geoportal is elaborated with website http://bsdi.asde-bg.org/index_en.php. It provides diverse information in the form of various digital thematic maps and satellite images, attribute and text data. Several thematic maps of natural disasters for the territory of the country are also available [12].

Publicly available information about the stakeholders involved in the building of NSDI, including a description of their roles, how they co-operate, how they share data/services and how to gain access the services via the national INSPIRE Geoportal, is still missing till now. During the last three years this Agency repeatedly published on its website the goals which include the national inherently obligations to implement requirements of the INSPIRE Directive. Since beginning of 2013, the EAECNIS works on a project titled "Creation of an information and communication platform for spatial data and services", which main result has to be the national Geoportal at the end of May 2014 [15].

The Bulgarian monitoring reports are published on the EU INSPIRE Geoportal as well as on the EAECNIS website as the national indicators are updated every year [15, 16]. The achieved results so far are related to the acquisition of spatial data covering three of the annexes under the Directive and developed at different levels. From the Bulgarian monitoring reports and indicators it is obvious that the country substantially lags

in performance of the INSPIRE roadmap. In Table 2, indicators concerning Meta Data, Data Sets, and Services from the last national evaluation report are presented. As it can be seen some of the indicators are partially completed or the activities connected with the three annexes of the INSPIRE Directive have not started at all. It is worth to summarize some of the conclusions made in the last report published in May 2013 [15, 16]:

- There are few practices and procedures, which the coordinating body has done so far in order to undertake actions to implement the INSPIRE Directive and to amend the national legislation;
- There are numerous thematic portals providing services with spatial data;
- According to the metadata descriptions there are exist for vector and raster data used in the experimental Geoportal for the following categories of thematic maps: administrative boundaries, Natural Objects, Seismic zones, Reference layer - BULCOVER, Simulation models of floods, transport infrastructure, Protected Areas, Operational satellite data, Risk observer raster data;

- Metadata for data and services administered by the Environment Agency are harmonized with the INSPIRE Directive requirements;
- At this stage no established controlling mechanism by which to monitor the quality of network services;
- Regulations and measures for the sharing of spatial data between administrators of spatial information are missing;
- There is no defined criteria for data quality, with the exception of data related to the application requirements of various EU directives, such as the Framework Directive 2000/60/EC;
- There are no services implemented with spatial data requirements of the INSPIRE Directive;
- The analysis of the available spatial data shows that the information contained is not in accordance with that required by the Directive specifications. At the same time, there is a large amount of other information that covers the national needs and it is used for administrative electronic services according to the E-Governance Act (State Gazette N46, 2007);
- Currently, no specific measures were taken at national level to promote the exchange of spatial data sets and services between public organizations.
- It is obvious that the efforts of responsible institutions, stakeholders, NGOs and organizations that are relevant to the Bulgarian SDI remain scattered till now. The assessment of NSDI initiatives reveals deficiency of political goodwill as occasioned by low awareness among the principal ministries and relevant institutions on the importance of SDI, confusion surrounding the definition or composition of NSDI, lack of capacity (human and physical resources) as well as complexity of the national issues such as the spatial data ownership, economic interests and positions of the geo-communities. Various reasons of this failure can be mentioned as one of the important is the lack of national policy for overall management and full use of the GI in favor of the state and the society.

The authors' point of view is that the existing organizational structure in Bulgaria is not enough efficient and it does not allows to overcome the lagging in the INSPIRE Directive implementation comparing to other European countries. Here, a new scheme of the organizational structure (see Figure 1) is proposed to overcome the above mentioned obstacles. In most of the EU countries the state geodetic and cartographic institutions are those which coordinate the activities related to NSDI developing. Therefore, the authors propose the existing organizational structure to be changed completely and the AGCC to become the coordinating institution, as shown in Figure 1. Other arguments in support of this suggestion are that this Agency is the National Mapping Agency; it is the responsible institution for defining the coordinate system and the appropriate map projections of Bulgaria on the basis of which to link all geospatial data; it realizes contacts with several international organizations like EuroGeographics, EuroSDR, the UNECE WPLA, etc.

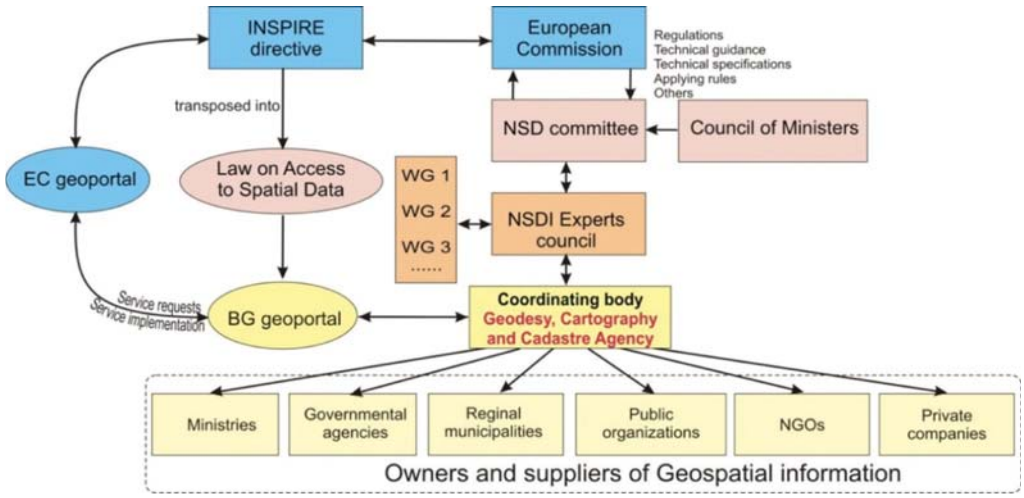
The proposed NSD Committee and NSD expert's council could include high qualified specialist with 5-7 and 15-17 members respectively. The council should coordinate the work of four or five Working groups (WG) whose activity is consisted with the basic elements of the NSDI and its functionality. A planning framework of this new organizational structure could to be set, which may include the following activities: performance analysis; setting NSDI policy; setting national strategy and road map; structuring governance, coordination, and control bodies; defining national and international exchange policy of GI information; consistency of national legislation with the EU INSPIRE Directive recommendations and requirements; Setting standards, guidelines, inquiring with the best practices and adaptation to the national requirements and specificities. The Association of geos-

Table 2: Implemented INSPIRE SDI indicators in Bulgaria for 2013

INSPIRE elements	Metadata		Data Sets		Services			
Indicator	Existence	Compliance	Extend	Compliance	MD accessibility	DS accessibility	Use	Compliance
Name	MDi1	MDi2	DSi1	DSi2	NSi1	NSi2	NSi3	NSi4
Value	20%	6%	34%	0%	5%	3%	0	0%
Numerator	109	34	7446829	2	26	16	0	0
Denominator	549	549	22144528	476	549	476	4	4

Source: EAECNIS website [15] and INSPIRE Geoportal [16]

Figure 1: Proposal of an organizational structure for the EU INSPIRE Directive implementation in Bulgaria.



patial information in the South-East Europe can play a leading role in coordinating and supporting SDI activities with close cooperation and the actively participation of the governmental, academia, educational, NGO institutions, private sector, and the public [11].

FYROM. First official document where the Macedonian NSDI was mentioned is a Strategic plan of SAGW for the period 2007 - 2010, in which for the first time it was recognized as project to be powered in FYROM based on European INSPIRE directive [3, 4, 18]. On the legal site, in 2008 a special chapter for NSDI has been added within the Law for Real estate cadastre.

Till today, on official level, just organizational activities have been powered by the Macedonian institutions, without any developed dataset. On March 2012, the NSDI strategy for FYROM has been promoted and published for the public, which goes through the costs and benefits of creating a NSDI and then lists the main areas in which work will be needed in order to implement such an infrastructure. The strategy has been approved by the government on July 2012, with decision for team building with representatives from key institutions for preparing the proposal law for NSDI. From October 2012 to March 2013, a proposal for Law for NSDI was prepared and submitted for further procedure within the government of FYROM. The proposed law consists of seven chapters: general conditions, metadata, interoperability of spatial datasets and services, network services, data sharing, NSDI management, and transitional and final provisions [19].

The Agency for real estate cadastre of FYROM is the responsible institution for establishing NSDI and the activities, which it is obliged to perform, include quality data collection, administration, sharing and use of geo-referenced spatial data [18]. Macedonian's NSDI vision is to facilitate the access, sharing, use and distribution of standardized spatial data/services in an efficient, effective and harmonized way in order to fulfill the needs of the private/public sectors as well as citizens, contributing to economic growth and sustainable development of the country. In other side, Macedonian's NSDI mission statement is to establish a technological, institutional, legal and administrative framework for inter-organizational collaboration that will support e-Government, to integrate the geo-information from different sources, and to be in line with INSPIRE Directive.

The objectives of the NSDI Strategy include the way of spatial data transformation to share within FYROM so it can underpin the social and economic development to the benefit of all. From the current state of scattered and unconnected collections of spatial data in the country, an incremental and sustainable INSPIRE Directive implementation path is needed so that the GI stakeholders to use effectively the integrated and harmonized infrastructure for sharing the spatial data. The institutional framework defined in the strategy should to include the main aims, policy and basic activities of the NSDI establishing. Following EU regulations according to the INSPIRE directive, all NSDI activities have to harmonized with the state policy and programs with reasonable use of the public funds for the NSDI development.

Proposal of the managing structure for Macedonian NSDI is defined in four levels, headed by the Vice prime minister of FYROM responsible for economic issues. It will be managed by the Council for NSDI, linked directly with NSDI Committee, and then with four working groups on law, technological, economic, and PR and capacities. On the last chapter of the law, it was defined that within three years the process of digitizing should be completed, interoperability should be enabled within five years, and till 2019 Macedonian NSDI should be operational and fully harmonized with INSPIRE Directive [19].

4 Cross-border collaboration between Bulgaria and FYROM based on Web-Geo services

The NSDI facilitates national economic planning and sustainable development by providing the information on national assets and extension of the possible applications. This provides a justification for governments to invest in the NSDI alongside other infrastructure such as transportation network, telecommunication, energy, and health care services. Following the roadmap of INSPIRE directive and accomplishing its requirements and recommendations, the European countries can exploit the NSDI functionality not only at national but on a regional or global level. To ensure the achievement of interoperable spatial data and services of all geospatial data, the NSDI should become a full operational system that makes data from several sources accessible to users, including the necessary access and distribution procedures. Thus, new opportunities to foster the economic growth in a cross-border region between European countries through developing Web Geo-Services for data mining, visualization, manipulation, analysis, and the usage for diversity of applications can be developed and integrated [e.g., 9, 17].

The Geoportal of NSDI is a gateway to enable an open access to official spatial data providers and generated spatial data available within a Graphics Device Interface framework. It is followed by defined rules for the governance and institutional coordination, metadata, data structure, data sharing, interoperability, access to data, searching systems and network services. The NSDI Geoportal is usually constructed using underlying World Wide Web infrastructure and information technology and commercial or free and open source GIS software. The web-environment provides a common framework that allows geospatial data to be shared and reused for different applications and purposes using multiple platforms, architecture, clients, developer environments, protocols, and encodings at local, national, regional, continental and global level. Network communication between end-users and web servers uses Hypertext Transmission Protocol. The inter-operability of data in terms of network services and the provision of access to data and services have been guaranteed through applying the recommended specifications. The foundation of many of INSPIRE specifications is laid down on the Open Geospatial Consortium consensus standards and the International Organization for Standardization standards for GI. Recommended rules concerning the copyright, publishing and sharing of the geospatial information also exist [5, 9].

Bulgaria and FYROM can successfully occupy a position in the international geo-services market when they make the geospatial data from several sources accessible to everyone as mentioned in [8]. All problems that arise in the process of INSPIRE Directive implementation should to be resolved on a national level with participation of all stakeholders having interests in full usage of the GI. Both countries have to implement the Directive requirements and recommendations and to create the conditions for mediation between the services provided locally at the national level and the EU-level usage. Data and services can be made available through INSPIRE network services following the provided guidelines in the INSPIRE documentation [5, 9]. However, the NSDI usefulness can be achieved only, if the provided geospatial data are regularly updated and made available when needed by the consumers through the decentralisation of NSDI services at all the local and national level to ensure that it penetrates every aspect of the society. Also, it should be pointed out, that fifty three cross-border projects have been funded by the IPA Cross Border Programme Bulgaria - Macedonia for 2009 and 2011 [20]. There are three priority axes which have been covered by the project proposals:

- Economic development and social cohesion;
- Improvement the quality of life;
- Technical assistance.

Some of funded projects, which are completed or in implementation have the titles and tasks including activities related to the NSDI subjects. But none of them does not include INSPIRE Directive topics and no attempt some of the EU regulations for geo-data maintenance and implementation to be develop. Very often, if the main implementation rules of the INSPIRE Directive are known, there is a missing set of national norms, implementation specifications, technical standards and providing services, which enable the effective gathering, managing, exchange and usage of geospatial data.

The explanations given above are a result of the authors' experience exploring the current state of INSPIRE Directive implementation and the necessity to develop a Web Geoportal for enhancing the business cooperation between two countries in cross-border area, and to utilize the existing national Geoportals and INSPIRE directive as a bridge between the geospatial data provided by two countries. This will be the first attempt to develop joint Web-Geo portal with applications in GIS environment following the INSPIRE Directive Implementation rules, which will stimulates the social-economical sustainable development using the advantage of new technologies and e-services.

5 Conclusions

In the last decade in Bulgaria and FYROM, many initiatives and activities for the NSDI building have been launched. This process started with the harmonization of national legislation and the setting up of institutional frameworks as a basis for future development. In Bulgaria, due to the NSDI has not been well conceived by the National Coordinating body with unclear financial support, the achievements are still insufficient. There is a need of technology, policies, criteria, standards and people for establishing the NSDI which will promotes the reliable geospatial data sharing throughout all levels of government, the non-profit sectors, business, and academia. Much has to be done to achieve the geospatial information being accessible and readily available across the country and Europe. Collaborative partnerships and joint efforts of many organizations are needed to develop and to maintain NSDI. Therefore this paper raises the question of what better should constitute the Bulgarian organizing structure and further recommends strategic issues, which the NSDI policy should prioritise. The authors conclude that it is necessary to change the entire organizational structure, which has to include representatives of all stakeholder groups. A new governance structure that fosters the collaboration and manages the process of INSPIRE implementation is crucial to ensure success of the efforts of geospatial community in the country. Following the implementation of projects financed under the European Programmes with state co-financing by the AGCC and the Military geographical service of the Ministry of Defense, it is expected to lay the foundations for the development of geo-portals meet the requirements of the INSPIRE Directive.

Specific characteristics of the approaches to build the SDI taken by the responsible authorities in Bulgaria and FYROM are outlined. A key element to successful cross-border cooperation between Bulgaria and FYROM is the day-to-day work of the stakeholders, GI users and providers following the INSPIRE recommendations towards the development of intelligent NSDI. The geospatial communities must be able to share the benefits and value of the NSDI beyond the current local users and supplier communities. The NSDI strategic policy and institutional arrangements are absolutely essential to be possible the realization of the interoperability and sharing of Geospatial information through Web Geo-portals across Europe, which will resulted in the socio-economic progress and the sustainable development of both countries.

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Cadastral and Hydrographic Data in Spatial Data Infrastructure of Republic of Srpska

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Abstract

Republic Administration for Geodetic and Property Affairs of the Republic of Srpska, as responsible institutions for the production, storage, sharing and distribution of most of the spatial data for the Republic of Srpska, including cadastral data as the most significant, according to the statutory authority took the role of the provider and integrator in the field of construction of Spatial Data Infrastructure of Republic of Srpska (SDIRS). The term spatial data infrastructure (Spatial Data Infrastructure - SDI) is used to denote the basic set of technologies, policies and institutional arrangements to facilitate the availability and access to spatial data, and therefore the data from the cadastre. SDIRS defines the basis for finding and assessment of spatial data, and applications for all users and suppliers of data at all levels of government, commercial sector, nonprofit organizations, academic institutions and the general public. SDIRS encompasses much more than just a data set or database. SDIRS contains spatial data and associated non-spatial data, which include proprietary information, required documentation about the data (metadata), best ways to find, visualize and evaluate data (catalogues and Web mapping), and methods for accessing spatial data. It is comprised of services and applications that need to support the use of data including: geoportal, e-cadastre, the network of permanent GPS / GNSS stations of the Republic of Srpska, e-commerce, feature catalogue and metadata catalogue. Geoportal of Republic of Srpska, which plays a central role in SDIRS, is implemented using ERDAS Apollo and contains layers of data according to INSPIRE data theme specifications. Among implemented data themes is also Hydrography which is linked to cadastral data. The paper presents the implementation of geoportal and associated services as part of SDIRS to support the integrated land and water management in Republic of Srpska. Presented implementation is thoroughly based on international standards.

Keywords: *geoportal, NSDI, cadastre, hydrography*

1 Introduction

Geospatial data is used in the process of effective decision-making for optimal management of resources and continuous development. The need for properly maintained cadastral records and geospatial data has imposed the development of spatial data infrastructure at national, regional and global levels. National Spatial Data Infrastructure (NSDI) reduces redundancy and allows for easy access, participation and sharing of spatial data on the principles of interoperability.

NSDI development must be based on the ISO 19100 series of standards [2] and OGC specifications [11], as well as to implement the principles of the INSPIRE Directive [6]. Annexes of the INSPIRE directive define themes of geospatial data that will be processed and one of them is related to cadastral records. Given the great importance of property for economic development, it is necessary to effectively organize cadastral records and that they contain well-structured data. Cadastral records should be well organized, and the data should be well structured so that interoperable systems can be realized, in order to become part of the national geospatial data infrastructure.

In order to allow the establishment of NSDI, it is necessary to adopt the recommendations and standards related to geospatial data. The standards are intended to prevent or reduce unnecessary duplication of spatial data collection and system development and ensure their accuracy. The implementation of the NSDI is progressive, with priority to implement predefined data themes including the cadastral records. Some data themes of the Directive can be implemented on the basis of data relating to the administration of land parcels and buildings on them. These are themes that are related to cadastral parcels, buildings and facilities, land use, administrative units and addresses. For these themes, it is necessary to make the INSPIRE profile for each country that implements the INSPIRE directive.

The INSPIRE profile for cadastral records has been developed in the Republic of Srpska. The data model is based on LADM model of ISO 19152 standard [3], recommendations of the INSPIRE Directive and the relevant legislation. The significance of this model is reflected in good structuring of large amounts of data that exist for the specified area, as well as the ability to integrate it into the European framework to ensure easy cross-border exchange of information.

The properties are an expensive resource and have a major impact on the economic development of the country. Well-organized records opens up the possibility for the development of real estate markets, and developing countries are often approved loans from the World Bank to improve the organization of cadastral records on the principles of interoperability.

The foregoing points to the need to establish a single interoperable real estate register. The data model defines a system level interoperability of the system with other systems. Therefore, modeling is the most important step in the development of interoperable systems. According to the INSPIRE directive, cadastral parcels should represent generic information locators. Cadastral parcels in INSPIRE are linked to national registries, so that other information related to the land, such as rights and rights holders, can be accessed through them. The data model for the INSPIRE cadastral parcel is compatible with LADM model, although LADM is broader model of INSPIRE cadastral parcels, as it contains additional information about the rights and the rights holders, outside the framework of the INSPIRE directive. Therefore, the new cadastre, which is based on LADM profile for the Republic of Srpska is also compatible with INSPIRE, including the corresponding extension.

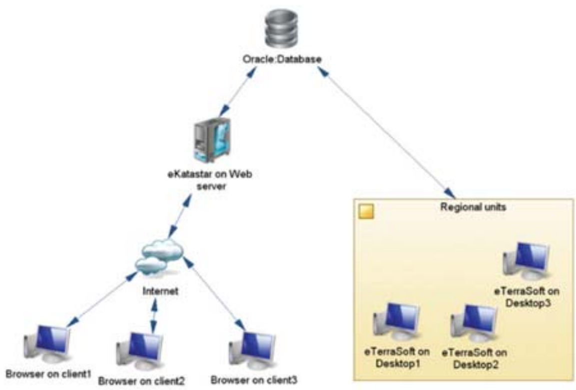
The importance of cadastral records and information technology support can be seen through the projects supported by the World Bank, which evaluates the quality of the cadastral system on the official website. One of the ranking factors of the economy of a country in the world is the registration of ownership on properties and its efficiency [17]. This ranking is essential to attracting foreign investments and economic development of the region.

In the following sections it will be describe how the interoperable cadastral information system in Republic Administration for Geodetic and Property Affairs of the Republic of Srpska (RGURS) is implemented, as part of SDIRS (Section 2). On top of it, other data themes according to INSPIRE directive are implemented including hydrographic data which is described in Section 3. The conclusion is given afterwards.

2 Application Solutions for the Cadastral System within RGURS

The cadastral system within RGURS included the development of a software solution based on a new data model for the real estate cadastre in accordance with ISO 19152 i.e. LADM profile of the domain model is formed for the Real Estate Cadastre of the Republic of Srpska [12, 13, 14]. LADM profile model [10] domain for Real Estate Cadastre of the Republic of Srpska was used as the basis for the two application solutions, web application eKatastar [16] and desktop application eTerraSoft [15]. Web application is intended for a wider range of users and provides access to the Internet. Benefits of such e-cadastre applications are discussed in [1]. Desktop application is intended for workers in the cadastre working on the establishment and maintenance of data. Both applications access the same database. Therefore, the data is always up to date from whichever application is used, as shown in the figure 1. Also, data related to cadastre is also used in the geoportal of the Republic of Srpska [9] because it is part of a national spatial data infrastructure.

Figure 1: The system architecture.



Web application is installed on the server and users access it over the Internet using their web browsers. The application reads data from the central Oracle database in which cadastral data and other data are stored. Desktop application is installed in the organizational units and only a certain group of users have access. The application reads and updates data from an Oracle database of cadastral data.

2.1 eTerraSoft

eTerraSoft is a software solution for all the participants in the technological chain of production, processing, maintenance and management of spatial data in alphanumeric and graphic form, as well as a number of other users that base their work on the use of spatial information with the elements of geometry, thematic content, ownership and limitations of space elements.

ETerraSoft software solution provides automation functions for recording and analyzing space (keeping spatial registers and supporting the performance of surveying duties), keeping records of geometrical and operational parameters of space (keeping records of geometry and thematic content of the elements of space, registration of ownership and rights to use the elements of space and keeping records of functional parameters of the space), keeping records and analyzing the quality of space (support for strategic, tactical and operational management of spatial resources, preparation of the maps about the elements of the space and publishing documents on the elements of space) and performing surveying and administrative control of the state of the space elements.

eTerraSoft is modularly developed solution with applications oriented to different representative workplaces and functions that are performed at each specific workplace. The system architecture defines the major static and dynamic characteristics of the system and describes of which parts or functional units a complex information system is comprised. Software architecture is based on a generic three-tier architecture which requires that the realization of the system provides deployment of the components on one of the tiers of the three-tier architecture - presentation tier, business tier and data tier. The software consists of two modules: alphanumeric modulus for dealing with non spatial cadastral data and graphical modulus (eTerraDGP) for processing digital geodetic plan.

2.2 Web Portal

Another application that provides access to cadastral and other spatial data is a Web portal consisting of several services including eKatastar and Geoportal of RGURS, shown on Figure 2 [4]. eKatastar is used to view non-spatial data about rights and right holders on real estates. It enables a quick access to real estate folios based on one of three search criteria (number of the real estate folio, number/sub-number of the land parcel or name/personal number of the holder of right).

Geoportal of RGURS is implemented using ERDAS Apollo [9] and it is used to access spatial cadastral and other data. Data is structured according to INSPIRE data theme specifications [8].

Figure 2: Layers of data on Geoportal of RGURS.

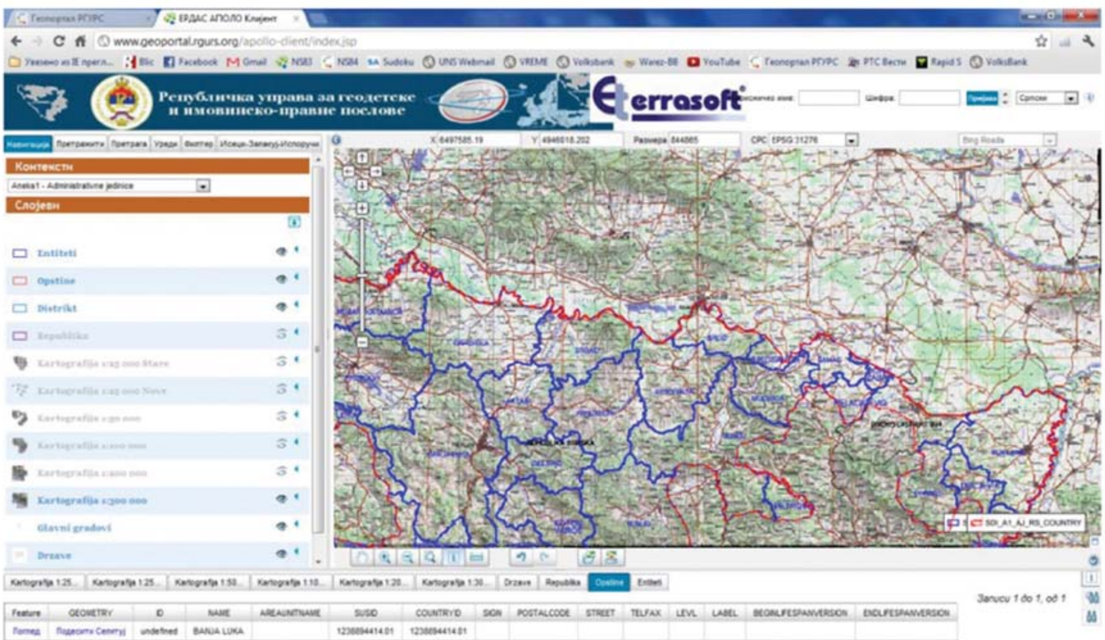
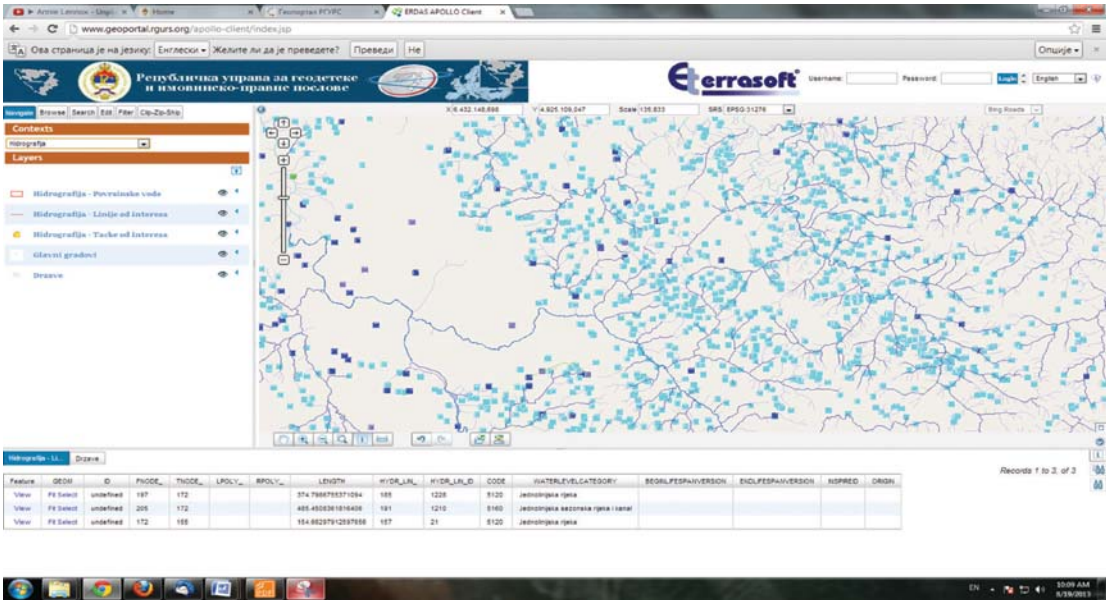


Figure 3: Hydrography themes.



Source: RGURS Geoportal [4].

3 Geoportal Data Themes

Geoportal of RGURS contains the following INSPIRE data themes:

- Administrative units,
- Cadastral parcels,
- Hydrography,
- Transport networks,
- Geographical grid systems,
- Coordinate reference systems,
- Elevation,
- Orthoimagery,
- Land cover,
- Land use,
- Buildings,
- Statistical units,
- Utility and government services.

Data in each theme is modeled according to data model specified in appropriate INSPIRE data specification with necessary extensions.

3.1 Hydrography

Hydrography theme covers the network of rivers, lakes and coastal areas [7]. Definitions are mainly based on use cases from Water Framework directive (WFD) and Floods Directive [5]. Static characteristics of hydro object are the subject of Hydrography theme, whereas dynamic characteristics, such as the level of water, are discussed in themes of Annex 3.

Hydrography data model is divided into three separate schemas that all depend on Hydro – base schema. Those are: Hydro – Network that models the flow of water through landscape, mainly used for spatial modeling and analysis; Hydro – Physical Waters that is used for the purpose of mapping water resources and Hydro – Reporting that is used for reporting according to WFD.

Hydro-base schema provides the basis for defining different views on hydrography. Its only class is HydroObject which provides a unique hydro identifier, geographical name and relationship to other hydro objects and is inherited by other classes of Hydrography Schema.

Data that can be found on geoportal RGURS concerning hydrography is divided into point features, line features and polygon features according to codebook of RGU. There are 5 different codes for point features and a total of 32676 point features, including sources - over 10 liters per minute, fountains, water troughs, wells, water towers or pumps and pumps or pools for industrial water. There are 9 different codes for line features and a total of 186 806 features including central lines of wide rivers, single-line rivers, central lines of wide canals, single-line canals, central line of wide seasonal rivers and canals, single-line seasonal rivers and canals, underground and above-ground water pumps, underground and above-ground irrigation systems, dams or embankments. Polygon features include 7 different codes and a total of 3399 features including wide rivers, wide canals, wide seasonal rivers or canals, lakes or swamps, swamps with or without cane, fish ponds and sea. This is shown on Figure 3.

4 Conclusion

This paper summarizes the development of the standard based cadastral information system for further development of the Spatial Data Infrastructure of Republic of Srpska. While cadastral data plays the central role in the system, other data is developed on top of it, modelled according to INSPIRE data specifications. Web portal of RGURS including e-cadastre service and geoportal for visualizing geospatial data is developed in a manner that allows, through the standard based services, the presentation, processing, distribution and collection of data under the jurisdiction of RGU, and on the other hand, provides interoperability with data from other institutions of the Republic of Srpska, which together with the data of the RGU create SDIRS, all in accordance with the INSPIRE Directive and other international standards in this area.

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Geoportals in Bosnia and Herzegovina as segments of the national spatial data infrastructure

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Abstract

In Bosnia and Herzegovina there is no single legal framework for the establishment and implementation of the National Spatial Data Infrastructure (NSDI). Thus, in the Republic of Srpska there is law which defines the establishment of SDI for institutions and subjects in the entity, while in the Federation of Bosnia and Herzegovina (the second entity) and Brčko District there is no legal framework, but are made of different regulations and annexes to existing laws that cover this subject rather partially and insufficiently. This paper will discuss the establishment of some geoportals in Bosnia and Herzegovina as segments of the NSDI. Along with a brief analysis, we will present examples of using the geoportal for promoting investments in Bosnia and Herzegovina (at a state level), and using them for zoning, land use and protection in Federation of Bosnia and Herzegovina (at the entity level and the level of the local government), as well as for utilities (at the cantonal level) with the integration of technical databases.

Keywords: NSDI, geoportal, legislation

1 Briefly about Bosnia and Herzegovina

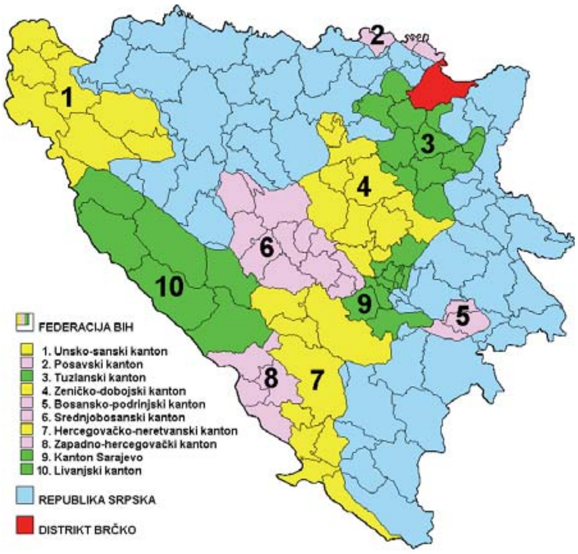
Bosnia and Herzegovina (B&H) is located in southeastern Europe, situated in the west of the Balkan Peninsula. It is a country with a complex political system - consisting of two entities (both are organized differently): Federation of Bosnia and Herzegovina (51% of the territory) and Republic of Srpska (49% of the territory). In addition, there is an independent administrative unit - Brčko district (Figure 1). The complexity of the political system is further complicated by the fact that the Federation of Bosnia and Herzegovina (FB&H) consists of 10 cantons and each canton has its own constitution.

Such a political system does not contribute to easy adoption and implementation of uniform decisions and regulations. This article will give a brief outline of the legal framework in Bosnia and Herzegovina and its entities, which have or should allow the establishment and implementation of the NSDI. It will also discuss geoportals – segments of the NSDI which are implemented in practice, regardless of whether or not there is a legal framework that defines it in accordance with the INSPIRE Directive.

2 Legislation related to the NSDI

Bosnia and Herzegovina has a very complex system of adopting legislation, where laws can but don't necessarily need to be harmonized between the entities. However, it should be noted that there are laws that have been agreed and are valid for all three major subdivisions, which relate to spatial data as well as the Law on Copyright and Related Rights [1] and the Freedom of Access to Information Act in Bosnia and Herzegovina [2]. (Official Gazette of Bosnia and Herzegovina, no. 28/00, 45/06, 102/09, 48/11).

Figure 1. Subdivisions of Bosnia and Herzegovina: Federation of Bosnia and Herzegovina, Republic of Srpska and the Brčko District



Source: My news [3].

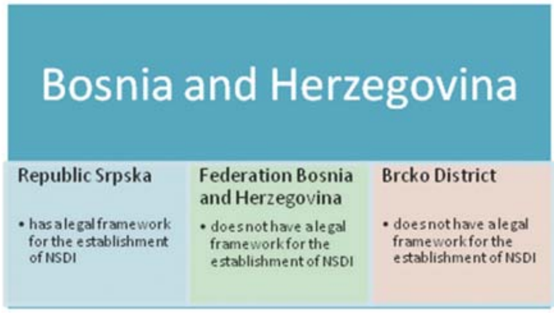
Law on copyright and related rights, among other topics, it concerns copyright protection of cartographic works, photographic works and works produced using a process similar to photography, as well as all presentations of scientific, educational or technical nature (technical drawings, maps, charts, forms, expert work and expert presentations in the form of sculptures and other works of the same nature) (Article 4). Databases are also copyright protected[1] [1].

Freedom of Access to Information Act in its second chapter it defines access and restriction of access to information, whilst in Article 5 it establishes exemptions of the freedom of access to information [2].

According to the Constitution of Bosnia and Herzegovina, Constitutions of the Federation B&H, the Republic of Srpska and the Arbitration decision on Brčko, spatial management and spatial data are the responsibilities of the two entities and Brčko District. The fact that in addition to the state level of government, there are two entities and Brčko District – all of which are organized differently, hampers the coordination of the creation process of the NSDI and the adoption of legislation on its establishment and implementation. The current situation related to the adoption of legislation on the establishment and implementation of the NSDI in Bosnia and Herzegovina can be seen in Figure 2.

1 This Act defines „database" as a collection of independent works, data or other material in any form which is systematically and methodically arranged and individually accessible by electronic or other means.

Figure 2. Regulations SDI by entities and Brčko District



It is even more complex as the signing of any international agreement (both multilateral and bilateral) is on the state level – Bosnia and Herzegovina, but its implementation is carried on by the entities.

For example, some of the duties of the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina are environmental protection, development and utilization of natural resources. The Ministry of Civil Affairs is responsible for geodetic, geological and meteorological work.

3 Legal framework for the establishment of NSDI in Republic of Srpska

In early 2012, Republic of Srpska adopted the Law on Survey and Cadastre, where its Chapter 10 discusses the infrastructure of the geospatial data of the Republic Srpska (IGPRS) [4].

Thus, this entity enabled the establishment, maintenance and the use of IGPRS. This law specified the subjects of the IGPRS infrastructure, the standards it rests on and defined its content (metadata, services and data sets). It also set rules for establishing, maintaining and managing the geoportal IGPRS's, as well as defining who is eligible for the IGPRS Council and what its tasks are. In addition, they adopted other regulations at the entity level, enabling access and restricting access to information. It also defined the funding model which is supported by appropriate legislation, but only for the Republic Geodetic and Property Affairs of the Republic Srpska (RGU).

The Republic Geodetic Administration maintains the public service metadata through the geoportal and provides operators and users the opportunity to connect with other services included in IGPRS and enables the retrieval, access and use of geodata IGPRS.

Geoportal includes: structuring databases, data collection for the IGP, collecting and updating GIS data over the Internet and delivering data over the Internet, searching, cataloguing, characterization and distribution of facilities, maps and images, setting up metadata catalogue.

With establishing the geoportal, the RGU has enabled networking and sharing of spatial data from different sources and different data owners and makes them easily accessible to users via the Internet or Intranet.

4 Creating conditions for the establishment of NSDI in the Federation B&H

Unlike the Republic of Srpska, the Federation of Bosnia and Herzegovina has not adopted the legislation that would define the establishment and implementation of NSDI. However certain projects are being made in this direction. Appropriate data models are being created and implemented (in accordance with international standards and with the rules of the INSPIRE Directive) as well as Regulations on procedures in practice, all created in order to overcome the opposition between current regulations and actual situations »on the field«.

Spatial data models are available to customers in analog and digital form. One such model belongs to the Administration for Geodetic and Property Affairs of the Federation of B&H (FGU) and which they're especially proud of, is the Real estate cadastre data model (established in 2008). The Regulations on the real estate cadastre was ased on this model and it has been successfully applied in practice. In late July 2013, a geoportal for the real estate cadastre was launched - Administration for Geodetic and Property Affairs of the Federation of B & H.

In addition to this model, in late 2012 FGU announced the launch of the Topographic data model and in early 2013 of the Cadastre utility device model. Adequate regulations on how to create and maintain a database produced by the topographic model and the cadastre utility device model are yet to be made [5].

5 Geoportals - examples from practice

As the establishment and implementation of the NSDI in Bosnia and Herzegovina is not unified and the need for spatial data services is growing by the day, the public sectors individually initiated and financed the creation of geoportal which allows the identification and access to geospatial data and geographic services (display, planning, analysis, etc.) via the Internet.

As geoportal is one of the key elements in the future establishment and implementation of the NSDI in B&H, successful projects need to be presented as examples from practice. This paper presents four web portals, all implemented at different administrative levels: state institutions (agencies), entity institutions (administrative organizations), cantonal public companies and city institutions.

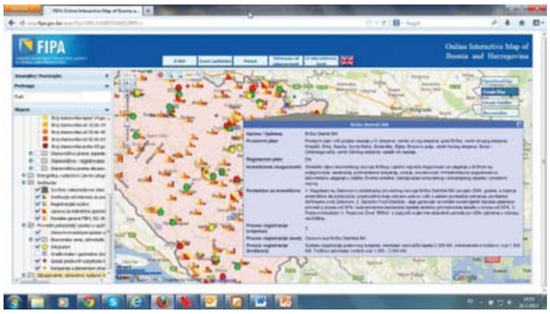
6 FIPA Business Map

Ministry of Foreign Trade and Economic Relations of B&H in cooperation with the Foreign Investment Promotion Agency of Bosnia and Herzegovina (FIPA) and the International Finance Corporation (IFC) - a member of the World Bank Group was responsible for the project entitled »Enhancing the Competitiveness - Business interactive map of Bosnia and Herzegovina« [6].

The result of this project was the first geoportal (Figure 3) which presented business mapping data at the state level. They used the GAUSS WebPresenter platform and Oracle Spatial technology.

Web portal offers the following topics: administrative boundaries, cities, roads, airports and border crossings, electricity infrastructure, natural features (land use and vegetation), basic demographic information, energy, mining and public service institutions, economic indicators and data on municipalities, education, health, culture and tourism and web services. FIPA provides the data maintenance. [7]

Figure 3. FIPA geoportal



Source: FIPA Online Interactive Map of Bosnia and Herzegovina [8].

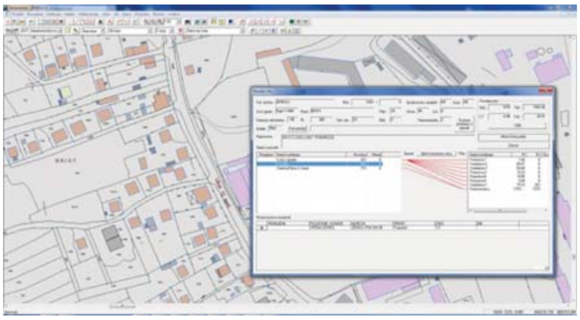
The business map of B&H is located on the website of the Agency for Foreign Investment Promotion FIPA Business Map-Online Interactive Map of B&H: http://map.fipa.gov.ba.

7 Katastar.ba

By the end of July 2013, a project for unique software for Federation cadaster was officially promoted: »katastar.ba« . Within this project, they developed a solution for public presentation of cadastral data through web by the geoportal (http://katastar.fgu.com.ba).

Geoportal allows users to access data aggregated database of existing cadastral data the Federation of B&H, via the Internet. It is formed by collecting and consolidating data kept by the municipal departments in charge of land surveying works. It enables access to Land Cadastre and Real Estate data, depending on which type of cadastre is kept at a certain cadastral municipality. This portal allows you to search for data by entering the cadastral parcel number or the title deed in selected cadastral municipality (Figure 4). Printing is for informational purposes only and cannot serve as a public document.

Figure 4. Query result set via geoportal

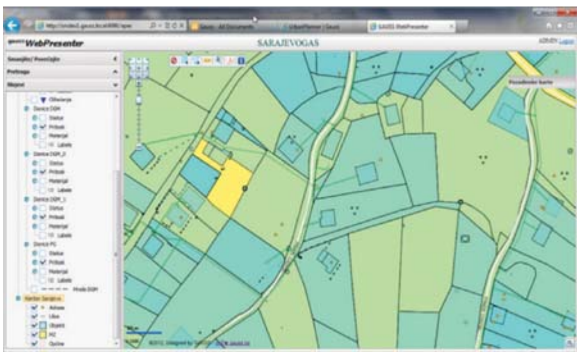


The project developer was the Federal Bureau for Geodetic and Property Affairs, and it was implemented by a consortium of companies B&H (Geometrika, Gauss, KA GIS) who have successfully completed this valuable project.

8 KJKP Sarajevogas

Cantonal public utility company Sarajevogas together with company Gauss as their partner implemented a project of a geo-information system used for design, development and maintenance of the gas infrastructure in the Sarajevo Canton.

Figure 5. Showing the gas pipeline to residential property



This project is an upgraded system made to support spatial decision-making on a development sector level, marketing sector level and distribution sector level. Geoportal was established throughout the company and is integrated with the technical database, the control system processes of connecting new customers and the damage statistics [9].

Geoportal is intended for company employees that need to access to spatial business data, but also to citizens who need spatial information related to the connection options, login failures and other purposes.

9 Mostar City

The Institute for Spatial Planning of Mostar has implemented a geographic information system for the entire organization in 2012. It consists of managing large sets of raster and vector data (orthophotos, LiDAR) located in the central database (Oracle) and complete spatial planning documents (Gauss UrbanPlanner).

Figure 6. Web presentation 3D geodata

The Web presentation of data (Figure 6) is achieved through a single geoportal (Gauss WebPresenter) that allows public review of a variety of 3D urban content [10]. The purpose of the geoportal is to enable citizens the access to spatial planning documents in its public exposure, but also to present the opportunities for investments in the construction of residential and commercial infrastructure. Now this geoportal is used internally and it is expected by the end of this year to be available to the general public.

10 Conclusion

Typically, geoportal provides an entry point to access all data (geospatial data, remote sensing, information and services) and could be used for Discovery, View, Download, and Transformation. Its primary purpose is distribution and visualization of spatial data over the Internet, but its interactive capabilities could bring its functionality far beyond [7].

The above examples of established geoportals show that this segment of NSDI is fairly represented in the Federation of Bosnia and Herzegovina. Although there is no formal legal framework for the establishment and implementation of the NSDI, there is a necessity for the use of existing digital spatial data. Individual projects to establish the geoportal for public institutions and their mass use may enable more their connections and end users for more than inspection, but also downloading trusted and reliable information about the area and the buildings on it. The interoperability level regarding of the geoportals and the remote applications are not evaluated for now.

Of course, it would be much easier to implement it if there was an appropriate legal framework, but we hope that the proposed legislation will soon be adopted and thus ensure the smooth exchange and use of spatial data in Bosnia and Herzegovina, and later in the region and the world.

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Environmental soil sensitivity

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Abstract

Traditional assessments of soil quality are based on soil physical properties and land as well as their interaction with the environment. In general, they provide flexibility assessing the suitability or soil / land in agriculture. While the environmental implications of agricultural activities are rarely described.

System models called the Environmental Sensitivity of Soil (ESS) treat environmental degradation related to agricultural activities. ESS offers points of view on existing environmental constraints on agriculture as: ground water contamination, soil prone to erosion and biodiversity tended to be protected. This type of approach is in line with EU priorities for rural development. ESS models and system suitability of integrated water (SSIW) is intended to help implement the joint policies of agriculture (JPA) of the EU environmental policy by integrating early estimates of water, soil and biodiversity in local development planning. Models within the system of ESS assess potential degradation which can be mechanized agriculture in the aquatic environment, the nature and the land. Three components are selected (water, land and nature) because they represent potential limitations of mechanized agriculture "land cultivation, extension'. They are not intended to represent and assess the whole environment.

The paper is conducted for municipality of Prizren. Three models of ESS combine a wide range of input data and they include numerous modeling and testing.

The paper will conclude with a description of each sub-group of ESS:
- Vulnerability of Underground Water Model
- Soil towards Sensitivity to Erosion Model

Keywords: environmental, sensitivity of soil, sensitivity to erosion, GIS,

1 Groundwater sensitivity

Currently, surface water in most low areas of Municipality of Prizren is contaminated, since a vast volume of wastewater is poured in it (Municipality of Prizren has no sewage treatment). Groundwater in the municipality of Prizren is important for drinking water supply, agriculture, industry and to maintain basic course (summer course)of the rivers. Global climate impacts and will definitely affect the groundwater resources in the region. Global warming causes, underground water supply to deteriorate especially in rural areas, therefore restrictive alternatives should be applied to accumulate more water in various reservoirs.

Various studies (Report'' Water Polluters Cadastre Kosovo'', 2000) have confirmed groundwater contamination troops in Kosovo, especially near urban areas. Groundwater is under a constant threat. Contamination can be caused by many activities which take place on or near its surface. Rehabilitation of polluted groundwater is very pricy, so it is important to prevent contamination of groundwater by applying spatial planning that takes into account the protection of resources within the Municipal Development Plans (NDPs)

As we face a serious lack of key data and monitoring studies of groundwater parameters (depth, availability, vulnerability, streams, pollution levels) for the entire municipality, the research has created a model that identifies broad examination of groundwater vulnerability pollutants originating from surface based on data collected / kept nationally. Research data and maps are an integral part of the NDP or national environmental policies to those moments when we have available more accurate data.

Sensitivity of groundwater or suspicion of groundwater contamination from polluting activity that produces surface or near surface is greater in some soil and hydrological situations than in others. This sensitivity depends on those natural features of the land, which determine the amount and speed of vertical movement (downhill) of pollutants. Sensitivity assessed by physical, chemical and biological soil and rocks which control the movement of water pollutants.

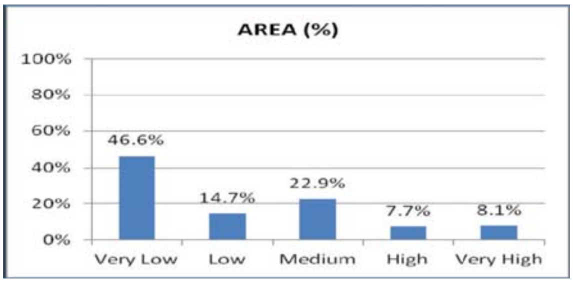
Factors which together determine the sensitivity of groundwater resources are (Nordin, N. and Palmer, R.C. 2011):

- The nature of the geological layer (consolidated or non consolidated) and unsaturated zones;
- The depth of the groundwater ;
- The presence and nature of the upper layer of soil.

In the municipality of Prizren data for assessing the sensitivity of the groundwater is scarce, so a very simple model is created in which all available data is integrated. These data cover the entire territory of the municipality of Prizren and are available in the form of map (Map 1).

A statistical analysis of the distribution of categories of CORINE land cover classes within groundwater sensitivity shows that most municipal areas and settlements of the municipality are located on lands with medium to very high groundwater sensitivity (Figure 1).

Figure 1. Groundwater sensitivity distribution of classes in Prizren municipality (%)



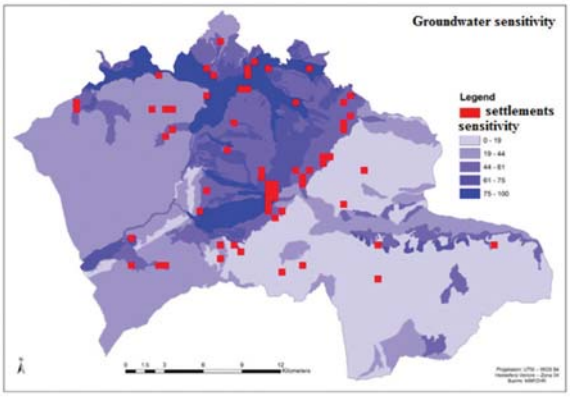
Similarly, agriculture dominates in the classes of Groundwater sensitivity, while forests are dominant in mountainous areas where Groundwater sensitivity is low or very low

Maps of groundwater vulnerability, together with other information, can be used to identify national or municipal areas in which polluting activities are likely to pose a threat to groundwater quality.

These activities include:

- Gas stations;
- Household septic tanks drainage system;
- Drainage channels near the surface;
- Dry cleaning premises;
- Industrial places.

Map 1. Sensitivity of groundwater against pollution



Groundwater sensitivity assessment is used only at the municipal level. Its accuracy can't be guaranteed for a more detailed level.

2 Sensitivity of soil erosion

Soil erosion caused by water is a natural phenomenon that has occurred historically, but its scale and intensity can be increased significantly by human activities. This erosion has major implications for the environment and the economy. So from erosion we may have loss of soil quality, increased risk of flooding, increased cost of agricultural production, etc.. In many cases erosion affects the infrastructure and construction. Therefore, it is important to make a special assessment of soil erosion risk in order to take appropriate measures against natural hazards of land.

Erosive power of the surface flow, depends on the angle and length of the slope, the more steep and long slope is the more likely the occurrence of the phenomenon of erosion.

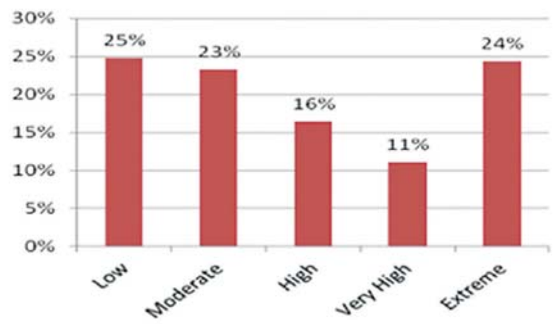
In the absence of detailed data for modelling the surface flow, slope angle is used. A matrix-based model is created, which can be implemented within GIS to assess the natural sensitivity of soil erosion in Prizren municipality. The model is implemented in existing groups of soil data, topography and rainfall. Model presents a spatial assessment of soil erosion sensitivity of the entire municipality of Prizren. It is suitable for 1:50,000 scale interpretations. For assessment of land, surfaces are considered bare without vegetation cover. In order to establish this evaluation system based on matrix model and its implementation at the municipal scale, the following assumptions are considered:

- All lands are considered without vegetation;
- It is considered just the erosion connected to surface flow (so, erosion by wind and other forms of mass movements are excluded).

- Consideration was given to the dynamic factors affecting erosion (for example, the impacts of land management practices or cases caused by weather as rapid melting of snow).

Due to low number of data available for Prizren municipality it has been impossible to model the effects of rainfall in particular or effects of different types of vegetation. Therefore, the final model only takes into account the mechanical sensitivity of the surface flow erosion. A simple model of Sensitivity of soil erosion integrates all available data, including soil texture, slope and rainfall. Sensitivity of soil erosion distribution of classes in the municipality of Prizren is shown in Figure 2 and Map 2.

Figure 2. Sensitivity of soil erosion class area in Prizren (%)

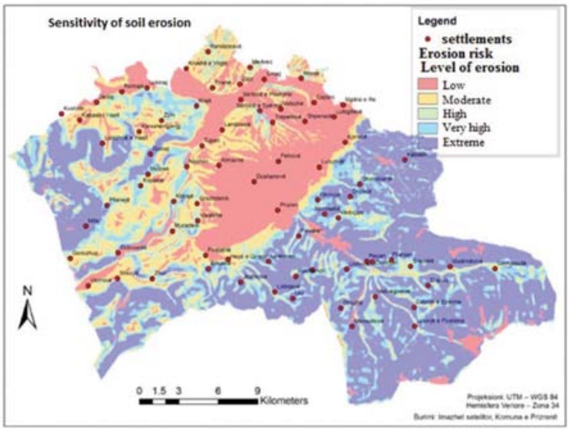


Gradient, combined with texture, is the most important factor in the Sensitivity of soil erosion model, so classes high sensitivity, very high and extreme forest dominate and large slope. In the other classes of low sensitivity and high in areas dominated by agriculture.

This simple model of soil erosion is suitable for planning decisions on larger spatial areas. However, the model lacks scientific accuracy for use in the most detailed level (at land parcel).

Maps of soil erosion sensitivity, associated with other data, can be used to identify threats from many activities such as, installation and maintenance of pipelines, the wave

Map 2 . Sensitivity to Erosion



of large-scale construction, etc.. Sensitivity to erosion maps can also be used to identify sensitive areas of fishing that should be protected from the damaging effects of sediment in the water flow.

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MSDI and Geoportals in Selected European States: A Comparative Analysis

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Abstract

Marine Spatial Data Infrastructure (MSDI) is the component of National Spatial Data Infrastructure (NSDI). It encompasses marine and coastal geographic and business information. An MSDI would include information on marine boundaries and limits, conservation and preservation areas, marine habitats, oceanography, bathymetry, hydrography, geology, marine infrastructure, wrecks, offshore installations, pipelines, and cables. For efficient use of Marine Spatial Data it is necessary to ensure a valid and accessible distribution. Geoportal is specialized web portal for sharing geospatial information on different levels using Internet. Geoportals are key part of SDI. In this paper, several European countries Geoportals will be reviewed (for example Norwegian, Irish or German) to determine their functionality, capabilities and the scope to which they support the sharing and reuse of Marine Spatial Data.

Keywords: MSDI, NSDI, Geoportal, Marine Spatial Data

1 About Marine Spatial Data Infrastructure

Marine Spatial Data Infrastructure (MSDI) is the component of National Spatial Data Infrastructure (NSDI) that encompasses marine geographic and business information in its widest sense. This would typically include seabed topography (bathymetry), geology, marine infrastructure (e.g. wrecks, offshore installations, pipelines and cables), administrative and legal boundaries, and areas of conservation, marine habitats and oceanography [8].

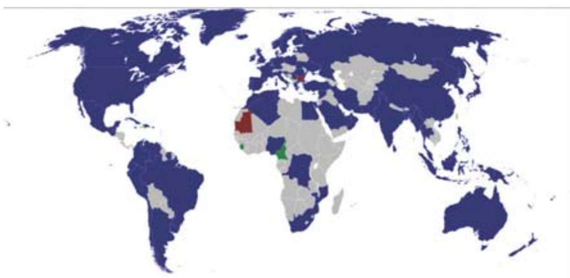
This is a framework which provides the integrated management of spatial data and information in the marine (maritime) environment covering processes such as:

- Technology
- Policy
- Standards
- Data
- People
- Organizations [14].

The Hydrographic Offices (HO) are uniquely placed to play a central role in the development of marine components of all SDIs. Significant support for all aspects of functioning HOs is International Hydrographic Organization (IHO) [15].

The IHO is an intergovernmental consultative and technical organization that was established in 1921 to support the safety of navigation and the protection of the marine environment [7]. Currently, the IHO has 81 Member States.

According Mataros (2007) “The Hydrographic Office (HO) is an important part of the National Geo-Spatial Data Infrastructure and, of course, the IHO has an important role to play in coordinating the requirements and demands for data collection, interoperability, dissemination, access, standards, security, pricing policy and possible funding models”[15].



Source: Wikipedia: IHO Members [19]

2 Geoportals

Important activities of SDI (and MSDI) are distributing and use of geospatial data. Advancement of technology helped the development of geoportal service. Geoportals are specialized Web pages used to discover, view and access geospatial information and additional geographic services via the Internet. Geoportal is a gateway to Web-based geospatial information and information services.

The Geoportal achieves this goal through the linking of spatial information oriented websites and databases. These websites may be local, regional, national and can be either publicly or privately owned. Within the context of an SDI it is propagated that there should be an entry point (a National Geoportal) to the following network of services. The premium version of this National Geoportal is expected to serve as a one-stop shop providing access to geo-information content and GI services so that they can be easily shared and reused. To provide this facility effectively and efficiently, an ideal National Geoportal should have access to the majority if not to all GI portals, GI datasets, and GI services within a nation whether privately or publicly owned [5].

3 MSDI and geoportals in selected countries

Discussion about difference between MSDI and SDI depends on every individual country case. The structure, organization and relationship between MSDI and Geoportal are different from country to country due to cultural, administrative and political reasons.

Only a few countries in the world manage to organize their geospatial data and processes in one unique Geoportal. Because different jurisdiction on sea and land data, many of them have two geoportals that are more or less connected.

The basis for the selection of these three sites was data availability to unregistered users, and different approaches to the Geoportal (MSDI within NSDI Geoportal).

3.1 German MSDI geoportal activites

Deutschland-Online Geo-Data has been started as a Deutschland-Online initiative in 2003. The central coordination has been given to North-Rhine Westphalia (NRW), represented by the Head of the State's mapping service GEObasis.nrw, which is assigned to the Cologne District Government. It is supported by a coordination office. Members of Deutschland-Online Geo-Data are representatives from ministries, mapping agencies, communities, and SDI initiatives. Private companies are invited to take part on a project basis. All Deutschland-Online Geo-Data projects have to use the German SDI rules and standards, which are defined by the German SDI initiative GDI-DE [1].

In Germany currently the development of a marine data infrastructure takes place with the aim to integrate existing technical developments (NOKIS –a metadata database in Germany –and the SDI of the German Federal Maritime and Hydrographic Agency [GDI-BSH]) as well as merging information concerning the fields coastal engineering, hydrography and surveying, protection of the marine environment, maritime conservation, regional planning and coastal research.

This undertaking is embedded in a series of regulations and developments on many administrative levels from which specifications and courses of action derive. On the European level it is the INSPIRE (Infrastructure for Spatial Information in the European Community) initiative as well as the Marine Strategy Framework Directive (MSFD), the Water Framework Directive (WFD) and Natura2000 with their regulatory counterparts in Germany and its federal states (MSRL, WRRL, FFH-RL, VS-RL) [16].

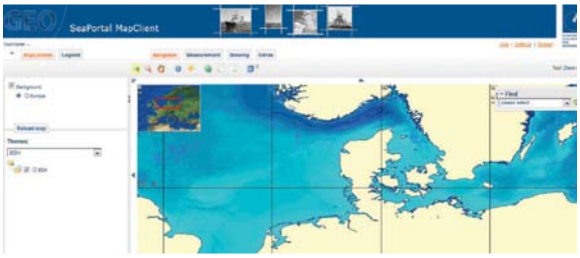
The website Geoportal.de, as a joint project of the Federal Government and the Länder (states), offers a view of the contents of the GDI-DE. The website is the central point of access to the data and services of the GDI-DE. Thus, it delivers clearly more performance than other geoportals, in which data and services are spatially or technically limited, for instance to a Land (federal state) or a specialist authority. At the same time the national Geoportal.de is a vital instrument for the coordination of the participants of the GDI-DE network. This website contributes to the implementation of the service-based Architecture of the GDI-DE [3].

Figure 1. National German Geoportal

Source: Geoportal.de [3]

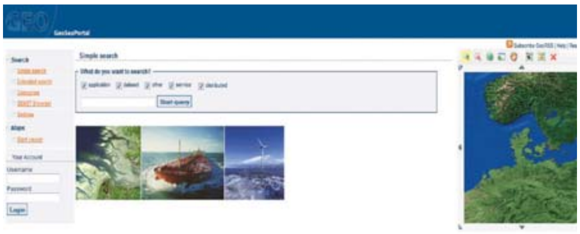
A provider of marine services in Germany is Federal Maritime and Hydrographic Agency (BSH). German MSDI geoportal – „GeoSeaPortal" provides centralized Internet access to geospatial data covering sea and coastal areas based on international standards.

Figure 2. GeoSeaPortal MapClient



Source: GeoSeaPortal[17]

Figure 3. Metadata search application



Source: GeoSeaPortal [4]

GeoSeaPortal consists of two components: MapClient [17] and GeoSeaPortal [4] (Metadata search application).

MapClient is a configurable web application which enables the efficient use of services distributed by a spatial data infrastructure. The services are integrated dynamically via standardized interfaces. MapClient is based on the mapClient Framework Technology developed by ConTerra and operates as a thin client, offering a wide selection of functions for displaying, navigating, searching, selecting and managing OGC WMS and ArcIMS services. By interacting with the Open Source Software of the 52°North Initiative, services that are protected by a web security service are incorporated in the mapClient. By connecting to an OGC Catalogue Service, the required services can be found by means of a text search and displayed in the mapClient. It is also possible to directly access a service via a favourites list, or by entering a URL. Current views can be saved as OGC WMC documents and displayed again later. The configuration and authorization management feature of the software allows the administrator to define the scope of functionality, the layout and the extent of access for different uses and user groups. MapClient's functionality can easily be extended by means of an adapter, with which modules for specific applications can be added [10].

GeoSeaPortal is a powerful and scalable metadata management system based on open standards, enabling the capture and serving of metadata for geo-resources. With user friendly search engine on the Intranet and Internet, this system enables access to distributed geographic information resources within public or enterprise-wide spatial data infrastructures. This application supports the search for, and maintenance of metadata via intuitive web interfaces. As well as making locally stored and managed metadata available to users via standardized interfaces, GeoSeaPortal broker function enables it to integrate external catalogues and data sources in its search for metadata (distributed searching and harvesting). GeoSeaPortal satisfies the requirements of the European Commission INSPIRE Directive for the creation of an EU Spatial Data Infrastructure. It provides an INSPIRE Discovery Service interface as well as supporting all INSPIRE metadata elements required for the collection, validation, display and search. With the Connector for ArcGIS product option, users can directly access discovered services and open them in ArcMap. In addition, many alternative map viewer and portal client connections are available that allow the direct transfer and visualization of the retrieved map services [18].

Available featured maps on GeoSeaPortal:

- Geological
- Navigational
- Marine environment
- Spatial planning
- Oceanography
- Tide Gauge Stations.

GeoSeaPortal allows unregistered visitors to:

- Navigate through map area part of the window (pan, zoom in and out)
- Measure (distance or area)
- Draw (point, polyline, area, text or activate coordinates on click)
- Change spatial reference system,
- Change scale
- Save and load their own project
- Send map via e-mail
- Add data and services (WMS, WFS, ArcIMS, AGS, GeoRSS, Inspire View Services, SOS)
- Print.

3.2 Norwegian MSDI geoportal acivites

The prototype Norwegian Geoportal - GeoNorge was launched in January 2004 [11].

The Geoportal is a vital part in the implementation of the Norwegian SDI 'Norway Digital'. Norway Digital is the Norwegian government's initiative to build the national geographic infrastructure. Norway Digital has been, since 2005, a working co-operation and infrastructure

Figure 4: Norwegian Geoportal

Source: GeoNorge [2]

with reference data and thematic data available, more than 100 operational web map services, Geoportal and other services. Thus Norway Digital is an existing implementation of the infrastructure described by the Inspire directive [12].

Spatial data that can be found in the GeoNetwork is often used as basic data in advanced web-based applications. Related applications will also allow the user to see what other spatial data makes part of the application. Related applications can in some cases be viewed directly through the GeoNetwork Dynamic Map interface.

Spatial data are often available for download. Data is provided in data formats that are compatible with most professional GIS applications and a variety of freeware GIS tools. The dissemination of information is based on new technologies for Internet distribution. Downloadable data are available in standard formats. Metadata is delivered together with the data. The geoportal is giving information about the present status of the available data and web map services. The technologies used are based on international standards (ISO and OGC) [11].

Unlike German, Norwegians have one Geoportal for sea and land geospatial data. The main area of GeoNorge window shows search results or chosen geospatial metadata. In that main area, we can also choose MapViewer tab where we see a map. On MapViewer tab, the graphical interface is offered for us to manipulate this geospatial data: navigate through map area part of the window (pan, zoom in and out), add or remove layers, measure (distance or area), change spatial reference system, change scale, save and load your own project, add data and print services.

GeoNorge has also three sections: Applications, Datasets and Map services. These sections provide a list of various applications, datasets and maps that can be sorted by relevance, popularity, change date, rating and title. Every offered item provides metadata according international standards.

On first sight this geoportal looks messy and piled. After some time spent with GeoNorge, we explore numerous possibilities and a wide selection of datasets.

3.3. Irish MSDI geoportal acivites

GeoPortal.ie is the Republic of Ireland's portal for Geographic Information. This portal has been developed by the Department of Environment, Community & Local Government (DECLG) and Ordnance Survey Ireland (OSi) with guidance and oversight from Irish public bodies on the Irish Spatial Data Infrastructure (ISDI) project steering committee [9].

Figure 5: Ireland's INSPIRE portal

Source: Geoportal.ie – [18]

Access (search, view, and download available datasets) is dependent upon the terms and conditions within the license after registration and is not automatic. Some datasets have restricted accessibility [13].

The ISDI project and GeoPortal.ie portal will compile a wealth of geographic information on a wide variety of environmental themes from official sources; it will ensure that standardized spatial data from a network of ISDI content providers will be published according to the INSPIRE principles of data being stored once close to the source and used many times. This ISDI network of data from content providers is published in association with high quality authoritative base mapping from OSi [9].

Very intuitive, eye candy and simple Irish geoportal (land and sea) provides visitor to search through metadata. There are five featured datasets (for unregistered users): administrative units, marine limits, natural heritage, land use and archaeological survey. Registered users have wider access to applications and datasets. They can also launch MapViewer with several options: navigate through the map (pan, zoom in and out), add services, pop up layer window, measure and tools and print.

4 Conclusions

Geoportal is the main point of access to distributed geospatial data on the Internet. Geoportal allows intuitive search, view and reuse of available geospatial information resources. Geoportal is an important part of the NSDI.

The purpose of the SDI and the geoportals is to make spatial data and services easy to find and use. A component of NSDI is MSDI, because of their specificity; these geodata are often organized by separate Geoportal (table 1). Whether the sea and land data are separated or together in unique geoportal they should meet the basic requirements and purpose.

German geoportals are examples of separated land and sea geoportals and that is the main reason why is this way of organizing geo-data very similar to Croatian. Because of only one land geoportal in Croatia, there is need for MSDI geoportal in scope of NSDI. Besides that, GeoSeaPortal provides better organization of geo-data by two applications (graphical and metadata) according to listed international standards, technical support and user friendly interface. By establishing their own MSDI geoportal, Croatia should consider the benefits and experiences of other geoportals (some of they are listed in the Table 2).

Geoportals must act as a gateway to very useful spatial data from a wide range of content providers. By making this geospatial data more accessible and interoperable, the geoportals aim to support and promote: access to and integrated use of spatial data and information, to promote multidisciplinary approaches to sustainable development; greater collaboration and integration between public bodies, to enhance understanding of the benefits of geoinformation.

Table 1: **Comparison specifications geo-portal selected countries.**

Country	MSDI in NSDI Geoportal	INSPIRE	Data avaibility
Germany	No	Yes	Restricted
Norway	Yes	Yes	Everyone
Ireland	Yes	Yes	Restricted

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Comparison of "real" data model created for management and needs of employees of Marina Veruda, with INSPIRE Data Specifications

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Abstract

In cooperation with employees and management board of company Tehnomont d.d. from Pula, Croatia, data model that will be implemented in Marina Veruda GIS was created. The purpose of this data model is to be used within GIS for management on everyday basis, maintenance and monitoring of work processes in marina Veruda. Therefore, data model was created as result of real needs of employees for certain datasets and attributes. On the other hand, INSPIRE data specifications provide specifications of marina related data differently. This paper elaborates this two different data models, and displays results of research about use of INSPIRE data specifications in practice.

Besides that, within this project Marina Veruda GIS was created using open source software OpenJUMP, and PostgreSQL database with PostGIS spatial extension.

Results, as well as some preliminary examples of spatial analysis were presented to marina employees, with summary conclusion that this kind of system leads towards excellence and state of the art way to run and manage marines.

Keywords: marina, INSPIRE data specifications, spatial data model, GIS

1 Introduction

Pilot project of creating Marina Veruda GIS was conducted to explore feasibility of existing spatial data and use of GIS in Marina Veruda.

Existing data was taken, and in coordination with Tehnomont d.d. employees additional necessary spatial data was collected.

At the time, due to relevance and main goals of pilot project, INSPIRE implementing rules were not considered. Therefore, afterwards we created preliminary conceptual data model according to INSPIRE data specifications as we would propose at early stage of data modeling. The main subject of this paper is to research practical use of this data model from perspective of marinas that are subjects of NSDI.

2 Marina Veruda GIS

Process of creating preliminary GIS with limited amount of data can be divided in few phases – collecting existing and new data, modeling data, processing data in CAD software, formatting data in GIS and preparing for import in spatial database, making GIS interface, creating preliminary examples of use.

The main data source was digital geodetic survey data in dwg file format. From this file we could extract most of the spatial data required by our data model, but besides that it was necessary to collect some other spatial data like location of fire extinguishers and some buildings.

2.1 Spatial data model

Spatial data model for managing infrastructure and everyday work processes was created with respect to future users needs. Two larger object groups *Infrastructure* and *Transport* were defined, each with own subgroups and feature classes (Table 1).

Table 1: Feature catalogue – data model

Object group	Subgroup	Feature class
Infrastructure	Above ground infrastructure	Road
		Parking
		Tollgates
		Building
		Moles
		Waste disposal
		Fire extinguisher
		Electric switchboards
		Public lighting
		Cranes
	Underground utilities	Telephone network
		Electricity
		Water network
		Sewer
	Nodes	Sewer manhole
		Septic tanks
		Other manholes
		Water network nodes (hydrants, valves, taps and manholes)
Transport	Berths	Berths
		Dry berths
		Underwater moorings

Source: Izrada GIS-a Marine Veruda [1]

In this pilot project data model has no relations between feature classes, no code lists and domains, and runs with geometric regime, but with clean topology created while exporting data from CAD to GIS.

Every feature class has set of attributes, e. g. Berths – berthNumber, contractNumber, contractDate, boatName, boatType, regitrationNumber, flag, boatLenght, boatWidth, productionYear, berthOccupation, occupationDate, note, or e. g. Fire extinguishers – controlTestingDate, nextControlTestingDeadline, overallMass, loadMass.

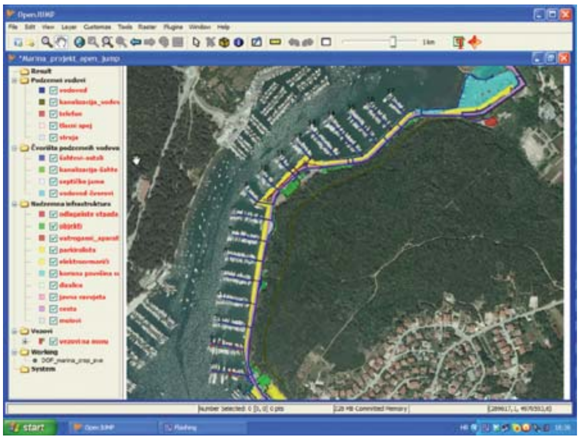
In context of this paper, we will concentrate only on list of feature classes, while full list of attributes is too extensive to elaborate.

2..2 Further data processing and Desktop GIS implementation

Since there is new official coordinate system in Croatia, HTRS96/TM based on ETRS89 datum, and data were georeferenced in old HDKS coordinate system and Gauss-Krüger projection, it was necessary to transform data to new official projection. Helmerts 7-parameter transformation method was used while taking into consideration current transformation parameters for entire state area. When overlapping result of the transformation and DOF raster basemap, conclusion is that transformation accuracy is satisfying. Afterwards, topology was created and certain layers were exported as Shapefiles which will later be used as feature classes.

Considering all parameters in building future complete GIS system, decision on using open source GIS software was made, regarding free use and option to modify source code according to project requirements. As ideal solution, OpenJUMP software was selected, due to user-friendly interface, visualization quality, great communication with PostgreSQL database with spatial extension PostGIS (Figure 1). Capability to perform full SQL queries on database within OpenJUMP interface, and automatic results visualization makes OpenJUMP ideal choice candidate, before the first competitor QGIS, as well as GRASS.

Figure 1: Layer list and Map view in OpenJUMP with imported feature classes and raster digital orthophoto basemap



Source: Marina Veruda GIS – OpenJUMP interface

OpenJUMP was used as tool for creating attribute schema according to data model, and inserting attribute data. Also, feature classes are arranged within OpenJUMP into object groups. These feature classes are then inserted in PostgreSQL database, while together with OpenJUMP forming Desktop GIS for exploring capabilities and feasibility of this kind of system in Marina Veruda.

2.3 GIS options and capabilities

GIS realized this way has numerous options and wide analysis capabilities – from simple spatial or attribute queries to complex spatial analysis like creating buffer zones, overlap two or more layers, spatial join, convex hull on layer, etc.

For example, using simple spatial query about selecting all features from Berths layer that are within distance of 30 m from closest parking, results like in Figure 2.

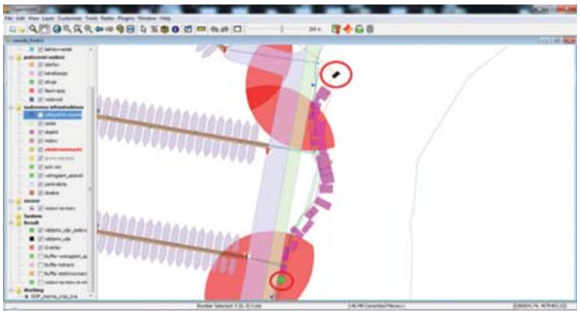
Figure 2: Berths with red colour are within 30 m distance from parking, while blue ones are more distanced

Source: Marina Veruda GIS – OpenJUMP interface

More complex example is exercise where it was demanded to conduct analysis about number and location of waste disposals which contain used oil to mach criteria of being within 30 m distance from nearest hydrant as well as the fire extinguisher in case of fire. In order to conduct this analysis, attribute query was performed to select hydrants from Water Network Nodes layer, then buffer zone around these selected hydrants and around fire extinguishers, and using two layers overlay option created polygon layer which contains areas where the two buffers overlap. After that, spatial query on Waste disposals which contain used oil preceding attribute query to select these features from Waste disposals layer was performed, and gave result like in Figure 3.

Besides querying and analyzing, there are many options to personalize and adapt GIS user interface (rendering, color adjustments, theming, labeling, various symbol definitions, etc.) (Figure 4).

Figure 3: Green features match the criteria, while black features do not match criteria



Source: Marina Veruda GIS – OpenJUMP interface

Figure 4: If berth is occupied then it is in red colour, otherwise green (colour theming); building features are labelled with name attribute

Source: Marina Veruda GIS – OpenJUMP interface

3 INSPIRE data specifications data model

In order to create conceptual data model for marinas according to INSPIRE implementing rules, one could consider more than one data specification – theme which is addressed in INSPIRE data specifications. While creating this particular conceptual data model, we used specifications for following themes out of 34 themes which are arranged in three Annexes (Annex I, II and III):

- Hydrography
- Transport Networks
- Sea Regions
- Buildings
- Elevation

While looking at data themes to identify which data theme would marinas be responsible for, from our point of view it would be Hydrography. But in this specification, there is an explicit explanation regarding this matter.

The Hydrography model does not contain a feature class for harbours or islands. This was discussed within the TWG but it was decided that both were not essential to the use cases identified. From a hydrographic point of view an island is hole in a physical water (StandingWater) potentially surrounded by a LandWaterBoundary and a shore.

Similarly a harbour is physical water with a specific function in terms of e.g. navigation or industry but not from a hydrographic point of view. Harbours are included in their navigation function in the Transport Network theme.

From the above it cannot be concluded that harbours and islands are not part of INSPIRE or even of the Hydrography theme; the conclusion is that they require a specific type of modelling in the light of the hydrographic network and potentially a different type of modelling for other purposes [6]. Since marina is type of harbour, we can apply this on marinas as well.

Therefore, as the marinas are used mainly for transport function (marina is a specially designed harbour with moorings for pleasure yachts and small boats [11]), the most of the features we could model are found in Data Specification for Transport Networks. Although, there are few very important features incorporated in this conceptual model from other specifications (bathymetry data, border lines, etc.).

3.1 Feature catalogue

Table 2 shows overview of features from different specification which are forming it's own feature catalogue for this data model.

Feature classes from 1-10 are addressed in application schema Water Transport Network in document D2.8.I.7 INSPIRE Data Specification on Transport Networks [8]. Due to relevance of some features from this application schema for this marina (InlandWaterway, CEMTClass, TrafficSeparationScheme), they were left out of the data model, so application schema is simplified (Figure 1).

Feature class 11 is provided in D2.8.I.8 INSPIRE Data Specification on Hydrography [6], feature classes 12 and 13 are provided in D2.8.III.16 INSPIRE Data Specification on Sea Regions [7], 14 is provided in D2.8.III.2 INSPIRE Data Specification on Building [4], and feature classes 15 are provided in D2.8.II.1 INSPIRE Data Specification on Elevation [5].

We need to mention, that this data model is conceptual data model, and would probably be altered in implementation phase, so there could be some possible changes, but the concept is the same.

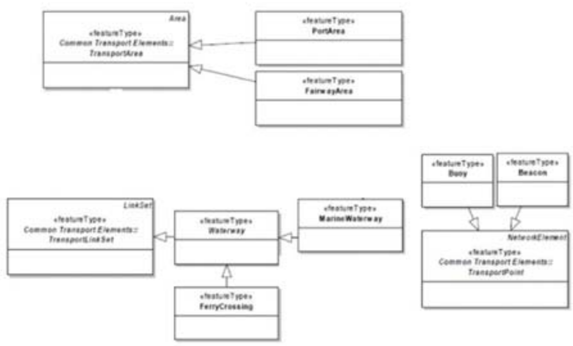
3.2 Comparison of real data model and INSPIRE data model

Marinas are obviously potential NSDI subjects, and could have use of implementing their own GIS. But, what data could marina use from SDI, or what data are marinas obligated to harmonize and provide?

Table 2: Feature catalogue for conceptual data model according to INSPIRE data specifications

	Feature class	Attribute
1	Buoy	InspireID
2	Beacon	InspireID
3	FairwayArea	InspireID
4	Ferry Crossing	ferryUse InspireID
5	Marine Waterway	deepWaterRoute InspireID
6	PortArea	conditionOfFacility InspireID
7	PortNode	conditionOfFacility InspireID
8	WaterLink Sequence	waterTrafficFlowDirection restrictionForVehicles InspireID
9	WaterLink	waterTrafficFlowDirection restrictionForVehicles InspireID
10	Waterway Node	formOfWaterwayNode InspireID
11	Shoreline Construction	levelOfDetail conditionOfFacility InspireID
12	Shoreline	waterLevel segment InspireID
13	InterTidal Area	highWaterLevel lowWaterLevel InspireID
14	Buildings	name conditionOfConstruction currentUse InspireID
15	ContourLine BreakLine IsolatedArea SpotElevation	(These Feature classes are part of bathymetry dataset, and each have own attributes)

Figure 5: Simplified application schema for Water Transport Network



Source: D2.8.I.7 INSPIRE Data Specification on Transport Networks [8]

In order to answer this question, we compared these two data models – real data model and one created from INSPIRE specifications, and we can see some differences. Of course, many of the feature classes from first data model are in scope and under authority of some other NSDI subjects (electricity network, water network, telecommunications network, sewer system – Utility and Governmental Services theme, then roads – Transport Network Theme). Also, some of feature classes from this second data model are in scope of other NSDI subjects, i. e. Shoreline and InterTidalArea could be responsibility of national hydrographic agencies, and they should provide these data to NSDI. On the other hand, there are several important feature classes not addressed, or very narrow defined in INSPIRE data specifications:

- Moles – we can map this feature class with ShorelineConstruction feature class, but it has no specified attributes except levelOfDetail and conditionOfFacility
- Berths – not provided
- Dry berths – not provided
- Fire extinguishers – this is probably entity that could not be included in INSPIRE data specifications due to it's size and nature, but is very important for risk analysis in marinas

As we can see, berths and dry berths are main resources for business of marinas, and they are not specified in INSPIRE.

Also, indicative scales of data - features specified in INSPIRE data specifications regarding these themes from chapter 3 are smaller then it would be appropriate for average marina infrastructure GIS (1:1000). Intent of these specifications is to cover rather large area (Figure 6).

Figure 6: Elements of Water Transport Network

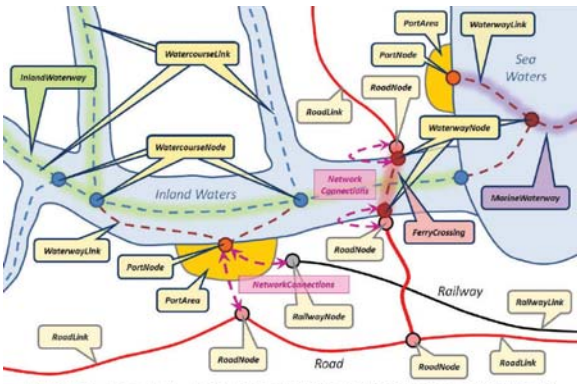


Illustration – Example of use of elements forming the Water Transport Network (1)

Source: D2.8.I.7 INSPIRE Data Specification on Transport Networks

The real data model was created for infrastructure GIS and everyday use for managing marina and work processes in marina. The main data source was digital special geodetic basemap from geodetic survey for scale 1:1000.

Although INSPIRE data specification allow intermodal connections with other transport network, cleat topological regime, interoperability and many other advances it is intended for wider use, and marinas manage much more detailed spatial data. Therefore, marinas that are NSDI subjects would be responsible for rather small amount of data.

4 Conclusion

INSPIRE data specifications consider marinas (and other types of harbours) as part of wider network or area. Therefore, marinas could provide and use some spatial data from SDI, mainly general data with lower level of detail (in context of covering just marina area, and area under concession in the case of Marina Veruda).

Based on experience of creating data model and infrastructure GIS for Marina Veruda, if marina that is subject of NSDI would implement infrastructure GIS, it would probably be necessary to use some additional data sources other than NSDI, in order to create complete data model – based on INSPIRE data specifications and expanded model for more detailed data.

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Zagreb, Sava, Spatial Data

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Abstract

Zagreb is spatially defined with two main geographical phenomenons – Medvednica Mountain and Sava River. Forested mountain Medvednica is protected park of nature, and its slopes are among most popular residential zones. On the other side, Sava River and Zagreb have long and controversial history of conflicts and potentials. Today, Sava is the largest strategic development area of the city, with multifunctional development plans.

Spatial data of the Sava in Zagreb are numerous and multidisciplinary. Different scientific and administrative disciplines have different views on this topic. Administrative units, cadastral parcels, protected sites, elevation, land cover, land use, population distribution, and other data themes are important for planning, protection and management of river areas. In Zagreb, lot of those data sets are part of local SDI geoportal.

Spatial data analysis is frequently used in decision making for strategic city planning. Example of population distribution and land use analysis is presented in the paper.

Keywords: Zagreb, Sava, Spatial Data, Spatial Analysis

1 Introduction

City of Zagreb is capital of the Republic of Croatia, and its largest urban centre with 790.000 inhabitants within its administrative borders [1]. It is positioned on the slopes of the Medvednica Mountain and in the Sava River walley.

Figure 1: Sava in Zagreb – evening panorama

Source: Wikipedia [2]

Development potential of the Sava was always important for city planners [3], and also for numerous other disciplines that produce and manage a huge amount of spatial data and information.

2 Zagreb and Sava history

Zagreb was originally founded on the slopes of Medvednica Mountain. Position was excellent considering Medvednica microclimate (protection of northern winds, fresh air) and terrain high enough to protect from the seasonal Sava floods and hostile attacks. Sava walley, although very fertile, was sparsely inhabited with only few small agricultural villages.

In 19^{th} century Zagreb started to spread toward the river, under protection of railway dikes. In 20th century river embankments were made, with large inundation areas by the riverbed.

Figure 2: Zagreb and Sava in 19th century

Source: City office for strategic planning, Zagreb

Large step was made between 1960s and 1980s with development of new residential areas on the other, south side of the river (“South Zagreb project”, today “New Zagreb”). Although the city area was enlarged, the river was bypassed and left for the later interventions.

Figure 3: “New Zagreb” residential areas

Source: City office for strategic planning, Zagreb

3 Sava development projects

Rapid urbanization in 20th century left large areas by the riverbed undeveloped or degraded. It was a mixture of former river meanders, abandoned gravel exploitations and infrastructure objects.

Fortunately, most of those areas were later converted to sports and recreational areas – Jarun sport and recreation centre, Mladost sport park, Bundek park, hippodrome, golf courses. Savica lakes, a former river meander, are declared as protected landscape important for ornithology and preservation of wetlands. All those projects made life by the river very attractive, especially in new quarters.

Figure 4: Jarun sport and recreation centre

Source: City office for strategic planning, Zagreb

Large infrastructural facilities are also settled by the river. While some are good examples (waste water treatment plant), some need modernization (power plant) or new solutions (Jakuševec sanitary landfill, University hospital site).

Figure 5: Jakuševec sanitary landfill

Source: Zagreb holding [4]

Sava is still very interesting for the city planners and developers [5]. New thermal bath, bridges, residential areas and public facilities are planned. At the moment, huge multifunctional development project “Zagreb on Sava”, which includes hydro power plants and new hydro technical solutions, is under consideration.

4 Spatial data

Sava Rivers runs for 29 kilometres through the geographical centre of modern Zagreb, generally from west to the east. Riverbed is average 100 meters wide, with inundation belts of average 100 meters (up to 500) on both sides.

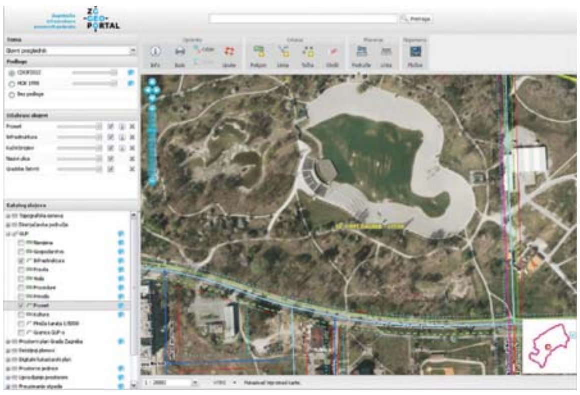
City of Zagreb administration is dealing with several data sets for Sava and surrounding area [6]. These are main city institutions responsible for spatial data:

- City office for cadastre and geodesy;
- City office for strategic planning and development;
- City office for physical planning, construction, utility services and transport;
- City office of emergency management;
- City office for agriculture and forestry;
- City institute for the conservation of cultural and natural heritage;
- City office for energetics, environment protection and sustainable development;
- City office for legal-property relations and the city's assets;
- Institute for physical planning;
- Zagreb holding, city utility company.

According to INSPIRE themes classification, city institutions manage (partially or completely) with following data sets for the city area: Administrative units, Addresses, Cadastral parcels, Transport networks, Protected sites, Elevation, Land cover, Orthoimagery, Geology, Statistical units, Buildings, Soil, Land use, Human health and safety, Utility and governmental services, Environmental monitoring Facilities, Agricultural and aquaculture facilities, Population distribution and demography, Area management / restriction / regulation zones & reporting units, Natural risk zones, Energy Resources, Mineral Resources.

Numerous data sets can be viewed in Zagreb spatial data infrastructure geoportal.

Figure 6: ZG Geoportal



Source: ZG Geoportal [7]

5 Spatial analysis

Strategic city planning is one of the largest users of spatial data. Spatial data analysis is important tool in the process of decision making for planning. In this process, two main information are needed – about people and about land. In INSPIRE language, we speak about Population distribution and demography, and Land use.

In this chapter spatial analysis of people and land around Sava River is presented. The goal of the analysis is to detect specificity of the river area comparing to the city in total.

6 Area of analysis

For the purpose of the spatial analysis, Sava River and surrounding area is chosen. Area includes riverbed, inundation belts, Jarun centre, Bundek park, and buffer zone 1.000 meters around. It is assumed that people in the area are connected with Sava River on everyday basis. Area covers 62 km^2, 9,7 % out of total area of the City of Zagreb.

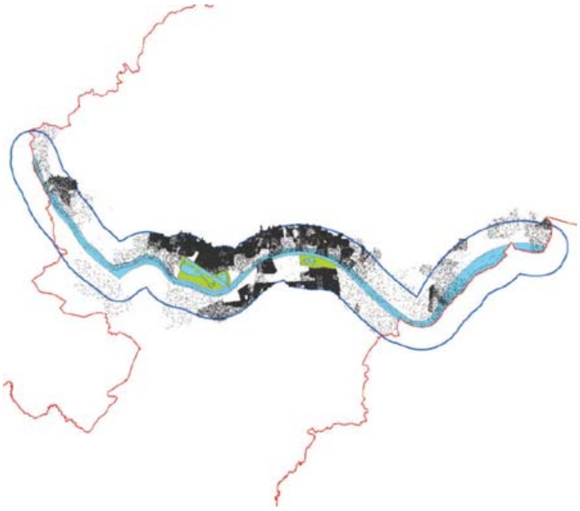
Figure 7: City of Zagreb and area of analysis

Source: author

7 Population

The last census for the area was conducted in 2011, with data about population, households and dwellings. GIS data used in the analysis were georeferenced on the basis of the smallest statistical unit – census circle. Census circle is an area with up to 130 households, and whole city area is covered with 4900 of them.

Figure 8: Sava and population distribution



Source: author

For the purpose of the analysis, census circles with centroids that overlap area of analysis were selected. This was made because census circles do not perfectly fit to the border of the analysis area.

According to the analysis, there are 148.967 citizens, 62.108 households and 77.927 dwellings in the area. In table 1 density per square kilometer and indexes are presented - for the area of analysis and for the City of Zagreb in total.

Table 1: Density analysis

Census data	/km² Area	/km² Zagreb	index
citizens	2402	1232	2,0
households	1002	475	2,1
dwelling	1257	603	2,1

Source: author

Results show that the area of analysis is twice as densely populated as compared with City of Zagreb in general.

8 Land use

Land use analysis of the area was based on the GIS data collected by the City office for strategic planning and development from the project "Analysis of existing land use and urban densities in 2011" [8].

Figure 9: Existing land use

Source: author

The goal of land use analysis was to determine land use distribution of the area and to compare it to average numbers for the City of Zagreb. Particular attention was given to the land uses important for the citizens – public services (education, culture, health, etc), public green areas and sport areas. Results are presented in table 2.

Table 2: Land use analysis

Land use	% Area	% Zagreb	index
residential, mixed	14,6	14,1	1,0
business	5,7	3,3	1,7
public services	2,0	1,2	1,7
green areas	2,3	1,0	2,3
sport	5,7	1,6	3,6
water	20,2	2,4	8,4
traffic, utilities	13,4	5,1	2,6
forests, agriculture	33,9	70,6	0,5

Source: author

Land use analysis results shows urban character of the area (twice less forests and agriculture), and average percentage of residential areas. Percentage of business, public, green, traffic and utility areas is twice the average in the city. The biggest difference from the average is in the sport and recreational areas (almost four times), and water surfaces (more than eight times). These results confirm that the river area of the City of Zagreb is very suitable for active lifestyle.

9 Conclusions

The river belt of the City of Zagreb is area with controversial history of large projects and great development potential. Placed in the geometrical center of the city administrative area, it is subject to the management in many administrative and scientific fields. For most of them, spatial data is needed, produced and used.

From the strategic planning perspective, most interesting are data about population distribution and land use. Spatial analysis shows that Zagreb river belt is above average populated and used mostly for urban purposes. Specialty of the area is high share of sport and recreational fields, which provides additional quality to local housing.

Integrated land and water information management is crucial tool for future development and protection of one of the symbols of the City of Zagreb – river Sava.

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5th Croatian NSDI and INSPIRE Day

Status of the Serbian geo-sector

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Abstract

Organizations operating in geo-sector in the Republic of Serbia are gathered around a common goal – the establishment of geodata infrastructure at the national level. An analysis of current status in the Serbian geo-sector is based on information collected via a survey. The survey is used for gathering of information on existing spatial data sets, available capacities for their production and maintenance, the ways of cooperation among stakeholders, as well as status of standards implementation. A 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 geo-sector organizations in general are on satisfactory level. A few leading authorities are significantly stand out and they are also major holders of production and distribution of the geodata. Existing production is a solid base for the building of NSDI. The most geodata sets are in digital form with the state coordinate system. Mainly geodata is already used for exchange.

Avoiding of overlapping in data production and improvement of sharing are the main fields to be addressed. Introduction and implementation of the standards, as well as more intensive activities on metadata harvesting are key factors for better conditions within the Serbian geo-sector. Reference data sets defining with corresponding national sources and stabile financing of the production will additionally make a favourable environment for the further development

Keywords: geodata, stakeholders, geo-sector, survey.

1 Introduction

Initial activities on the National Spatial Data Infrastructure (NSDI) establishing in the Republic of Serbia had been started in the 2008. The initiator of the activities was Republic Geodetic Authority, which also earlier had initiatives for connecting and integration of spatial data. Through III phase of the twining project with the Norwegian Cadastral and Mapping Agency (Statens Kartverk) had been started work on adjustment to the European legislation related to geodata, as well as directing efforts to the firmer links between the geo-sector participants and improvement the existing spatial data for quality and wider use.

Legal base for NSDI establishing was provided in September 2009 with the adoption if the Law on State Survey and Cadastre which contained provisions related to NSDI. The Law prescribes the basic elements of legal framework for NSDI establishing, by defining stakeholders, content and utilization of NSDI data, metadata, metadata sets and services, establishing of the National geoportal, limitations of access to geodata sets and services, NSDI bodies and competences of the NSDI Council. This Law directly transposed some of the INSPIRE (INfrastructure for SPatial InfoRmation in the European Community) Directive provisions into Serbian legislation. The law was foundation for organizational structure of the NSDI, which had been established during the 2010-2011. Organizational structure consists of the following organs: NSDI Council and NSDI Working Groups [2]: for cooperation, for legal framework and for technical framework.

The Government of the Republic of Serbia appoints representatives of the certain Ministries as members of the NSDI Council that is managing creation of institutional and technical framework for establishing common geoinformation infrastructure on the national level, through formulation of clear guidelines and resources to achieve this goal.

Working group for cooperation has a role to create a model of cooperation between NSDI stakeholders through the creation enabling environment for the efficient geodata exchange, where the conditions are defined in the Cooperation Agreements. Working group for legal framework has jurisdiction to prepare proposals of laws and under law regulation in the field of geodata, where the most important task is full transposition for INSPIRE directive and related implementing rules into national legislation. Working group for technical framework is competent for creating and developing technical elements of the NSDI by proposing introduction of technical standards in the field of geoinformation and information-communications technologies (ISO, INSPIRE, OGC, CEN, W3C, etc), defining criteria and measures for geodata quality control and supporting development of national geoportal.

Currently, NSDI bodies cover 62 representatives from 32 organizations [6], ranging from state administration of all levels, over scientific institutions, to private sector. Members are almost entirely representatives of public authorities. General overview of the type of organizations can be seen in the Table 1 [6].

The Republic Geodetic Authority, being the central institution of geo-sector on the national level has the coordination role in NSDI establishment, and on international level has role of the INSPIRE contact point. Additionally, on the regional level it is a national partner in INSPIRATION project (Spatial Data Infrastructure in the Western Balkans Project) and other regional incentives. In accordance with the Law on State Survey and Cadastre, the Republic Geodetic Authority is entrusted with the establishment, maintenance and management of the initial national geoportal 'GeoSRBIJA' (www.geosrbija.rs). A part of the initial geoportal, which had been lunched in the 2009, is maintenance of the public service for the metadata and providing users with connection with other services included in NSDI, as well as access, discovery and usage for spatial data.

Working together through the NSDI bodies have been adopted strategy for establishment for the period 2010 – 2012 and mid-term program of works on the NSDI establishing and maintenance for the period 2011 – 2015. In order to fulfill goals defined by strategy and mid-term program, apart from the NSDI bodies, are formed five work teams: a work team for preparing the draft strategy for the period until 2015.; a work team for preparing the draft law for the complete transposition of the INSPIRE

Table 1: NSDI organizational structure

Organization type	NSDI Council	Work Group for Cooperation	Work Group for legal framework	Work Group for techni-cal fra-mework
State administrat.	10	15	7	13
Ministries	7	5	3	4
Special organizations	3	5	2	4
Public companies	-	2	1	4
Other public organizations	-	3	1	1
Province organs	-	1	-	-
Local government	-	3	2	5
Municipal administration	-	2	2	3
Public companies	-	1	-	2
Scientific institutions	-	-	1	4
Scientific institutions	-	-	-	1
Scientific-educational Institutions	-	-	1	3
Private companies	-	-	-	1
Total	**10**	**19**	**10**	**23**
		62		

Source: NSDI: INSPIRE Country Report: Serbia (Draft – Version 0.1), Republic Geodetic Authority. 2013 [6]

Directive; a work team for analyzing the situation in geo-sector; a work team for preparation the text of the agreement, and a work team for reviewing the technical framework document for standardization within the NSDI. Work teams were formed by delegated members of the working groups, mixed and have fewer members than the working group and thus more operative. Documents created by the work teams have the status of the initial version of which will be discussed at the joint meetings of the working groups. After compliance within the working groups documents will be sent to the NSDI Council for approval.

Working team for analyzing the situation in geo-sector completed its task and of determination of current state and needs for further development in the geo-sector. 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 Geo-sector Status 2013” [4], with short overview presented here.

2 An analysis of the status of the geo-sector

For the purposes of analyze current state in geo-sector a comprehensive questionnaire had been designed, consisting of 33 questions in 5 themes:

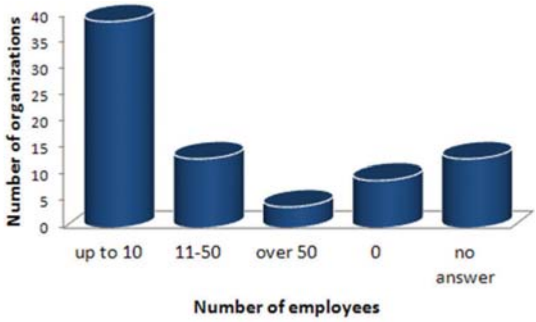
1. Details on organization;
2. Spatial data production;
3. Cooperation between spatial data producers and users;
4. Standardization in the spatial data field;
5. Miscellaneous.

The questionnaire had been sent to the broad range of organizations, which are assumed to have some links with spatial data. It was open for answering from late August until the end of December 2012. Answers had been collected through web form (based on the open source application LimeSurvey), electronic in doc format or in paper form. Answers were presented with simple descriptive statistic, and it has conducted professional analysis of results. That provided as a result conclusions and recommendations regarding the state of geosector in the Republic of Serbia.

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. The structure of the type of organizations responding to questionnaire was in accordance with NIGP organizational structure. Regarding territorial level of operation, there is uniform representation of organizations from the national and local level (44 % each). The majority of spatial data producers and users (84 %) are the budget funds users – exclusively or combined with own revenues, only 15 % of organizations being financed from their own revenues.

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.

Figure 1: Employees primarily working on spatial information



Source: NSDI: Detail overview and analysis of questionnaire on the state in geosector (Draft – Version 0.4), Republic Geodetic Authority. 2013. [4]

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. 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).

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. Around half of organizations do not have capacity for developing spatial data management applications, and already developed applications exist in 28 % of organizations. 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.

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). Apart of this, there is rather sharp division to two groups of organizations operating in geo-sector:

1. Spatial data producers and users; and
2. Exclusive spatial data users.

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

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 %). Negative aspect of the existing spatial dataset is that the percentage of metadata existence is extremely low (25 %), 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 (22 %).

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.

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.

Existence of overlapping in spatial data production is notable in the Republic of Serbia, namely for addresses, orthophoto, topographic dataset, data on transportation, hydrography, and other items. 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. 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. The most important reasons of spatial data unavailability in general are high price, non-existence, outdated and unavailability on the internet.

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 distributer 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.

Table 2: Different distribution methods

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

Source: NSDI: Detail overview and analysis of questionnaire on the state in geosector (Draft – Version 0.4), Republic Geodetic Authority. 2013. [4]

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.

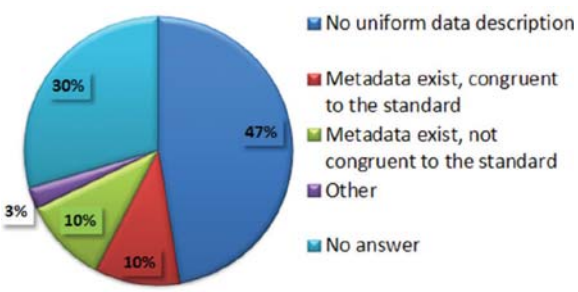
The existing cooperation in the geosector is being performed on demand, pursuant to the law or contract i.e. agreement. On the other hand, for use of spatial data produced 35 % or organizations notes that they produce data for their own needs. Significant users are also citizens, organs of local and 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 %). 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.

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 2.

Figure 2: Metadata existence



Source: NSDI: Detail overview and analysis of questionnaire on the state in geosector (Draft – Version 0.4), Republic Geodetic Authority. 2013. [4]

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.

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. Therefore, the existing spatial data protection is mostly not appropriate.

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

3 Conclusions and Recomendations

Pursuant to the current state in geosector in the Republic of Serbia, it is necessary to [7]:

- 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, Oracle, MySQL, etc);
- 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.

4 Gratitude

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Albania towards the Implementation of NSDI

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Abstract

This paper make sure to provide You with information on realisation of legislative and institutional process on Directive INSPIRE/2007/ EC and Implementation of SDI in Albania. The paper dealt with mainly with three main topics in the context of Inspire adoption such as: Understanding of directive Inspire and NSDI, legislative and institutional process during 2010-2013 for adoption and transposition of Directive, achievements and actual situation to start the implementation of NSDI in Albania. Elaborating the paper under this frame of those topics the authors have been aware to take the attention and to make evident the results and products achieved during the lawful process, institutional aspects in continuation, stakeholders, public and private institution involvement, geospatial data and information state, raising the public awareness, impact of various EC projects in Albania, relation and need for them with Geo European Institutions to assure their guidance and expertise for starting of implementation of NSDI. As Albania is in the process of building the NSDI institutions such as Governmental Authority of Geospatial Information (Alb:.ASIG) and Board of Geospatial Information (Alb. BIG), it is understandable that starting of the implementation of NSDI in Albania is considered as the most important phase in the completion of INSPIRE in general. In this context question and problems like steps to be undertaken, capacity and level of expertise on geoinformation, concept of designing data NSDI, role of ASIG and public institutions, ratio with the European institutions, building metadata, realising the interoperability in various levels, architecture of NSDI, geodata services, etc. are put and done evident in order to take attention of various stakeholders, public and private geo data producers and providers as well as well as even the organisation in regional and European levels interested or responsible in developing and implementing the NSDI.

Keywords: *NNational Spatial Data Infrastructure /NSDI/, geospatial information, Governmental Authority of Geospatial Information/ASIG/, geoinformation*.

1 Introduction

During three last years as Albania carry out the legislative process for Directive Inspire adoption and is actually continued to build the institutions responsible for realisation of this Directive.It is clear that the implementation of NSDI as the main product of Inspire is accepted to start immediately. From this point of view taking in account that Albania is a country under the status of Enlargement to EC as well as other factors like the level of understanding of NSDI, impacts of various projects from EC realised or in process, level in the expertise in some important issues as are those of institutional and technical issues, still the process mentioned above need an overview. Just this overview accompanied maybe with new comments and conclusions based on the level of developments in this moments, is done in this paper.

The purpose of the paper is to make evident what are achievements and weak points out, what are achievements and the obstacles that maybe should be take care in the process of implementing NSDI. So, evaluation of public awareness, understanding metadata and standards, role of institutions, principles and designing NSDI, architecture to be done, understanding the specifics of the INSPIRE themes, role of coordinative systems system in the context of integration into European NSDI, building the metadata, standards and specification, situation of building portals, realising of interoperability, and many other aspects are relayed in this paper too. Due to many reason and according to stage of INSPIRE in Albania is made evident the need for collaboration with European institutions which pay attention on NSDI for each country even for those in the process of Enlargement.

2 Understandingand the proces of adoption of INSPIRE

Statistics from the last two decades show that the demand of the governments and the public for quality, structured, accurate and prompt geospatial information has grown. Information technologies developed until now along with GIS systems in connected computation environments which utilize and produce geospatial information, are growing quickly, allowing for a large scale utilization of the geo in formation.

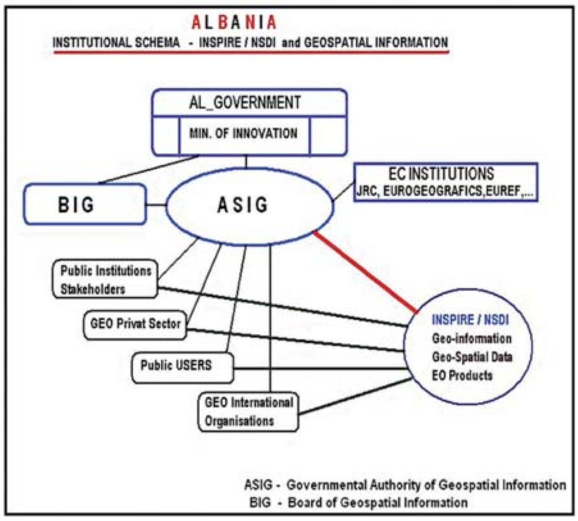
The demands and needs for geospatial information based on the principles and achievements mentioned above, were addressed initially by the USA and after the year 2000 by the European Community, through the INSPIRE 2007/II/ Directive, by designing, legitimating, and institutionalizing the development of a National Spatial Information Infrastructure (NSDI). NSDI is conceived and designed as a framework of policies, lawful and institutional regulations and regulations of the geo-information technologies.

Estimation of potential benefits foreseen from Directive Inspire and Implementation of NSDI in the context of a good and modern governance as responds of the demands and needs for applicative and accurate geospatial data and information from public and various institutions served as a motivation for the Albanian government to start the adoption and transposition phase of Directive and actually is in the phase of making the first efforts to begin the implementation of the Albanian NSDI.

The lawful and institutional developments of the Albanian Government for the implementation of INSPIRE 2007, such as the adaptation of the Directive at the end of year 2010, the composition and approval by the Albanian Parliament of the Law Nr. 72/ 2012 on "The organization of the geospatial data infrastructure", along with several Government Decisions, concluded in the creation of the: Geospatial Information State Authority (ASIG) and Board of Geospatial Information (BIG).

Creation of ASIG and BIG were the most important decisions of Albanian government and parliament , this due to the fact that ASIG was mandated as the main institution responsible referred the Albania Government and EU Institutions for implementation of NSDI, whereas BIG

Figure 1 Institutional Schema of Albanian SDI



Source: Authors of papers [1]

as an permanent institutional component to support, to relate proposals, to take approvals on ASIG decisions, to suggest and advice ASIG for specific issues based technical and legal expertises, to realise the collaboration and relations between ASIG and the other public and private Institutions, and other activities in accordance with Directive INSPIRE /2007/EC. BIG and a specific executive geodetic Directory inside the ASIG is seen as a solution which fill the gap of lack of national geodetic Authority. Albania didn't have such institution since 20years.

2.1 Activities and and building a stradegy for Implementation of NSDI

As it was underlined above at the end of the 2010 Albania started the process of adoption of INSPIRE. After, in a very short time was made clear that before implementation of INSPIRE Directive an analyses is needed to understand what is the legislative and institutional situation to support the implementation of INSPIRE and in straight wards terms the implementation of NSDI as the main product of INSPIRE. This analyses and a study done by Albanian Government generated a process of starting implementation of INSPIRE, with the question what to do and to plan to come in the implementation of NSDI as the Directive ask for.

The analyze of this situation at the beginning of 2011 shows that existing situation from the point of view of legislative, institutional and less of technical aspects wouldn't support the implementation of the INSPIRE. The analyses underlined the fact that realizing a legislative process as the part of INSPIRE Directive application, was a precondition to open and support the establishing the institutional schema in order to designed and implemented the NSDI based on the EU and international standards.

At the end of the year 2010, Albanian Government signed the agreement for adoption of Directive INSPIRE 2007/ 2/ CE. At the begging of 2011 started the process of adoption of directive, by appointed an Inter-ministerial Working Group combine with a technical expertise company. At the end of 2011 based on the expertise of mentioned company approved the documents as follows:

- Compilation of a Document on the Geospatial Data Policies, in real terms on NSDI.
- An Action Plan on Implementation of INSPIRE and NSDI in Albania.
- A law frame on implementation of Inspire and NSDI, in real terms a basic law to take decision from Albanian Parliament.
- Designing of a Institutional frame or modeling reference with the Directive INSPIRE2007/2/EC;

As this process was realized by IWG mainly during 2011 till half of 2012, it should be underlined that those tasks resulted to be completed successfully.

The decision of the Albanian Parliament of June28, 2012was very important day for geospatial and geoinformation in Albania and for INSPIRE and NSDI. It was approved by the Parliament the Law nr. 72/2012, as the basic law to support implementing of NSDI in Albania in institutional bases in conformity with Inspire Directive.

The further steps according to the Action Plan were realized after. So, at the begging of 2013, the Council of Ministers take some decision on establishing the ASIG(Governmental Authority of Geospatial Information), its structure, functioning, budget, responsibilities, tasks, etc.

ASIG and geo-information board were determined to be the main body responsible to implement the INSPIRE and NSDI. ASIG also covers even the lack of a National Geodetic Authority. Actually ASIG is in the moment of becoming operative and hopefully at September 2013 to start activities on implementing the NSDI.

2.2 Documents of Polycies and Road map – a prelimenary strategy for implementation of NSDI

"Document of Policies for establishing NSDI" was valuated as the most important document or as the mile stone for implementation of INSPIRE.In this document was included also the Road Map for implementing NSDI. It should be underline that Road map devoted specific attention the legislative and institutional steps and processes and in more general terms the technical issues for implementation of NSDI in Albania [5].

As this document was approved by Government at the end of the year2011 it was become clear that the road map has starting to be executed. So, the steps of Road Map to be implemented were [5]:

1. Prepare the basic documents to support establish the legislative and institutional bases for implementation of INSPIRE / / NSDI.
2. Approval by the Albanian Parliament of Law no. 72/2012, date 28.06.2012, on NSDI, " as the basic law for implementation of Directive INSPIRE and NSDI.
3. Creation of a formal mandate for a National Coordinator of GIS by Counsel of Ministers., 4. Determining of Albanian Geodetic System in conformity with the requirements of INSPIRE as well as in the context of ALBPOS an GNSS infrastructure, which needed to be georeferenced according to European geospatial and satellite references ..
4. Establishing through some governmental decisions based on the law nr. 72/2012 the, Authority for Geospatial Information (ASIG), responsible for implementation and executing the establishing of NSDI. 6. Establishing of the Board of Geospatial Information, with the representative from Ministries and the main public Institution providers
5. As ASIG will be set up and will determine its role in relation to the other public institutions and stakeholders, it should start to design the further steps for technical implementation of NSDI.
6. Also, roadmap have paid attention what it is expected as the NSDI is establishing. In this context is foreseen to realized: Creation of "Geospatial Data Warehouse", Applying a GIS system and Creation of exchanged standards;

All this tools will be design in order to realize usage of data and geo products to be generated from NSDI for the various users and costumers in conformity with their requirements.

One important topic which takes answer of those documents is the priorities of themes to be implemented as basic in Albanian SDI. As the document has underlined the sorting of them is done based on conformity with themes presented in the three annexes of INSPIRE Directive as well as in the priorities of Albanian Government in the field of geo-information. Themes foreseen to be as priority in Albanian SDI are [5]:

1. Determination of Geodetic Reference Frame and geodetic control;
2. Cadastral information;
3. Addresses;

4. Geographic Names;
5. Administrative and politic boundaries;
6. Transport;
7. Hydrographic
8. Land use and soil coverage;
9. Leveling and Bathymetry;
10. Orthomapimage for all territory;
11. Census and Demography;
12. Urban Infrastructure and key natural recourses;

Those priority themes are determined based on analyses of geospatial data state of play in Albania. This mean that those data are now under the control and processes of governmental or public institutions and in this point of view can be used and implement in SDI more efficiently. Those priorities fit with the themes of Annex I [3].Also the other themes which are designed under the annexes II and III in INSPIRE Directive are seen to be later implemented maybe with other public and private institutions.

2.3 Impact of EC projects for the adoption of INSPIRE.

It is important to point out that lawful and institutional process as a transposition process of the INSPIRE during 2010 2011was accompanied with activities of some EU projects with Albanian Partners. Their activities play very important role in promoting, evaluation and supporting the implementation of INSPIRE in Albania. Those projects through their activities realize many products such as reports with analyses and recommendations, brochure, various presentations and papers as feedback and gave an important impact in the issues such as raising the awareness of public, analyses on the process and law documents, experience of Albanian public and Private sector , issues of NSDI as metadata, interoperability, services etc. its architecture, experience geospatial data processing along the years, inventory of products, achievement, level of expertise, education capacity etc. In this context some of those aspects are reported in this paper in order to be used as the data and arguments for a final discussion the problematic on implementation of SDI in Albania.

First it should be underline the specific importance of INSPIRATION project which has carry out some activities in Albania such as two National Workshop respectively at October 2012 and march 2013, an International Conference on Education Capacity refers the Inspire at march 2013 , one INSPIRE day at march 2013. Those activities were attended by more 200 specialists from the various public, private and academic institutions dealt with geospatial data and geo-information. During the two first phases mainly at the end of 2012 analyze on the Law 72/2012 on NSDI approved by Albanian Parliament were done in detailed by the project. Also, through the recommendation given in the produced reports, a geospatial data art of play, role of cadastral institutions in Balkan Level, as well as the need for a institution in regional level to take care for implementation of NSDI-s in those country.

EC Project OBSERVE in combination with EC Project BgNet which run during 2011-2012, make many activities and gave some many important products in identification a of stakeholders nets, institutions, coherence between those institutions in Balkan level, raising the awareness of public, needs for relation and member ship in Geo international organizations refer the standards, specification as well as exchanging of data. National thematic reports realized by each Balkan country were very important documents to be care in building strategies for implementation of NSDI.

So, in this context the two last project realized the identification of the all stakeholders in Balkan countries and build a Stakeholder data base with over 400 stakeholders, where 22 were identified in Albania, classified in three levels: Producers, Providers and Users. Also some of workshops and meeting kept in Balkan countries supported in useful way the awareness of public, specialist for the need of a national SDI which will be integrated with a unique one European SDI.

2.4 Stakeholders and geospatial data in Albania

It is known that INSPIRE Directive take very specific care on such issues as geospatial data state of play, their quality, standards and specification, awareness of public, usage of data by local and central government and private sector, conformity of NSDI with the main European SDI, identification of stakeholders, geospatial data providers and producers etc.

As it was underlined above as impact of running some EU project where Albania institutions were partners, were realized the identification of some issues such as inventory of geospatial data and geo and EO data institutions, stakeholders, etc. which can help and support the implementation of SDI in Albania.

A part of inventory of geodata and respective institutions are given illustrated even with good practices in following:

Based on the principles of INSPIRE to build NSDI such as: “Capture spatial data only once and manage it where it can be done in the most efficient way” ask for a wide range of data in time and in space to be considered for building of NSDI [3]. It is clear that inventory or the identification of issues mentioned above to be a reflect of answer to the questions as What?, Who?, When? Evaluation?, etc.) In following are given the most important stakeholders in the role of producers and providers in Albania.

Albanian Geographic (Military) Institute (AGMI) has been for a long time but not now, with the status of Geodetic Authority in Albania. The inventory of geodata and mapping shows as follows [2]:

Till 1990 it produced for all Albanian Territory - Topographic Maps at ranges of scales, from 1:10 000 till 1:100 000. Topographic maps, in range of scales 1:10000 and 1:25000 are actually digitized, georeferenced in national geodetic system Alb87 and evaluated for accuracy and quality. Can be used in INSPIRE as "spatial data only once".

Central Office Registration of Immovable Properties and Parcels and its branches has been producing Ownership Index Maps, Cadastral attributive data and maps, Cadastral zoning, Ownership charts, addressing, codes, etc.[2]

Albanian Geologic Survey (AGS)[2,5]

Main producer of Geologic, Hydrologic, Risk and Natural Hazards, Mineral Resources etc. maps or range of scales 1:10000 till 1: 100 000 and in more, as 1: 200000.[2].

Figure 2View of GIS application in geology

Source: AGS and author of paper [1]

Those maps are implemented by GIS, build with 11 layers. AGS has actually increased

Agency for Legalization of Urban and Informal Zones and Buildings (ALUIZNI)[2,5].

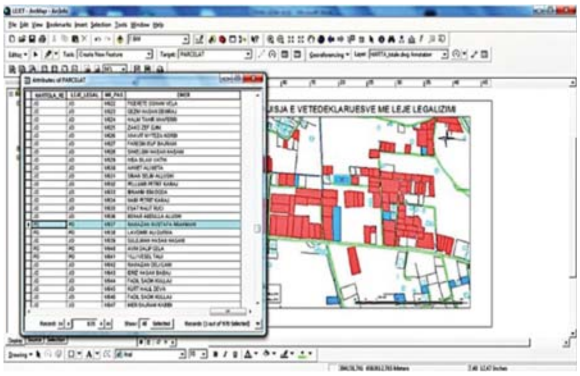
ALUIZNI is the provider of Orthophoto for all Albanian Territory, obtained from a flying Mission of 2007. It is with high accuracy and can support topographic mapping in cities from the scales 1: 1000 and smaller. This EO and geospatial product can be a entry in SDI as a theme of it.

Central Technical Archive in Tirana. Has archived and it is provider of all local geodetic nets and topographic &mapping survey plans, Engineering Geologic Studies

Figure3:Orthophotoimage by ALUIZNI and vectorization.

Source: Produced by Aluizni for public [1].

Fig.4 Vectorization and GIS by Aluizni



Source: Source: Aluizni public publications [1].

and maps, etc. of all Cities and Towns as well as many villages in Albania at ranges of Scales1:500, 1:1000 and 1:2000, done before the year '90, from a Ex-Technical Institute Geology -Geodesy. All those works or EO Data Sets are evaluated as with high accuracy standards. Updating, filtering, migration, geo-referencing of all those data first into the National Coordinative System Frame, adaptation of them in respect with specification and standards of INSPIRE directive, can be result as EO data entry in SDI.

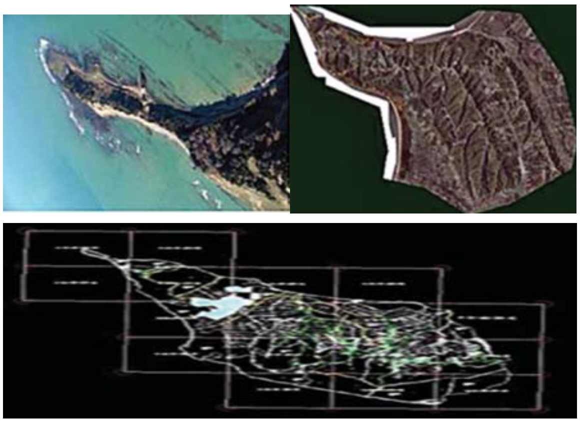
Ministry of Interior (MI) - Department of Local Authority in the MI is working since several years on the development of a geographic data system related to addresses register at a national level. From this system are expected to benefit all public institutions concerning the improvement in communication between them and the private sector and citizens. It allows the standardization of the addresses system with those of the EC. This system is expected to have many beneficiaries as well as an impact in the organization and planning of the territory, in the long process of property evaluation and compensation.

Figure 3 GIS for addresses system in Albania

Source: Internet [1]

ZRPP – Registration of Immovable Properties office [2,5**]**in collaboration with foreign organizations, as World Bank, Sweden Cadastral Survey, etc. is working on improving the immovable properties registration system. The completion of the GIS system for cadastral parcel and property registration and administration and the utilization of the ALBPOS, an satellite GNSS system, using of the orthophoto of 2007 for Index map and cadastral, are considered as the important products related to the implementation of the NSDI. From them will the public and private sector, as well as the citizens.

Fgure 5. Using orthophoto image for cadastral Index maps



Source: ZRPP [1]

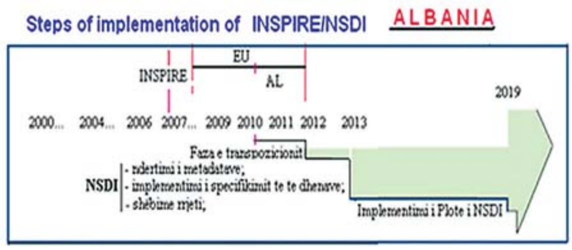
AKPT – Territory planning national agency currently has developed a GIS system for purposes of administration, planning and urbanization of the territory. This system results to be compliant to the NSDI requirements. During it's development, metadata and standards that can be integrated with NSDI layers have been utilized. Also others National Agency of Forest and Waters, National Agency of .Environment, Urban Offices in Municipalities or Cities Hall in Albania, Geo Private Companies have processed various geodata and themes till at the level of GIS. Those EO data in digital format can be an entry to INSPIRE.

2.5 A summary discution on the process of adoption of Inspire and implementation of NSDI.

By realizing a valuable lawful and institutional process where ASIG and BIG as the two responsible institution in the context of Directive INSPIRE, it is become clear that Albania has arrive in the point of beginning of SDI Implementation.

In the figure below is presented this process that was carry out during the years end of 2010 till now at year 2013.

Figure 5 Implementation of INSPIRE and NSDI



Source: Processed by authors [1,4]

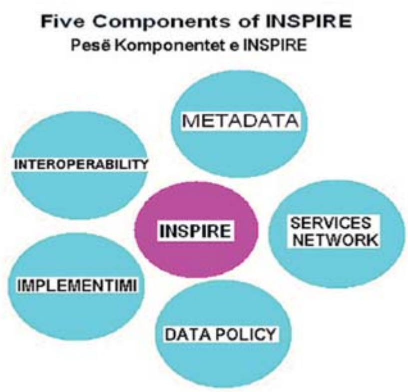
According to the reported situation on adoption and implementation of INSPIRE/ NSDI described through the topics of this paper, we were trying to offer an general and specific information the readers and more the EU geo Institution to take their attention and their support considering that Albania is a country included in the EC Enlargement process.

As this process can be evaluated as a positive and successful one, where establishing the ASIG and BIG as a package of laws and decision seems to be a good progress for Albania and in terms of realization of directive Albania is in the moment of starting the implementation of NSDI.

By reporting facts, activities and achievements during this, it should be aware that at the same time Albania has again questions to solve. Those questions are link with the realization of schema of five INSPIRE/ NSDI components: Data Policy, Metadata, Interoperability, implementation, network services.

Analysis on this figure in this context of progress done from Albania for adoption of Inspire and implementation of SDI should be done. This in order to understand **how** and **what** Albania needs more to do to realize this

Figure 6: Five components to implement INSPIRE/ NSDI



Source: Processed by authors [1,4]

schema, which seems to be very important for realization of directive in general.

All activities mentioned in the pre- paragraphs as well as some analyses of the situation where in the context of this schema have make evident even the weakness for each of them.

So, as the process of Directive adoption was developed referring the document of Inspire Directive EC/2007, again remain issues to be continued especially with the Regulations which should be arrange in the context of Metadata and Operability. It known that these two components are very important in the contexts of designing the NSDI in three levels: local (national), regional (Balkan) and European.

These arguments bring the question of treating the metadata and then operability and services. INSPIRE is a large standardization program, which should be realized or reflected to NSDI.

The metadata as it is known beyond its known definition as “data on data”, in the NSDI system is seen to be a component with functional property and to play an important role in building the SDI and to realise the process of data services to the response of demands for obtaining the various geospatial data products for public and private institutions as well as citizens.As it can be understand, Metadata have a key role in building of NSDI in order to achieve harmonization or operability [1,2].

In order that Metadata to be with the mentioned role, it should make evident that metadata can do this role in connection with standards and specifications as well as with the portal and data service network.

Realizing of this models or relation between those part make possible to oobtaining a working Schema which relate Metadata, Specifications and Networks Services to match the geo-standards in closed relation with European Organization and Agencies.

In order to realize those items of NSDI it, should be taken in account the classification of Themes in the Directive Inspire. It is obvious that Themes of Annex I are very important to be treated in the close relation with Geo European Organizations which are responsible and interested in the realization of NSDI in all EC countries. In real terms Themes of Annex I seem to be a common base for all NSDI of EC for their integration into a unique geospatial information system in European Level. It is understandable that Metadata of this Annex like Geodetic Coordinate Systems, Heights, Administrative Units, etc. should be arrange to in order to realize an operability from the local till in European Level of all NSDI. From this point of view Albania, specifically ASIG, should put contacts or to participate in European Organizations as JRC, Eurogeographics, Euref, etc. during the implementation of its SDI. It should start efforts to come close in specific organization with direct impact in the process of building the NASDI as IOC TF (Initial Operating Capability Task Force) or SDI_WG (Spatial Data Services Working Group). In the terms of Metadata refer the principles of INSPIRE for standards on them, it is clear that OGC and ISO standards are also obligatory to be aware and put relation from ASIG. Lack of a national geodetic authority for more than 20 years as well as that Albania has been for a long time in the Enlargement process have cause a weak membership of it in International Geospatial organizations and even a weak coherence with such organizations in Balkan and European levels.

Another question to be discussed is about the NSDI technologies for collection and processing the Geospatial Data. As it known that GPS (GNSS), Remote Sensing and GIS are three main technologies which are seen as to establish, process and maintain the NSDI. Actually Albania is facing up problems with functionality of ALBPOS (Albanian GNSS system) first due to institutional aspects and then even for expertise. This has cause that till now it is not functional., not integrated in the EUPOS, nevertheless that it was establish at the middle of 2010.

Attention also should be put on the applications of remote sensing. As the satellite images and their data and products are improving accuracy and spatial resolutions every year, it is understandable to see this technology as an important tool for implementation of SDI and for many other applications in the context of overall territory planning, road system development, urban infrastructure, study of coast line, etc.

In order to Albania to profit from this technology, it should establish a Centralized Remote Sensing Center under the ASIG dependency, to improve the expertise and education in RS as well as to increase the member ship in the international RS centers and institutions.

Increasing the expertise is connected even with the education. Improving the RS as a teaching subject in universities, as well as qualification of Albanian specialist in RS centers considering various themes in SDI suggested from Directive it would be a good perspective for the future and for the maintenance of system and for many other applications.

In the scope of Education, it should be also considered even the Public Administrate, especially the part of it which will use and obtain various geospatial data and information.

At the end thinking that this modest paper will attract the attention of the Geo European Organizations, we hope that after those organizations will become more interested and can increase their support for ASIG and BIG, in order Albania to make progress and go forward in the implementation of SDI.

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INSPIRATION – INSPIRE and beyond?

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Abstract

The countries of the Western Balkans have become the focus region of European enlargement activities during the last few years. The countries of this particular region are either EU candidate countries or potential candidate countries. Some are about to join the Union, like Croatia, others haven't yet started negotiations. In the process of joining the European Union accession countries have to adopt the EU legal framework and EU laws. One of the criteria for joining the EU is the establishment of EU conform legislation and administrative structures to be able to fully implement the INSPIRE Directive and the related implementing regulations as part of the Environmental Acquis Communautaire of the EU.

This paper aims at introducing the results of the INSPIRATION project which identified the major obstacles and supports the further development of SDI in the region. The project INSPIRATION – Spatial Data Infrastructure for the Western Balkan is focusing on three main areas of NSDI, the legal framework as well as the situation regarding SDI education and SDI awareness. Furthermore the paper will conclude with an outlook into the future in both terms, for SDI in the reason and for INSPIRE as such.

Keywords: INSPIRE, NSDI, INSPIRATION, SIIF

1 Scope

This paper aims at informing you on the activities and results of the project INSPIRATION – Spatial Data Infrastructure for the Western Balkan which aims at the assessment of the current status and the further support of the development of SDI in the Western Balkan Region. Furthermore this paper aims at providing an outlook on NSDI usecases beyond the planned technical infrastructure defined by the INSPIRE Directive. [1, 2, 3]

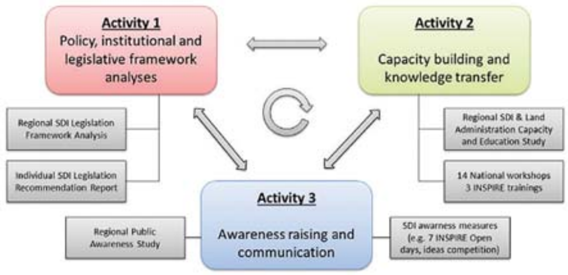
2 INSPIRATION Project

One of the key challenges the INSPIRATION project faces, are the different situations between the seven beneficiary countries – Albania, Bosnia and Herzegovina, Croatia, Former Yugoslav Republic of Macedonia, Kosovo, Montenegro and Serbia – in terms of level of SDI progression and expectations. Nevertheless all countries in the region are progressing regarding legal and technical SDI development as can be concluded from the first surveys and consultations during the inception and preparation phase. Beside the support of the individual SDI's and their legal frameworks it is the dedicated aim of the project to support and increase the already established regional dialog and cooperation concerning SDI. [4, 5]

In the following explanations the key activities of the INSPIRATION project as well as their respective results, recommendations and related individual measures will be introduced.

The major tasks of the INSPIRATION project are based on three major activities which represent the success criteria for SDI implementation - the legal & institutional framework, education & capacity building and awareness raising and communication.

Figure 1: INSPIRATION project structure



Source: INSPIRATION project [2]

2.1 Policy, institutional and legislative framework analyses

The further development and improvement of the legal framework regarding SDI is the key expectation of the beneficiary countries which will be supported by Activity 1 – Legislative Framework Analyses – of the INSPIRATION project. The analysis started with an assessment of the state of play regarding SDI and land management implementation on regional level which was the basis for the development of regional recommendations. Furthermore individual studies on the implementation of SDI in each of the countries of the region will be prepared. These individual national SDI studies are in alignment with the structure of the already existing State of Play Reports regarding INSPIRE to enable comparability and sustainability.

Based on the regional study results the project has stated huge potential for further improvements in the field of regional cooperation. Therefore the key recommendation of this activity and for the whole project is to extend already existing cooperation, to formalize them and to develop them towards an operational structure. The core objectives of the proposed regional cooperation are:

- Development of joint visions and strategies regarding SDI and spatial data
- Development of joint regional SDI services boosting economy, education and tourism
- Exchange of knowledge and best practices
- Joint fund raising

The structure proposed for this regional cooperation is divided into three levels - the decision level (a board), the operative level (a secretariat) and the working level (working groups).

2.2 Capacity-building and knowledge transfer

For realization of the national spatial data infrastructures (NSDI's), as well as for the regional SDI, and for adoption of the principles of the INSPIRE Directive and their implementation in the beneficiary countries an obvious precondition is the building up of human resources and capacities. SDI requires certain set of specific skills and knowledge different from the traditional land administration (LA) skill sets. Beneficiary countries already were aware of certain deficits in that regard, and the project had to give better understanding of the magnitude of that deficit comparing to the needs, but also to provide recommendations on how to address the gap.

Activity 2 – Capacity-building and knowledge transfer includes action on two levels: one is the study of the capacities and current education schemes, together with recommendations, and the other is implementation of the capacity building activities through trainings and workshops.

The study included a survey of capacities and current education schemes in which SDI stakeholder organizations filled in a questionnaire, a review of the university programs for geodesy and geomatics, and an assessment of the situation by the project´s local experts. Based on the assessment of all filled in questionnaires, a comparative analysis of the cadastral agency´s responses and the SWOT analysis for the region a set of recommendations was developed.

First and central recommendation is to take advantage of the regional approach and organize capacity building for SDI on the regional level. Others recommendations are addressing the issue of education methodology, contain suggestions for curricula for SDI profiles, improvement of availability of data for education purposes and organizational support.

To facilitate knowledge transfer the project organized three regional trainings and 10 national workshops. Through these, information on concepts and practical implementations was relayed to the attendees - the employees of cadastral agencies and other SDI stakeholders from the beneficiary countries.

2.3 Awareness Raising & Communication

Results achieved under INSPIRATION project have even bigger impact on improvement of citizens' lives in the Western Balkans if all INSPIRATION' activities are well communicated among media and general public. Therefore, public awareness and sustainable and transparent communication is essential for the project to be visible and fully successful. The Awareness Raising & Communication (Activity 3) component of the

INSPIRATION aims at clarifying information on the state of play and analysis for future improvement of awareness raising measures targeting both, stakeholders and the public.

Spatial data infrastructure is not only about information technology it is rather more a process which relies on the contributions of a wide range of stakeholders. Therefore, the awareness of potential customers, stakeholders or users is a key indicator for the success of each information service. The process of detecting each country's state of play started in the second half of the year 2012. The Study analyses the state of awareness on NSDI and the expectation of the involved stakeholders regarding communication. The main messages (among others) from the survey were that cross sectorial communication including the economy should be improved and that all stakeholders see the governmental institutions as main responsible for communication and information. Based on the study results several measures to increase the political and public awareness were developed and implemented:

- INSPIRE Brochure in all national languages of the region targeting stakeholder and decision makers
- INSPIRATION ideas competition asking for GIS mash-up concepts targeting all especially the academic sector
- Information movie on SDI and INSPIRE with voice over explanations in all national languages of the region
- Individual awareness measure coordinated by the beneficiary country and supported by the INSPIRATION project

Further to the implemented measure the strengthening of national and regional communication was recommended. While for national communication a round table concept is proposed the regional communication should be facilitated under the umbrella of the proposed regional cooperation (Activity 1 recommendation).

3 INSPIRE and beyond

In the development of SDI on national level INSPIRE, with its clear roadmap and specifications, appears as blue print. It is often forgotten that the infrastructure initiated by the INSPIRE Directive serves the purpose of information sharing in the sense of the Aarhus Convention in the first place. But it is still not a holistic SDI approach and actually only a subset of data relevant for eGovernment and economic purposes is considered. Therefore it is important to see INSPIRE not as final stage of SDI development but rather as a building block towards an even larger and wider information and data infrastructure not limited to spatial data or environmental data any longer. [8]

Two of the main messages of INSPIRATION project to the beneficiaries were:

- National Spatial Data Infrastructures exceed the scope of INSPIRE in terms of horizontal coverage. Therefore the thematic coverage of SDI has to be considered as much wider.
- INSPIRE defines not the end point and final goal of SDI development and implementation. INSPIRE has to be seen rather as initial trigger.

The first developments for data flows taking advantage of INSPIRE but also widen its scope can be observed in Europe already now. Especially in the environmental sector, who is also the main scope of INSPIRE, several initiatives started to develop thematic data infrastructure. One example is the plan for development of "Structured Implementation and Information Frameworks" (SIIF). These thematically oriented infrastructures shall be developed for all key environmental laws serving the purpose of updating the environmental reporting mechanisms to European standards to increase interoperability and enhance public information, participation and visibility. [9]

The SIIF are supposed to use INSPIRE data and infrastructure specifications in order to enable interoperability between the independent environmental reporting and data flows. The development of SIIF started for environmental law related to different water issues in 2013, such as urban waste water treatment (UWWTD). [10]

Another example for extended use of INSPIRE data and service specification is the predecessor of the ongoing SIIF concepts, the Implementing Provisions for Reporting (IPR - 2011/850/EU) under the Air Quality Directive (2008/50/EC). This example of eReporting which is already implemented in European law is considered as the first environmental information and data flow which explicitly integrated INSPIRE specification to achieve interoperability even if the thematic range of the reporting is much wider as the data requested by INSPIRE. [10]

These two examples – air quality eReporting and SIIF concepts – provide an idea of the further development of information infrastructures and their mutual connection in different fields using commonly used IT standards.

The countries of the region are facing a wide range of difficulties on their way towards EU accession. The INSPIRE directive and the development of infrastructure for spatial data is just one of the challenges. But in the process of development it is important to keep in mind that the original scope of SDI can be much wider than the scope of INSPIRE.

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Status of Croatian NSDI

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Abstract

Article gives an overview of the status of the Croatian National Spatial Data Infrastructure (NSDI). New National Spatial Data Infrastructure Act is transposing INSPIRE Directive in Croatian legislative. It fulfils EU preaccession obligations of the Republic of Croatia. NSDI Act is making Croatian legislative compatible with EU, and it makes basis for development of Croatian NSDI. It is one of the main milestones on the path of development of NSDI. NSDI Act is defining State Geodetic Administration as National Contact Point (NCP). It is a new NSDI organizational body. NCP established and maintains Register of NSDI subjects and Register of NSDI spatial data resources. At the moment nearly 30 subjects and 70 sources of spatial data resources are registered in NSDI. NSDI registers are living documents. To define NSDI spatial data themes, NCP published document NSDI Definition of Data Specification Annex I and II Themes and Scope. NCP also published new version of NSDI Metadata Specification. In development are new regulations and documents as Strategy of Croatian NSDI, Agreement on Exchange, Access and Use of Spatial Data and Services in NSDI and NSDI Business Model. The NCP is working on establishing the NSDI Geoportal. Development of NSDI Geoportal is connected to financing through EU Instrument for Pre Accession assistance project (IPA). The project started recently, after more years preparations. The first realize of NSDI Geoportal can be expected soon. To promote NSDI, data sharing and exchange of knowledge NCP is regularly updating NSDI web site (http://www.nipp.hr), organizing traditionally annual NSDI and INSPIRE Days conferences, organizing NSDI Workshops with NSDI subjects and promoting NSDI on other conferences. Considering future development, after transposing INSPIRE Directive in Croatian legislative by NSDI Act, new development platform is defined. Several new obligations and responsibilities are defined. System of monitoring and reporting to EU should be developed.

Keywords: NSDI, NSDI Act, National Contact Point, NSDI Registers, metadata.

1 Introduction

The importance of spatial data, their products and services have for a long time been recognized as the infrastructural foundation for the development of society. European Commission (EC) established INfrastructure for SPatial Information (INSPIRE) as Community policy on the environment, but it is developed in Spatial Data Infrastructure (SDI) that is serving as the basis for development of the branches on the EU and national levels.

State Geodetic Administration (SGA) has obligation to implement INSPIRE Directive about establishing an Infrastructure for Spatial Information in the European Community. New Croatian National Spatial Data Infrastructure (NSDI) Act fulfils one of the EU pre accession obligations of the Republic of Croatia. It is making Croatian legislative compatible with EU and making legislative basis for development of legislative, organizational, technical and other aspects of NSDI. NSDI Act is one of the main stones on the path of development of NSDI.

The NSDI Act is defining State Geodetic Administration (SGA) as INSPIRE and NSDI National Contact Point (NCP). NCP has the new NSDI organizational structure. NCP is the main NSDI coordination body with responsibility to make platform for development of NSDI on the national level, and it is serving as the link between Croatian and EU spatial data infrastructures. NCP is developing cooperation and partnership on national and international level as one of the essential prerequisites for the development of society, economy and the NSDI.

By the NSDI Act NSDI bodies, their goals, tasks and activities are redefined. NSDI Act is defining role of NSDI Council as governmental body serving as NSDI umbrella organization. Structure of the NSDI Council is defined as governmental body joining primarily institutions on the level of ministries, but also having members from public bodies, representatives of the branches and National Contact Point. Role of NSDI Board is to make link between NSDI Council and NSDI Workgroups. Members of the NSDI Boards are from NSDI Council, NCP and NSDI Workgroups.

Considering development of NSDI and obligations from NSDI Act, National Contact Point established some of the new regulations and documents:

- Register of NSDI subjects [8],
- Register of NSDI spatial data resources [7]
- NSDI Annex I and II Data Specifications [6],
- NSDI Metadata Specification, version 2.0 [13].

Established registers of the NSDI subjects and NSDI spatial data resources are defining NSDI family. Until now about 70 spatial data resources and about 30 spatial data stakeholders have been registered in the NSDI making NSDI operational basis.

Development of new regulations and documents as NSDI Strategy, Agreement on exchange, access and use of spatial data and services in NSDI [9] and NSDI business model are in progress.

To raise awareness of importance and possibilities of spatial data and NSDI, NCP is using several tools, from regularly updating and maintaining official NSDI web site, organization of annual NSDI and INSPIRE Day events, organization of NSDI Workshops, presentations on the conferences, workshops and meetings and other.

NSDI and INSPIRE Days conference, because joint meetings known as SDI Days, is annually organized and until now five conferences were organized. This year the SDI Days **have a special importance because of Croatian membership in EU.** SDI Days are contributing to development of spatially enabled society [1], [5].

2 National Spatial Data Infrastructure Act

The main activity of the NSDI community until the 1st of July 2013 was adoption of NSDI Act which represents stand-alone law defining establishment, maintenance and development of the National spatial data infrastructure in the Republic of Croatia. NSDI Act represent transposition of INSPIRE Directive [10] in Croatian legislation.

Working group for INSPIRE transposition was set up at SGA consisting of three lawyers and three SDI specialist. Working group drafted first version, and it was delivered to NSDI working groups (approximately 40 persons in five WG). The draft NSDI Act was presented and discussed on the 2nd NSDI Workshop organized from 19th to 20th February, 2013 in Zagreb. Opinion about the NSDI Act was also given by experts from INSPIRATION project. In an iterative process the Act was finished, and after public hearing adopted in May 2013 [11], [3].

Generally, NSDI Act is divided in the main chapters:

1. General provisions
2. NSDI establishment and maintains
3. NSDI bodies and National contact point
4. NSDI development
5. Supervisions
6. Responsibility and penal provisions
7. Transnational and final provisions

One of the differences from INSPIRE Directive is that NSDI in Croatia has 35 data themes and INSPIRE has 34 data themes. The new data theme is Data on suspected minefields area which represent data of national interest.

3 NSDI Bodies

NSDI Act defines also the NSDI institutional framework. Three levels of organization are defined. NSDI bodies are (Fig. 1):

- The NSDI Council,
- NSDI Board,
- Workgroups.

Figure 1. NSDI bodies

The supreme governing body is the NSDI Council. It is the body at the highest, political level. The NSDI Council is responsible for leading the establishment of the NSDI and the coordination of the activities of the NSDI subjects, and it is a body which implements the National Spatial Data Infrastructure within the Republic of Croatia.

Croatian Government, at its session on the 1st of August 2013, adopted the appointment of the president and members of the National Spatial Data Infrastructure according to NSDI Act. The Council has 17 members, and the President of the NSDI Council is Minister Ms. Ana Mrak Taritaš, from the ministry responsible for the operation of the National Contact Point.

The NSDI Board is appointed by the NSDI Council. It makes organizational and coordination link between NSDI Council and NSDI Workgroups. There are six workgroups. New Workgroup on NSDI Spatial Data was established because importance of maintaining NSDI spatial data. Workgroup defined the register of NSDI spatial data and subjects. Workgroup will deal with NSDI Metadata, spatial data model transformation and support NSDI spatial data stakeholders.

Heads of workgroups are appointed by the NSDI Council. SGA which represent "nucleus" of NSDI is acting as National Contact Point (NCP). Secretary of the NSDI is coming from NCP.

4 National Contact Point

According to NSDI Act the State Geodetic Administration is the NSDI NCP in the implementation of the INSPIRE Directive. The NCP is responsible for communication with the bodies of the European Commission regarding the implementation of the INSPIRE Directive, efficient development of the National Spatial Data Infrastructure and performs secretarial tasks and coordination of the NSDI bodies as well as technical support services of the NSDI establishment, maintenance and development [2].

After the NSDI Act, SGA has double role. It is serving as the NSDI NCP that coordinates the activities of NSDI subjects within the scope and with rights and obligations determined by the Law, and SGA has the role of the NSDI subject providing basic NSDI spatial data resources.

According to the Law on the NSDI the NCP shall:

- prepare draft NSDI strategy and operational programs for the Government of the Republic of Croatia,
- maintain the register of NSDI spatial data resources and NSDI subjects,
- develop a detailed description of spatial data themes,
- establish, maintain and monitor the work of the NSDI Geoportal,
- establish and maintain metadata public service within the NSDI Geoportal in a manner that enables NSDI subjects interactive maintenance of metadata within their competence,
- work on spatial data interoperability and, where necessary, homogenization,
- coordinate and monitor the application of implementation rules in the Republic of Croatia,
- develop and propose to the NSDI Council a program of activities and measures necessary to meet the conditions for spatial data infrastructure establishment, maintenance and development,
- prepare reports on the implementation and use of spatial data infrastructure for the European Commission, Croatian Government and public,
- in coordination with the NSDI bodies, propose national implementing rules,
- cooperate with the European Commission related to the INSPIRE Directive,
- inform the NSDI subjects and the general public about the activities concerning the establishment, maintenance and development of the NSDI,
- monitor the application and provide suggestions for improving NSDI implementation in practice.

5 NSDI Registers

The NSDI subject are defined by the NSDI Act as public authorities whose competences, i.e. scope of work, include establishing or maintaining spatial data, pursuant to the NSDI Act.

But, also a third party may become an NSDI subject if fulfils the conditions set out by the NSDI Act:

- spatial data resources are within the scope of a third party work,
- spatial data resources within its scope of work are included on the list of spatial data themes pursuant to the NSDI Act,
- spatial data resources within its scope of work are in line with technical requirements or rather the NSDI implementation rules.

The NSDI Council should make final decision considering third party to become the NSDI subject.

NSDI spatial data resource that should be registered in NSDI may be a spatial data set, series of spatial data sets or services. NSDI spatial data resources, after the NSDI Act, should fulfill the conditions:

- they apply to the territory of the Republic of Croatia, its internal sea waters, territorial sea, epicontinental belt and its ecologically protected or economic areas and other areas where the Republic of Croatia exercises sovereign rights,
- they are in electronic format,
- they are under the authority or within the scope of work of NSDI subjects,
- they apply to one or several NSDI data themes,
- they do not apply to classified spatial data.

In the case when there are several identical copies of spatial data, only the original version of the data can be NSDI spatial data resource. NSDI Act does not impose the collection of new spatial data.

The NSDI spatial data resources and NSDI subjects are making the NSDI operational basis and according to the Law on National Spatial Data Infrastructure, National Contact Point is obliged to establish and maintain:

- Register of NSDI subjects,
- Register of NSDI spatial data resources.

Workgroup for NSDI spatial data in cooperation with the NCP prepared a proposal of content of the registers. Draft Registers are given to members of the NSDI bodies on discussion and to public on the NSDI web site (http://www.nipp.hr).

Register of NSDI subjects contains unique code number, contact details, data about legal basis for competence on spatial data source, title and unique code number of spatial data sources under its competence as well as date of becoming NSDI subject.

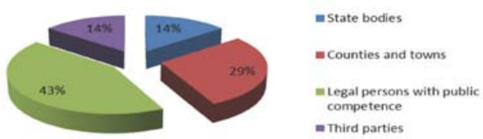
Register of spatial data sources contains unique code number, name, short description, type of sources, data format, URL addresses, data about responsible subject, affiliation to spatial data theme, geographic coverage, access and use conditions as well as date of inclusion into NSDI.

NSDI Council has adopted the registers on meeting held on September 11, 2013. The registers were distributed to the "potential" NSDI subjects and they were asked to fill the registers. At the moment (September, 2013) nearly 30 subjects and 70 sources of spatial data are registered. It could be notified that the following groups of NSDI subjects are registered:

- state bodies,
- regional and local authorities,
- legal persons with public competences,
- third parties.

Figure 2 shows distribution of registered NSDI subjects (September, 2013) according to the above mentioned groups.

Figure 2: Distribution of registered NSDI subjects



According to the NSDI Act, NSDI subjects are public institutions (state bodies, regional and local authorities and legal persons with public competences) whose competences, i.e. scope of work, include establishing or maintaining spatial data that are defined by the Law. Third party could become NSDI if it fulfils requirements defined by the Law. It is recognized that there are many third parties in Croatia. They have very valuable spatial data and are willing to be part of NSDI. Therefore, National Contact Point will take the necessary measures to put proposal to the NSDI Council to welcome them into NSDI family.

It was already mentioned that NSDI subject have registered about 70 spatial data sources. State Geodetic Administration is responsible for the most spatial data themes from Annex I and II of the NSDI Act.

Trough initial process of identifying NSDI subjects, meetings of the National Contact Point with spatial data stakeholders and trough discussion on the NSDI Workshops specific spatial data themes groups can be articulated. Sometimes they are covering more NSDI spatial data themes and sometimes they are narrow part of some NSDI spatial data theme. This relations and spatial data groups is results of characteristic Croatian development of spatial data legislative, maintaining, distribution and use of spatial data.

The approach to define NSDI subject through request that spatial data stakeholders recognize themselves as NSDI subject is only initial approach. In the other EU Member States NCP exercises more methodologies to define NSDI spatial data stakeholders important for NSDI. The approaches are not based only on legislative principles, but also on maintaining of spatial data important for NSDI and society.

Data in the established NSDI registers represent the initial versions. There is a huge work now to detect other NSDI subjects and there spatial data resources. NSDI registers are living documents.

6 NSDI Metadata

When using spatial data, such as maps in raster or vector format in GIS environment, spatial databases, or when downloading data through a web-service, we often don't know or are not sure who collected the data, to what epoch refer the data, what is the quality of the data, in what coordinate reference system the data are, what is a version the data format or other information about data that allow them to be used and interpreted properly. Such data and products and services created and based on them have a lower value. To avoid these problems, metadata are collected. Metadata are integral part of data. Important actions related to data resource have to be documented through metadata.

To enable NSDI discovery service, harvesting and communications between different metadata systems, metadata systems should be developed considering strict standardization and specification systems. Croatian NSDI metadata profile fulfills ISO standardizations requests [12], [13]. It is extension of INSPIRE metadata profile, and it is compliant with INSPIRE metadata system.

International standardization and spatial data harmonization are essential to make a background for streaming spatial data sets and an interaction between services, making spatial data more interoperable. Spatial data interoperability is one of the main focuses of the INSPIRE and NSDI.

NSDI metadata editor and related discovery service are going to be released in the first version of the NSDI Geoportal.

7 NSDI Geoportal

The National Contact Point should establish, maintain and develop the NSDI Geoportal for the purpose of managing the metadata and providing the services to discover, view, download, transform and invoke the spatial data resources as well as other information regarding the NSDI.

Development of NSDI Geoportal is connected to financing trough EU Instrument for Pre Accession assistance project (IPA). The project started recently, after more years preparations. It is expected that the first version of NSDI Geoportal is going to be published very soon. The first version will have functionality of collecting metadata trough metadata editor, discovery service and view service. How many data resources will be included in view service in the big mater depend of published services of spatial data stakeholders. Download service, as download prepared files packages, is also planned to be in the first realization of NSDI Geoportal. Transformation, invoke and other services will be developed in the second NSDI Geoportal development phase that will follow soon the first phase.

NSDI Geoportal should enable discovering as well sharing the spatial data and services between ministries, institutions, private sector and citizens. Spatial data services and products create the basis for new development cycle, as a basis for investment and economic development.

8 Future development

After transposing INSPIRE Directive in Croatian legislative by NSDI Act several new obligations and responsibilities are defined; as monitoring and reporting to EU, making official NSDI subjects and NSDI spatial data resources, future development of NSDI legislative basis considering NSDI Strategy, Agreement on exchange, access and use of spatial data and services in NSDI are in progress. NSDI Strategy will be basis for making NSDI Operational Program.

Documents Agreement on Exchange, Access and Use of Spatial Data and Services in NSDI as well as NSDI Business Model are in progress and will be basis for developing system of licensing spatial data [4].

NSDI Geoportal should be made operational. It will enable collection of NSDI metadata through metadata editor and discovery services in the first phase of development, as well as development of view and download services. Transformation, invoke and other services will follow the first phase very soon.

NSDI monitoring and reporting system should be developed. It should include activities as collection of data from NSDI subjects, but also real time monitoring of NSDI spatial data services if they are NSDI/INSPIRE compliant.

To promote NSDI, spatial enabled society, sharing of data and ideas considering an interdisciplinary character of NSDI National Contact Point is:

- using NSDI web sites (http://www.nipp.hr),
- organizing traditionally annual NSDI and INSPIRE Days conferences,
- organize NSDI Workshops with NSDI subjects,
- promoting NSDI on other meetings and conferences.

9 Conclusions

In the recent year the new National Spatial Data Infrastructure Act is made official. It fulfils EU pre accession obligations of the Republic of Croatia, and it is transposing INSPIRE Directive in Croatian legislative. NSDI Act is making new basis for development of Croatian NSDI. State Geodetic Administration is defined as National Contact Point (NCP) as a new NSDI organizational body.

NCP established and maintains Register of NSDI subjects and Register of NSDI spatial data resources. There are in the NSDI at the moment registered nearly 30 subjects and 70 sources of spatial data resources. NSDI registers are living documents.

NCP published documents NSDI Definition of Data Specification Annex I and II Themes and Scope and the new version of NSDI Metadata Specification.

Under development are new regulations and documents as Strategy of Croatian NSDI, Agreement on Exchange, Access and Use of Spatial Data and Services in NSDI and NSDI Business Model.

The establishment of NSDI Geoportal is connected to financing trough EU Instrument for Pre Accession assistance project (IPA). The project recently started, after more years preparations and the first realize of NSDI Geoportal can be expected soon.

To promote NSDI, data sharing and exchange of knowledge NCP is regularly updating NSDI web sites (http://www.nipp.hr). It organizes traditionally annual NSDI and INSPIRE Days conferences and NSDI Workshops with NSDI subjects as well promoting NSDI on other meetings and conferences.

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Near Real-time Risk Assessment During Spring Flooding in 2013

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Abstract

Planning for a flood is too late once the water level start rising. Effective implementation of policies and procedures depends on quality of pre-emergency planning. Croatian National protection and rescue directorate use GIS based Land information system (Zemljopisni obavijesni sustav – ZeOS) in utilizing geoinformation technology and national spatial data infrastructure for advanced strategic planning.

During the catastrophic events many unexpected situations arise and tactical near real-time disaster response is crucial to effectively manage the risks associated with floods. Reliable monitoring system based on spatial data infrastrusture will ensure saving human lives and livelihood, as well as utility infrastructure, facilities and livestock protection.

This paper will present usage of Near Real-time Risk Assessment During Spring Flooding in Croatia in 2013. on the examples of Sava and Dunav-Drava river basins. Hydrological and predictive models, real-time measurements and aerial data used as spatial decision support system will be presented and discussed.

Keywords: Flooding, GIS, Near Real-time Risk Assesment

1 Introduction

Planning a response to floods is too late once the water level start rising. Preparations for disaster management must be done far in advance. Effective implementation of policies and procedures depends on quality of pre-emergency planning. Croatian National protection and rescue directorate use GIS based Land information system (Zemljopisni obavijesni sustav – ZeOS) in utilizing geoinformation technology and national spatial data infrastructure for advanced strategic planning..

During spring flooding period in 2013., Sava and Dunav-Drava river basins watercourses have reached very high water-levels and combined with high precipitation these days have represented serious threat for human lives and properties.

2 NSDI at National Protection And Rescue Directorate (DUZS)

NSDI in Croatia is still in developing phase but data exchange between State Geodetic Administration and National Protection and Rescue Directorate is present at satisfactory level. However, data provided by State Geodetic Administration is not always in useful form, rather some conversions and geoprocessing is needed to make this data usable for analysis, disaster management planning, flood prediction, inventoring livestock, farms and other private and industrial properties, maps and reports production.

For example, digital terrain model is received as collection of breaklines and geodetic z points and therefore proper interpolation method should be applied in order to produce DMR used for flood prediction analysis.

2.1 GIS at National Protection And Rescue Directorate (DUZS)

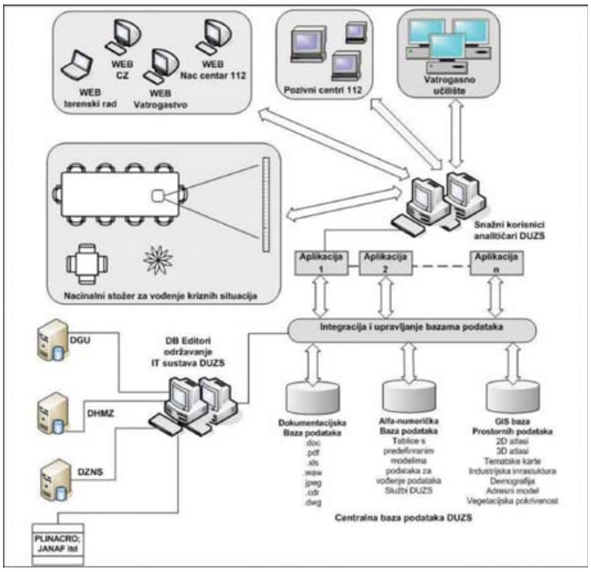
GIS staff at National Protection and Rescue Directorate is educated in the field of Geographic Information Systems (and constantly developing) so they manage at certain level to deal with uncollated data received from State geodetic administration and other institutions (like Croatian Water Agency). Protection and Rescue Directorate GIS Sector has built and now maintain their own GIS database. In the same time, they communicate with other stakeholders in order to develop Croatian NSDI.

2.2 GIS based Land information system (ZeOS) [1]

Croatian National protection and rescue directorate has developed GIS based Land information system (Zemljopisni obavijesni sustav – ZeOS) with the functionalities of Data production, Data warehousing, Spatial Queries and Analysis and Mapping.

ZeOS is based on ESRI ArcGIS software platform customised to end-user needs. Main users are Emergency teams at 112, Police, Firefighters but also DUZS analysts. Architecture of the ZeOS is described in Figure 1.

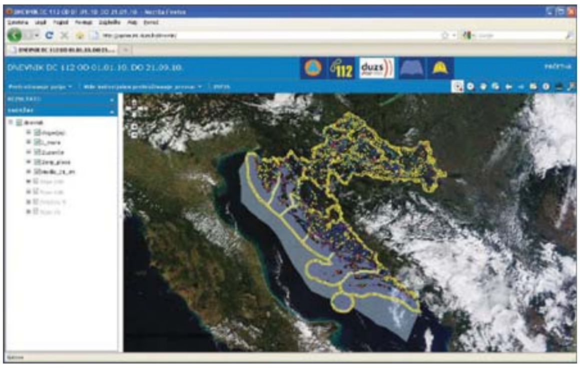
Figure 1: ZeOS architecture schema.



Example of ZeOS web application (112 Event Register) is shown in Figure 2.

ZeOS has become common tool at DUZS and is constantly upgrading number of users, infrastructure and functionality.

Figure 2: ZeOS web application.



2.3 Near Real-time Risk Assessment

Endsley (1988) has defined Situation Awareness as »the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future,« Gaining situation awareness involves identifying the current conditions that confront the emergency managers: what risks threaten, what damage has occurred, what weather or other conditions would affect response, and what resources are available (Comfort, Dunn, Johnson and Skertich, 2004).

The outcome of Near Real-time Risk Assessment during the spring flooding 2013. was the production of flood hazard and flood risk maps to be used in the spatial decision support system combined with the near real-time weather information and rainfall scenarios.

In order to accomplish that task, GIS staff at Croatian National protection and rescue directorate supported by GIS Institute experts has produced Digital Elevation Model based on State Geodetic Administration measurements, and also collected many other alphanumeric and spatial datasets to be used in ZeOS.

Based on that data, spatial analysis tools were applied to illustrate possible scenarios.

2.4 Real world examples

Figure 3 describes outcome of GIS analysis combined with water gauge Batina near real-time data (+731 cm). Red areas on the map represent lower terrain which was at the flooding risk in that particular moment.

Most vulnerable points and potentially affected areas in the event of breakage of the embankment, mine suspected areas and endangered farm with the number and type of different livestock were shown on the topographic maps. An example of such a map is illustrated in Figure 4.

Figure 3: Near real-time analysis on Dunav river.

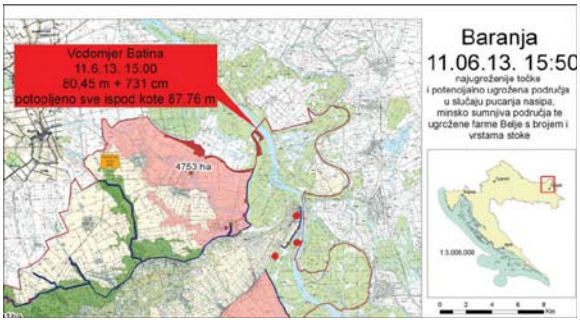


Figure 4: Mapping endangered areas.

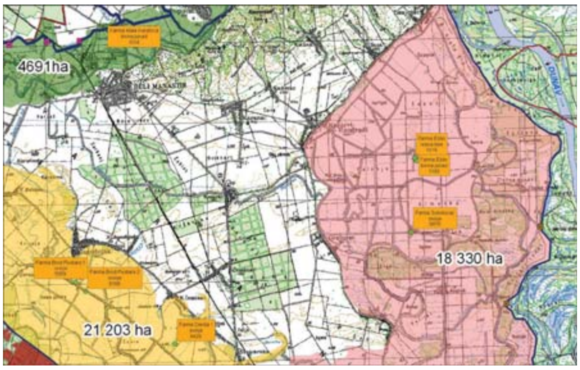


Figure 5: Presenting number of people and livestock.

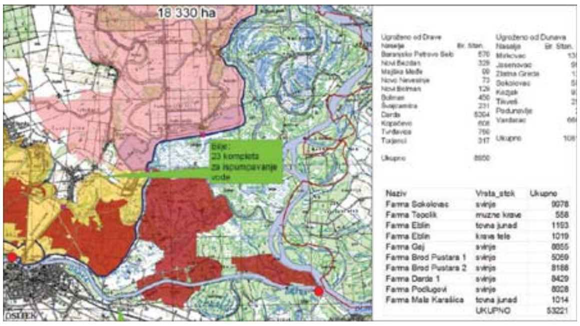
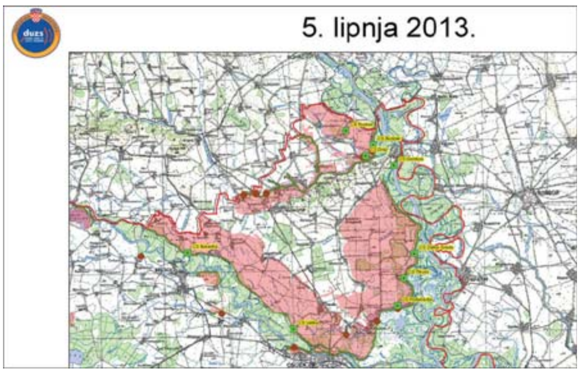
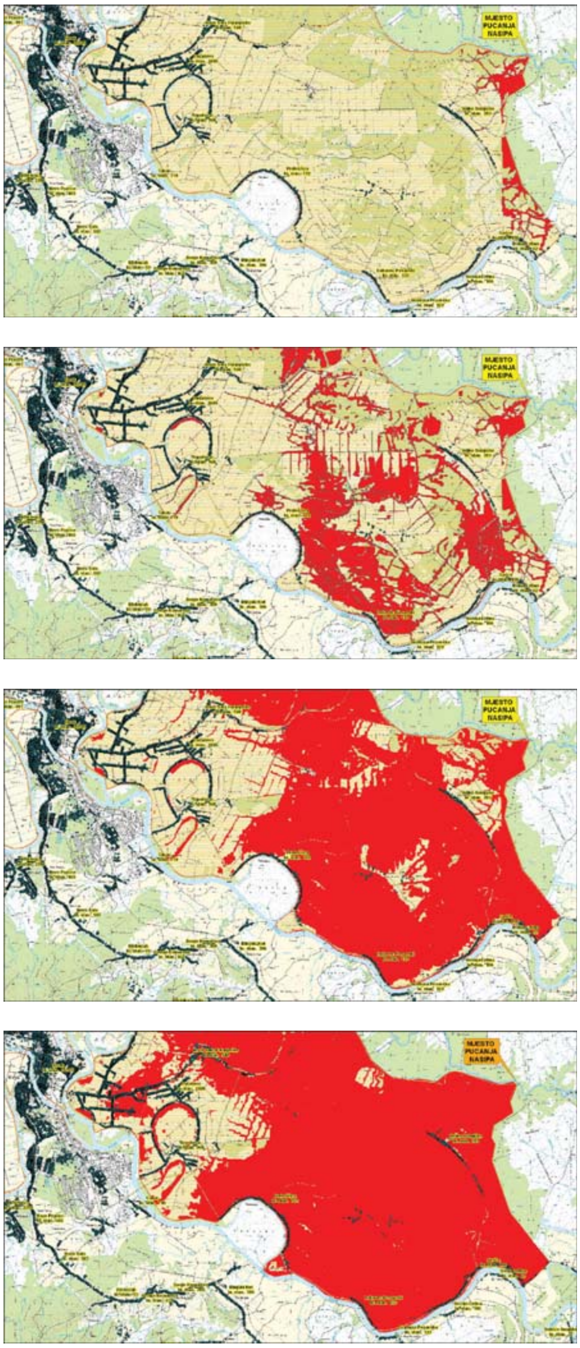


Figure 6: Mapping Floodgates and Pumping stations.



Knowing where the assets are, and dynamically tracking the changes of flooded and therefore closed roads is of vital significance in every emergency situation. Furthermore, large part of the Croatian territory is covered or suspected to be covered by land mines and explosive devices. Affected flood areas were no exception. Mine suspected areas were mapped dark brown in the map. Tables with number of people with permanent address and inventory of livestock were also produced.

Figure 7: Prediction of flooded areas.



Floodgates and Pumping stations locations were presented on the series of the overview maps.

Earlier in the 2013. river Sava high water level combined with high background waters have caused emergency situation and GIS analysis was made to illustrate flooded area prediction in the event of breakage of the embankment after 1, 2, 3 and 4 hours.

3 References

[1] Antolović, A. (2010): Land Information System at National Protection and Rescue Directorate, 2nd Croatian NSDI and INSPIRE Days, Opatija.

The position of Agreement on exchange, access and use of spatial data and services within NSDI

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Abstract

Being an EU member Croatia is subjected to The Lisbon Treaty which is the latest of the Treaties which, to date, have amended the Treaties on the basis of which the Communities and the European Union were founded. According to The Lisbon Treaty in order to exercise the Union's competences, the institutions shall adopt regulations, directives, decisions, recommendations and opinions.
A regulation shall have general application. It shall be binding in its entirety and directly applicable in all Member States.
A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods.
A decision shall be binding in its entirety.
A decision which specifies those to whom it is addressed shall be binding only on them. Recommendations and opinions shall have no binding force.
Therefore, Commission Regulation (EU) No 268/2010 of 29 March 2010 implementing Directive 2007/2/EC of the European Parliament and of thr Council as regards the access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions (also known as „implementing rules for data sharing") is already part of our national law and INSPIRE directive's results ought to be achieved through recently adopted NSDI law.
Following the main principles set in this directive and regulation, adjusting them to national practice and legacy, the working group is continuously making effort in order to find the simplest and „fit to all" model of The agreement on the exchange, access and use of spatial data. The main role and purpose of this implementing instrument is to set in advance the term of uses and to remove an obstacles which might occurred at the point of use.

Key words: treaty, regulation, agreement, data sharing.

1 Introduction

Being an EU member Croatia is subjected to The Lisbon Treaty which is the latest of the Treaties which, to date, have amended the Treaties on the basis of which the Communities and the European Union were founded.

The Treaty came into force on the 1stdecember 2009 and has modified legal and institutional framework of the European Union (EU) which replaced the previous term European Community (EC) and had renamed the EC Treaty to " Treaty on the Functioning of the European Union" in parallel to the "Treaty of the European Union".

The „Treaty of the European Union" originated from Maastricht 1992 sets out the EU constitutional basis while „Treaty on the Functioning of the European Union" (originally signed in Rome in 1958 as the Treaty establishing the European Economic Community), lay out how the EU operates.

2 Legal frame for the Agreement on exchange, access and use of spatial data and services – hierarchy

The reduction and simplification of legal acts is more than welcomed. Before the entry into force of the Treaty of Lisbon, which introduces a new classification for legal acts, there were ***fourteen*** types of legal acts which could be adopted by the EU institutions. Now, they may adopt only ***five*** types of act.

Croatian national legal hierarchy has very long and firm tradition therefore is well known: Constitution, International agreement (ratified and published), Law, Regulations and bylaws.

2.1 Lisbon Treaty

According to The Lisbon Treaty in order to exercise the Union's competences, the institutions shall adopt ***regulations, directives, decisions, recommendations and opinions***.

- A regulation shall have general application. It shall be binding in its entirety and directly applicable in all Member States.
- A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods.
- A decision shall be binding in its entirety. A decision which specifies those to whom it is addressed shall be binding only on them.

Recommendations and opinions shall have no binding force. (1)

A new category, defined as delegated acts may also be considered as a further step towards the simplification. In this case a legislator delegates the power to adopt acts amending non essential elements of a legislative act to the Commission.

For example, delegated acts may specify certain technical details or they may consist of a subsequent amendment to certain elements of a legislative act. The legislator can therefore concentrate on policy direction and objectives without entering into overly technical debates.

However, this delegation of power has strict limits. In effect, only the Commission can be authorized to adopt delegated acts. Furthermore, the legislator sets the conditions under which this delegation may be implemented.

2.2 INSPIRE directive – NSDI law

Following the above mention definition which states that directives are legally binding to Member States, but not to its citizens, Croatia has fulfilled its membership obligation and transposed INSPIRE directive into national legislation through adoption of National Spatial Data Infrastructure Act (Official Gazzete no. 56/2013).

Data sharing chapter of the Directive is transposed through the Article 21 of the NSDI Act:

„The NSDI council shall adopt the general conditions for availability of spatial data sources for the purpose of interoperability or rather define the general terms for licensing as well as pricing, where applicable.

In defining general conditions, consideration will be taken to avoid all unnecessary limitations that could create obstacles in practice for the sharing of spatial data sources occurring during use and, at the same time, to ensure measures to prevent their unauthorised use." (2)

The INSPIRE Directive makes a reference to other Directives that may be applicable to the

Provision of spatial data sets and services, such as Directive 2003/4/EC on public access to environmental information and Directive 2003/98/EC on the re-use of public sector information amended by Directive 2013/37/EU of 26 June 2013 (PSI Directive).

The INSPIRE directive increases the technical access and practical use of spatial data, mainly for public bodies through the sharing arrangements, but also for the general public through the services. However, it does not influence the rights of the public to access data under the PSI directive, the environmental access directive or other national regulations on access to public information.

This means for example that one cannot refer to the lack of INSPIRE compliant services as grounds for refusing access to public sector information or environmental information under any of the mentioned directives. Furthermore, re-use of data provided for on the terms of the INSPIRE directive will still be regulated by European and national PSI regulations. (3)

2.3 Implementing rules for data sharing – Regulation

Hence, Commission Regulation (EU) No 268/2010 of 29 March 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the access to spatial data sets and services of the Member States by Community institutions and bodies under harmonized conditions (also known as „implementing rules for data sharing") is already part of our national law and is binding for each individual citizen and do not require transposition.

So the principles such as : terminology harmonization, restrictions on access, transparency, arrangements, metadata, use of spatial data and services, response time, reasons for limitation of use, etc., are not supposed to undergo any further adoption processes on national level. Only lawyer – linguists interpretation might be appreciated because some terms that are used requires further explanation in order to be properly interpreted on national level as it is strictly laid down by the regulation. For the time being there is no official translation of this document to Croatian language what means a more effort to beneficiaries in finding the „real meaning" of the term.

2.4 Terms of uses – NSDI Council decision

This is the new task stipulated by NSDI Act to the NSDI Council as the permanent highest level NSDI body. This is also a pavement to the modernization of legislation which will be capable to follow modern technologies and public needs.

The terms of uses adopted by NSDI Council, upon proposal of NSDI contact point as operational body, will be published on NSDI Internet site and thus mandatory to NSDI subjects. The process of changing or amending of the general conditions should be simpler and faster than the process of bylaws changes.

Detailed arrangements of these general conditions supposed to be the scope of the Agreement of exchange, access and use of spatial data and services as the lowest level act in this legal hierarchy. It is the instrument for data and service sharing implementation in the practice which has to be acceptable to so many different agreement parties.

2.5 Agreement on exchange, access and use of spatial data and services – implementing instrument

Pursuant to the main principles set in INSPIRE directive and respective Regulation, adjusting them to national practice and legacy, the working group is continuously making effort in order to find the simplest and „fit to all" model of The agreement on the exchange, access and use of spatial data. The main role and purpose of this implementing instrument is to set up in advance the term of uses and to remove obstacles which might occur at the point of use, i.e. to offer a prior settlements in a way that case by case negotiations, procurements, contracts, licenses etc. are no longer needed.

The NSDI Act had profiled two types of subjects:
a.) those who must participate ex lege:

- „NSDI subjects are public authorities whose competences, i.e. scope of work, include
- establishing or maintaining spatial data from Article 9, para. 1 and which are, pursuant to
- this Act, obliged to participate in NSDI establishment, maintenance and development."

b.) those who might become a subject:

- „A third party may become an NSDI subject if it fulfils the conditions set out by this Act, after the NSDI Council passes a relevant decision about it at the proposal of the National Contact Point."(2)

NSDI coordination components:

Guidance on the 'Regulation on access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions' created by Drafting Team for Data and Service Sharing and dated 09/01/2013 (revision) gives many valuable advices.

One of them, which we agreed to apply in our task of creating a framework agreement is „Stepwise implementation":

- „Trying to include the largest possible number of participants right from the beginning may prove to be unfeasible. It is therefore recommended to
- "think big", but to "start small". A successful approach is to go for a limited number of
- partners, preferably involving the sharing of data sets for which there is a general feeling
- amongst stakeholders that access to these data should be arranged for in the short term
- and for which a sufficiently important number of administrative or policy driven processes can make use of these data on a structural basis." (3)

Besides the fact whether subjects are obliged by the NSDI Act to participate in the agreement, they could also be differed according to their legal status: state level bodies, regional level bodies, local government and self-government level, or according to their financial status: budget financed, self financed, partially on budget partially on the market.

In parallel with this attributes it is not possible to have just one general framework agreement. Therefore a working group is suggesting "a first step agreement", ("stepwise implementation") which will include all respective state administration bodies financed by budget. The proposal will include a generous definition of granted usage rights as well as free of charge pricing model with strong obligation of the agreements' parties to prevent any unauthorized use.

Such proposal is in line with initiatives of open data government and it will affect numerous existing agreements within the state level bodies. There is no publicly available comprehensive information on how many such agreements currently exists and what is their financial flow and effect but it might be revealed after a short period of the implementation of NSDI.

Aware of the fact that long term practice cannot be changed overnight, exceptions must be predicted. So if any of the state level bodies considers that framework agreement does not cover some specific and applicable to all issues due to the nature of certain data or services, pricing, licensing or distribution, it will be possible to sign a "special agreement" between two or more subjects. That means that individual separate agreement between some state level bodies exists only if there is a justifiable cause but it has to be completely harmonized with general agreement i.e. no different meaning of the agreed terms etc. Signatures parties must publish information on existence of such agreement at NSDI Internet site.

The further step would be to create at least another two types of the agreements; agreement applicable to the public sector bodies other than state administration bodies and agreement for the third parties. That is a challenge for the working group to keep up with the main concept and apply it to so many different subjects at the best of their conveniences.

3 References

[1] Treaty of Lisbon (2007), OJ C 306, 17.12.2007

[2] National Spatial Data Infrastructure Act (Official Gazette no. 56/2013)

[3] Guidance on the 'Regulation on access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions', Creator DT Data and Service Sharing Date 09/01/2013 (revision).

Implementation of INSPIRE compliant national metadata catalog of physical plans

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Abstract

This paper describes technical implementation of INSPIRE compliant national metadata catalog of physical plans. The paper describes components that make up the final product, with special attention given to GeoNetwork and the role it plays in the final product solution.

Keywords:inspire, metadata catalog, physical plans, GeoNetwork

1 Introduction

One of the tasks of state, local and regional government is development of the physical planning information system. This IS consists of spatial registers and spatial informationconcerning physical planning, integrated into national physical planning geoportal.

As part of this IT development effort for Ministry of construction and physical planning, APIS IT developed custom solution for authoring, management and publication of spatial metadata of physical plans.

The requirements of the system called for specialized authoring interface that would consider clients specific organizational structure and decision making processes. Also, there was a requirement for the system to be able to hold data outside the core ISPIRE specification.

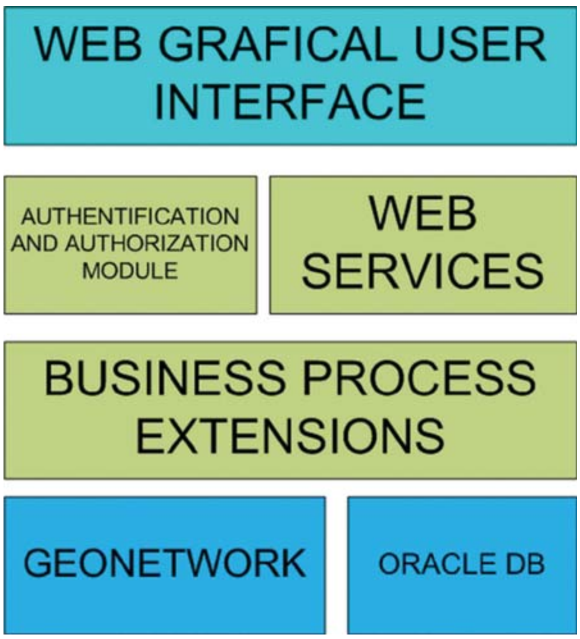
This paper will describe technologies used to develop this solution and the ways that they together make a robust system for metadata authoring, management and publication.

2 System arhitecture

The system is comprised of several components that work together to create the final product.

Figure 1 shows high level view of system architecture. Basically, this is a 3 tier web application. All custom parts of the solution were implemented using Microsoft® .NET with the exceptions of GUI which was implemented using Ext.JS open source library and of course the GeoNetwork. Both GeoNetwork and extra business data use Oracle® DBMS as their data store.

Figure 1: High level architecture



2.1 WEB GUI

The GUI layer of the system was implemented using ExtJS open source library. ExtJs was chosen for its user interface controls and framework for development of AJAX web applications.

Entire application is contained in a single web page, with all specific user interface elements and segments drawn on per need basis dynamically. This approach posed some unique challenges with regard to handling of user authorization and security. Parts of the interface had to be drawn or hidden based on the role of the active user and in a way that would be secure, so potential malicious user could not gain unauthorised access to the system.

This was achieved by careful modelling of authorization data models, combined with security checks in both client and server code. No operation can be performed, or specific data accessed, if user doesn't have the right privileges for them.

The final product is a modern and robust user interface with great user experience in which the operation flow is not interrupted with page reloads.

Figure 2: Search user interface

Figure 3: Authoring interface

These figures (2 and 3) show main user interface elements for searching and authoring of metadata.

2.2 Server components

Server components are comprised of authentication and authorization module, web services layer used by GUI and implementation of business process rules and workflows.

The main goal of this layer of the system is to implement metadata auditing and publishing features. The Ministry of construction and physical planning consists of dislocated organisation units responsible for metadata creation. One of the main requirements was to provide IT support for the existing organization and current business processes.

This was achieved by implementing an application layer on top of GeoNetwork that would handle proper metadata management. This layer ensures, for example, that the metadata, that hasn't been published yet, doesn't show up in any public searches, or that one organizational unit can't edit metadata records that belong to another unit.

In this architecture, GeoNetwork is reduced to the role of data storage and retrieval system, while its user interface and other features aren't visible to end users. More details about GeoNetworks role in the final system will be examined later in the article.

Because GeoNetwork handles metadata in XML format (all its services communicate in XML, and data is stored in XML in the database), business process extension layer extensively uses XML technologies like XSLT, XPath etc. This way the overall system design was much simpler and the development was faster.

2.3 Data storage

As mentioned earlier, in this system architecture, GeoNetwork has assumed the role of data storage and retrieval. Although we were aware that this isn't conventional use of GeoNetwork, this decision was made after careful consideration. Time that would take to extend GeoNetwork to meet the specifications would be greater than in case of the chosen approach. Also, user experience we would be able to deliver with the same effort would be worse if we were to take the GeoNetwork extension and customization route. Basically, we took the best from Geonetwork and integrated it in our solution.

All data that relates to business process extensions is stored in Oracle DMBS. Also, GeoNetwork was configured to use Oracle as its data store.

3 GeoNetwork

Geonetwork is open source spatial metadata catalog web application. It offers complete solution for metadata management, from metadata storage to discovery services.

Although all parts were not used, GeoNetwork still plays a central role in the final product and the entire solution was designed around it. This presented special set of challenges.

One of the biggest challenges was somewhat lacking documentation. This was the biggest problem in initial phases of development. Not knowing all its specifics in advance, we had to adapt overall system design on the go. As we got more familiar with GeoNetwork, development accelerated and we could plan ahead.

Current system uses 2.8 version of GeoNetwork. At the time of development latest stable version was 2.6.4.

3.1 XML schema customization

First task was to customize XML schema which were to be used in our solution. GeoNetwork comes with a set of XML schemas (called plugins) that can be used out of the box. One of those was ISO 19139. As this is the schema on which INSPIRE metadata specification is also based it was a natural choice for customization. This was one of the most challenging parts of the entire development. Official documentation is very scarce and it was difficult to distinguish between parts that were necessary to customize and parts that we could bypass, as they were used for user interface customization. As we chose not to use GeoNetworks user interface directly, we could skip those parts. Some work still had to be done so the plugin would be accepted by GeoNetwork.

In the end, we customized XML schema, and more or less cleared all parts of the plugin that were used for UI customization, so they can fall back to default behavior of ISO 19139 plugin. This way Geonetwok UI would still be usable for administrative purposes.

Along XML schema, some other customizations were needed. This part was well documented and we followed those instructions.

An interesting area of customization was Lucene configuration. As we added new data fields to XML schema we had to include those in GeoNetwork search capabilities. Lucene is an open source component which indexes all stored metadata. Those indexes are used in GeoNetwork search. Out testing proved the search to be very efficient.

To configure Lucene, we made customizations to index-fields.xsl inside our plugin, but also we had to make changes to config-lucene.xml, which is part of GeoNetwork configuration files. Changes in this file enabled some additional search capabilities like data tokenization which we needed.

Only problem that we could not solve, was to add date range search to our new date fields. After extensive research, and source code analysis, we found that this was not possible without making changes to GeoNetwork source code. This was not an option for us. We wanted to have unalteredGeoNetwork distribution, so we could easily upgrade to newer version as they come.

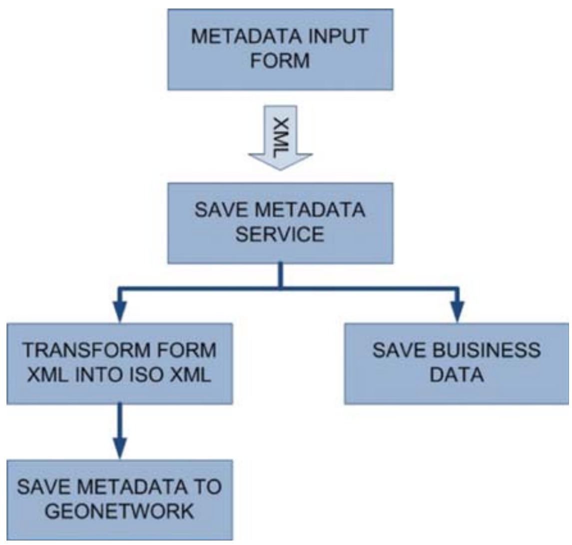
In the end we added this capability through our business process extension layer. Those date fields were replicated in our own database, and search results were included in those that came from GeoNetwork. Although this meant some data is replicated in two places, it was minimal amount and we gained feature that was needed by our system without interventions in GeoNetwork source code. Also, we already combined results from GeoNetwork with our business layer so it was a minimal intervention on application design.

3.2 Storing and retrieving metadata

Storing of metadata record starts when user chooses one of the options to save the record on metadata input form. Different save options are presented to the user, based on his role and current point in the lifecycle of that metadata record.

Figure 4 shows a simplified storing process. There are a couple of important areas. First thing to notice is that we send XML formatted data from our client application to web service. Normally this would be done with JSON, but that would create problems down the line. As GeoNetwork stores all metadata in XML format, it was very convenient and time saving to format our metadata records in some form of xml, as it first appears in

Figure 4: Metadata saving process.



the system. Ideally, that would be in same XML format in which it would later be stored. Unfortunately, XML format in which metadata ends up stored in GeoNetwork is too verbose, and those XML records tend to grow to 1MB in size. This is too large for internet transport. We had to define our own transport format, one that is small enough and flexible enough so it would be able to transport current and future metadata records over the internet.

Once record reaches the server, the process forks into two branches. Onesaves business data, like metadata record lifecycle data, organizational data and mentioned date ranges data. Other branch transforms the transportation XML format into ISO XML format using XSLT transformation.

For XSLT transformation we used Saxon XSLT transformer. We chose it because it supports XSLT 2.0 and it has superior performance to one that comes bundled with .NET framework.

To save metadata record to GeoNetwork, we used its xml web services (xml.metadata.insert). This part of GeoNetwork is very well documented, so we had no issues implementing this feature.

Similar to this process, metadata record retrieval first fetches XML from GeoNetwork, then transforms it to transport XML format and merges into it business data and then delivers it to the Javascript client that requested it.

For both sending and receiving XML on the client side, we use Javasript library we specifically developed for this purpose.

3.3 Search

As mentioned before, there was some work involved in configuring GeoNetwork to properly search for records within our customized data model. Biggest challenge was combining results from GeoNetwork and our business data. As the same search could find one set of records in GeoNetwork and the same or different records in in our business data. This was also additionally complicated by the fact that the user running the search may not have the privileges to see all the retrieved records.

To solve this problem, our search web service combines records from both sources and filters them through authorization module. This complex operation obviously brings a performance penalty, but with some optimizations and server side cashing we were able to achieve respectable performance.

Our general experience with GeoNetwork was twofold. On one hand we were able to deliver a quality product, one that could be easily reconfigured for other specialized metadata catalogs. We feel that Geonework saved us a lot of development time. On the other hand, initial development phases were tough as we found GeoNetworks documentation lacking on some crucial information. Getting the information we needed on some instances required inspections of its source code to understand how it works. This could have been potentially hazardous for us, but fortunately, we had a competent development team that was motivated to deliver on time.

4 Future development

Future development plans are to integrate our catalog solution with geoportal solution which was also developed for the Ministry of construction and physical plans. This requirement also played a role in some technological decisions that were made to ensure this integration would go seamlessly. Also, one of the major future areas of development is to open discovery (CSW) service. This will bring unique set of challenges as the same business data like metadata record lifecycle information have to be integrated in this service. Again, we will not be able to directly use GeoNetworks CSW service, but we will have to implement a wrapper around it.

5 Conclusion

Implementing this metadata catalog was challenging at times but also very interesting. In the course of development, we were able to learn a great deal about GeoNetwork. With hindsight, we would probably implement some parts differently, but this was our biggest challenge from the start. GeoNetwork started as a black box and design planning was very difficult. As the project evolved, our knowledge of GeoNetwork improved. Knowing those things beforehand would save us some development time. This is our biggest issue with Geonetwok. Lack of in depth documentation which forces one to learn by experience. But, we still feel that decision to use GeoNetwork was the right one and we would use it again.

The metadata catalog of physical plans can be publicly accessed at https://ispu.mgipu.hr/

6 References

[1] Geonetwork documentation (http://geonetwork-opensource.org/manuals/2.8.0/eng/developer/index.html)

Building Spatial Data Infrastructure Using Free and Open Source Software

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Abstract

In recent years the implementation of Spatial Data Infrastructures (SDIs) at all levels has become a very hot and important topic. The European Union Directive 2007/2/EC, Infrastructure for Spatial Information in Europe (INSPIRE), passed by the European Commission, defines a set of specifications for common data formats and services for SDI across Europe. All EU member states will have to transform national geodata to INSPIRE defined standards and make this data available through web services according to reference architecture defined by Open GIS Consortium (OGC), and in-line with ISO/OGC standard. There are a lot of ways to achieve this goal. Typical approach to the establishment of SDI implies the use of one of the leading proprietary software such as ESRI, Intergraph or MapInfo. On the other hand, a number of free and open source GIS projects (FOSS4G) of good quality have grown dramatically over the course of the last decade. Some of them have reached such a development in functionality that they can effortlessly replace a well known proprietary GIS programs. Reasonable and effective FOSS components for publishing, mapping, manipulation and editing geospatial information are developed. The purpose of this research paper is to present some of the well known solutions for the establishing SDIs based on FOSS components and to show that viable FOSS components can be an alternative to the proprietary solutions for the implementation of SDIs.

Keywords: Spatial Data Infrastructures (SDIs), Free and Open Source Software (FOSS).

1 Introduction

One of the most interesting developments over the past decade, if we consider a well-known fact that our society has become spatially enabled and one of commonly cited facts-phrase that “80% of data is geographic”, is the implementation of Spatial Data Infrastructures (SDIs) at all levels (government, counties, cities and large companies), with the aim to provide simple, interactive and flexible access to geospatial data.

The ability to appropriately access to high quality and up-to-date geospatial information is critical for decision makers at all levels. Therefore it is very important for society to build a portal where each stakeholder and the organizations can access, use, collaborate and exchange geospatial data for various activities in many sectors. It is important to understand that for these objectives we need internationally recognised standards which include the Open Geospatial Consortium (OGC), Infrastructure for Spatial Information in Europe (INSPIRE), and the International Organization for Standardization (ISO). Also, in some countries sharing geospatial data is enforced by law.

In the Republic of Croatia the State Geodetic Administration [14] is a central place for collecting, updating, controlling and distribution of current spatial data. On July 2012, a new Geoportal of the SGA was introduced. The geoportal presents central place for spatial data access. The new Geoportal is significantly improved regarding the previous one, considering the utilization and number of available spatial sets [12]. It is very interesting to note that this new Geoportal was developed using mostly Open Source Software which consisted of (but not limited to): Geoserver, PostgreSQL/PostGIS, OpenLayers, WordPress CMS and Linux OS [9].

This paper, in the first part, presents a general definition of an SDI and FOSS. Also paper proposes possible FOSS4G based SDI architecture. In the second part, the paper presents the Finnish national geoportal "Paikkatietoikkuna" based on open source and implemented by applying and extending open source code libraries and components, and some of the well known solutions for the establishing SDIs based on FOSS components from OSGeo Foundation using OpenGeo Suite geospatial software stack.

2 SDI Definition

There are many definitions created to describe an SDI but not a single one describes the SDI completely. For example, Chan ***et.all*** [1] collected eleven popular SDI definitions that were used around the world. All definitions from this research are very similar with minor differences. One of the first is the definition created by U.S. National Research Council, published in the Federal Register Vol. 59, No. 71 on April 13, 1994 [19]:

"National Spatial Data Infrastructure (NSDI) means the technology, policies, standards, and human resources necessary to acquire, process, store, distribute and improve utilisation of geospatial data".

Another well-known definition for SDI from GSDI Cookbook [5]:

"...the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general".

Definition for NSDI from Croatian National Spatial Data Infrastructure Act [13]:

"The NSDI is a set of technologies, measures, standards, implementation rules, services, human resources and other factors enabling efficient integration, management and maintenance of the sharing of spatial data as defined by this Act for the purpose of satisfying needs on both the national and European levels, which will be an integral part of the European Spatial Data Infrastructure defined by the INSPIRE Directive".

According to the definition above, the basic software components of an SDI may consist of: user interface and interactive internet applications for querying, display and analyse geospatial data, a software for publishing system, a software for storing and managing metadata for datasets, a software for storage of spatial datasets and maps, a software for extract, transform, load (ETL) and also for testing and validation of geospatial data and GIS software for the creation and servicing of data.

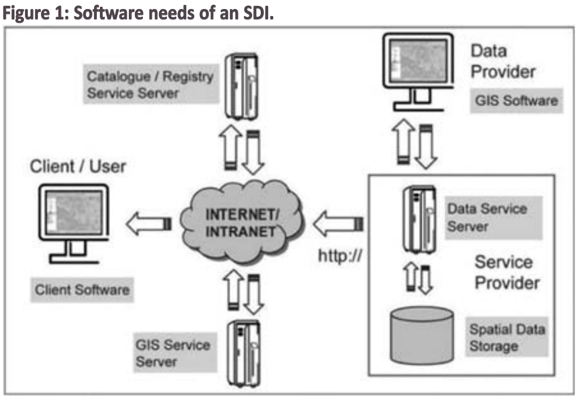
2 SDIs and Free and Open Source Software

According to Free Software Foundation [4], free software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software. More precisely, it refers to four kinds of freedom for the software users: the freedom to run the program for any purpose (e.g. the possibility of studying the software, for the scientific research, for educational or even business purposes), the freedom to study how the program works and change it in a way that suits you, the freedom to redistribute copies and the freedom to distribute copies of your modified versions to the others, and give the whole community a chance to benefit from your changes.

Several authors have dealt with the issue of FOSS, and made a general classification of such software [2, 10, 15, 17]. The growth and the use of Free and Open Source Software in many fields have also resulted in the increase of publications on the topic of FOSS for SDIs. One of the earliest article, from more than a decade ago, [11] is today extremely relevant and clearly demonstrable because the authors predict the great potential of FOSS in SDI field.

According to Steiniger and Hunter [16], classification of the available Free and Open Source Spatial Software components for SDIs include: SDI web map servers, SDI server GIS, SDI Spatial Data Base Management System (Spatial DBMS), SDI catalogue and metadata software, SDI desktop GIS clients and SDI web GIS development toolkits (fig 1).

Figure 1: Software needs of an SDI.

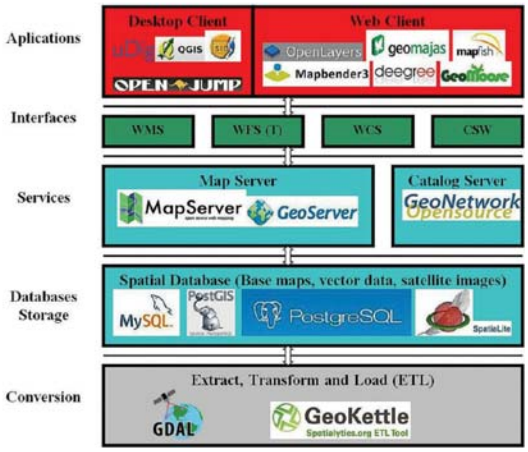


Source: Steiniger and Hunter [16].

The authors have made one of the most comprehensive review of all available FOSS components and concluded that for all categories of GIS software required for the implementation of an SDI, a free and open software product is available.

The figure below shows the proposed FOSS4G based SDI architecture, FOSS projects and components that are available today. Due to page limits, software projects and components are not explained in detail.

Figure 2: FOSS4G Based SDI Architecture.



3 FOSS4G SDI Projects

One of the most interesting national geoportal based on the Free and Open Source Software is certainly the Finnish national geoportal "Paikkatietoikkuna". The portal is available also in English [3]. In November 2010, the portal won the Quality Innovation of the Year award in a competition organized by Excellence Finland. Paikkatietoikkuna is based on the open source and is implemented by applying and extending the open source code libraries and components such as: Liferay, OpenLayers, Geoserver, PostgreSQL/PostGIS, ExtJS, GeoExt, GeoNetwork and GeoWEB-Cache.

The source code and code development demos as well as documentation are available at the website (www.oskari.org) under EUPL or MIT licenses. The current stable version of Oskari is 1.12 which was released on the 25th of June 2013. National Land Survey of Finland in cooperation with many spatial data providers is responsible for the development of Paikkatietoikkuna. The map user interface is the Map Window offering for browsing more than 300 different map layers provided by 25 data providers (fig. 3). The maps are available in various categories, and can be viewed as transparent layers on top of each other.

Figure 3: Finnish geoportal.

Source: Finnish national geoportal [3].

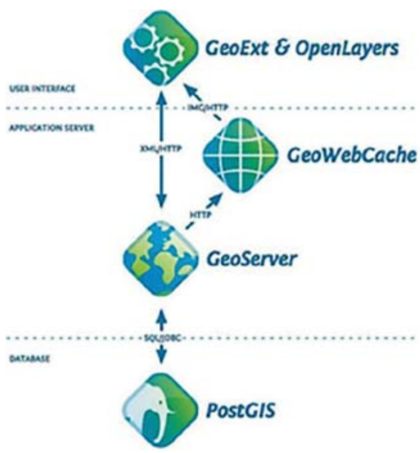
You can create your own map view by selecting map layers, compile a map view and make it public by embedding it on another website by copying and pasting a few lines of html-code, define one or more background map layers, add your own places/objects to the map. Many of these functions require that you are logged in to Paikkatietoikkuna.

4 FOSS4G SDI Projects under OSGeo Umbrella

With the establishment of the Open Source Geospatial Foundation (OSGeo) as roof and umbrella for projects and communities, the development of Free and Open Source Software in the spatial domain and its use and popularization in a variety of purposes, including also for the development of SDIs, is constantly increasing. The OSGeo is a global, non-profit and volunteer based organization founded in February 2006 which promote and support the highest quality open source geospatial software and free and open geospatial data [8]. The OSGeo is responsible for organizing the annual FOSS4G conferences, for the establishment of Local Chapters who share OSGeo's goals, for the development of OSGeo Live which is a bootable DVD, USB thumb drive or Virtual Machine with fully configured Linux environment based on Xubuntu, with all the free and open source software reedy to use without installing anything.

Also, the OSGeo is developing the OpenGeo Suite project. The OpenGeo Suite is a complete geospatial software stack containing all the tools necessary to easily import, analyze and publish geospatial data on the web through OGC compliant services (WMS, WFS, WCS and CSW), including an integrated spatial database, application server, web client API, and a desktop GIS tool

Figure 4: OpenGeo Architecture.

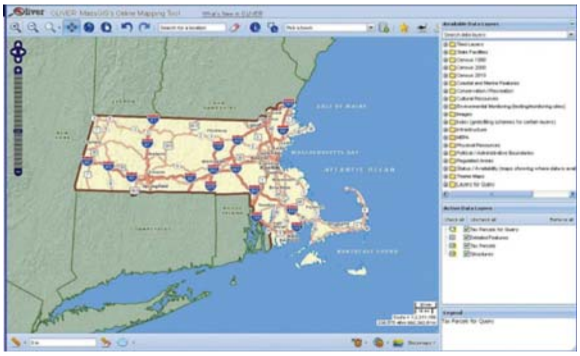


Source: OSGeo [8].

namely: PostGIS, Geoserver, GeoWebCache, GeoExt and OpenLayers (fig. 4).

There are several very successful examples of the establishment data portals [7] at all levels (government, independent administrative authority or large companies), totally based on OSGeo geospatial software or with mixing proprietary and open source software. For example (fig. 5 and 6): Office of Geographic Information MassGIS, Commonwealth of Massachusetts [6], Information Technology Division, the Regulatory Authority for Energy (RAE) in Greece [18].

Figure 5: MassGIS.



Source: MassGIS Online Mapping [6].

Figure 6: The Geospatial Map of the Regulatory Authority of Energy (RAE), Greece.

Source: The Geospatial Map of RAE [18].

5 Conclusion

All levels of government, counties, large and small towns, have recognized long time ago the benefit of a well organized GIS in terms of presenting their services towards citizens and make their data available through web services. For the realization of such project, beside well-known proprietary software which is generally very expensive, there is a solution for the development of SDIs with Free and Open Source Software.

A number of good quality, Free and Open Source GIS projects (FOSS4G) have grown dramatically over the course of the last decade. Some of them have reached such a development in functionality that can effortlessly replace a well known proprietary GIS programs.

Many very successful examples of the establishment data portals at all levels, totally based on free and open source geospatial software, suggest that various tools and software components like conversion tools such as Gdal and GeoKettle, map server projects such as GeoServer and MapServer, spatial database management systems such as PostGIS, PostgreSQL, MySQL and SpatiaLite, catalog and metadata software such as GeoNetwork, frameworks for web mapping such as OpenLayers, MapFish, Mapbender, Geomajas, and Deegree and desktop GIS projects such as Quantum GIS, gvSIG, uDig and OpenJump are available for all categories of GIS software required for the implementation of an SDI.

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Electronic signature

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Abstract

What is an electronic signature, which components of an electronic signature. What is the process of signing and why need to check the electronic signature. The paper clarifies the Electronic Signature Act and Certificate Authority in Croatia.

Keywords: Advanced Electronic Signature, Timestamp, Certificate Authority, Public Key Infrastructure.

In everyday life we encounter the term electronic signature. Electronic signature or e-signature is used as an equivalent for handwritten signature. However, many people do not understand the purpose of e-signature and its components, which may lead to a misuse of e-signature. The aim of this paper is to explain some basic terms regarding electronic signature.

1 What is e-signature

A scanned handwritten signature is a signature in electronic form, but it is not an electronic signature. It is merely an image of the signature. Therefore, scanned signatures and signatures made by the so called e-pad devices are not e-signatures. A set of data must meet two essential requirements in order to be regarded as an e-signature. The data has to enable the identification of the signatory and confirm the authenticity of the signed document. If these two requirements are met, then the signature can be regarded as an e-signature. The layout of an e-signature (if it is visible) reminds of barcodes that are used on goods in a convenience store.

When signing a document at public notary's office the notary must first identify the signatory. Then you can sign the document that the public notary will verify. You sign the paper that way so that any modification of the document can be visible. Besides that, one copy of the signed document is kept in the public notary's archive. When it comes to digital documents, there is no paper that we can sign to authenticate the content. Such digital data needs to be protected in order to prevent modifications to the document. In a way, the e-signature "locks" the data to preserve its authenticity.

1.1 Components of an e-signature

To understand how the e-signature works, we need to be familiar with some terminology. To get an e-signature one must obtain a *Qualified Certificate* and the corresponding *Private Key* from the *Certificate Authority* (CA). Another key, called the *Public Key* is kept by the CA. This is put into function through a mathematical algorithm that creates a *Hash* in the processes of signing and later verification.

Digital signature was invented in 1976 after the discovery of public key cryptography (Diffie-Hellman), which is also called asymmetric cryptography. There is no need to go into details, but the important thing to know is that private key comes with the certificate. This is private data and it should be kept secret because it is used in the making of an advanced electronic signature. Unlike the private key, the public key is available to everyone. The public key is made when the certificate is issued and it is used to verify the advanced electronic signature.

There are different types of digital record algorithms (RSA, DSA) which can be used to make a hash. It is important to note that hash length must always be the same regardless of the size of the document. The most important feature of the hash is that it changes every time the document is modified.

Public Key Infrastructure (PKI) is also used with e-signatures. PKI is a system for signature verification.

2 How does an e-signature work?

Let us consider for example the situation if we could send parcelling surveys and other geodetic survey reports to a cadastral office via e-mail. The report would have to be protected from unauthorised modifications and the identity of the sender would have to be verifiable.

A signature would be added to a digital report. In the process of signing an algorithm is used to calculate the report hash, which is then "locked" with a private key. The report and the signature (the hash is locked with a private key) is then sent via e-mail. We can, therefore, conclude that the e-signature will always be different.

A clerk in the cadastral office receives the report and the signature. The clerk makes another hash of the report and sends a request to the CA to lock the hash with a public key. The calculated hash and the received hash are then compared in order to verify the signature. If they match, the signature is authentic.

The question here is why the certificate authority keeps the public key. Would it not be easier to send it together with the signed document? In that case we could not be sure that the public key belongs to the signatory. The CA has a role of the keeper of the confidential public key data. The CA is an equivalent to a public notary.

E-signature contains various data. Among other data, it contains the information about certificate authority. In order to verify a signature one should contact the CA to check the signatory and to see whether the certificate is still valid or if it is cancelled. Electronic Signature Act (Official Gazette of the Republic of Croatia 10/2002, 80/2008) stipulates that a certificate can be valid for the maximum period of five years.

In Croatia anyone can be a certificate authority given that they are eligible according to the following laws and regulations: Electronic Signature Act, Regulation on Electronic Signatures, Use of Electronic Signatures Technology and General and Specific Terms and Conditions for Timestamps and Certificates Service Providers in the Republic of Croatia, Regulation on the Registration of Certification Service Providers in the Republic of Croatia and the List of Normative Documents for the Application of the Electronic Signature Act and the Regulation on Electronic Signatures, Use of Electronic Signatures Technology and General and Specific Terms and Conditions for Timestamps and Certificates Service Providers in the Republic of Croatia.

For the time being, Financial Agency FINA is the only certificate authority in Croatia. FINA is also the certificate authority for e-signatures for Croatian public administration. In July, Croatia became a member state of the EU, so it is expected that certificate authorities from other member states will spread their business into Croatia. Their certificates would, under certain conditions, be equally valid as those issued by FINA.

Ministry of Economy is the National Certificate Authority in the Republic of Croatia (NCARH).

NCARH was founded in order to establish trust in the exchange of data and digital documents in e-business on the national level. The purpose of the NCARH is to connect PKI domains in Croatia and to connect with foreign PKI domains. The provider of technical, IT and operative support for the NCARH on behalf of the Ministry of Economy is the Financial Agency (FINA).

Pursuant to the Decision of the European Commission 2009/767/EC and according to the Directive on services 2006/123/EC, the Republic of Croatia (Ministry of Economy) will soon publish the list of controlled qualified certificate providers which operate in accordance with the Directive on electronic signatures 1999/93/EC. When the list is published, other member states will be able to verify the authenticity of the qualified certificates issued by controlled /accredited certificate service providers from Croatia, which will enable the use of advanced electronic signatures outside Croatia.

3 Electronic Signature Act

3.1 Advanced electronic signature

The term *advanced electronic signature* is defined by law. AES has to be a guarantee of the identity of the signatory, so that the signatory can undoubtedly be identified according to the signature. AES is made by the use of devices that the signatory operates on his/her own, and that are exclusively controlled by the signatory. The best example of such a device is a debit card used for the withdrawal of cash from ATMs. One has to have a debit card (device) and know the PIN (controlled exclusively by the card owner). When the AES certificate is issued, the user also gets the so called PKI card which contains the password protected private key. A USB token can also be used instead of the card.

The last condition is that AES must be directly connected to the belonging data. This was explained on the example of geodetic report, the making of hash and private key locking.

3.2 Timestamp and advanced timestamp

Besides e-signature, there are also *timestamp* and *advanced timestamp*. These were defined by Amendment to the Electronic Signature Act. When issuing official documents, e.g. a property deed or a copy of cadastral map in digital form, it is not important who issued the document, only the content of the document matters. So, the definition of a timestamp is the following: timestamp is an electronically signed certificate that verifies the authenticity of the given data in the given time period. To put it simply, timestamp is a set of characters which, among other data, marks the date and time when the document was verified. Just like an ordinary stamp that can be used by more than one person on an analogue document, timestamp can also be used by more than one person. Timestamp will primarily be used in the archiving of digital documents, because time stamp guarantees the authenticity of the digital document regardless of the status of electronic certificate signatory.

Advanced timestamp is an electronic certificate written by the certifier, which meets the requirements needed for an advanced timestamp.

An advanced electronic signature has the same legal validity and it can replace a handwritten signature, as well as a handwritten signature and a stamp in a digital document.

Finally, it should be emphasized that AES is authentic, unique and indisputable.

It is authentic because AES is an unambiguous signature of a specific person and it shows that the document was signed on purpose. Furthermore, AES cannot be forged, because it shows that the document was signed exclusively by the signatory to whom the AES belongs. It is unique because the same AES can never be used again. The signature cannot be transferred from one document to another, and the signed document cannot be modified afterwards. Besides that, the signature is indisputable because both the signature and the document are material. The signatory, therefore, cannot deny the signing of the document.

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Assessing Territorial Attractiveness in SEE

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Abstract

Effective monitoring system and better coordination among different development and sectorial policies are basic conditions for achieving territorial cohesion and territorial development goals on transnational, national, regional and local level. Project Attract-SEE will support policy makers to achieve better coordination of territorial cohesion and growth policies as well as their implementation and evaluation. The aim of the project is to establish a framework concept as well as tools useful for policy makers to enhance the quality of development decisions. The results of the project are to be used by policy/decision makers in improving their cooperation and networking at the South East Europe scale, in view to reinforce the role of territorial knowledge in promoting cohesion and growth in South East Europe.

Keywords: Territorial monitoring system, indicators, INSPIRE Directive, Project Attract SEE

1 Introduction

The Attract-SEE project, which started in September 2012, will last 24 months, ending in August 2014. It involves ten partners, an 'EU Associated Strategic Partner' and seven 'Observers'. The Lead Partner is the Geodetic Institute of Slovenia. The Attract-SEE project is financed by the South East Transnational Cooperation Programme. Partners come from Slovenia, Austria, Hungary, Italy, Serbia, Former Yugoslav Republic of Macedonia, Croatia and Federation of Bosnia and Herzegovina [1].

Partners from Croatia in Attract – SEE project is Institute for Spatial Planning of the Koprivnica-Križevci County and as observer Public Institution for Management of protected Natural Values in the Area of the Koprivnica-Križevci County, Town of Koprivnica and State geodetic administration.

Monitoring is the periodic review of a project inputs, activities and outputs undertaken during implementation. It includes the review of the procurement and delivery of inputs, the schedules of the activities, and the extent of progress made in the production of outputs. Monitoring, therefore, involves the process of collecting information about the actual project performance during implementation. The gap between planned and actual performance is assessed using various control strategies during the evaluation. Evaluation is a judgment on the effectiveness of a project.

As the continuous monitoring of spatial development is a major tool for policymakers to assess recent development trends, to identify problems and to communicate needs for action, the framework for the selection of indicators reflecting the territorially orientated policy is of crucial importance [2].

Therefore two remaining components of territorial monitoring are typologies and classifications and complex policy strategies. The accent in the territorial monitoring systems report is going to be put on those two components and also on the transnational dimension of the projects which has its specificities. Transnational level represents an aggregation level of complex territorial monitoring systems at national levels or if territorial monitoring activities at national level are absent or weak regional level is taken into account.

Main complex policy strategy at the European level was ESDP from 1999 where three main axes were: polycentric development, development of infrastructure and protection of natural and cultural heritage. It was replaced in 2007 by the Territorial Agenda of EU which was updated during the Hungarian presidency in 2011. Mentioning of the territorial monitoring in the Territorial Agenda is in the part about territorial cohesion implementation mechanisms. Territorially sensitive evaluation and monitoring practices should be integrated into regular national and European reports related to Cohesion Policy and Europe 2020 Strategy. Monitoring of territorial trends should be improved with involvement of the European Commission and the ESPON Programme, Member States and other institutions such as the European Environment Agency.

ESPON Programme which is operational since 2002 groups around hundred projects which represent a fruitful methodological source for the territorial monitoring practice. One of the projects is the ATTREG project with the focus on territorial attractiveness.

INSPIRE Directive of the European Union from 2007 provides common technological framework in order to have spatial data comparable and usable in national and transnational contexts. The Directive requires that common implementing rules are adopted in specific areas (metadata, data specifications, network services, data and service sharing and monitoring and reporting).

2 Territorial Monitoring Systems in the Countries Participating in the Attract-SEE Project

Attract SEE project operates in eight countries in the transnational region of South-eastern Europe which is defined for the purposes of EU regional policy. It doesn't correspond to the geographical notion of South-East European macro-region, it is a bit wider, covering Slovakia, Hungary, Austria, Moldova and parts of Italy and Ukraine, but not European part of Turkey. Among partners from eight partner countries some are represented at national and some at regional level. Partner from Macedonia is the transnational organization NALAS.

Legal systems of the Attract SEE partner countries are different, mostly due to their different political organizations – federal states and centralized states. Federal states are Italy, Austria and Federation of Bosnia and Herzegovina. Slovenia, Croatia, Serbia and Hungary are centralized states. Territorial monitoring appears in laws or regulations in all countries except Slovenia where it was defined in the previous planning law from 2002, but not in the law on spatial planning from 2007 which is now in force. In federal countries where laws exist on subnational level, territorial monitoring doesn't appear in all subnational laws. If regulated by law territorial monitoring is mentioned in laws which deal with spatial planning. In Hungary, Croatia and Federation of Bosnia and Herzegovina there are regulations which are more precisely defining territorial monitoring systems.

Hungarian Government Decree on the information system and obligatory data provision concerning territorial development and spatial planning from 2007 defines content and main aspects of operation for the National Information System Territorial Development and Spatial Planning, abbreviation in Hungarian: TeIR which was established in 1997.

Croatian Ordinance on the contents and required spatial indicators in reports on the spatial status from 2012 regulates the report which contains an analysis of the status and trends of spatial development on the basis of mandatory indicators on the implementation of spatial planning documents and other documents and evaluation of the situation and proposals for the improvement of urban development with a plan of activities and proposed spatial parameters for a further period.

Ordinance on content and bearers of unique information system in Federation of Bosnia and Herzegovina from 2007 with amendments from 2010 gives framework for the GIS based territorial monitoring system which should link databases on different levels from national to regional and local; this system is still in construction; the ordinance defines topics and forms for data gathering.

In Austria as a federal country some regions have territorial monitoring system defined by Law (examples are Upper Austria and Styria Spatial planning laws). In some regions territorial monitoring systems are defined by non-legally binding regional development plans/strategies (examples are Regional Development Plan for Lower Austria from 2004 and Regional Development Strategy for Tyrol from 2011). At national level in Austria, national territorial monitoring system is foreseen by the Austrian spatial development concept.

The Emilia-Romagna Regional Planning law from 2000 "General Discipline of land use and territorial protection" foresees the establishment of the Territorial Observatory (introduced by a modification of the regional planning law in 2009) with the aim to simplify the planning processes, ensure the coordination of territorial monitoring activities and improve the public data accessibility. Territorial observatory, which is still under construction, will be established at regional level, being built upon a "mosaic" of relevant information contained in the Territorial Coordination Plans (PTCP) of the nine Provinces.

An embryo of territorial monitoring system in Slovenia was introduced into Spatial Management Act from 2002. It introduces territorial monitoring, which is defined in detail with an executive regulation – a list of indicators was annexed to the regulation. The proposed system was never implemented and list of indicators was proved to be impossible to calculate and monitor due to data unavailability. The act itself was replaced with the Spatial Planning Act in 2007, paragraphs defining territorial monitoring system were abolished. The new legislation abandoned previously provided territorial monitoring system. It only provides procedures and competences in spatial planning process. There is no comprehensive territorial monitoring to support this process.

3 Indicators

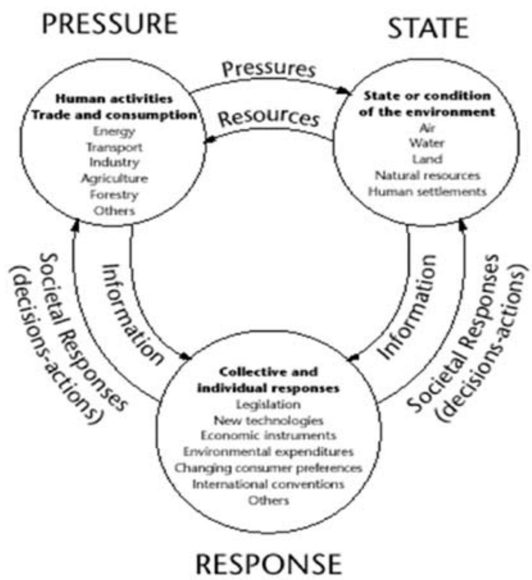
Indicators perform many **functions**. They can lead to better decisions and more effective actions by simplifying, clarifying and making aggregated information available to policy makers. They can help incorporate physical and social science knowledge into decision-making, and measure and calibrate progress toward sustainable development goals. Further, they can provide an early warning to prevent economic, social and environmental setbacks. They are also useful tools to communicate ideas, thoughts and values [4].

When defining indicator one should be aware of the fact that indicators can have different roles and functions in the decision-making process. A review of different monitoring frameworks shows different purpose of indicators. Some indicator models classify indicators according to their functions and roles in the decision-making process. For example, the sustainable indicator sets of the OECD and the United Nations are developed on the basis of a linked model of "pressure, state, response" [5].

Often these types of indicators are used in an environmental context. Pressure-state-response indicators can be described as follows:

- **Pressure, process or control indicators**: these indicators are used to diagnose and gauge the process that will influence the state of progress; these are often classified into underlying factors or forces such as population growth, consumption or poverty;
- **State indicators**: indicators that aim to provide a simple description of the current state of development; the state refers to the condition that results from the pressures, e.g. the levels of air pollution or land degradation. The state will, in turn, affect human health and well-being as well as the socio-economic fabric of society. For example, increased land degradation will lead to decreased food production, increased food imports, etc.;
- **Target, response or performance indicators**: these assess the impact brought by policy changes. These responses may include regulatory action, environmental or research expenditure, public opinion and consumer preference, changes in management strategies, etc.

Figure 1: Pressure-State-Response Model



Source: FAO, 1999 [3]

Another way of defining indicators can be found in the European Directive 2001/42/EC on Strategic Environment Assessments that contains input (response) indicators as well as outcome indicators:

- **Input/response indicators**: indicators that focus on actions to be undertaken to achieve an outcome (e.g. installing catalytic converters in new cars to reduce the level of air pollution). These are "mean" indicators;
- **Outcome indicators**: indicators that focus on the outcome sought (e.g. clear air) rather than how it should be achieved. These are "ends" indicators. Outcome indicators differentiate from **output indicators**. Some examples help to illustrate their differences which highlight the fact that outputs are specific and outcomes are more vaguely defined and cannot be directly measured. For example in the policy area of health an output might be the number of health centres, whereas outcomes would be measures of health gain; in the policy area of environment one output is the hectares of derelict land freed of pollution, whereas the outcome is the improvement to the productivity of the land [5].

In Attract-SEE distinguish have done between the transnational and the national/regional level. On transnational level mainly state indicators will be defined as well as partly pressure indicators. Additional state and pressure indicators could be defined on national/regional level as well as performance indicators as they imply that explicit targets are set, e.g. monitoring of the implementation of specific plans or concepts.

Table 1: Types of indicators in Attract-SEE project

	Pressure indicator	State indicator	Response indicator
Transnational level	x	x	
National/ regional level	(x)	(x)	(x)

For a better overview indicators need to be structured along lines of several "pillars". For example does ESPON structure their indicators into eight themes and further sub-themes . The ESPON themes are: Agriculture and Fisheries, Demography, Transport, Energy and Environment, Land Use, Social Affairs, Economy and Cross-Thematic and Non-Thematic Data [4].

Criteria for the definition of a core set of indicators within the Attract-SEE project are mainly:

- Relevance regarding attractiveness; indicators should cover issues that are relevant to measure attractiveness/quality of regions for different target groups, i.e. companies, tourists, residents;
- Availability of data; core indicators are chosen that can be calculated by most countries with data that is either readily available or could be made available within reasonable time and costs;
- Compactness; 1-2 indicators per asset are chosen to keep the set of core indicators compact and manageable. Additionally, the set of core indicators can be optionally extended with national/regional indicators.

Indicators can be structured into (1) transnational core indicators, and (2) optional regional indicators. The basis of the monitoring framework is a set of core indicators that are common for the whole SEE territory. Core indicators cover social, economic, environmental, land use and transportation issues that are required for the monitoring system to operate. In addition to the core indicators the monitoring framework can be extended with other optional indicators. Optional indicators do not refer to the overall transnational South-East-European territory, but can refer to the national or regional level.

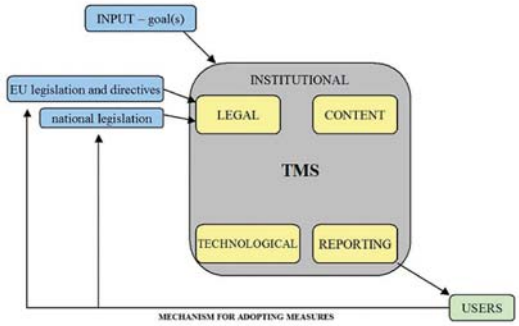
Table 2: Thematic classification of indicators into capital and assets in Attract-SEE

Capital	Assets
Environmental capital	Environmental quality Territorial/ecosystem integrity Natural resources and energy
Anthropic capital	Urban quality Landscape integrity Infrastructures
Socio-cultural capital	Culture Quality of life
Economic/human capital	Knowledge & innovation Employment Specialization / key sectors Tourism Investment promotion Population
Institutional capital	International relations

4 Common Territorial Monitoring Framework

Territorial monitoring framework is the model for territorial monitoring system. Elements of Common Territorial Monitoring Framework are: **input** (goals, that is to be monitored with Territorial Monitoring System-TMS); **legal framework** (laws, regulations etc. concerning territorial monitoring system-regulation name, year of enactment, administrative level(s), short description of purpose and scope, basic definitions related to territorial monitoring system and indicators); **content** (the concept of TMS, taking into account the EU guidelines, solutions, etc., criteria and how to choose the individual components of TMS, definition of individual component); **institutional framework** (the development of content of TMS and determination of components, data - gathering, processing and storage, selection of indicators, development of the methodology of each indicator, calculation of indicators and reporting); **technological framework** (software, database, data gathering, processing, storage, calculation, storage, calculation, storage and distribution indicators, development of a portal-website for the publication of reports, distribution and awareness raising); **reporting** (the content of reporting, reporting periods, ways of reporting and methods of awareness raising); **users** (stakeholders); mechanism for adopting measures (changes in legislation, upgrade of data sources, organization changes and technical amendments) and **financial framework**.

Figure 2: Elements of CTMF



5 Stakeholder involvement

Though many projects and programmes are running with huge financial support all over Europe, in the case of most of these projects, the embedding of these projects into their own local region and reflecting the conception of local stakeholders are not general. In this way, developments can cause unfavourable effects and the approach of stakeholders regarding the project issues and results is turning negative. To prevent these drawbacks involving stakeholders from the very beginning of the planning procedure is crucial.

In the course of ATTRACT-SEE project Project Partners try to take every potential stakeholder into not only the evaluation of the project results but the project staff is also committed to involve them into the process of defining concept of attractiveness, data gathering, forming indicators to measure attractiveness, and establish territorial monitoring framework together with transnational network to exchange experiences. What is more, stakeholders can contribute to the analysis of Project regions/countries with their valuable ideas through national and transnational workshops which will take place to follow up project results.

6 Conclusions

Results of the Attract - SEE project should be an input for the decision and policy making processes in the South-Eastern Europe. The topic of attractiveness is only one complex territorial concept for which territorial monitoring system can be applied. Territorial monitoring is one of the main topics for transnational territorial cooperation in the South-east Europe region (other transnational areas are overlapping in the SEE region are: Danube, Adriatic-Ionian, Mediterranean, Black-Sea, Carpathian, Alps, Dinaric, Pannonian, Central-European). The methodology of the Attract - SEE may be extended to other topics (complex, other sectoral or comprehensive) and to other countries of the area which are not participating in the project. Since one part of countries of South East Europe (Western Balkans) hasn't participated in the ESPON program which has been accumulating territorial monitoring methods and results for ten years (since 2002), the need for a more intensive activity in the domain of territorial monitoring in SEE space is obvious.

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The availability of spatial data about utilities in the local SDI

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Abstract

This paper gives an overview of the availability of spatial data about utilities in the local spatial data infrastructures. There are given a research about possibilities of discovery, view and sharing spatial data according to INSPIRE specified web services at the official local croatian geoportals. This web services include: (meta) data discovery services, data view services, data download services, data transformation services and invoke services. Based on the research results the Croatian local SDIs are compared with good practices in the European Union. Guidelines for a better availability of spatial data sets about utilities in Croatia are also provided.

Keywords: utilities, Local SDI, Web services

1 Intoduction

Collected and edited data about utilities are an important environmental management data set at the local level.

It is necessary to implement certain services for searching the required information and quality exchange spatial data about utilities and related data between users in the Local Spatial Data Infrastructure (LSDI) framework.

In Croatia, there is no good political strategy or good practice example in management and inter-institutional coordination of land information on public utility infrastructure under the LIPP framework. As shown by the research of local geoportals, in the developed countries of the EU, such a practice exists and can be further improved by introducing recommendations given in the thesis [1].

This paper gives an overview of the availability of spatial data about utilities in the local spatial data infrastructures, i.e. at official geoportals of Croatian cities. The possibilities of discovery, viewing and sharing spatial data between users according to the INSPIRE specified web (network) services are researched.

2 Local SDI and Web services

Local Spatial Data Infrastructure (LSDI) is the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data, and is a basis for spatial data discovery, evaluation and application for users and providers within the local government level.

Everyday needs for spatial data application has led to SDI development which aim to provide a simple and clear dataflow and service availability from data provider to the users. This development rises hierarchical from local to global SDI [2].

Spatial data at the local level are the most detailed space information, which means the level of detail that corresponds to the scale of 1:5000. Because they are the most detailed, they are the most expensive regarding their data collection, processing and maintenance. These data also require very frequent updates because their changes are first noticed. Furthermore, the local data level are the basic datasets for hierarchically higher levels SDI.

In order for all SDI levels to become interoperable the European Commission adopted the INSPIRE Directive (INfrastructure for SPatial InfoRmation in Europe). Its purpose is to provide access for decision-making, evaluation and monitoring, and the member states should themselves ensure the availability, quality, comparability, completeness and consistency of their spatial data [4].

At least three common INSPIRE principles stressed the role and importance of local governments. These three principles are:

- data should be collected only once and kept where they can be most effectively maintained
- it should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications
- it should be possible for information collected at one level/scale to be shared with all levels/scales; general for strategic purposes.

In order to facilitate data discovery and sharing and the overall interoperability between different users systems web services were established. The web service groups are:

- (Meta)data discovery services
- data view services
- data download services
- data transformation services
- invoke services.

The INSPIRE directive specially emphasizes the importance of free of charge discovery and viewing services.

3 Stakeholders and utilities registers

Facility management are utility registers of responsible institutions who manage spatial data about those utilities.

In Croatia, the utility cadastre is an official public utilities register managed by responsible institutions for the local self government administration unit. This register contains utility maps, the main utilities' technical characteristics and name of the utility owner or administrator. The chartered surveyors are authorized to collect spatial data about utilities.

There are different management examples of utility registers in the world. Statutory regulated utility registers like the Croatian ones exist only in former Yugoslav countries. So called „call centres" are established in some countries with the aim of utilities protection, known as „call before you dig", such as in Great Britain, the Netherlands, Denmark, the United States of America and Australia. Slovenia is a unique example of central data collection and registers about public utilities in their utility cadastre (Slo. Zbirni katastar) at national level.

The system stakeholders related to utilities in the framework of local SDI are providers and users of spatial data about utilities. The data providers are: communal and other public service companies, the local self administration units (cities and communities), the State Geodetic Administration, land registries, surveying companies and other. The users are: citizens, architects, project companies, private investors and others. The local self administration has a special role in the local SDI, and forms together with the utility companies the main stakeholders of large scale spatial data, i.e. local level data [5].

The local governments are both providers and users of spatial data. Their task is to decide which information will be in use, and through its spatial policies determine the content and size of these datasets.

The use case model of utility cadaster, used as a utility register, in LSDI can be shown by model on Figure 1.

The model shows that the utility cadastre layer is only updated by utility companies in their responsibility scope. These utility companies are: Telecommunications network operator, Water supply company, Electric utility company, Gas company, utility company named NN (manager of some remaining public utilities) and the local administration as the manager of street illuminations and road registers. All the registers are managed in GIS and supported by relevant facility management systems.

The INSPIRE Directive addresses 34 spatial data themes needed for environmental applications. These themes are subdivided in the three annexes of the Directive. Spatial data about utilities are included in the sixth theme in Annex III, these datasets are [6]:

- utility
- government services.

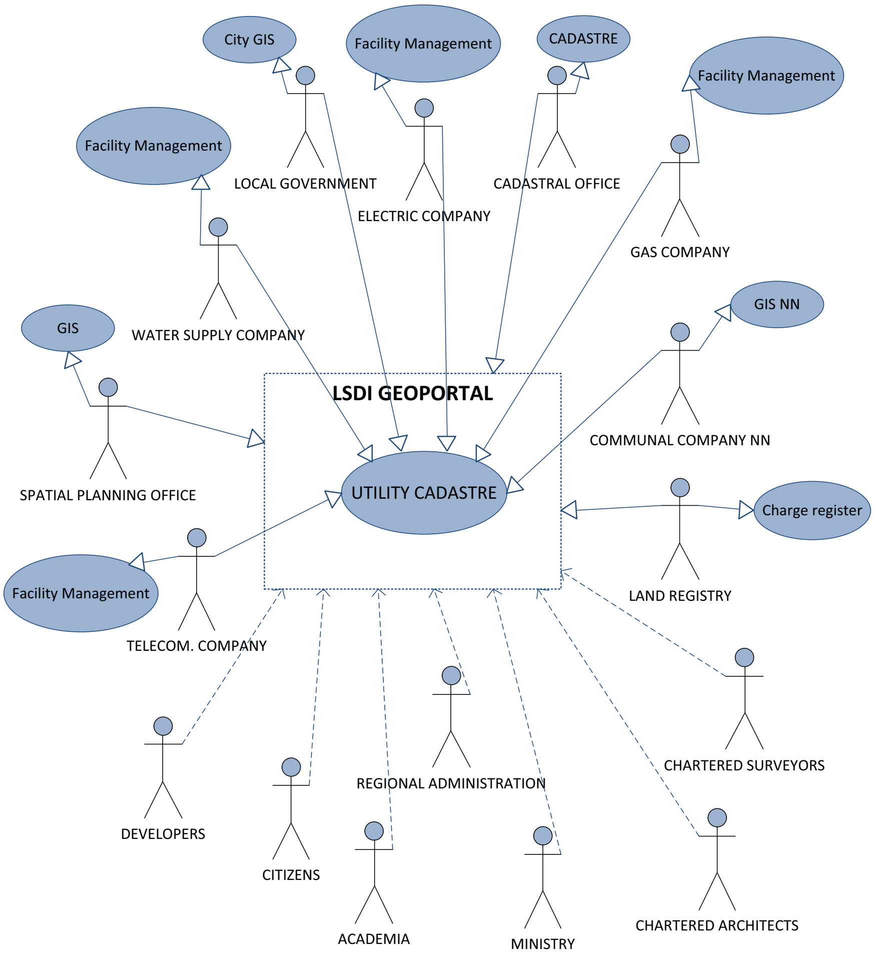
The Thematic Working Group for this theme (TWG-US) identified five groups of public utilities, those groups are:

- water network
- sewer network
- oil and gas network
- electricity network
- telecommunications network.

4 The availability of data about utilities – state and perspectives

The aim of the research was to analyze the availability of data about utilities on the official city government geoportals and to compare them with those in other EU countries. The intention is the preview of the current state and the readiness to implement the INSPIRE specifications on the local level. The research included all 127 Croatian cities, and 26 cities in 11 countries of the European Union.

Figure 1: UML Use case diagram as a utility cadastre in LSDI



Source: [1].

The research included all relevant types of utilities which are known in professional literature and for those with existing registers. These types are all utilities according to the Croatian Regulations regarding the utility cadastre [3]:

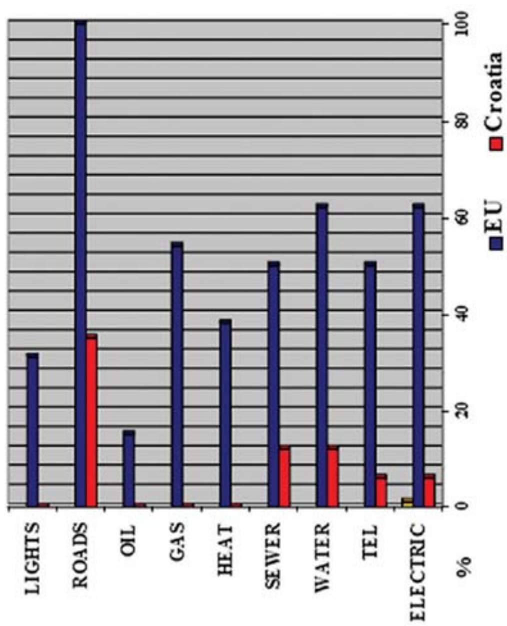
- electric utilities
- telecommunications
- water supply pipelines
- sewage utilities
- heat pipeline
- gas pipelines
- oil pipelines

These types of utility are added to two other local relevant utility types. These types are:

- roads
- street illuminations.

Croatian utility data appear in about 35% of the implemented local geoportals, whereas we can find them in all local geoportals in the other EU countries [1].

Figure 2. The data availability of individual utility types



Based on the research analysis one can determine that the greatest dataset incidence are roads (Croatia 35%, EU 100%), followed by the water supply utilities (Croatia 12%, EU 62%) and sewage (Croatia 12%, EU 50%). It can be concluded that the utility data are insufficiently involved in the local spatial data infrastructures. Other utility types are less or not at all available in the local geoportals as the graphic displays Figure 2.

As downloading of web services is concerned, the research data show us that there is no local geoportal with vector or raster data download services supported by WFS and WCS standards. So it can be concluded that spatial data at local level in Croatia are not shared on the Web. In the EU countries the vector data downloading on geoportals is on the level of 54%, while the raster data downloading is only 8%.

5 Conclusion

The main purpose of the local SDI is its being the best solution for the sharing of relevant spatial data between all SDI stakeholders, and it is very important that each spatial dataset is being managed by the responsible spatial data provider.

The survey data revealed a poor availability of utilities data and poor implementation of the network or web service for spatial data sharing in Croatian local SDI's. The current situation should be harmonized with OGC and ISO standards and INSPIRE implementing rules for network services that should be available at LSDI geoportal.

The real value of one spatial data set only gets integrating with other related data sets. This improve their usability and provide a comprehensive spatial analysis, and generally improve the quality of land information. For this purpose, data sets about utilities must be easily accessible to all potential users, and also within LSDI framework integrated with other data sets such as cadastre, spatial planning, orthoimagery, topography, spatial unit register and others.

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