National SDI Report 2019

For Montenegro

Delivered: D5.5.3-4_EN

Author(s)/Organisation(s):
Goran Barović / UCG-FF / 01
Work Package / Task:
WP5 / TG5.3 National Stakeholder Coordination
References:
Project Description
Short Description:
Annual BESTSDI SDI Report serves to strengthen ties with SDI stakeholder in partner countries, raise visibility of the project, provide information to Project Advisory Committee (PAC)
Keywords:
National Report, SDI, annual, stakeholders, PAC, BESTSDI

Content

1. INTRODUCTION

Project named “Western Balkans academic education Evolution and professional's sustainable training for spatial data infrastructures – BESTSDI” project has been proposed by project consortium led by the University of Zagreb, Faculty of Geodesy for Erasmus+ Key Action 2 – Capacity Building in field of Higher Education call for year 2016 and accepted for execution. Project is worth 978.166,66 € and is one of 147 selected among 736 submitted applications.

A Spatial Data Infrastructure (SDI) is a framework to share, discover and re-use spatial data among public authorities, the private sector and citizens. SDI’s are based on a “coordinated series of agreements on technology standards, institutional agreements, and policies” (Kuhn 2005) that unlock geospatial information resources for a wide range of application fields, for instance environmental monitoring and policy making, transportation planning, health care, physical planning, national security, etc. They are an integral part of the e-government movement and open data initiatives.

INSPIRE is an EU Directive (2007/2/EC) aiming to establish an infrastructure for spatial information in Europe to support Community environmental policies and policies or activities which may have an impact on the environment (http://inspire.ec.europa.eu/). The Directive addresses problems regarding the availability, quality, organisation, accessibility and sharing of spatial information. INSPIRE may be seen as the legal framework of a European SDI.

BESTSDI is based on findings of the EU IPA2010 project “INSPIRATION – Spatial Data Infrastructure in the Western Balkans” executed in 2012-2013 and the follow-on project “Cooperation in the Western Balkans region – Infrastructure for Spatial Information in the region of Western Balkan” (IMPULS), financed by Sida (Swedish International Development Cooperation Agency), being under execution.

While INSPIRATION focused on promotion of SDI and coordination of its further development resulting in strong legislative activities among the involved National Mapping and Cadastral Agencies (NMCA’s), IMPULS is a project aiming to provide support to the development of the Regional SDI’s in accordance with the INSPIRE Directive and SEE 2020 (South East Europe 2020 Strategy), as well as the improvement of interoperable spatial information and services in the Western Balkan region for efficient support to e-Government. The IMPULS project primarily addresses the internal needs of the NMCA’s in the partner countries and recognises a severe shortage of qualified staff able to develop spatial data infrastructures, both with respect to data and service provision as well as its usage.

This report includes a description of the current status of the Spatial Data Infrastructure (SDI) in Montenegro, the SDI in Higher Education in Montenegro and the requirements analysis of BESTSDI project. Through the status of SDI, the following topics are considered: legislative, organizational aspect (bodies and responsible institutions), technical organizations (web, geo portal, brochures) on SDI in Montenegro, key institutions and administrative bodies, business sector, educational institutions users - local government and self-government, public companies, citizens, etc. Below, information on curriculum development is provided through BESTSDI project support at the universities participating in this project, as well as an analysis of the current state and extent of SDI involvement in curricula and life-long learning (LLL) programs.

BESTSDI Partners

Coordinator: Sveučilište u Zagrebu (University of Zagreb) – established in Croatia

Partners:

- Katholieke Universiteit Leuven (Catholic University of Leuven) – established in Belgium
- Sveučilište u Splitu (University of Split) – established in Croatia
- Univerzitet "Sv. Kiril i Metodij" Skopje (Ss. Cyril and Methodius University in Skopje) – established in Macedonia
- Hochschule Bochum (Bochum University of Applied Sciences) – established in Germany
- Universiteti Politekniki i Tiranës (Polytechnic University of Tirana) – established in Albania
- Universiteti Bujqesor i Tiranes (Agricultural University of Tirana) – established in Albania
- Univerzitet u Banjoj Luci (University of Banja Luka) – established in Bosnia and Herzegovina
- Sveučilište u Mostaru (University of Mostar) – established in Bosnia and Herzegovina
- Univerzitet u Sarajevu (University of Sarajevo) – established in Bosnia and Herzegovina
- Javna Ustanova Univerzitet u Tuzli Universitas Studiorum Tuzla (University of Tuzla) –established in Bosnia and Herzegovina
- Universiteti Nderkombetar per Biznes dhe Tehknologji UBT (University for Business and Technology – UBT) – established in Kosovo
- Javna ustanova Univerzitet Crne Gore Podgorica (Unviersity of Montenegro) – established in Montenegro
- Unvierzitet u Beogradu (University of Belgrade) – established in Serbia
- Univerzitet u Novom Sadu (University of Novi Sad) – established in Serbia
- Universiteti "Ukshin Hoti" ne Prizren (University of "Ukshin Hoti" in Prizren) – established in Kosovo

Associated Partners:

- Republička uprava za geodetske i imovinsko-pravne poslove Republike Srpske (Republic Administration for Geodetic and Property Affairs of Republika Srpska) – established in Bosnia and Herzegovina
- Federalna uprava za geodetske i imovinsko-pravne poslove Federacije Bosne i Hercegovine (Federal Administration for Geodetic and Property Affairs of Federation of Bosnia and Herzegovina) – established in Bosnia and Herzegovina
- Agencija na katastar na nedvižnosti (Agency for Real Estate Cadastre) – Established in Macedonia

Subcontractors:

- Lantmäteriet (Swedish National Mapping and Cadastre Authority) – established in Sweden
- Novogit AB – established in Sweden

Additional benefits:

New level of communication and cooperation among the partner universities with the emphasis on SDI but expanding it on institutional and project cooperation.

Exchange of students and staff will be fostered through the projec activities and information about activities conducted by the partners communicated among the partner universities

2. STATUS OF SDI IN MONTENEGRO

General condition of spatial data in Montenegro is characterised by division of datasets and data sources. Datasets are often not harmonized and available to public, which sometimes causes collection of the same data by different institutions, in an inadequate way and not in line with regulations. The Spatial Data Infrastructure Act was adopted from 09.06.2017 in Montenegro. This law regulates the establishment and maintenance of spatial data infrastructure as well as other issues of importance for the spatial data infrastructure. According to the above mentioned law, spatial data infrastructure is a set of technologies, rules and standards for processing, access, sharing of spatial data and their optimal use. The Spatial Data Infrastructure include: metadata, network services and technologies used for spatial data exchange, exchange methodology, access to and use of spatial data, spatial data usage conditions, geoportal spatial data infrastructure.

The issue of availability of data which are the possession of the government and other bodies is defined in a series of laws, before all in the Constitution of Montenegro, Act on Free Access to Information and Law on Ratification of the Convention on Access to Information, involvement of the public in decision making and the right to legal protection in environmental issues, as well as other legislation regarding competence for geospatial data. Constitution and laws guarantee access to data which are possessed by government and other bodies; they also guarantee that general policy is directed towards public access to data in digital form. Exchange of geodata between government and other bodies is arranged by Constitution, laws and other general acts. Act on State Administration prescribes general obligation of state administration and other organs to cooperate and deliver data and information necessary for work. Since the way of exchange is not regulated in detail by the law or sub-laws, in many cases the way of exchange of geodata is defined by state or other organs themselves, in accordance with agreement between state and other organs, or on the basis of previously concluded agreements.

National SDI (NSDI) comprises digital geodata and appropriate geodata services in Montenegrin territory, which are jurisdiction of: organs of state and public administration, organs of local government, legal entities that perform tasks of public interest, legal entities that are entrusted with management of geodata and legal entities that use data and services comprised by NSDI and provide public services based on those geodata.
More efficient planning, decision making and general improvement of society in which we live today is being more and more directed to usage, exchange and analysis of information on space. To properly arrange the information on space we create and use, establishing their infrastructure has become necessary. Defining and improving the existing national infrastructure of geospatial data has become not only a requirement, but also an obligation for all relevant stakeholders in Montenegro One of the ways to do it is Directive 2007/2/EC of the

European Parliament and of the Council on establishment of spatial data infrastructure in the EU (Infrastructure for spatial data in European Community - INSPIRE), which entered into force on 15 May 2007. The purpose of this directive is establishing spatial data infrastructure in the EU for the needs of policies and activities which can impact on the environment. Although this directive is mandatory only for the EU member countries, keeping in mind Montenegro's commitment to joining the EU and the significance of geospatial data in modern society, our strategic goal is to introduce INSPIRE directive into Montenegrin legal system. In Montenegro, various institutions which function at local, regional, national and international level produce or use geospatial data, mostly about spatial planning, environment, tourist, agricultural, water management and manufacturing capacities. A high percentage of organizations obtain different kinds of geospatial data needed for their everyday operations from other institutions. All this

indicates the importance and complexity of establishment and maintenance of National Spatial Data Infrastructure which ensures the possibility of combining spatial datasets and services interaction. It is clear this is not a one-step task, but requires long-term cooperation of numerous institutions and a strong support from the Government of Montenegro, with the purpose of developing e-Government, to ensure conditions for exchange and usage of geospatial data, which shall produce benefits that will be reflected in public and private sector, the economy and citizens.

At the moment, several regulations are in process, which will be more closely regulated:

- Content and structure of spatial data sets covered by spatial data infrastructure,

- Metadata specifications,

- Network services specifications for accessing to the spatial data.

Recommendations for further development of NSDI in Montenegro should help and provide additional value for the social community and the development of information society as a whole. From the viewpoint of further implementation of the recommendations are structured in three frames: the legislative, institutional and technical.

According to the time and significance of the further development of NSDI, the recommendations are given in three categories:

- Implementation recommendations that should be implemented immediately or as soon as possible;

- Implementation of recommendations that would be desirable to realize;

- Recommendations that should be taken into account in future considerations regarding the establishment of NSDI.

National Spatial data infrasturcture shall firstly enable better functioning of the public sector, while integrated infrastructure shall enable benefits to both private and public sector. NSDI implementation, in accordance with INSPIRE directive, shall have a large spectre of interested parties:

- Public sector – policy makers: they shall have a quicker and simpler access to information on space, as prerequisite for making optimal decisions. Examples include planning economic and residential development, monitoring climate change effects, preserving endangered resources, optimization of land usage. This refers to several levels of the public sector;
- Public sector - services: they shall have benefits from information exchange. Examples are responses to emergency situations, traffic management, fight against crime etc;
- Citizens: they shall have better information on locations in Montenegro, as well as different type of information on them, and also benefits from improved public sector services; state and other organs. There is good communication and cooperation between state and other organs, which is an encouraging step, although just the beginning of NSDI development.
- Private sector: opportunities to create additional value to their services, using or producing standardized information and integrated data groups
- Academic sector: access to integrated data groups, which are often necessary for research work.

3. BESTSDI PROJECT RESULTS

The aim of the BESTSDI project is to increase awareness of the importance of SDI. Through project activities, it is also important to establish greater representation in subject curricula in all educational institutions that are users of spatial data. The project aims to spread the experience and project results in order to create additional value and increase the impact of the final results.

The wider objectives of the BESTSDI project is to improve the quality of higher education in Geographical Science and Technology field, SDI and geodesy, enhance its relevance for the labour market and society and to improve the level of competences and skills in HEI's by developing new and innovative education programmes within the field of SDI. These wider objectives are fully compliant with the priorities of the Capacity Building projects within the Erasmus+ program.

The specific project objectives are to develop, test and adapt new curricula, courses, learning material and tools within the field of SDI. In doing so, existing undergraduate and graduate geodesy and geoinformatics curricula's in the academic institutions in the WB region will be lifter to higher levels, recognising the of spatial data for modern society and its development. By the incorporation of SDI concept and other modern concepts based on spatial data and information, the students of the new courses will have the ability to provide efficiently spatial data and services to SDI users.

In parallel, the project also introduces SDI and related concepts in undergraduate and graduate study programs on academic institutions which profiles are well recognized as SDI users, raising awareness among the students and professionals about the relevancy of SDI and advantages of well organized spatial data.

Throughout the project, equipment was provided for the implementation of modernized curricula and programs at partner universities in order to be able to adequately implement the teaching and theoretically practically and at the academic level within the partner studies at partner universities as well as through lifelong learning courses. Memorandum of Understanding between the project partners will be established through the project so that there will be a formal framework for future exchange and harmonization of curricula, learning materials, partnerships, etc. Student and staff exchanges will be fostered through project activities and information about the activities carried out by partners transmitted among partner universities.

3.1. DELIVERED BESTSDI PRODUCTS

In the project activities were conducted researches, and documents were submitted, which served as a basis for the realization of the project's defined objectives. For the purposes of informing about project activities, electronic newspapers (e-newsletters) have been created and distributed. For the purposes of internal information, electronic newsletters "BESTSDI Info" have been created and distributed to 200 e-mail addresses, and for the purpose of informing the general public, electronic newspapers "BESTSDI Newsletter" have been created, which are distributed over 2,000 e-mails address.

Within the framework of cooperation with focal points for the SDI, as well as all participants in development of SDI in BESTSDI partner countries, Albania, Bosnia and Herzegovina, Kosovo, Montenegro and Serb, were created National SDI reports for 2017 and 2018. These reports provide an overview of the current state in SDI, as well as some basic recommendations for future action by the academic community. It is primarily a document which present the base for all who is interested in SDI development, to get space

to give their opinion on the needs related to the development of the SDI and therefore also for the future needs related to the competencies of the staff necessary for the development of the SDI in the partner countries. The project has developed a project curriculum that is differentiated to those who acquire basic knowledge about SDI, advanced course SDI, LLL courses and specific topics related to SDI. Within the second year of implementation of the project were created the materials for the topics that will be available through the modules mentioned above (Table 1).

Table 1. Adaptation of project curiculum

Modul	Tema
Module 1. SDI concepts and principles	The usage of spatial data in different application domains: examples of spatial data (sets) and applications;
Module 1. SDI concepts and principles	Existing barriers to access and use spatial data: non-harmonisation, licensing and pricing, restricted use, …;
Module 5. SDI Assessment and Quality Issues	Quality and Experience of a Service: how well does a service work from a user perspective (the way it is organised and can be used, portrayal, …) and from a technological perspective, i.e. against standards or specifications (availability, capacity and performance);
Module 2. SDI at Work	Introducing the publish-search/find-bind paradigm by using single points of access (portals) to distributed data and services;
Module 9. SDI Application Development	Different approaches and different steps in applications development: the need to start with a well thought and good design;
Module 9. SDI Application Development	Methods for requirements analysis in GI including the definition of work processes and data flows, functional and non-functional requirements;
Module 9. SDI Application Development	The design of usable user interfaces to support the many interactions in the work process: using mock-ups to create a first visual outline of the intended interfaces;
Module 2. SDI at Work	The role of metadata in SDI, the different types of metadata (discovery, evaluation and usage) and the standards they are built upon (ISO 19115, ISO 19119 and ISO 19139);
Module 3 SDI Data Modelling and Data Harmonization	Comparing existing data sets or data models against specifications;
Module 3 SDI Data Modelling and Data Harmonization	Methods and steps for data transformation and the definition of syntactic and semantic transformation rules;
Module 5. SDI Assessment and Quality Issues	Overview of tools and environments to perform testing and validation;
Module 7. Technological Trends	SDI to improve sharing and exchanging data, but taking into account sensitive information by using secure access mechanisms and protection of (spatial) features.
Module 9. SDI Application Development	Some examples and exercises to identify use cases given a pre-defined work process for different actors;
Module 9. SDI Application Development	Methods for mapping and describing business/work processes to identify the activities, the actors and interactions that take place, and the role of data and geographic information in those processes in particular;
Module 9. SDI Application Development	What are and how do Agile development methods work, such as Scrum: the interactive approach through the organisation of sprints;
Module 1. SDI concepts and principles	Different types of SDI and different models: hierarchical or network based, connecting distributed resources;
Module 1. SDI concepts and principles	Different components of SDI: data, metadata, access mechanisms, standards, people and organisations, institutional and legal aspects …;
Module 2. SDI at Work	How to evaluate whether a data set or a service is of the required quality and is fit for purpose (fit for intended use);

Module 3 SDI Data Modelling and Data Harmonization	Reading and using the UML conceptual modelling language (including how to read application schema's);
Module 3 SDI Data Modelling and Data Harmonization	Modelling our universe of discourse: spatial, temporal and other aspects;
Module 4. SDI Access Mechanisms	Fundamentals on how the WWW works, the technology stack and protocols used, its basic operations and the importance of URI's, URL's and URN's;
Module 5. SDI Assessment and Quality Issues	The difference between QA of spatial data production and data products (in terms of accuracy, completeness …) and QA of SDI components;
Module 5. SDI Assessment and Quality Issues	The difference between QA and conformity/compliancy with standards and specifications in the context of SDI;
Module 6. Non-technological Developments	Overview of different license and business models for the distribution of spatial data (including the Creative Commons framework);
Module 6. Non-technological Developments	The Open Data movement and the application of Open Data principles in the context of SDI in different countries of Europe;
Module 7. Technological Trends	Overview of the major developments and trends as defined by UN-GGIM and OGC (with focus on technological trends);
Module 7. Technological Trends	3D/4D geospatial data: space and time including the provision of examples on: moving objects in space (eye-tracking), agent-based modelling (indoor/outdoor); augmented reality (looking to the past and into the future); etc.
Module 8. SDI for Thematic Applications	Analysis of differences and commonalities between different data sets and identification of specific challenges to link/integrate them;
Module 8. SDI for Thematic Applications	Visit to and exploration of specific platforms and tools: small assignments to access and use the available information/data.
Module 9. SDI Application Development	What are Application Programming Interfaces (API's) and what are geospatial API's: examples of how they are used in the context of SDI;
Module 9. SDI Application Development	Zooming in on different geospatial API's such as OpenLayers, OpenStreeMap, Leaflet, etc. Smaller exercises to use these environments to carry out simple GIS tasks.
Module 3 SDI Data Modelling and Data Harmonization	Data harmonisation and semantic interoperability;
Module 3 SDI Data Modelling and Data Harmonization	The role of ontologies and vocabularies;
Module 2. SDI at Work	The role of catalogues and catalogue services, and the concept of harvesting catalogues;
Module 5. SDI Assessment and Quality Issues	Detailed QA and quality control issues related to metadata and catalogues: problems and issues that might occur, including examples and how to solve them;
Module 6. Non-technological Developments	Authoritative spatial data and official registries and/versus volunteered geographic information and crowdsourcing.
Module 8. SDI for Thematic Applications	Overview of relevant European Directives and national legislation in the thematic (and related) fields;
Module 3 SDI Data Modelling and Data Harmonization	Explaining and analysing examples of product specifications and INSPIRE data specifications in particular (examples to be chosen depending on the field of interest);
Module 6. Non-technological Developments	Geospatial data and their integration with other data/information for different applications;
Module 1. SDI concepts and principles	Main geospatial standards, the standardisation process and relevant standardisation bodies;
Module 5. SDI Assessment and Quality Issues	Methods for testing and validating harmonized data against data specifications including examples;
Module 7. Technological	The influence of huge amounts of data on the way we work (big data): cloud

Trends	computing; workflow and provenance; big data analytics; big data coming from social networks/media; etc.
Module 7. Technological Trends	New ways to publish and use geospatial data on the web by making use of semantic web technology such as linked data: examples and small exercises on usage and implementation;
Module 4. SDI Access Mechanisms	Architecture patterns and overview of the Service Oriented Architectures used in most SDI's, based on at least three tiers: data, applications (clients) and services;
Module 3 SDI Data Modelling and Data Harmonization	Encoding mechanisms and data exchange formats (including XML, GML and RDF);
Module 4. SDI Access Mechanisms	OGC web service interfaces for accessing, discover, download, visualize, process … geospatial data;
Module 4. SDI Access Mechanisms	Detailed explanation and discussion on how WMS, WFS and CSW work, including examples from INSPIRE;
Module 6. Non-technological Developments	E-Government processes and the location enablement their G2C, G2B and G2G interactions;
Module 6. Non-technological Developments	Analysis of typical e-Government processes and modelling them using the BPMN (standard) language;
Module 3 SDI Data Modelling and Data Harmonization	Data quality and validation of transformed data.
Module 4. SDI Access Mechanisms	Exercises to set-up different type of OGC web services such as WMS/WMTS, WFS, CSW;
Module 8. SDI for Thematic Applications	Approaches to make the linking and integration of disparate data resources from the same application field including some exercises;
Module 2. SDI at Work	Providing examples of good geoportals and open data portals and discuss the characteristics of good portals (rich content, multiple providers…).
Module 5. SDI Assessment and Quality Issues	What is Quality Assurance in the context of SDI's and how does the quality control process work?
Module 5. SDI Assessment and Quality Issues	Introducing aspects related to value, cost/benefits and performance management in the context of SDI's.
Module 3 SDI Data Modelling and Data Harmonization	ISO 19100 series of standards: reference model, spatial schema, temporal schema, rules for application schema, portrayal, data product specification…;
Module 4. SDI Access Mechanisms	Web services: what are they; what can they do; how do they work and what are different types of web services;
Module 4. SDI Access Mechanisms	Overview of support of OGC web services in popular GIS software;
Module 6. Non-technological Developments	How to share spatial data to a maximum degree, while protecting sensitive information (such as personal information);
Module 8. SDI for Thematic Applications	Identification of specific metadata initiatives and specifications, and different ways to handle and describe the metadata;
Module 8. SDI for Thematic Applications	Analysing metadata records and comparing them with basic discovery metadata collected in SDI catalogues;
Module 2. SDI at Work	Provide examples and 'simple' exercises to search for specific data sets and services, to correctly evaluate the content of the metadata record and to bind the data in a GIS desktop or other application;
Module 1. SDI concepts and principles	Examples of existing SDI's, their evolvement over time and comparison worldwide.
Module 5. SDI Assessment and Quality Issues	SDI assessments: different methods to compare and benchmark SDI implementations;
Module 7. Technological Trends	Major programmes to support better and more data, more accessible and easy to use: Copernicus and GNSS, Galileo,…
Module 1. SDI concepts and	SDI's as answer to resolve those barriers: facilitating access, stimulating sharing

principles	and optimizing use;
Module 5. SDI Assessment and Quality Issues	Exercise to explore different SDI's and evaluate them based on one or more methods and to compare results;
Module 7. Technological Trends	New ways of data acquisition and new data sources: UAV's; Image-based Mobile Mapping, Laser scanning, Crowd Sourcing and VGI; etc.
Module 3 SDI Data Modelling and Data Harmonization	Difference between conceptual, logical and physical data models;
Module 4. SDI Access Mechanisms	Discussing the need for elaborating a good strategy for service implementation: how to implement portrayal, how to organise layers (in case of WMS); potential issues of performance; …
Module 6. Non-technological Developments	Detailed overview and comparison of relevant European (and national) legislation with regard to GI and other public sector information: INSPIRE, PSI, Aarhus & Access…;
Module 8. SDI for Thematic Applications	Overview and analysis of specific spatial data models and comparison with the relevant INSPIRE specifications: examples of existing data sets;

3.2. BESTSDI PROJECT SDI CURRICULUM

The specific BESTSDI project objectives are to develop, test and adapt new curricula, courses, learning material and tools within the field of SDI. By the incorporation of SDI and other modern concepts based on spatial data and information, students of the new courses will provide efficiently spatial data and services to SDI users when entering the job market.

Actually partners, in parallel with new curriculum development are executing some courses, in winter semester which includes the SDI contents. These courses are executed in both levels, Bachelor and Master. They are mostly ruined in Geodesy, Geoinformatics and Geo environment studies. The goal of this Task to make a clear view of the existing running courses and to give a clear view of the SDI contents included in these courses.

Within the BESTSDI project, an extensive curriculum structure was developed that addresses the needs of the consortium as a whole and which should cover the needs of education of all participants in the development of SDI. Thus, harmonization of the curriculum between the various participants was performed (Table 2).

Table 2. Adaptation of project curriculum on University of Montenegro

The basic SDI content selected for existing curricula and programs	**Faculty of Philosophy**		**Biotechnical Faculty**		**Total**
	Response	**Percent (%)**	**Response**	**Percnet (%)**	**Percent (%)**
SDI concept	7	100	5	50	**70**
SDI in work	6	86	3	30	**53**
Data modeling	7	100	7	70	**82**
Data access	6	86	6	60	**70**
SDI ssessment	5	71	4	40	**53**

The basis for creating a new curriculum was the previous metadata analysis of existing courses programs, modules and courses on partner institutions, existing learning materials, and the individual requirements of partner institutions. Therefore, the structure is made for the basic curriculum (curriculum that all partners want to offer) (Figure 1.)

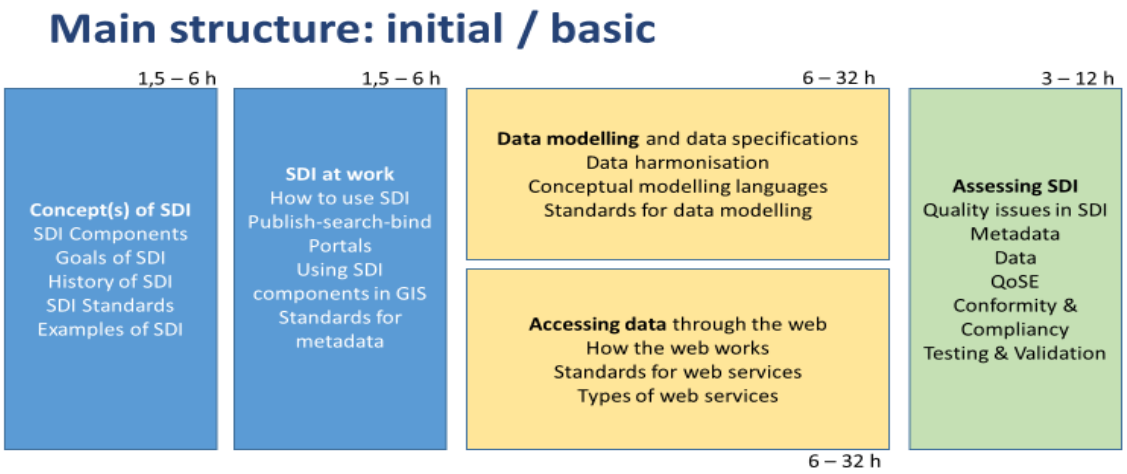

Figure 1 Structure of basic curriculum

In addition to the basic, the structure of the advanced SDI curriculum, which is related to the Faculty of Philosophy and Biotechnical Faculty, has been developed and will be studied (Figure 2).

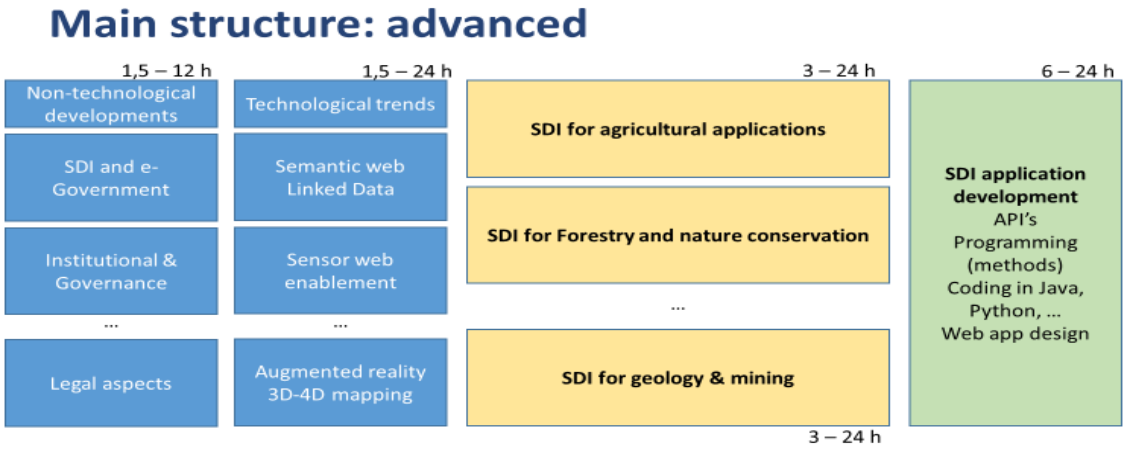

Figure 2 Structure of advanced SDI curriculum

In addition to the basic and advanced curriculum, materials for curricula of innovative SDI topics and curricula of specific SDI topics have been created.

4. SDI CURRICULUM IMPLEMENTATION

Within the project activities, an analysis of existing curricula of subjects at partner Universities was made, which served as a starting point for developing new proposals and adapting new case curriculum solutions. Based on the preliminary analysis of metadata course related to the SDI and geoinformation, some conclusions and recommendations for existing curricula and the development of new sepcial SDI curricula for partner countries can be made:

- Spatial data are represented in subject curricula, but geospatial data infrastructure is often not recognized as a topic in learning materials.
- It is necessary to identify and promote SDI aspects which are more recognizable by the users and communities.
- Master studies should be the main target level for the new BESTSDI curricula.

- At the beginning, SDI courses will be offered as electives, primarily due to administrative procedures related to the updating and accreditation of new study programs and course curricula.
- The curriculum of the subject will be restructured in order to better present what is going on in the courses (summaries and learning outcomes).
- The benefits, use cases and SDI applications missing in geodisciplines.
- It is necessary to put GIS into a broader context in order to achieve the use of technology in decision-making at all levels.

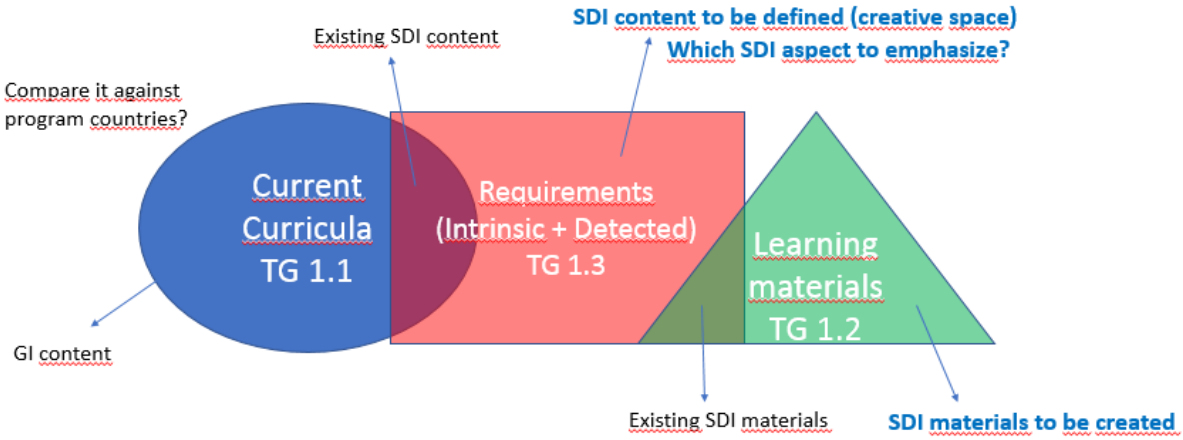

Figure 3 Establishing new curricula

4.1. SDI IN STUDY PROGRAMMES

To develop appropriate curricula, courses and their content for both target groups (SDI providers and SDI users) of academic institutions. This includes the development of:

- SDI compulsory course for undergraduate study programs in geodesy
- SDI modules for graduate study programs in geodesy and geoinformatics
- SDI user course components (not necessary full courses) for undergraduate study programs of partner faculties
- SDI elective courses for graduate study program of partner faculties (SDI users)
- Development of sustainable training courses (life-long education) of broad scope of professionals

By analyzing the current state, there were questions about the improvement of the existing curricula of the subject. It has been analyzed to what extent existing programs of the subjects correspond to their purpose. In which extent are the students after finish the studies able to participate in the development of SDI and whether materials are offered something that is appropriate for the users.

Project partners agreed for the part for using and download of courses, course metadata, structure and learning materials. In 2018, the University of Montenegro agreed on the implementation plans under academic 2018/2019. (Table 3.).

Teble 3. Implementation of SDI on University of Montenegro

Number	Faculty	New study program	Subject
1.	Faculty of Phylosphy	-	Geography of soil Temporary geography GIS
2.	Biotechnical Faculty	-	Amelioration Amelioration and soil reclamation GIS in Agriculture

To disseminate the project experiences and results in order to create additional value and multiply the impact of the results. As a consequence, dissemination will be made about best practices in teaching on SDI, the content of the developed courses, experience in introduction of newly developed courses and training courses for professionals to professional society. Theses dissemination activities are made to targeted audience like professional bodies, public authorities etc.

To provide equipment for implementation of modernized curricula to partner universities so that new kind of professionals will be equiped with broade cognition, knowledge and skills about SDI and other modern spatial data related concepts will be result of education process in involved institutions.

4.2. SPATIAL DANA INFRASTRUCTURE IN LONG-LIFE LEARNING COURSES

One of the tasks defined in the framework of the BESTSDI project is the establishment of lifelong learning courses. This concept is insufficiently represented in Montenegro and certainly represents an important part of the education of stuff in spatial data infrastructure. In the previous report, an analysis of the application where the importance of maintaining LLL courses was presented. Most interested parties expressed a great need for continuing education on this issue to train a staff that will be able to adequately implement the decisions of the SDI Development Council. Within the framework of the BESTSDI project two lifelong learning courses are currently being proposed:

1. Bacis of SDI for providers – A course that introduces students to SDI concepts and technology for spatial data providers (engineers who produce new spatial data sets based on observations and measurements or based on spatial analysis of existing data). Through this course, students will acquire knowledge: understanding and explaining the concept and components of SDI, understanding of the main chapters of the INSPIRE directive, identification and description of principles, concepts and characteristics of web services, understanding and describing the specification of OGC standard for CSW, WMS, WFS with practical use, use the web service to download data within a GIS application or web map.

2. Setting OGC Web Services – A course that introduces the participants to the service setting (WMS, WFS and CSW) intended for spatial data providers. Through this course, students will acquire knowledge: settings for creating a web service, WMS configuring and testing of the quality of characteristics of attributes, setting of operated WFS and testing of the quality of characteristics and attributes, setting of operated CSW and testing of the quality of characteristics and attributes.

Current courses have a basic character and it is necessary to develop advanced and specialized lifelong learning courses defined according to the specific needs of SDI development participants. The meaning of organizing such courses is primarily due to insufficient education of staff in this area, the importance of this

issue in establishing an e-government and constant changes in technological solutions that can be used to effectively enforce decisions defined by this issue.

Table 4. Implementation of SDI in LLL on University of Montenegro – Biotechnical Faculty

Faculty	New study program	Long-life learning courses
Biotechnical Faculty	-	SDI and Soil analysis SDI and Soil sampling SDI and using data of National Forest Inventory

5. CONCLUSION

User requirements for SDI are no longer just applicable to conventional charts, charts, etc. forms, but to up-to-date, geometrically accurate and easily accessible spatial data in digital format. Due to the fact that 80% of information is associated with a spatial component, spatial data and their distribution become of general interest. It is based on a large number of different human activities, including agriculture, transport and public infrastructure, telecommunications, environmental protection and real estate markets on them. The increasing demand of users as well as the increasing volume of spatial data with regard to modern technology for their collection has stimulated the development and building of spatial data management systems, known as spatial data infrastructures or geoinformation infrastructures worldwide. Their development is made possible by exceptional technological advances in the field of computer and communication technologies.

Within the 2018 report, basic notes are given regarding to the status of the Spatial Data Infrastructure (SDI) in Montenegro with reference to SDI in Higher Education and Analysis of BESTSDI Projects Requirements. The role of the University in NSDI is related to its development from the academic aspect in terms of the presence of SDI in study programs. Through this report, information on participants in the development of geospatial data infrastructure and their future role is provided.

As was the conclusion in the National SDI Report for 2017 and 2018, also with this report suggests that there are numerous tasks and obligations in Montenegro regarding the arrangement of spatial records that should be conscientiously accessed and resolved in a timely manner and which is of interest both for the benefit of the entire country and for fulfilling the conditions set in the process of accession to the European Union.

The need to establish a spatial data infrastructure is no longer questionable, and when and how it will be built. Only a few thoughts on spatial data infrastructure have just begun in Montenegro and it may be useful to draw on and take the lessons and experiences of other countries. First and foremost, it is necessary to adopt and implement European and international standards relating to geoinformation, which is also one of the priority tasks in the forthcoming period.

The growing demand of users as well as the increasing volume of spatial data with regard to their modern collection technology has stimulated the development and construction of spatial data management systems, known as spatial data infrastructures or geoinformation infrastructures worldwide.

Special emphasis through BESTSDI project has been put on the development of materials for lifelong, but also to introduce the assumption that we will always be able to improve the situation in the development of SDI through continuous improvement of the staff who are working on its development.

6. References

Aleksić, Ivan (2013): INSPIRATION National report MONTENEGRO

Cetl, Vlado (2003): Uloga katastra u nacionalnoj infrastrukturi prostornih podataka

Crompvoets, Joep (2017): Task Report: Task T1.3: Requirement Analysis

Global Spatial Data Infrastructure (GSDI) Association : www.gsdi.org

INSPIRE Infrastructure for Spatial Information in the European Community http://inspire.jrc.ec.europa.eu/

Ministarstvo nauke (2012): Izmjene strategije naučnoistraživačke djelatnosti Crne Gore (2012-2016)

Šoškić, Snježana (2012): Razvoj infrastrukture prostornih podataka u Crnoj Gori (NIGPCG)

Tutić, Dražen, Vanderbroucke, Danny (2017): Task Report Task T1.1: Current Curriculum Status

Uprava za nekretnine (2013): INSPIRE i Nacionalna infrastruktura prostornih podataka u Crnoj Gori

Uprave za nekretnine Crna Gora: www.nekretnine.co.me

Zakon o infrastrukturi prostornih podataka (Službeni list Crne Gore, broj 37/2017)