

BESTSDI National SDI Report 2018

For Montenegro

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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

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Content

1. INTRODUCTION	3
2. STATUS OF SDI IN MONTENEGRO.....	4
2.1. DEVELOPMENT OF NSDI IN REPUBLIC OF MONTENEGRO	5
2.2. STAKEHOLDERS IN NSDI DEVELOPMENT	6
3. BESTSDI PROJECT RESULTS	8
3.1. DELIVERED BESTSDI PRODUCTS.....	8
3.2. BESTSDI PROJECT SDI CURRIUCLUM	13
4. SDI CURRICULUM IMPLEMENTATION	14
4.1. SDI IN STUDY PROGRAMMES.....	15
4.2. SPATIAL DANA INFRASTRUCTURE IN LONG-LIFE LEARNING COURSES.....	16
5. CONCLUSION.....	17

1. INTRODUCTION

Project application „Western Balkans Academic Education Evolution and Professional’s Sustainable Training for Spatial Data Infrastructures“–BESTSDI has been selected for funding in frame of ERASMUS+ KA2 Capacity Building in Higher Education call 2015. Project is worth 978.166,66 € and is one of 147 selected among 736 submitted applications.

Project applicant is Faculty of Geodesy at University of Zagreb and project partners are:

- Catholic University Leuven (B),
- University of Split (HR),
- Ss. Cyril and Methodius University Skopje (MK),
- Bochum University of Applied Sciences (D),
- Polytechnic University of Tirana (AL),
- Agricultural University of Tirana (AL),
- University of Banja Luka (BiH),
- University of Mostar (BiH),
- University of Sarajevo (BiH),
- University of Tuzla (BiH),
- University for Business and Technology Prishtina (XK),
- University of Montenegro (MN),
- University of Belgrade (RS),
- University of Novi Sad (RS) and
- University of Prizren „Ukshin Hoti“ (XK).

Associated partners are:

- Federal Administration for Geodetic and Real Property Affairs of FBiH (BiH),
- Republic Administration for Geodetic and Real Property Affairs of RS (BiH) and
- Real Estate Cadastre Agency of Republic of Macedonia (MK).

The expected results of the BESTSDI project are the development of appropriate curricula, courses and content for the two target groups (providers and users of infrastructure spatial data (SDI)) of academic institutions. This includes the development of a compulsory SDI course for undergraduate study programs in geodesy SDI modules for graduate programs for geodesy and geoinformatics, SDI user component

courses (not required for full courses) for undergraduate study programs of partner faculties, SDI elective courses for graduate study programs of partner faculties SDI users), developing sustainable training courses (lifelong learning) for a wide range of professionals. Also, the distribution of experience and project results is expected in order to create additional value and multiplying the impact of the 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 labor market and society and to improve the level of competences and skills in higher education institutions by developing new and innovative education programs within the field of SDI.

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 BESTSDI–Western Balkans Academic Education Evolution and Professional’s Sustainable Training for Spatial Data Infrastructures With the support of the Erasmus+ program: Higher Education–International Capacity Building N° 574150-EPP-1-2016-1-HR-EPPKA2-CBHE-JP Strana 3 od 15 geoinformatics curricula’s in the academic institutions in the Western Balkan region will be lifted to higher levels, recognizing the of spatial data for modern society and its development. The annual report on spatial data infrastructure within the BESTSDI project provides information on activities carried out through coordination tasks within work package T5.3.

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. University's role of SDI is described, related to its development from the academic aspect and in terms of the presence of SDI in study programs. 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. At the end of this report, it presented requirement analysis of BESTSDI project and a review of National SDI Report 2017 for Montenegro, the recommendations of individuals and institutions included in SDI in Montenegro, based on the reviewed National report, and Conclusions.

2. STATUS OF SDI IN MONTENEGRO

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.

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.

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.

The need for geospatial data has increased in Montenegro in the last few years. By accepting new trends and technological achievements, requests for data in analogue form are neglectable compared to requests for data in electronic form, which implies the conclusion that there is a need to digitize available data. Better availability of spatial data through network services has been ensured in the previous period. Spatial information consolidated into common infrastructure prevent duplication and data inconsistency, and provide the possibility of efficient management, faster, easier access and decision making.

2.1. DEVELOPMENT OF NSDI IN REPUBLIC OF MONTENEGRO

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.

The current geo information market requires more accessible data that provides public institutions, as well as favorable conditions for use of data and services in accordance with the agreed rules of cooperation. The fundamental vision of NSDI development in Montenegro is to make existing spatial data available to all stakeholders. This vision is based on the unification of all existing spatial data and their harmonization to facilitate their search and identification. One of the visions is the development of a well-organized geoinformation community established on an open public-private-academic partnership. The most important thing to note in this respect is the need to harmonize the policies, technical standards and operational capabilities of the NSDI with European principles.

While intensively work on updating, aligning and standardizing spatial data is in process, still some of the data does not correspond the criteria required for a quality NSDI. Additionally, the associated metadata is missing for part of the data. As spatial data is a fundamental component of NSDI, this is one of the major weaknesses of the Montenegrin NSDI.

Well-defined legal regulations have established a good foundation for the Montenegrin NSDI. The Law on State Survey and Immovable Cadastre established a legal framework for the establishment of NSDI that is in line with the INSPIRE Directive.

2.2. STAKEHOLDERS IN NSDI DEVELOPMENT

According to the Montenegrin Law of Spatial Data Infrastructure, for maintenance of National Spatial Data Infrastructure are responsible: state organs, state administration bodies, local self-government bodies, local government bodies and legal entities that have been given public authority, and the possibility of including third parties, which have spatial data.

The roles and responsibilities of the NIGP actors are defined in the existing law:

- Participants are required to describe their spatial infrastructure sets in metadata form, as well as to provide interoperability and the necessary services to access their data,
- Ministry responsible for the environment - The Ministry of Sustainable Development and Tourism is a contact point and has a coordinating role, and is responsible for the establishment and management of the geoportal.

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.

2.3. ROLE OF UNIVERSITIES IN NSDI DEVELOPMENT

Science plays a key role in solving a many developmental problems in Montenegro, primarily facilitating the overcoming of low levels of economic and social development, positively affecting the renewal of economic activity and economic growth and generating preconditions for establishing spatial data.

In the development of SDI in Montenegro, universities must play one of the key roles. In view of the insufficient knowledge and opportunities provided by the SDI concept, it is necessary to promote and educate the academic staff in various ways, which will adequately integrate these concepts into all areas of work and activities of various state-owned institutions as well as private entities through where the data exchange and standardization will be adequate.

Certainly, to make this possible, it is necessary to modify the curricula and programs, to adapt them to the needs of the economy and to specific subjects in order to ensure the quality of staff that will enable these requirements to be implemented. In addition to training a new staff, it is necessary to organize lifelong learning courses which will be adapted to the needs of business subjects.

Within the academic community, the following higher education institutions are actively participating in various SDI development projects:

- Faculty of Civil Engineering
- Biotechnical Faculty
- Faculty of Philosophy
- Faculty of Science and Mathematics
- Faculty of Architecture
- Other higher education institutions.

Within the aforementioned programs organized at the University of Montenegro, the academic staff and students of the nineteen faculties that make it have the opportunity to be included in the domain of spatial data infrastructure and to improve knowledge in this field at the national and international level.

Curricula and programs of University do not contain enough subjects, as well as teaching topics that are relevant to the development and implementation of the SDI.

Their improvement (which is the aim of the BESTSDI project) would create the conditions for launching new research projects and intensifying cooperation between universities in the public and private sector in this area. With extending curricula and subjects in this area, the curriculum would be more appropriate and in line with market needs and the educated experts would be more prepared for the challenges of applying new geo information technologies, standardizing the field of work and managing geospatial data, and applying concepts that define the infrastructure of geospatial data.

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.

Within the project activities, the dissemination of the best practices in SDI learning, the content of already developed courses, the experience of introducing new courses and training courses for professionals within the framework of life-long learning programs, was conducted. Through the previous dissemination activities which were concerned primarily with the targeted environments of SDI development participants, all in order to establish the necessary foundations for participating partners universities. 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

As part of the project activities, systematic was approached to numerous studies in order to provide a comprehensive analysis of the current state of affairs in partner countries, starting from the academic community to business entities that have a strong need for staff with adequate knowledge of SDI. Based on these studies, future activities have been set up and incorporated into project results. Within the project activities 6 researches were conducted, and 17 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, two types of electronic newspapers (e-newsletters) have been created and distributed. For the purposes of internal information, 12 electronic newsletters "BESTSDI Info" have been created and distributed to 200 e-mail addresses, and for the purpose of informing the general public, two 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. 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 curriculum

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/compliance 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, OpenStreetMap, Leaflet, etc. Smaller exercises to use these environments to carry out simple GIS tasks.
Module 3 SDI Data Modelling and Data	Data harmonisation and semantic interoperability;

Harmonization	
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 Trends	The influence of huge amounts of data on the way we work (big data): cloud 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	Data quality and validation of transformed data.

Modelling and Data Harmonization	
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 principles	SDI's as answer to resolve those barriers: facilitating access, stimulating sharing 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 CURRIUCLUM

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 (Table 2) 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 sassessment	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.)

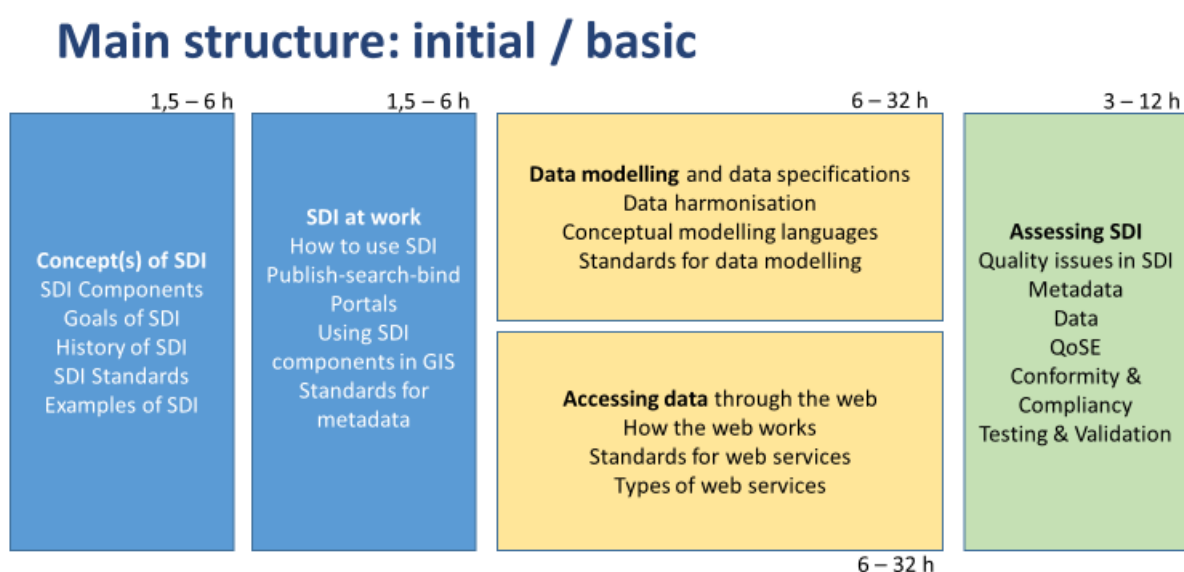


Figure 1 Structure of basic curriculum

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).

Main structure: advanced

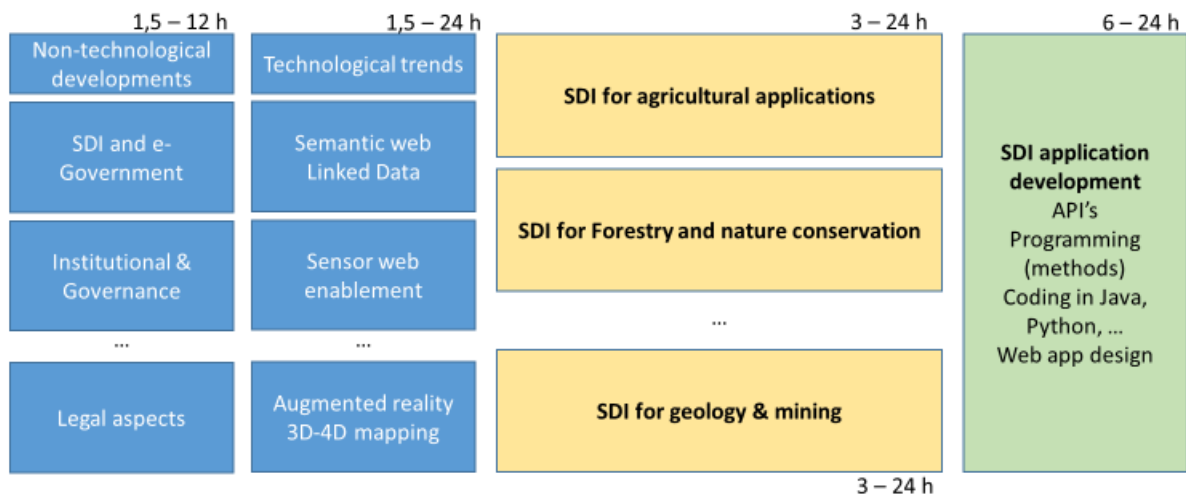


Figure 2 Structure of advanced SDI curriculum

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 special 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.

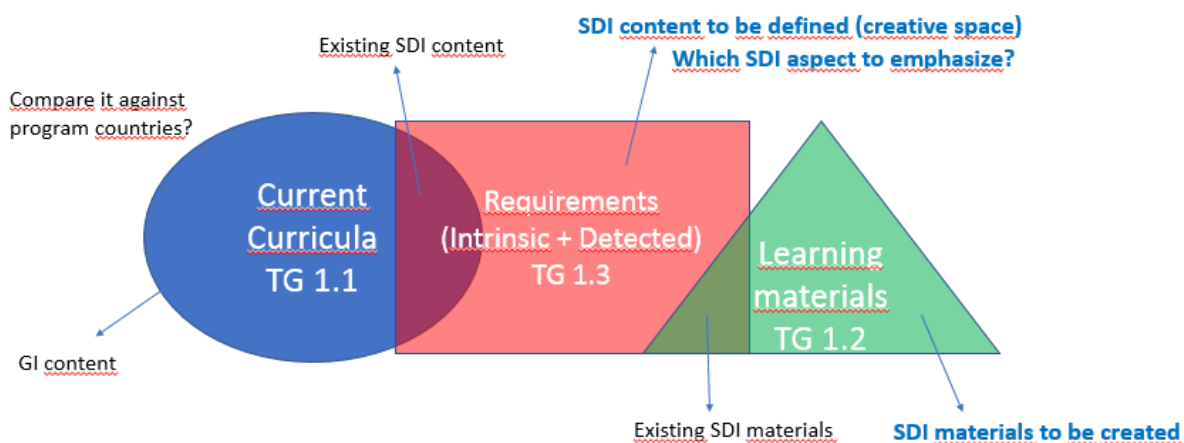


Figure 3 Establishing new curricula

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.).

Table 3. Implementation of SDI on University of Montenegro

Number	Faculty	New study program	Subject
1.	Faculty of Phylosphy	-	Geo ecology and Environmental Protection Geo informatics Geography of land Temporary cartography GIS
2.	Biotechnical Faculty	-	Melioration of soil Melioration and organization of soil GIS in Agriculture

4.1. SDI IN STUDY PROGRAMMES

The specific objectives of the BESTSDI project are to develop, test and adapt new curricula of courses, courses, learning materials and tools within the SDI field. With the incorporation of SDI and other modern concepts based on spatial data and information, students on new courses will acquire knowledge for more efficient spatial data management and SDI services when they find themselves in the labor market. In parallel, the project also introduces SDI and related concepts to undergraduate and postgraduate studies at academic institutions that educate profiles that are recognized as someone developing and using SDI. Also, education is used to raise awareness of the benefits of well-organized, harmonized and accessible spatial data.

In this context, specific project objectives are to develop appropriate course curriculum, courses and content for both target groups (SDI providers and SDI users) at academic institutions as well as optional lifelong learning courses. This implied the development of:

- Obligatory SDI course for undergraduate study programs;

- SDI modules for postgraduate programs;
- Components of the SDI user course (not required for full courses) for undergraduate study programs at partner faculties;
- SDI elective courses for graduate study programs of partner faculties (SDI users);
- Development of sustainable training courses (lifelong learning) of a wide range of professionals

In the data set of 220 courses described in the metadata, considering that these are courses in a particular domain offered in sometimes very similar studies at different institutions throughout the region, is expected to be duplicates or very similar courses that somehow describe the topics relating to the SDI and INSPIRE.

The implementation of infrastructure data is planned in existing subject curricula and during the time with the new systematization of the curriculum at the faculty is planned to create new subjects with a concept based on spatial data and information.

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 staff 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. Basis 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.

5. CONCLUSION

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, 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.

As part of the activities for 2018, adequate preparations have been made in order to start new academic topics from the academic year 2018/2019 into already existing subjects at the University Units - Faculty of Philosophy and Biotechnical Faculty.