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BESTSDI – Western Balkans Academic Education Evolution and Professionals 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

National Stakeholder Coordinator for Serbia

National SDI Report 2018

For Serbia

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WP5 / TG5.3 National Stakeholder Coordination

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Project Description

Short Description:

Annual BESTSDI National 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

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1. Introduction

BESTSDI is the project that is, with its full title "Western Balkans Academic Education Evolution and Professionals Sustainable Training for Spatial Data Infrastructures", financed within the ERASMUS+ programme, Key Action 2 (KA2) – Capacity building in higher education. Approved budget of the project amounts to 978.166,66 €. This has added significance in the view of the fact that the project was chosen as one of 147 approved projects out of 736 projects that were submitted.
This confirms the level of importance that European Union (EU) places on education and capacity building in Serbian higher education institutions within the field of spatial data infrastructure (SDI).
This also shows that, through financing this project, EU is determined to help Balkan countries with the development of their own SDI on the basis of European Parliament and Council of Europe directive, number 2007/2/EC from March 14, 2007 - "Infrastructure for Spatial Information in the European Community (INSPIRE)".
Coordinator of BESTSDI project is Faculty of Geodesy, University of Zagreb, while the partners are: Katholieke Universiteit Leuven (B), University of Split (HR), University of „St. Cyril and Methodius" Skopje (MK), Hochschule Bochum (D), Universiteti Politeknik i Tiranës (AL), Universiteti Bujqesor i Tiranës (AL), University of Banja Luka (BiH), University of Mostar (BiH), University of Sarajevo (BiH), University of Tuzla (BiH), Universiteti nderkombetar per biznis dhe teknologji UBT (XK*), University of Montenegro (MN), University of Belgrade (RS), University of Novi Sad (RS) i Universiteti „Ukshin Hoti" në Prizren (XK*), and associated partners, Federal Administration for Geodetic and Property Affairs (BiH), Republic administration for geodetic and property affairs RS (BiH), Agency for Real Estate Cadastre (MK), Lantmäteriet (Swedish National Mapping and Cadastre Authority) and Novogit AB, Sweden.
BESTSDI project is planned with the aim to improve the quality of higher education and life-long-learning in the field of geographic sciences and technology, field of SDI and geodesy, and to increase their importance in the labour market and in the society. The other goal of the project is to improve the level of competencies and skills within the higher education institutions by developing new and innovative study programs in the field of SDI. Defined goals of the project are realized through development, testing and adaptation of new study programs, courses, learning materials and tools in the field of SDI.
Realization of the project goals will provide support to creators of the development policies on national and on local levels to increase the share of the contemporary innovative technologies in the development of geoinformation market. Local communities will have significant benefits from the new technologies and programmes for application and analysis of spatial data. Due to its development nature and orientation towards modern study programs and courses, BESTSDI is completely synchronized with development programs of the EU. It is planned for the project to last for a three years, from October 2016 to October 2019.
In recent years, in Serbia, as well as in other European countries, the demand for geospatial data is considerably increased through implementation of new technological advances and trends. This implies that the need for digital, as opposed to analogue, data is also increased. Geospatial data organized in common infrastructure enables more efficient management, easier access and decision making related to spatial data. In that sense, Republic Geodetic Authority of Serbia, with the help

from Norway, made the first steps in establishing SDI and created initial Serbian internet Geoportal (http://www.geosrbija.rs) on November 29, 2009.
As a part of regular project activities, yearly BESTSDI National Reports on spatial data infrastructure (SDI) are related to task T5.3 – National coordination. These reports provide information on the SDI status in Serbia and SDI in higher education. Status of the SDI deals with legal and organizational aspects (responsible organizations and institutions), technical organization (web, geoportal, dissemination) related to national spatial data infrastructure (NSDI), key institutions and government bodies, business sector, educational institutions, and end users: local administrations, public enterprises, citizens. The report includes the description of the role of universities in relations to development of NSDI from the academic stand point and the aspect of presence of SDI in study programs. The analysis of the BESTSDI project demands and conclusions are also given in the report.

2. Status of the SDI in Serbia

2.1 National spatial data infrastructure in Serbia

Establishment and efficient functioning of the National spatial data infrastructure (NSDI) in Serbia is conducted through the Directive "Infrastructure for Spatial Information in the European Community (INSPIRE)" of the European Parliament and the Council of European Union, number 2007/2/EC from March 14, 2007. When strategic plans of Serbia are taken into account, efficient NSDI has practically became one of its the strategic goals.
There exists a large number of laws and legal documents that are related to the use of spatial data and which are obligatory towards development and strengthening of SDI. Most of them are based on the INSPIRE directive. Significant step in development of SDI was made with the official adoption of the Law on State Survey and Cadastre (Official gazette, no. 72/2009), which, in its Chapter XI, represents a legal basis for the forming of the National spatial data infrastructure – NSDI.
In previous period, an important role in the development of the NSDI was with the “Strategy for establishment of the spatial data infrastructure in Republic of Serbia for the period from 2010 and 2012", "Decree on midterm program of NSDI 2011-2015", as well as with the establishment of Republic of Serbia Geoportal within the Republic Geodetic Authority (http://www.geosrbija.rs).
Significant step that followed was the adoption of the Law on NSDI, April 14, 2018. This law regulates, in detail, the establishment, maintenance, and usage of NSDI in Republic of Serbia as an integrated system from the local to the national level. In practice, this law implements, into domestic legislative, the directive of the European Union 2007/2/E3 – INSPIRE. The same is with the parts of the demands given in the Chapter 27 – Environment and climatic changes that are part of the process of Serbian accession to the European Union (EU).
Within the Law on NSDI, Republic Geodetic Authority (RGA) is identified as the main subject regarding the activities related to NSDI in Serbia with a key role of its Centre of spatial data management.
RGA has, in previous period, worked on the development of the NSDI through activities within the IMPULS project that has an aim of establishing a modern and functional framework for spatial data sharing that is in accordance with regional and international standards

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(https://www.lantmateriet.se/sv/Om-Lantmateriet/Samverkan-med-andra/impuls/about-the-impuls-project/). Also, one more project that is conducted with the aim of NSDI development is the project SPATIAL (https://www.kadaster.com/-/spatial-project-for-the-western-balkan-region)

Next step that followed in the development of NSDI, was the formal nomination of the members of the Council of National Spatial Data Infrastructure (Decree 24, number: 119-9822/2018, of the Government of the Republic of Serbia, from October 25, 2018).

In accordance with the Law on NSDI, it is expected that in the near future the Council of NSDI initiates adoption of a number of legal acts that will, in more detail, regulate the activities related to implementation rules for metadata, monitoring and reporting, interoperability, network services and access to domains and spatial data services, with inclusion of public access and exchange of data among public authorities. Also, this needs to be followed by the adoption of special formal documents by the Council of the NSDI that deal with the description of the spatial data themes, authorities that are responsible for creation, acquisition and maintenance of the spatial data that are related to defined spatial data themes, and also those public authorities that use spatial data as a part of their regular activities within their jurisdictions.

Regardless of the significant efforts invested into development of the NSDI, it can be concluded that the status of accessing and use of spatial data in Serbia has following characteristics: irregular updating, heterogeneity of IT systems (from contemporary to undeveloped), multiplication of efforts and expenses, insufficient use of standards, poor accessibility, poor data exchange, poor state of the intellectual property rights, lack of coordination, poor web service development, insufficient human and financial resources, etc. The progress was made in the sense of establishment and management of NSDI, communication with the EU and Government of the Republic of Serbia, legal basis was created that is in accordance with INSPIRE Directive, linkage of the NSDI with the Open Data concept and e-Government strategy is ongoing, sustainability of the NSDI is ensured, Serbian Geoportal is established and functional, several organizations are providing data through NSDI, local self-government authorities are included, there exists a large number of NSDI good practices, metadata standards that are used are in accordance with INSPIRE technical specifications, basic data is available on the NSDI geoprotal. In general, it is necessary to improve the capacity on all levels. The topics that require investment of particular efforts are: preparation of engagement/communication strategy; linking the NSDI with the goals of the sustainable development needs to be planned; strengthening of the cooperation between the universities and R&D institutions in an effort to improve the development of innovative solutions for new application creation aimed at increased benefit from NSDI; significant amount of work needs to be invested into harmonization of data with INSPIRE technical specifications; socio-economic benefits of the NSDI are not sufficiently recognized.

The adoption of NSDI development strategy for the next period will have a key role in the further development of the National spatial data infrastructure. It is expected that this strategy defines the directions and action plan for the development of NSDI services and the role of individual subjects in the development of the NSDI. This action plan has to include the following: cooperation in the spatial data infrastructure sector; improvement of spatial data and services; development of the proposals for the legal documents; financing models; capacity building; monitoring and reporting; INSPIRE Directive implementation; the role of NSDI services; cooperation with the e-Government; positive effects on state bodies, economy and citizens.

2.2 Stakeholders in NSDI

Having in mind a broad spectrum of fields related to National spatial data infrastructure, as well as all the subjects that need spatial data for conducting everyday jobs, NSDI stakeholders encompass the whole of the society and they can be differentiated into three groups: public institutions (ministries, special organizations, autonomous provinces and local self-government services, public enterprises, etc.); private companies (that deal with geodetic-mapping services, market analysis, investment planning, freight forwarding services and similar); citizens that have a need to use spatial data, i.e., those who could benefit from improved quality information regarding locations and improved public services.

Within the pool of public sector representatives, NSDI stakeholders are from the field of spacial urban planning and spatial development, economic development, ecological monitoring, agriculture, forestry, water resources, mining, geology, … Significant group of users that already expresses the need for efficient NSDI are companies for production and distribution of electrical power, telecommunication, communal services, etc. These companies often have their own spatial data infrastructures that are formed according to their own needs, so utilisation of these databases is important for their more efficient use. Apart from these companies, potential users are the representatives of institutions responsible for traffic management, emergency services, crime fighting services, etc.

Academic community is an important stakeholder due to the fact that the access to integrated databases is often necessary for conducting scientific research work of sufficient quality. Considering the heterogeneity, at the state level, in the manner of application, processing, storing and the regulations/freedom of access to data relevant to spatial data infrastructure, it is extremely complex to conduct research within this domain.

2.3 Role of universities in NSDI

The role of universities in the society is primarily to transfer knowledge, conduct scientific research and to ensure its application in professional practice. In that sense, principles of spatial data development, ways of creation and use of spatial information databases represents a significant task for universities that have to contribute to education of necessary number of experts that would have required skills to create, maintain and apply spatial data. University of Novi Sad and Belgrade are actively involved in the NSDI work groups. It can be noted that on other higher education institutions there is an increased number of courses that are aimed at development and/or application of spatial data. Apart form educational activities, universities are involved, or try to get involved, with international projects in the field of SDI.

Still, it can be observed that universities are not represented in the part of SDI that deals with cooperation with the institutions responsible for NSDI, in other words, the potential of the universities is not fully exploited in this field. Analysis of the study programs and content of courses, conducted within the BESTSDI project, showed that there is a need for the increase of number and content improvement of the existing courses that deal with development and application of SDI. Realization of BESTSDI project goals could significantly contribute to initialization of new research

projects, more intensive cooperation between universities and other stakeholders and creation of experts with higher levels of knowledge in the field of SDI.

3. BESTSDI project results

BESTSDI project has a goal of raising awareness regarding the significance of the SDI. An effort is made through project activities to achieve greater representation of SDI content in the courses curricula within all education institutions and which are, to some degree, users of the spatial data. The project aims to exchange of experience and results in order to create added value and increase the effect of final results. Within the project activities, a dissemination is conducted, Figure 1, regarding the best practices in learning related to SDI, improvement of existing courses, experiences in implementing new courses and courses for professionals within the frame of life-long-learning. Through previous dissemination activities that were related, primarily, to specific profile of SDI development of participants, an effort was made to create necessary foundation for the work/activities of partner universities.

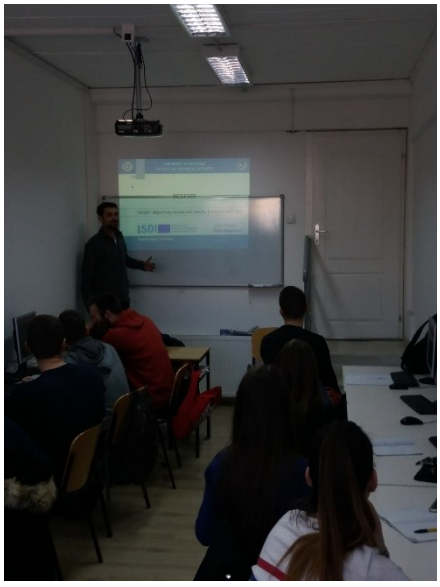

Figure 1, a) i b). Dissemination – best practices in application, lessons in the field of SDI, BESTSDI project, Faculty of Technical Sciences University of Novi Sad, lecturers: Milan Vrtunski i Željko Bugarinović

Through project activities, necessary equipment was secured for the implementation of modernized course curriculums and programs on partner universities in order to have adequate realization of lectures, both theoretical and practical, and on suitable academic level within the studies at partner universities, but also for life-long-learning courses. The project will result in memorandum of understanding among the partners in an effort to create a formal framework for future exchange and harmonization of curriculums and programs, learning materials, mobility among partners institutions, etc. Exchange of students, staff and information will be encouraged through project activities carried out by individual partners and among partner universities.

3.1 Delivered BESTSDI products

Within project activities, a systematic approach to numerous research was applied in order to conduct comprehensive analysis of current status of SDI in partner countries, starting from the academic community to business entities that have pronounced need for staff with adequate knowledge in the field of SDI. Future work is founded on the basis of these research activities and their results are incorporated into project results. For these purposes, 6 research activities were conducted, with 17 documents that served as the basis for realization of previously defined project goals. For the purpose of dissemination regarding the project activities, two types of digital newspapers were distributed (e-newsletters). Internal dissemination was conducted through 12 e-newspaper issues "BESTSDI Info" that are distributed to 200 e-mail addresses, and, for the purpose of informing wider public, 2 issues of e-newspapers „BESTSDI Newsletter" were distributed to more than 2.000 e-mail addresses. Within cooperation with contact points of SDI development, as well as with all participants in SDI development in partner countries, national reports were created for the year 2017, for Albania, Bosnia and Herzegovina, Kosovo, Montenegro and Serbia. The reports contain analyses of current status, basic recommendations for future activities of the academic community. This report is primarily a document that could provide a ground for all stakeholders, interested in development of SDI, to voice their opinion regarding the needs relative to SDI development and, by doing that, also to give their opinion regarding the needs with respect to staff competencies necessary to develop SDI in their respective countries. Within the project, a curriculum was developed that was differentiated to those who need to gain basic SDI skills, advanced SDI skills, life-long-learning (LLL) skills and specific topics related to SDI. In the second year of the project, a material was developed for topics that are to be available through previously defined modules (Table 1).

Table 1. Adaptation of the project curriculum

Module	Theme

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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	Modelling our universe of discourse: spatial, temporal and other aspects;

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and Data Harmonization	
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 environment 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;

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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 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 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 curriculum

Within the BESTSDI project, a structure of the detail curriculum was developed that deals with the needs of the whole consortium and that should cover the needs of educating all participants in the development of the SDI. By doing so, a harmonization was achieved between curricula of different participants (Table 2).

Table 2. Adaptation of the project curriculum on the level of all project participants

Basic SDI content, chosen for existing study programs and curriculums	**Geodetic faculties**		**Other faculties**		**Total**
	Responses	**Percentage (%)**	**Responses**	**Percentage (%)**	**Percentage (%)**
SDI concepts	7	100	5	50	**70**
SDI art work	6	86	3	30	**53**
Data modelling	7	100	7	70	**82**
Data access	6	86	6	60	**70**
SDI evaluation	5	71	4	40	**53**

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Basis for the creation of the new curricula represented a necessary analysis of the metadata regarding the existing course curricula, modules and course on partner institutions, existing learning materials and individual demands of the partner institutions. Therefore, a structure was created for the base curriculum (curriculum that every partner wishes to offer) (Figure 2.)

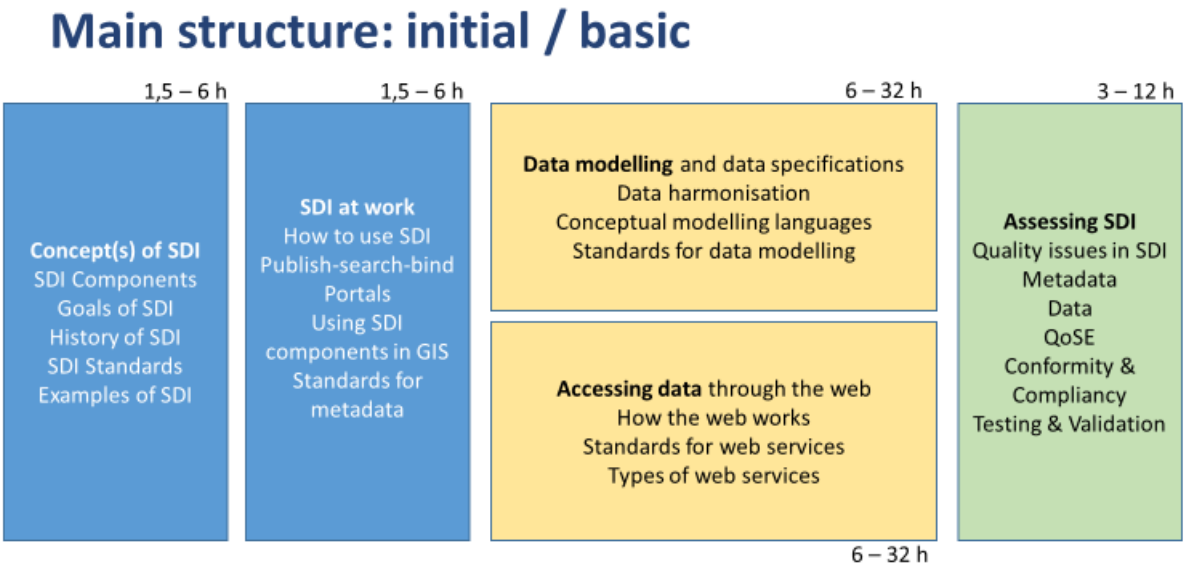

Figure 2. Basic curriculum structure

Apart from the basic SDI curriculum, basic structure of the advanced SDI curriculum was created that is primarily aimed at geodetic faculties that are inclined to study these topics (Figure 3.).

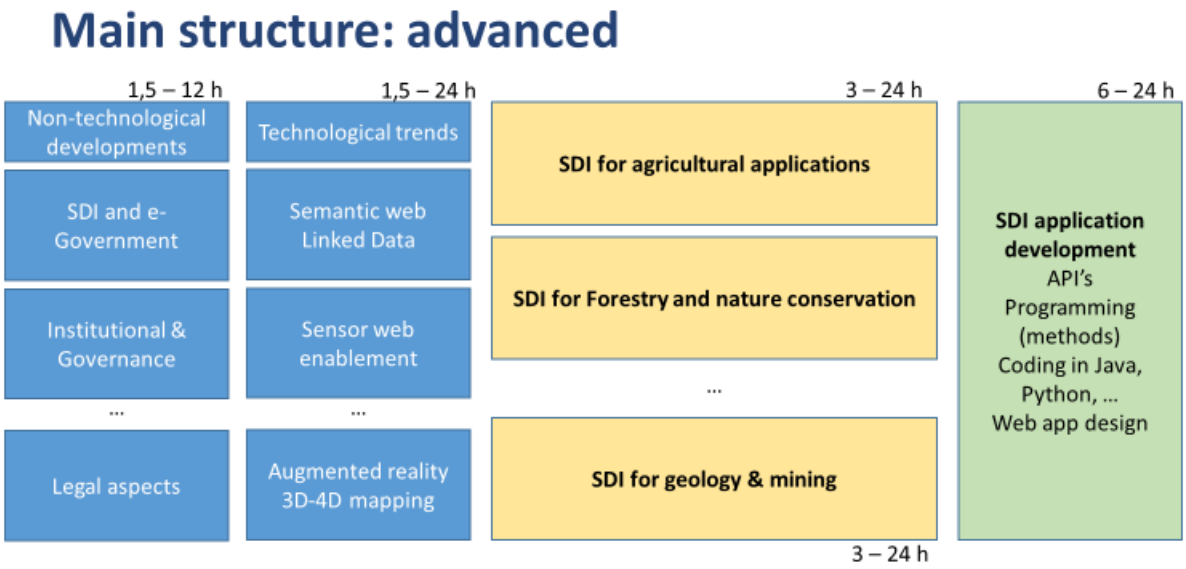

Figure 3. Advanced curriculum structure

In addition to basic and advanced curricula, materials for the curricula of innovative SDI topics and curricula of specific SDI topics were created also.

4. SDI curriculum implementation

As a part of the project activities, an analysis was conducted of the existing curricula for the courses on partner universities. This served as an initial basis for the development of new proposals and adaptation of the existing solutions for the course curricula. Based on the preliminary analysis of the metadata on courses related to spatial data infrastructure and geoinformation, some conclusions and recommendations could be derived for the purpose of developing adaptations of existing curricula and development of specific SDI curricula for partner countries (Figure 4). The following conclusions/recommendations were derived:

- Spatial data were present in course curricula, but spatial data infrastructure most often is not recognized as the topics within the learning materials.
- It is necessary to identify and promote SDI aspects that were recognized by the users and the community.
- Master studies should be the main goal of the new BESTSDI curricula.
- SDI courses, initially, can be offered as elective courses, mostly due to administrative procedures that have to do with updating and accreditation of the new study programs and course curricula.
- Course curricula will be restructured with the aim of making the presentation of what is actually the content of the course (aims of the course and learning outcomes).

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- SDI is mainly present in elementary form (elective courses).
- Benefits, possible uses and application of SDI is missing within geosciences.
- It is necessary to place the GIS into wider context in order to promote the use of technology in decision making on all levels.

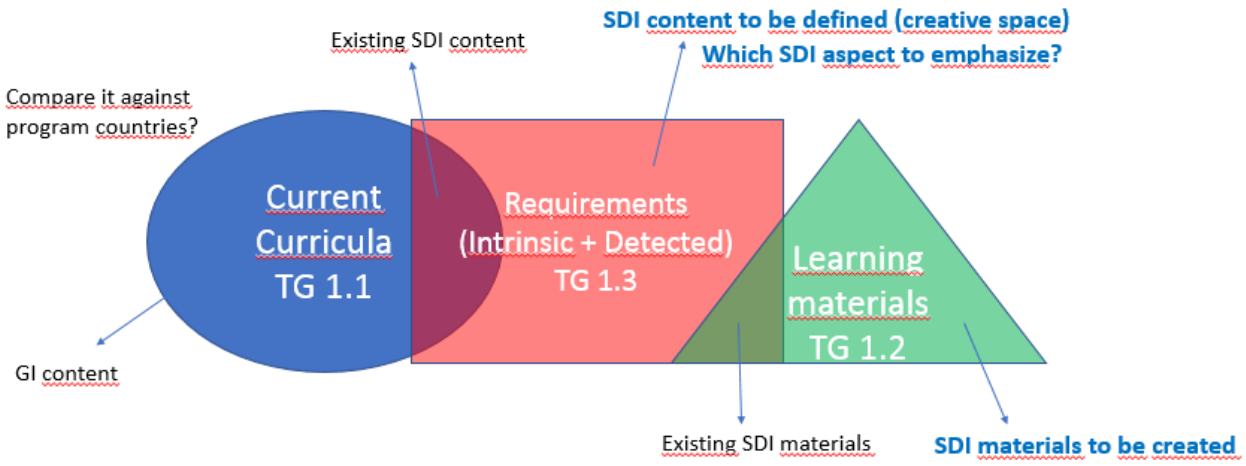

Figure 4. Creation of the new curriculum

Analysis of the existing status brought the issue of current curricula adaptation. The analysis dealt with the level in which current curricula correspond to their intended purpose or, the measure in which students, following the completion of their studies, are capable in the filed of development of SDI and whether the materials that are offered are suitable for users. The proposals for the implementation of the new curricula of the courses related to SDI and INSPIRE were defined for the following courses:

1. Geospatial data infrastructure
2. Spatial data infrastructure
3. Geoinformation infrastructure
4. Topographic models
5. Real estate appraisal
6. Geoinformation systems
7. Geoecology and heritage conservation
8. General cartography
9. Applied cartography
10. Thematic cartography
11. GIS
12. Geospatial data bases

13. Spatial and urban planning
14. Sustainable use of natural resources and environmental protection systems
15. Land consolidation
16. Cadastre
17. Detection of underground infrastructure
18. Basics of remote detection and image processing
19. Active geodetic reference grid
20. Basics of mathematical cartography
21. Structural geomorphology
22. Geo-diversity and geo-heritage

Project partners agreed upon the manner of using and exchanging courses, metadata on courses, structure and learning material. Within 2018, plans for implementation in the academic school year 2018/2019 were defined (Table 3).

Table 3. Implementation of SDI courses with harmonized plans on the level of BESTSDI participants - Serbia

No.	Faculty	New study program	Course	Expected number of students
1.	Faculty of Civil Engineering Subotica	-	Geology and Petrology	80
			Engineering Geology	80
			Irrigation and drainage	20
	University of Novi Sad (UNS FCE)		Basics of urban planning	20
			Building heritage protection and revitalization	20
			Basics of building design	20
			Design of multi-family buildings	20
			Traffic infrastructure and space	15
			Complex synthesis project	20
2.	Faculty of technical sciences University of Novi Sad (UNS FTN)	-	Spatial Data Infrastructure	50
			Geoportals and Geospatial Services	50
			Remote sensing and Image Processing	60
			Photogrammetry	60
			Laser Scanning of Terrains and Objects	60
			Geospatial databases	60
			GNSS Basic	60
			Digital Terrain Models	60
			Geoinformatics	60
			Underground Infrastructure Detection	60
			Basic cartography	60

			GIS	60
			Mathematical cartography	50
			Geospatial data visualization	50
			Geosensor networks	50
			Basic Geoinformation technology	50
			Basic GIS	50
3.	Faculty of Forestry University of Belgrade (UBG)	-	Geodesy	127
			Spatial Data Infrastructure (GIS)	127

4.1. Spatial data infrastructure in study programmes

Specific goals of the BESTSDI project are to develop, test and adapt new curricula, courses, learning materials and tools within the filed of SDI. With the inclusion of SDI and other modern concepts based on the spatial data and information, students on these courses will obtain knowledge for more efficient management of spatial data and services for SDI users. This will in turn, increase their potential on the labour market. In parallel, the project provides information regarding the SDI, and complementary concepts, for bachelor and master studies on academic institutions that educate experts recognized as the professionals that develop and use SDI. Additionally, through education, the goal is to raise awareness regarding advantages of well organized, harmonized and accessible spatial data.

In this context, specific goals of the project are to develop suitable course curricula, courses and their content for both SDI providers and SDI users within the academic community as elective life-long-learning courses. This implies the development of:

- Obligatory SDI course for the bachelor level studies in the filed of geodesy;
- SDI modules for post-degree programs in geodesy and geoinformatics;
- Components of SDI user course (full courses were not necessary) for study programs of bachelor academic studies on partner universities;
- SDI elective courses for master academic studies on partner universities (SDI users);
- Development of sustainable training courses (life-long-learning education) of wide array of professionals.

In the assemblage of 220 courses described in metadata, considering that those are the courses within the domain of offered programs that are sometimes very similar for different institutions throughout the region, it was expected that there are sometimes identical or very similar courses, all

of which in some way describe SDI or INSPIRE. The analysis revealed a certain number of such courses on partner universities (Table 4).

Table 4. Similar courses on partner university

Course title	No. of occurrences
Survey	6
Engineering geodesy	6
Geoinformation systems	5
Photogrammetry	5
Cartography	5
Satellite geodesy, positioning and navigation	5
Cadastre	4
Geodesy	4
Land Consolidation	3
Remote detection	3
Physical geodesy	3
Geospatial data basis	3

4.2. Spatial data infrastructure in life-long-learning courses

Establishment of the life-long-learning courses was set as one of the goals defined within the BESTSDI project. This concept has insufficient presence in Serbia and certainly represent an important part of the educating professionals in the field of spatial data infrastructure. During the joint workshop of IMPULS and BESTSDI projects, in April 2018, an importance of LLL courses was analysed. It was concluded that most of the stakeholders have expressed a need for continuous education in this field in order to produce the professionals that are capable, in adequate manner, to use and to participate in the development of the NSDI. On the level of partners of the BESTSDI project in Serbia, following life-long-learning courses were proposed:

1. Application and practical use of SDI in Civil Engineering - UNS FCE
2. Application and practical use of SDI in Urban Planning - UNS FCE
3. Fundamentals of SDI and its engineering applications - UNS FCE
4. Application and practical use of SDI in Forestry - UBG
5. Application and practical use of SDI in Ecological engineering-
6. Application and practical use of SDI in Landscape Architecture

7. Application and practical use of SDI in Smart City UNS FTS
8. Application and practical use of SDI in Agriculture UNS FTS
9. Application and practical use of SDI in Interactive Learning UNS FTS

While these course are partly basic, most of them are specialized LLL courses defined according to specific needs of the participants of the SDI development. Main goal of organizing such courses is primarily to overcome insufficient knowledge of staff/professionals in the SDI domain.

5. Conclusion

Within the report for 2018, basic overview was given related to the status of spatial data infrastructure (SDI) in Serbia with special attention placed on the role of higher education institutions and the analysis of the project goals of the BESTSDI project. The role of universities in NSDI was analysed through possible directions of development/improvement in the sense of the SDI related contents within study programs but also in the sense of presence of universities in NSDI development on the state level.

As one of the most important, a conclusion can be made that universities in Serbia are not sufficiently involved in the part of the SDI that deals with cooperation with the institutions responsible for NSDI, in other words, the potential of the universities is not sufficiently exploited in this area. Analysis of the existing study programs and course curriculum contents, conducted within the BESTSDI project, revealed that there is a need for expansion of the number of courses and content improvements of the existing courses with the topics related to development and application of SDI. Realization of the BESTSDI project goals would considerably contribute to creation of new research projects, more intensive cooperation between universities and public/private sector that represent stakeholders when it comes to production of professionals with high quality education in the field of SDI.

Specific attention was devoted to development of life-long-learning materials that is to ensure improvement of knowledge of working professionals, but also this would introduce the prerequisite of constant development and improvement of SDI through specialization of professionals in this field.

Within the activities conducted in 2018, adequate preparations were made for implementation of improved and adapted SDI related curricula of courses and study programs that started in the academic school year 2018/2019 at the Universities of Novi Sad (Faculty of Civil Engineering Subotica, Faculty of Technical Sciences) and University of Belgrade (Faculty of Forestry).