

Efficient Association Established on GIS and SDI - the role of education and communication with subjects and users

Željko BAČIĆ¹, Vesna POSLONČEC-PETRIĆ^{1*}

¹ University of Zagreb, Faculty of Geodesy, Zagreb, Croatia

Abstract. The application of Geographic Information Systems (GIS) in the work of government bodies, economic subjects and units of regional and local self-government presents the real situation today in every European country, as well as in its regions. The organisation of collecting, storing, distribution and usage of spatial data, in accordance with the principals of spatial data infrastructure (SDI) presents the next (higher) level in the application of spatial data and GIS.

Rapid development of GIS application in the last decade highlights two problems in the efficient usage of GIS technologies, entailing the usage of spatial data in general. The first problem is the lack of the concept in organising the spatial data that has been solved basically through the development of IPP concept. The other problem lies in the fact that the subjects and the users do not have enough knowledge of GIS and IPP. Therefore, special attention has been paid within the frame of INSPIRE project to the development of education concept for the subjects and users of IPP, in order to provide the possibility for them to use the advantages offered by the concept of enhanced technologies and IPP itself.

The paper presents the current situation in the education referring to GIS and IPP, and describes the activities carried out for the purpose of creating the environment that would provide quicker and more efficient implementation of National SDI (NSDI) based on better information given to the subjects and users.

Keywords: education, SDI, Western Balkan

*Vesna Poslončec-Petrić <vesna.poslonceec@geof.hr

1 Introduction

Education about and usage of GIS technologies and solutions is today standard in every European country and Croatia as well. It is present in number of secondary school curricula's as well as university programs educating various profiles of professionals.

Quite opposite situation is regarding SDI education. It is not easy to find in European academic arena university courses focused solely on SDI issues, what is rather surprising when we know that SDI become topic of high interest of geospatial society including official institutions, companies, educational institutions and also citizens. The fact that most of European countries, among them all European Union (EU) countries, have in past years adopted special legislation on SDI speaks about relevancy of SDI, but still did not resulted in visible changes of curricula's or university programmes.

Nevertheless, GIS and SDI got a strong push with adoption of INSPIRE Directive in EU and national SDI legislations in European countries. This is also valid for the Western Balkan region, although only two (Slovenia and Croatia) out of eight countries are EU members.

Adoption of EU INSPIRE Directive gave a strong push to develop NSDI's in the region resulting in introduction of SDI in the legislative frame, either by expansion of existing (mainly surveying) laws, or adoption of specific NSDI laws in almost all countries in the region in very short period of time.

For example, Croatia was first country in the region introducing SDI in its legislation expanding Law on State Survey and Real-Estate Cadastre [10] with chapter on NSDI. This initial framework served to launch starting activities on NSDI establishment in Croatia and paved the way to comprehensive present NSDI law [11].

Same as in Croatia, incentive to develop SDI in the countries in the region has come from the surveyor's side, especially national mapping and cadastre authorities (NMCA). As biggest collectors of spatial information, producers and maintainers of official maps and state registers NMCA's organized internally in more or less systematic manner structure of their spatial information. But development of technology and society (globalization) requires more systematic approach to organization of spatial information, demanding new legislative, organizational and technical frame involving multiple layers of stakeholders in this process (state and educational institutions, private sector, professional associations,...) pushing NMCA's to look for new ways trying to satisfy needs of the society [3].

Beside the need for concept in organising the spatial data that has been solved basically through the development of SDI concept, rapid development of GIS application in the last decade highlights another problem in the efficient usage of GIS technologies regarding the

lacking knowledge about GIS and SDI among the stakeholders and users.

Table 2: Overview of the institutions educating geodetic experts in Croatia (Bačić, 2011)

School/University:	Students
Geodetic Technical School Zagreb	387
Civil Engineering-Geodetic School Osijek	140
Civil Engineering-Geodetic Technical School Split	120
Civil Engineering Technical School Rijeka	105
Technical School Pula	120
High-School A.M.Reljković Slavonski Brod	54
High-School Metković	30
Total (secondary school):	956
Faculty of Geodesy, University of Zagreb	825
Faculty of Construction, Architecture and Geodesy, University of Split	60
Total (university):	885

Lacking knowledge has in the past caused failure of many projects and programmes Worldwide and therefore special attention has been given to this problem by the Croatian NSDI Council and NSDI Board. The issue has been addressed by establishment of the Working Group (WG) for NSDI capacity building, see chapter 2.3.

2 GIS and SDI in education

2.1 GIS in education

Education about GIS and its various applications is today well represented and become standard part of the secondary school and university education for surveying technicians and engineers. The volume of GIS education depends on profile of educational institution. So for example the Geodetic technical school in Zagreb (secondary school) provides 3 courses on GIS, where at the Faculty of Geodesy in Zagreb 6 courses on GIS are taught for Bachelor degree and 4 to 7 courses for Master degree at graduate level. Mentioned courses provide good general knowledge and understanding.

When we speak about GIS education at the Faculty of Geodesy sufficient number of courses on GIS is provided, but they are scattered through the curriculum, common link as well as systematic in depth knowledge and specialization and practical work are missing.

Therefore, transfer into the working environment requires frequently additional education.

2.2 SDI in education

Regarding SDI education situation is quite opposite. There is no formal course on SDI neither is SDI major topic in any course. In the secondary school education SDI is mentioned, and at the Faculty of Geodesy tackled in several courses. In education of other professions in Croatia SDI is not even mentioned. In practice, most of SDI education in Croatia till now has been done by State Geodetic Administration (SGA) through its activities on promotion of SDI. SGA started as first in the region with capacity building and promotion activities, conducting number of activities [8]:

- courses for SGA executives and staff provided by sister organizations from donor countries (Statens kartverk from Norway and Lantmäeriet from Sweden for example),
- international workshops for GI staff from SGA, other governmental institutions, academia and GI and surveying professionals introducing NSDI models from other countries (Canada, Germany, Sweden and Norway),
- launching in 2010 annual Croatian NSDI conference called "NSDI & INSPIRE day" bringing together over 200 participants annually and
- releasing brochures and leaflets about NSDI and launching official NSDI web page www.nipp.hr.

All those activities had visible positive impact, but on rather limited circle of people, professionals from governmental bodies and private sector involved in SDI and SDI activities. This fact has been recognized and steps have been undertaken on more systematic manner with intention to develop sustainable framework for dissemination of knowledge on SDI on a level sufficient for broader circle of people (whole surveying society and others involved in SDI and GIS) to become able to contribute SDI development in Croatia.

2.3 WG for NSDI capacity building

The Working Group (WG) for NSDI capacity building has been established in October 2009 and her members are professionals from State Geodetic Administration, Faculties (Geodesy, Forestry), Institutes for Spatial Planning (Zagreb, Virovitičko-Podravka County), Town of Virovitica, companies (APIS-IT, GDI GISDATA, Croatian Forests).

Its mission is efficient establishment of NSDI capacity building model which should develop knowledge platform among the professionals dealing with spatial information enabling adoption of NSDI concept in society and its installation in work processes.

Following tasks have been given to this WG:

- to identify weaknesses in capacity building for

NSDI establishment and give best practices examples,

- to build NSDI capacity building model,
- to work on professional literature on NSDI,
- to make proposals for NSDI subjects on different educational levels (schools, faculties etc...),
- to establish network and communication between educational institutions in Croatia and abroad.

Starting with the work the WG tried to make an inventory of situation, especially to gather information about understanding of NSDI in different groups in Croatian society (scholars, students, SDI involved and uninvolved professionals) and knowledge about it. At the very beginning of the work information about several issues have been identified as insufficient:

- lack of knowledge on the courses dealing with spatial data in the Croatian education system,
- lack of knowledge about expertise of teachers in secondary school educational institutions on GIS and SDI,
- lack of information about resources for mentioned education and
- overview on experts in GIS and SDI in Croatia.

Therefore it has been decided to gather missing information starting with the basic level, detected as the secondary educational institutions. Facing lot of unknowns, the survey was limited to eight secondary schools educating surveying technicians, meaning that both questioned groups (scholars and teachers) are familiar with the spatial information topic, have knowledge on GIS and related issues and should be interested to participate in survey. The aim of the survey conducted among teachers of secondary schools in Croatia was to:

- explore the representation of spatial data in the educational system, with special emphasis on the National Spatial Data Infrastructure (NSDI),
- assess the knowledge on the use of spatial data that students receive during their schooling,
- determine whether the curriculum meets modern educational trends,
- get teachers' recommendations for teaching improvements in the field of spatial data.

For the survey we decided to use the questionnaire of combined type. Some questions were open-ended, while the others were multiple choice questions. The questionnaire included a header with an introduction and instructions, followed by 17 questions.

Questions in the questionnaire were divided into the following topics:

- topics related to spatial information in the curriculum
- using spatial data in:
 - teaching activities
 - extra-curricular activities

- suggestions for improvement

NIPP - ANKETA ZA SREDNJE ŠKOLE

Prostorni podaci obuhvaćeni nastavnim programom

Navedite kolegije koji obrađuju temu što su prostorni podaci i na koji način se mogu koristiti?

U kojoj su mjeri, prema Vašem mišljenju, u nastavnim programima zastupljene informacije o prostornim podacima?

1 2 3 4 5

Uopće ne Odlično

Imate li problema sa dostupnošću karata ili drugih prostornih podataka potrebnih za redovito održavanje nastave?

1 2 3 4 5

Uopće ne Jako puno

Smatrate li da bi veća dostupnost prostornih podataka doprinijela povećanju kvalitete nastave?

1 2 3 4 5

Uopće ne Jako puno

Figure 1. Part of the questionnaire form

2.4 Survey results

The survey has been conducted in May – December 2011. This survey gave the WG preliminary finding which has later been enhanced with findings from surveys conducted among other professional groups and profiles. Collected preliminary results have already provided a clear view on needs of secondary school teachers. Constructive suggestions have been given by them that can be systemized in a few topics:

I. Education of teachers and pupils:

- practical workshops of experts in the NSDI fields should be organized,
- Croatian national e-learning portal should be extended using games, exercises, presentations on the NSDI topics (<https://lms.carnet.hr/lms/>),
- mechanism of update with new sources of information of NSDI development to teachers should be organized and
- field education for teachers about best practices should be organized.

For example rating of relevancy on question in survey “*Is it necessary to better inform teachers about spatial data and its usage?*” clearly shows that teachers in secondary schools are interested in SDI and related developments and request to be informed about them, see Figure 2.

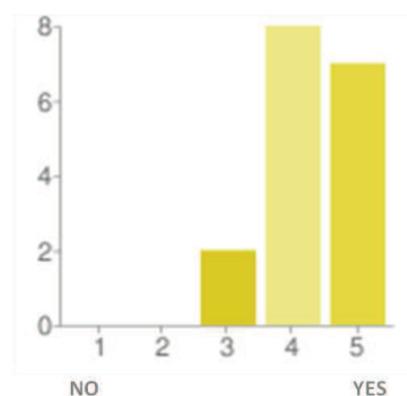


Figure 2. Distribution of answers on how important knowledge about SDI is for teachers [7]

II. Connection of Internet pages (teachers/NSDI):

- link to teachers’ educational Internet pages www.skole.hr should be established as a tool of information dissemination
- NSDI portal should be connected with the national e-learning portal.

Regarding question “*Would usage of spatial data and NSDI in teachers’ educational portal raise the quality of education?*” respond is showing that teachers in secondary schools rely on ITC technology in gathering new knowledge’s, see Figure 3.

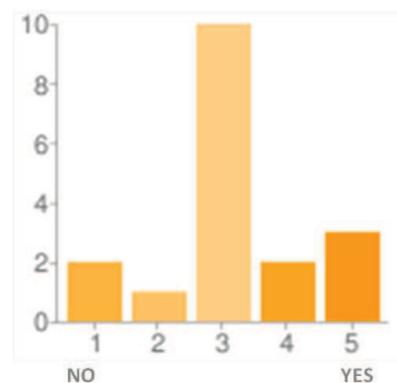


Figure 3. Distribution of answers about role of teacher’s education portal [7]

III. Higher interoperability of spatial data:

- sets of spatial data should be made available to teachers and teaching processes,
- higher interoperability of spatial data through Internet and other media should be made and
- prices of maps and navigation tools for schools should be lower.

IV. Extension of curriculum:

- NSDI should be introduced as a new subject in the high schools and university curriculum.

V. Cooperation between schools and teachers with NSDI institutions and experts:

- better communication and cooperation between teachers, secondary schools and NSDI institutions and experts should be achieved and
- better communication and cooperation between teachers from secondary schools and university as well as knowledge transfer should be achieved.

The responses on question “Would guest lecturing as part of regular teaching on the subject of usage of spatial data and NSDI be useful for teachers and pupils?” are also showing the interest of teachers to enhance the knowledge about SDI and use additional forms of education in effort to spread knowledge, see Figure 4.

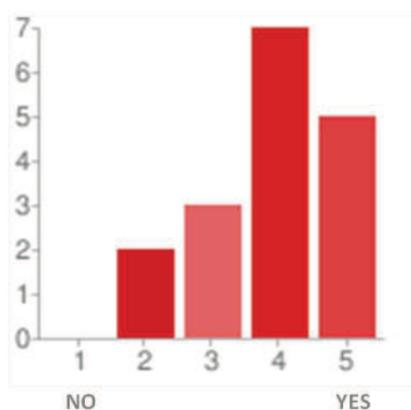


Figure 4. Distribution of answers about engaging guest lecturers on SDI in secondary schools [7]

2.5 Survey conclusions

The experience of teachers who are directly involved in the educational system of future GIS and NSDI specialists is of great benefit. They helped us in developing guidelines and recommendations on how to intervene in order to successfully build the capacity of NSDI. [9]

The preliminary processing of survey results has clearly indicated needs of teachers for additional education, for higher spatial data interoperability, for communication and cooperation with other stakeholders and among them, and connection to internet pages about SDI topics.

The first survey results gave clear recommendations for further work of the NSDI WG on Capacity Building. They express clear need for capacity building and education, higher interoperability of spatial data in the educational processes in secondary schools and cooperation.

Final result of the WG on Capacity Building work along with recommendations and proposals for the introduction of courses on SDI in secondary school

curricula's for surveying technicians and other geo-oriented profiles as well as at university level, the WG on Capacity Building is going to produce guidance for capacity building of NSDI in the Republic of Croatia. This will take some time and beside the WG members will include experienced teachers directly involved in teaching GIS and SDI and professionals from the practice (business sector).

3 Present findings

Work done till now gave relatively clear picture about the status of GIS and SDI education and needs in Croatia. Findings can be summarized in following items:

- there is need for formal education on SDI,
- there is need for streamlined and standardized education on GIS,
- GIS & SDI education should include practical education and involvement in real projects,
- Formal education itself is not enough, especially for present stakeholders and professionals (who might or might not be aware of their role) and
- GIS & SDI are interdisciplinary and approach to education should also be interdisciplinary.

But, this work has also identified number of questions on which answers should be found in a way to give NSDI bodies (Council and Board) sufficient information to make proper decisions. Surveying and analysis are raising the following questions:

- do we have sufficient number of specialists to teach teachers and students in Croatia,
- do we have structures capable to educate all levels of stakeholders and in all levels of knowledge,
- how and who should carry communication with stakeholders and users to promote SDI and education?

Discussing raised questions collected information and other inputs coming from various domestic and international SDI projects (establishment of Zagreb SDI, INSPIRATION project, ...), scientific activities (papers by scientists, [5] & [6] for example), formal activities of governmental bodies (new NSDI law, establishment of registers and metadata service by SGA) and global character of SDI (either as Croatia being part of EU, or general global initiatives Worldwide like GSDI, UN GGIM, etc.) several paths have been detected as possibility how to establish education on SDI in Croatia.

4 National and regional approach

From the Croatian example came out clear that presently there are not enough educated and well informed professionals as well as teachers/lecturers who would be able to transfer the necessary knowledge on GIS and especially SDI. Situation in other countries in the region is similar or even more demanding. Therefore the question arises whether Croatia or other countries in

the region should solve this problem by themselves or is the solution of the problem in regional approach?

Advantages and shortcuts of national and international (regional) approaches are known. National model is easier to implement on organizational and technical level, there are no lingual issues and costs are lower. But national model lacks on sufficient number of specialists capable to transfer knowledge on all aspects of establishment and implementation of NSDI. The international/regional approach can solve the lack of specialists much easier, but is more complicated for organization and cost more.

Mentioned issues have been investigated in the multi-country INSPIRATION – Spatial Data Infrastructure in the Western Balkans project prepared and proposed by beneficiary countries in the frame of regional cooperation on cadastre and SDI [3].

5 INSPIRATION project

The project is financed by the European Union. The project aims at promoting spatial data infrastructure (SDI) and coordinating its implementation in the Western Balkans with a view to preparing beneficiaries to meet the objectives of the EU INSPIRE Directive. INSPIRATION will contribute to a favourable environment for accurate, up-to-date, high-quality, well structured and accessible spatial data in local, regional and state administrative bodies in the region.

The project's implementation period is from 1 January 2012 to 31 December 2013. The beneficiary countries are Albania, Bosnia and Herzegovina, Croatia, Kosovo, Macedonia, Montenegro and Serbia, see Figure 5. Direct benefactors are, primarily, their National Mapping and Cadastre Authorities (NMCA's), secondary other stakeholder and tertiary educational institutions.



Figure 5. Western Balkans Region & Regional cooperation on cadastre and SDI countries – areas of institutional responsibility [1]

Three major fields of activity are in focus of

INSPIRE project:

- legislative framework and its improvement,
- organizational setup of NSDI bodies and its improvement and
- capacity building and education, provided directly by the project and giving recommendations for further development.

Through number of events, regional or national conferences and workshops capacity building and education have been discussed resulting with *Regional SDI & Land Administration (LA) Capacity and Education Study and Regional SDI & LA Capacity and Education Recommendation Report*, [12]. Regarding capacity building and education Study recommends introduction of regional structures in the Western Balkan in following manner (recommendations) [12]:

- Building a Network for Geographic Information in the Western Balkans
- Development of curricula for profiles of SDI experts or users
- Develop the concept and tasks for learn-on-project work of the students
- Develop atomic simple skills based on the Train-the-Trainers concept
- Make data freely accessible and available for education purposes
- Develop a proposal for an initial set of webinars that cover specific SDI topics
- Extend the work and mandate of the NSDI working groups for capacity building

Whole study and report with recommendations is available on the INSPIRATION project web-page:

<http://www.inspiration-westernbalkans.eu>.

Those recommendations as well as other documents produced by project team under leadership of GFA Consulting Group from Hamburg have to be evaluated and accepted by the beneficiary NMCA's, incorporated in national SDI strategies and then implemented in practice. This process will definitely take some time but it should not last too long because synergy of INSPIRATION project and memento of entering in to the EU (for Croatia) will not last forever.

6 Conclusions

Activities undertaken in Croatia in past six years on establishment of NSDI have achieved visible results but still there is lot of work to be done especially in frame of new NSDI law and Croatia becoming member of EU. Capacity building and education have essential role in establishment and implementation of SDI especially from the sustainability point of view.

The work done by the NSDI WG on Capacity Building provided detailed insight view in present status on SDI perception and level of knowledge among the various groups (teachers, students, professionals, civil servants). The finding will be used in further work of

Capacity Building WG which should result in recommendations and proposals for the introduction of courses on SDI in secondary school curricula's for surveying technicians and other geo-oriented profiles as well as at university level.

National efforts (WG on Capacity Building) should be harmonized and balanced with international/regional efforts (INSPIRATION project) and common strategy on capacity building and education in Croatia and other countries in the region of Western Balkans should be developed.

SGA in Croatia and NMCA's in the region should consider the provided materials, findings and recommendations and use the opportunity, to analyse and evaluate them and propose measures to solve at least some of open questions in reasonably short period of time!

References

- [1] Bačić, Ž. & Poslončec-Petrić, V.: Regional Cadastre Study 2012, 5th Regional Conference on Cadastre, Banja Luka - Laktaši, Bosnia and Herzegovina, June 2012.; Publishers: Bureau for Geodetic and Property Relations of Republic Srpska and Federal Geodetic Administration of the Federation Bosnia and Herzegovina 2012, 114 pages.
- [2] Bačić, Ž.: Modernizing High school and University Curricula for Surveyors in Croatia, FIG Conference, Rome, Italy, 6-10 May 2012.
- [3] Bačić, Ž., Obradović, Ž. (2010): Regional SDI Cooperation – SEE Inspiration in South-Eastern Europe, Facing the Challenges – Building the Capacity, FIG Congress 2010, Sydney, Australia, 11-16 April 2010
- [4] Poslončec-Petrić, V.: Distribution of Spatial Data official cartography in the Republic of Croatia, University of Zagreb, Faculty of Geodesy, Ph.D. thesis, 2010.
- [5] Poslončec-Petrić, V.; Hećimović, Ž., Bačić, Ž.: Implementation of the NSDI into secondary school education, Impact of the NSDI in Society, Challenges for Establishment, Skopje, Macedonia, 19-21 September 2011.
- [6] Poslončec-Petrić V.: Adaptation of the NSDI concept to the secondary school education requirements, 3. NSDI & INSPIRE and 7th Conference Cartography and Geoinformation, Split, Croatia, 14-16 September 2011.
- [7] Poslončec-Petrić, V.: Efficient Society Established on GIS and SDI - the role of education and communication with stakeholders and users. Regional Conference on Capacity Building and Education, Durres, Albania, 5 March 2013, http://www.inspiration-westernbalkans.eu/5/9/6/8/3/8/Efficient_Society_Established_on_GIS_and_SDI.pdf
- [8] Poslončec-Petrić, V. & Bačić, Ž.: Interaction in Geosciences Education and Spatial Data Infrastructure development – Example Western Balkans – issues, impact and projects, 13th SGEM GeoConference on Ecology, Economics, Education and Legislation, SGEM2013 Conference Proceedings, ISBN 978-619-7105-05-6 / ISSN 1314-2704, June 16-22, 2013, Albena, Bulgaria, Vol. 2, 445 - 452 pp.
- [9] Poslončec-Petrić, V., Hećimović, Ž., Pernar, R., Boto, D., Ludaš, S., Šustić, I., Grgesina, V. Pavić, M., Matošina-Ljulj, M., Klement, M.: Capacity Building of the NSDI in Croatia – Case study of secondary schools. ICA2011, Paris, France. Poster
- [10] Republic of Croatia: Law on State Survey and Real-Estate Cadastre. Official Gazette 16/2007, 2007.
- [11] Republic of Croatia: Law on National Spatial Data Infrastructure. Official Gazette 56/2013, 2013.
- [12] Skender, I: Regional SDI & Land Administration (LA) Capacity and Education Study and Regional SDI & LA Capacity and Education Recommendation Report (Act. 2.1 and 2.2). INSPIRATION – Spatial Data Infrastructure in the Western Balkans project, March 2013.