

Local Spatial Data Infrastructure as a Service for Efficient Spatial Management

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SUMMARY

Local spatial data infrastructure level (LSDI) covers managing of data in local administrative units (municipalities and cities). Precisely a local level is specific because the managed data are the most detailed, in the biggest scales, and therefore the most expensive to collect and update. The Zagreb City (capital city of Croatia) administration recognized in 2009 the importance of development of the area, and within work of the Coordination for creating Information system of the Zagreb City spatial management, started activities on the set-up of a Zagreb spatial data infrastructure (ZSDI). In the City of Zagreb many bodies of city administration use and create in their work daily various sets of spatial data and services. It is pretty much clear that they have to make the data fully available and share them. The ZSDI set-up entails a big number of activities and tasks that will influence a more efficient and improved use of spatial data and services, which will, on the other hand, bear influence upon transparency of the city administration, support to citizens, support to economy and the city in general. In this paper an overview of the current status of ZSDI is given with practical examples of how to efficiently manage space in an urban area through different applications in a local SDI.

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1. INTRODUCTION

Today, urbanisation is a major change taking place globally. This growth causes a lot of ecological, economic and social problems. It is increasingly difficult to manage this growth in a sustainable way (FIG 2010). Cities are complex, networked and continuously changing social ecosystems, shaped and transformed through the interaction of different interests and ambitions. Ensuring employment, sustainable development, inclusion and quality of life are important concerns. There is no doubt that in these challenges, spatial data plays a crucial role. The Bathurst declaration already pointed to that, stressing additionally the importance of access to high-quality spatial data as a prerequisite for the achievement of better land policies, better management and finally, better land use (FIG 1999). An efficient access to spatial data, through spatial data infrastructures (SDI) at global, national, and local level, therefore has become an important prerequisite for the realization of sustainable development (FIG 2001).

The term “Spatial Data Infrastructure” (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general (Nebert 2004).

SDI has always existed in a certain form, but the level of its implementation has differed according to a particular moment. Against this backdrop, building or establishment of an SDI can be seen as improvement or enlargement of the existing one. In line with this, improvement of an SDI can be defined as a number of activities aiming at easier access to and simpler and more efficient use of the existing spatial data (Cetl et al. 2009a). These activities include:

- Raising social awareness of the importance of spatial data, and managing better coordination and cooperation between all included subjects;
- Adjustment (harmonization) of the existing spatial data to the appropriate standards and technologies;
- Design of metadata which describe the existing sets of spatial data;
- Creation of a catalogue with the necessary infrastructure, and provision of web services that offer a readily-usable access to spatial data.

In the SDI hierarchy (Rajabifard et al. 2000), an SDI at national level (NSDI) has a crucial role in the development and implementation of other levels of SDIs. However, an important prerequisite and basis to develop an efficient NSDI is the improvement of local SDIs. A local SDI (LSDI) level covers managing of data in local administrative units (municipalities and cities). Precisely a local level is specific because the managed data are the most detailed, in

the biggest scales, and therefore the most expensive to collect and update.

2. SDI IN CROATIA

The first activities concerning improvement of the SDI in Croatia started already in the late 1990's and early 2000's (Cetl et al. 2003). State bodies such as the Government and the State Geodetic Administration (SGA), as the national mapping and cadastral agency (NMCA), had the main role in it, in collaboration with the public and commercial sectors as well as with the academic community. As the main factor in creating the SDI, the SGA launched several initiatives with the goal of installing new technologies, equipment and procedures in map production, and establishing digital topographic and cadastral databases. In 2001 the Croatian Government adopted a Programme for State Survey and Real Estate Cadastre for the period 2001-2005. At the time the term SDI was not so well-known but the similar principles and ideas can be seen in the mentioned document. According to the Programme, the SGA was obliged to establish the so-called Multipurpose Spatial Information System (MSIS), fostering national needs for an efficient and rationale use of spatial data produced by the governmental bodies and private sector. The MSIS establishment anticipates development of the national databases for products under the responsibility of the SGA, and their connection into a unique information system that will allow users to use data effectively and expand them by their attributed data (Rašić and Bačić 2010).

2.1 NSDI

A synergy of different initiatives and activities resulted in 2007 in the enforcement of a new Law on State Survey and Real Estate Cadastre (OG 16/2007), in which a separate section deals with an NSDI, which is in this way legally defined. A chapter in the Law defines NSDI as a set of measurements, standards, specifications and services which aim at enabling effective gathering, management, exchange and use of georeferenced spatial data within the framework of e-government. The law defines NSDI and metadata, describing the content of metadata information, services, NSDI data and subjects required to participate in its establishment and maintenance. Most importantly, it sets out an institutional framework and defines NSDI bodies and their responsibilities. Note that at the time this law was being prepared, a definition of INSPIRE directive (<http://inspire.jrc.ec.europa.eu/>) was in its final phase. And although Croatia is not yet an European Union (EU) country and is therefore not required to apply the INSPIRE directive, it was decided to take it into account, thus rendering the information society ready to implement the INSPIRE the moment Croatia became an EU member. This resulted in a high level of compatibility between the law and the INSPIRE directive. The law established a basic NSDI framework as a first step towards transfer of the INSPIRE into the national regulations (Cetl et al. 2009b).

There is no formal national geoportal established in the Republic of Croatia yet. The SGA Geoportal (www.geo-portal.hr) is the main point of access to the distributed geoinformation resources in Croatia. Via this geoportal it is possible to search the available geodata (data, applications and services) and order them in digital form. Several projects have been set up to establish a national geoportal. Croatia provides discovery and view services for a selected

number of the INSPIRE themes while a number of them can also be downloaded.

A very detailed overview of the current situation and activities in the Croatian NSDI is available online on the NSDI web page (Figure 1).

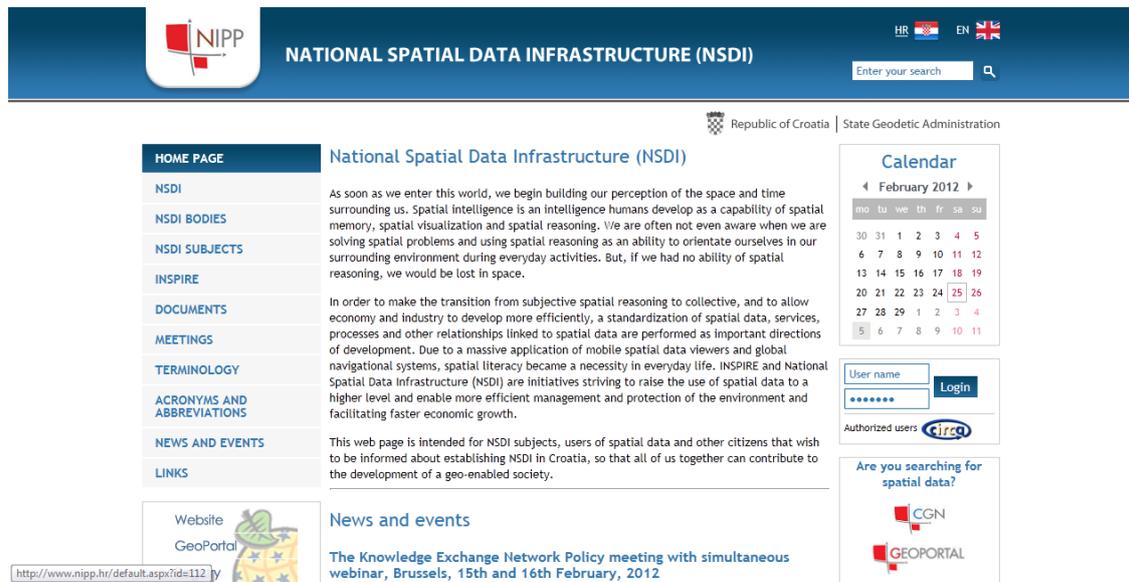


Figure 1. The Croatian NSDI Web page (www.nipp.hr)

This web page is intended for the NSDI subjects, users of spatial data and other citizens who wish to be informed about the establishment of NSDI in Croatia, so that all of us together can contribute to the development of a geo-enabled society. It has to also be mentioned that currently a new law on the NSDI is in preparation, which will fully transpose the INSPIRE directive into the Croatian legislation. This law must be adopted before Croatia becomes a full EU member (i.e. before 1st of July 2013).

2.2 LSDI in the City of Zagreb

2.2.1 City of Zagreb in brief

The City of Zagreb is the biggest city in the Republic of Croatia with the area of 641.355 km², and the capital of Croatia. The Zagreb City is a cultural, scientific, economic, political and administrative center of Croatia with the seats of Parliament, President and Government (www.zagreb.hr). The population numbers 792.875 inhabitants (data from 2011).

The City of Zagreb founded 19 city administrative offices for performing activities within the self-administrative sphere and activities entrusted by the state administration:

- The Mayor's Office
- City Control Office
- City Office for Strategic Planning and Development of the City
- Service for the Local Self-Administration

- City Office for General Administration
- City Office for Financing
- City Office for Economy, Labour and Enterprise
- City Office for Education, Culture and Sports
- City Office for Health and War Veterans
- City Office for Agriculture and Forestry
- City Office for Physical Planning, Construction of the City, Utility Services and Transport
- City Office for Legal-Property Relations and City's Assets
- City Office for Cadastre and Geodetic Activities
- OEM - City Office for Emergency Management
- City Institute for the Conservation of Cultural and Natural Heritage
- City Assembly Professional Service
- City Office for Social Protection and People with Disabilities
- City Office for Energetics, Environment Protection and Sustainable Development
- Professional Service of the Mayor.

Outside of the administrative bodies there is a lot of different city institutions (schools, hospitals, cultural institutions, etc.). There are also some municipal companies owned or co-owned by the Zagreb City (e.g. Zagreb Holding etc.).

2.2.2 Early GIS applications in the City of Zagreb

Development of the Zagreb City GIS started with a project of digital cadastral system at the end of 1980's. The participants were the Municipal Institute for Cadastral and Geodetic Activities, which has legal capacity for cadastral data, then the Municipal Office for Construction, Utility and Residential Activities, Traffic and Connections, as the main user of cadastral data, and finally the Municipal Institute for Data Processing - GZAOP, responsible for the information technology support. A primary data capture started in 1993 and finished ten years later. Maintenance of the database began at the same time as the primary data capture, so the database is today updated on a daily basis.

The most important project was the web-application "GIS of the City of Zagreb", built for use in all city offices, through a local Intranet. Data available to city employees are:

- topographic and ortophoto data;
- 3D city model;
- real estate cadastre;
- spatial units register;
- utility cadastre;
- spatial plans;
- spatial management and building documents (licenses);
- georeferenced statistical data;
- data on land use and land vegetation;
- cadastres of utility service companies,

- geotechnical cadastre;
- cadastre of public green areas;
- protected immovable cultural goods;
- zones of utility fees and payments;
- register of city property;
- ...

In this web viewer city employees can see a specific town area in different ways, dependent on their needs (Figure 2).



Figure 2. GIS of the City of Zagreb

At the same time when the Zagreb City GIS was developed, a Zagreb City Interactive map was created (Figure 3).

Data on the city Internet portal available to all citizens free of charge are:

- master town-planning;
- traffic and utility infrastructure;
- registry of spatial units;
- DOF and HOK (Croatian Base Map).

The Zagreb City interactive map on the Internet has very fast achieved its primary goal. Citizens do not have to go to the city offices to get information, because there is plentiful useful information available on the City web portal.



Figure 3. Interactive map of the City of Zagreb

2.2.3 Development of a Zagreb Spatial Data Infrastructure (ZSDI)

The Coordination for creating Information system of the Zagreb City spatial management (the ISPU Coordination) soon after its establishment in 2009 saw the need for developing a local spatial data infrastructure of the Zagreb City area (ZSDI) (Šiško et al. 2012). During 2010 and 2011 various activities were initiated towards this goal: studies on metadata, exchange and distribution, and on ZSDI network services; organization of various meetings and workshops; and creation of a web page with a metadata catalogue (Figure 4).



Figure 4. The ZSDI web page with a metadata catalogue (<https://e-uprava.apis-it.hr/zip/>)

The set-up of a metadata catalogue at the City level created prerequisites for efficient spatial data management, from which primarily the city administration staff, but also citizens, will benefit. Through coordinated collecting, maintaining, updating and using of spatial data, significant financial savings will be achieved. The metadata catalogue is publicly available and can be searched according to several criteria, including thematic categories according to the INSPIRE.

The ISPU Coordination launched also several projects to improve the existing ZSDI:

- Georeferencing 2011 Census Data. A georeferenced GIS database was created on the 2011 Census of population, households and dwellings, intended to monitor processes related to the Zagreb City population and physical space. The data were georeferenced on three levels – city districts, local communities and enumeration areas, and some fifty different visualizations and analytical comparisons of the 2001 Census and 2011 Census data were carried out.
- Analysis of the Planned Land Use in the Zagreb City. In 2010 an analytical GIS database of the planned land use was created, which includes the land use zones as defined by the strategic documents on physical planning of the Zagreb City. The GIS tool helped to establish each basic land use area, and its share in an overall surface area of the Zagreb City territory. The analysis reveals that one third of the Zagreb surface is planned for development, while two thirds are intended for forestry, agriculture, public and protective vegetation, water and water resources, etc.
- Mapping the Actual Land Use in the Zagreb City. In May 2011, a comprehensive mapping project was launched aimed at recording the actual state of physical planning in the Zagreb City. The plan for 2011 and 2012 is to finish the primary mapping and create a digital database of the developed areas of the Zagreb City. Undeveloped areas that include natural environment, agricultural land and other undeveloped land shall be included in the second project stage which will be based on the existing databases.

Based on a proposal of the ISPU Coordination, the Zagreb Mayor passed Rules on the Content, Method of Development and Maintenance of the Zagreb Spatial Data Infrastructure (ZSDI) on 15 December 2011. The Rules set up basic definitions, actors, metadata, data sharing, public accessibility of data, responsibilities and control. A competent body for the administrative and technical part of creating and managing the ZSDI is the City Office for Strategic Planning and City Development, whereas supervising is done by a coordination body appointed by the Zagreb Mayor. The ZSDI is envisaged as a subset of the NSDI, and thereby of the INSPIRE, which connects city offices, institutes and services, companies in the Zagreb city ownership or co-ownership, and city institutions. The conclusion set the obligation to create metadata and update them at least on an annual basis. The ZSDI subjects have the duty to mutually exchange spatial data for the purposes of activities under their competence, and to make data available to the public free of charge.

It is estimated that more than 20 subjects (city offices, institutions etc.) are directly and daily connected to using georeferenced spatial data in various activities: strategic planning, agriculture and forestry, spatial planning and building, property management and property

legal issues, geodetic-cadastral activities, emergency management, preservation of monuments of culture and nature, environment protection, water supply and drainage, gas supply, public green area maintenance, etc. Most of these subjects create their own spatial data sets, most often digitalized and in the form of a GIS or CAD system.

An analysis of the existing state of registries and spatial data information systems showed that they do not satisfy entirely the needs of the city administrative officials, nor of the public in general. Based on that, in 2011 a project for a new ZSDI Geoportal has been launched (Figure 5).

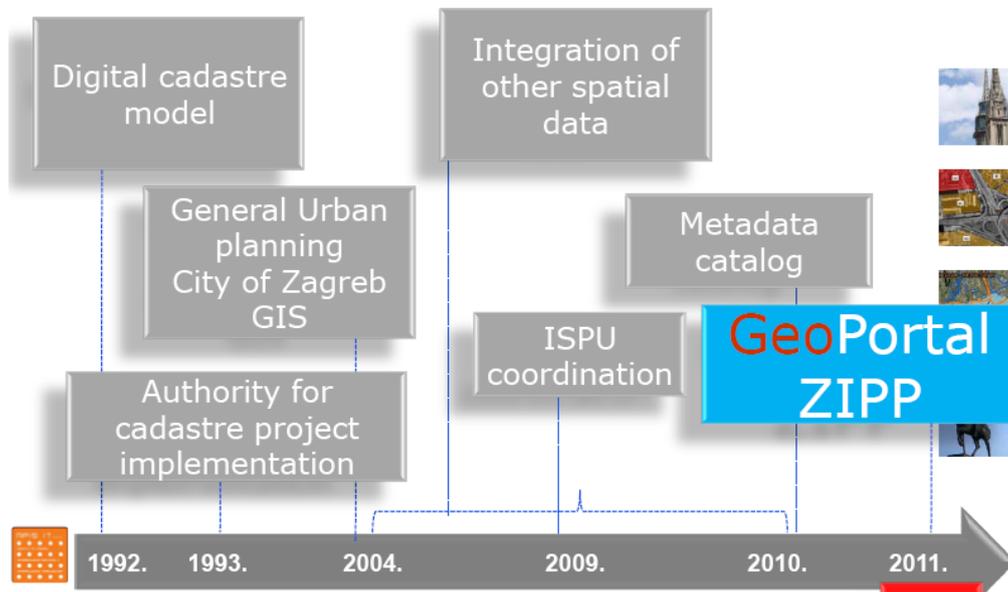


Figure 5. ZSDI Development: From a Digital Cadastre to a ZSDI Geoportal (Batić 2011)

To achieve interoperability and to enhance development of the new geo-oriented services, it is necessary to provide a single access point to all spatial data through a unique and simple geoportal. In the context of the European movements a ZSDI Geoportal was designed. The geoportal will connect the currently isolated GIS units into a single access point open to all subjects – from citizens and companies to the city and state officials (Stručić 2011).

The main idea is to connect the public part of the existing Zagreb City GIS (the Interactive map) with the part for the city administration into a single ZSDI Geoportal.

To ensure interoperability with the NSDI and the INSPIRE, the new geoportal will be made in line with the OGC standards (Catalogue Service, WMS, WFS,...) and ISO standards. The existing metadata catalogue will also be part within the geoportal. Creation of the ZSDI geoportal is entrusted to the APIS IT company, and a first prototype was introduced in the beginning of 2012 (Figure 6).

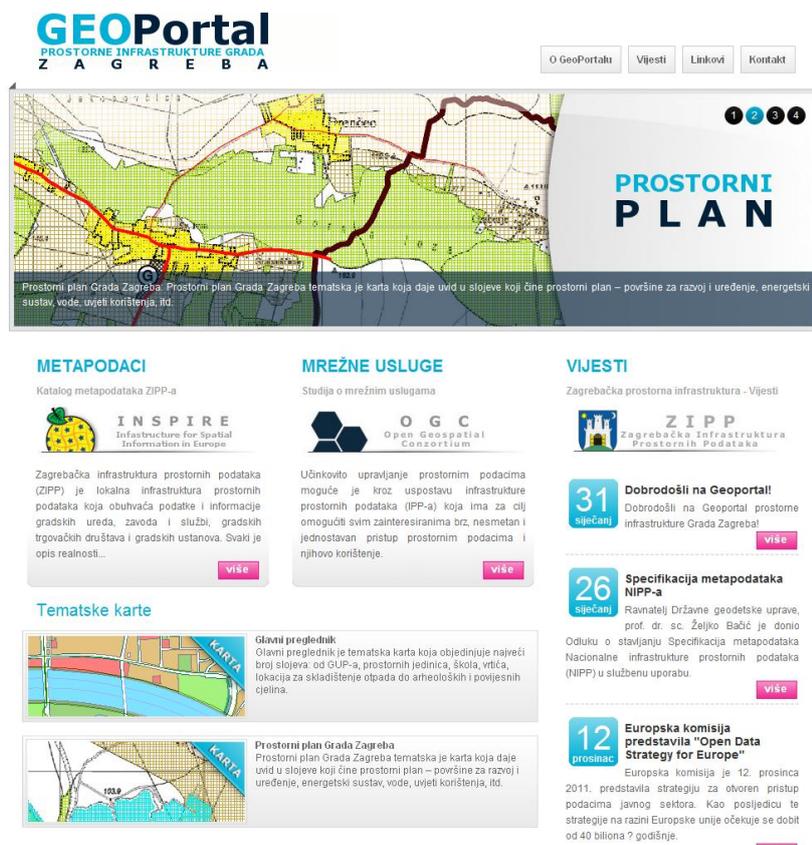


Figure 6. First prototype of the ZSDI Geoportal

A guideline for establishing a ZSDI Geoportal was the Study on Zagreb Spatial Data Infrastructure (ZSDI) Network Services from September 2011 made by the Faculty of Geodesy, University of Zagreb. The Study aimed at collecting data on the current status, relevant standards, international experiences, and preparing guidelines for creation of a ZSDI Geoportal as the City of Zagreb central platform for finding, viewing, using and exchanging spatial data.

Promotion of the importance of spatial data among the public and citizens is extremely important and success of the SDI greatly depends on it. For that purpose, the Office for Strategic Planning and Development opened its new ZgForum premises in December 2011. The ZgForum is planned to be a venue for a range of activities aimed at communicating with the public: organization and moderation of discussion platforms, communication with citizens and relevant individuals and groups, presentation of projects, workshops, lectures, exhibitions and more. On the occasion of the opening of the premises, the City Office prepared an exhibition the main topic of which was the development and implementation of ideas and the ZgForum visual identity.

3. CONCLUSION

Introducing the first GIS technologies and GIS toolkit in the Zagreb city government has

resulted in a more efficient workflow and better service to the citizens and other city departments, utility companies and private enterprises. Furthermore, the city employees participate in the creation of new GIS applications with their ideas and suggestions. The number of GIS workplaces grows very fast, and the data foundation entered and analyzed in GIS applications is bigger every day.

Nevertheless, the time brings changes, and awareness of the need to understand interdependencies of environmental and social phenomena has also increased. Today, just the availability of spatial data is not enough, neither for city employees nor for ordinary citizens. They want and they need more. The more spatial data we have, the more we see the need for sophisticated processing and analysis models that can turn data and information into insight and intelligent action. To reach this goal, local governments around the world develop and use local SDI as a service for efficient spatial management to increase accuracy, reduce costs, improve efficiency, and enhance every-day decision making. This is a right answer to new challenges in every-day efficient city management.

The Zagreb spatial data infrastructure (ZSDI) is an example of development of the spatial data infrastructure concept at local level as a basic part of the Croatian NSDI and the INSPIRE. We strongly believe that improvement of the ZSDI will bring: significant benefits through a simple and easy exchange of data between public authorities (agreements about sharing, access and use of spatial data); business process improvement in the city government through modern GIS technology and application of the best European practice of the OGC standards (WMS, WCS, CWS, WPS, ...); and increased transparency of the local government work.

REFERENCES

Batić, S. (2011): Geoportal of the city of Zagreb spatial data infrastructure. 3rd Croatian NIPP and INSPIRE day, Split, Croatia.

Cetl, V., Roić, M., Šiško, D. (2003): Towards a Spatial Data Infrastructure in Croatia. Proceedings of 2nd FIG Regional Conference - Urban-Rural Interrelationship for Sustainable Environment, Marrakech, Morocco.

Cetl, V., Mastelić Ivić S., Tomić H. (2009a): Improvement of National Spatial Data Infrastructure as a Public Project of Permanent Character. Cartography and Geoinformation, Journal of Croatian Cartographic Society, Vol. 8, Number 11, p. 69. – 83.

Cetl, V., Bačić Ž., Rašić Lj. (2009b): NSDI Framework in Croatia, GIM International Vol. 23, Number 12, p. 18.-21.

FIG (1999): The Bathurst Declaration on Land Administration for Sustainable Development. Presented at the UN-FIG Conference on Land Tenure and Cadastral Infrastructures for Sustainable Development, Melbourne, Australia (www.fig.net).

FIG (2001): The Nairobi Statement on Spatial Information for Sustainable development. Presented at the FIG-UN International Conference on Spatial Information for Sustainable Development, Nairobi, Kenya (www.fig.net).

FIG (2010): Rapid Urbanization and Mega Cities: The Need for Spatial Information Management. FIG PUBLICATION NO. 48. (www.fig.net).

Nebert, D. D. (ed.) (2004): Developing Spatial Data Infrastructures: The SDI Cookbook ver. 2.0. Global Spatial Data Infrastructure Technical Working Group, GSDI.

Official Gazette (2007). Law on State Survey and the Real Estate Cadastre, 16.

Rajabifard, A. Williamson, I.P., Holland, P., and Johnstone, G. (2000): From Local to Global SDI initiatives: a pyramid building blocks. Proceedings of the 4 th GSDI Conference, Cape Town, South Africa.

Rašić, Lj., Bačić, Ž. (2010): The Role of National Mapping and Cadastre Agencies in Establishment of NSDI: Croatian Example. Proceedings of XXIV FIG International Congress Facing the Challenges – Building the Capacity, Sydney, Australia.

Stručić, A. (2011): Geoportal ZIPP - Spatial Data Infrastructure in the cloud. 16th Conference of Croatian Oracle User Group, Rovinj, Croatia.

Šiško, D., Cetl, V., Batić, S., Veselić-Bruvo, J. (2012): Spatial Data Infrastructure of the City of Zagreb. Cartography and Geoinformation, Journal of Croatian Cartographic Society, Vol. 11, Number 16.

BIOGRAPHICAL NOTES

Vlado Cetl is an associate professor at the Faculty of Geodesy, University of Zagreb. Currently he is working as a postdoctoral researcher at the Institute of Environment and Sustainability, Joint Research Centre of the European Commission in Ispra, Italy. He obtained his PhD in 2007 from the University of Zagreb with the thesis “Analysis of Improvement of the Spatial Data Infrastructure”. The main fields of his interest are Cadastre, Land Management, GIS, SDI and Risk management. He is a member of the AGISEE managing board (Association for Geospatial Information in South-East Europe), president of the Technical Committee TC211 of the Croatian Standards Institute, and member of the Croatian NSDI Committee. He authored or co-authored more than 40 papers in various fields of geodesy and geoinformatics.

Darko Šiško, M. Sc. in Geodesy was named chief of the Spatial Information and Research Department at the City Office for Strategic Planning and Development. He participated in preparation of all strategic documents related to spatial planning in the City of Zagreb and of several detailed plans, and in 2009 he coordinated preparation of the City of Zagreb Spatial Plan. He is a member of the City of Zagreb GIS Project Team, as well as of the Coordination

Committee for the Development of the Spatial Planning Information System for the City of Zagreb. He was a co-author of several papers for conferences in Croatia and abroad, and of articles published in professional journals. His key professional interests include spatial information management, land management and geodetic aspects of spatial planning and construction.

Jadranka Veslić Bruvo, M. Sc. Arch., has been the Head of the City of Zagreb (Croatia) Office for Strategic Planning and Development since 2008. The Office is responsible for co-ordination and encouragement of regional development, strategic documents, e.g. ZagrebPlan, strategic projects and programmes, spatial data infrastructure, urban statistics and demography, etc., carrying out entrusted tasks through synergy, coordinated efforts and cooperation on the City, regional and international level. She authored or co-authored more than 20 papers in the field of spatial planning in professional journals and conferences.

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