The Use of the Spatial Data Infrastructure in Spatial Planning: Case studies in Poland

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Abstract

The importance of geographical information (GI) and the computer-based software for mapping and analysing spatially reference data in the area of spatial planning cannot be underestimated. The geographical information system (GIS) supports different phases in a spatial decision process and understanding of spatial aspects of social and economic development. But taking the complexity of spatial planning into consideration, there are many obstacles to using GIS effectively. One of the problems for development practitioners and planners is geographical data access, management and integration. An increasing number of implementations of spatial data infrastructures (SDIs) on different levels of government (e.g. national, subnational) can not only maximise access to GI, but also become a powerful tool in spatial planning. The purpose of this study is to assess the SDI's effects on performance of spatial planning. This paper presents some case studies on urban and local level planners' tasks in Poland and the results of the SDI use process evaluation.

Key words: land use, development planning, spatial data infrastructure (SDI), use process, user organisation performance, SDI effectiveness

JEL Classification: R50, Y80

1 Introduction

Widespread implementation of the spatial data infrastructures (SDIs) opens the door to new possibilities in data accessing and analysing, and makes inroads into many different fields of practise and specialisation. From the users' perspective the infrastructures should fulfill their purpose and expectations. Nedovic-Budic, Pinto and Budhathoki (2008) underline it is the perspective that matters the most and that will ensure the successful application and use of the SDI products and services. It is also one of the evaluation level of the SDI effectiveness from a business project view (Zwirowicz-Rutkowska, 2014). But the users issues have not been thoroughly investigated so far and only the results of some preliminary research on the case studies of SDI use and methodologies to assess usability and usefulness are presented (e.g. Crompvoets et al., 2004; Askew et al., 2005; Vandenbroucke et al., 2013). In general the assessment of SDI initiatives is (Grus, Crompvoets and Bregt, 2007) problematic for a number of reasons, including differences in the understanding the concept of the SDI, difficulties in

identifying uniform criteria of merit for the SDI inputs, outputs and outcomes, because of the national context of the infrastructure. Moreover, a complexity in assessing SDIs is their (De Man, 2008) multi-faceted nature.

Among different groups of the geoinformation infrastructures' users, the urban, regional and local level planners are also considered as the potential beneficiaries. The literature review shows some effects of the SDI on planners' work in both theoretical and practical dimension. The former includes, among others, potential contribution of the SDI to local urban planning (Phillips, Williamson and Ezigbalike, 1999), the advantages of the web feature service and web coverage service in spatial planning tasks (Sudra, 2012a). There are also the examples of the practical research on the national infrastructures and the regional and local level spatial planning. Nedovic-Budic et al. (2004), in their evaluation of the use of two state level SDIs (Australia and USA) conclude that the infrastructures do not effectively serve the needs of local planning. Vandenbroucke et al. (2013) analyse six organisations involved in the process of land use planning in the region of Flanders (Belgium) to assess that the support of the regional SDI in this process is quite perceptible. Georgiadou and Stoter (2010) describe the Dutch Spatial Planning on-line portal and state that value assessment of the portal depends on which beneficiary's values count as important.

The aim of this paper is to develop the methodology of the SDI assessment from the user perspective and the detailed study of the measures for the Polish SDI in the area of the use process, the user organisational performance, information and support provided . The objective is also the application of the methodology in the field of the Polish urban and local spatial planning.

The contribution of this paper is a wider analysis of the use of the Polish spatial data infrastructure by the group of the urban and local level planners. It is also a step towards effectiveness evaluation of the Geoportal 2 project's products. The results of the ex-post evaluation develop some theoretical assumptions (Sudra, 2012a; 2012b) concerning the usefulness of the Polish SDI in the area of the urban and local level planners tasks.

2 Methodology

To evaluate use of the Polish spatial data infrastructure among urban and spatial planners the methodology is developed in the following subsections. The assessment dimensions are as follows: use process, user organisational performance, information and support provided. Based on an extensive review of the literature on operational research, management information systems and the SDI assessment theory sets of indicators are elaborated concerning the Geoportal 2 project's products (i.e. the geoportal, software applications, spatial data, metadata, web services). The application of the methodology is based on the survey conducted in July and August 2014. The survey instrument consisted of ten topics and different types of closed-ended questions referring to characteristics described below. A total of 63 questionnaires were mailed to firms specialising in urban and local level planning. A completion rate was 44,4 percent.

2.1 Use process and user organisational performance

The following sub-sections describe the concept of measuring use process and user organisational performance.

2.1.1 Awareness

Implementations of the different geoportals and the multiple sources of spatial data should be followed by the increase of the users' awareness of these facts.

2.1.2 Geoportal and its content accessibility

The content of the geoportal and its applications may not be obtainable for the many different reasons. The list of factors of the potential lack of accessibility includes: (1) internet access, internet speed, hardware, software, web browsers; (2) conditions of the access and use, user's authorisation; (3) no/not enough support of the administrator; (4) no/not enough training. Each factor is scored on a scale of 0 to 10.

2.1.3 Geoportal usability

Usability is the quality of hardware or software that enables it to be user-friendly, such as easily understood and conveniently employed by a user (Weik, 2001). In this study usability is described by the level of intuitiveness, clarity and content presentation of the Geoportal 2 project's output, i.e. geoportal and its parts (e.g. the map viewer), spatial data and services. To rate the level of usability the 0 – 10 scale is proposed. Table 1 presents twenty-two features and functions of the website to be scored.

Tab. 1 Features and functions of the Polish geoportal

No.	Features and functions	Scores
1.	Set the map scale command	
2.	Pan command	
3.	Zoom in/out command	
4.	Info about the feature command	
5a.	File menu – Link to the map composition	
5b.	File menu – User's maps	
6a.	View menu – Map content	
6b.	View menu – Add maps	
6c.	View menu – Centre the map	
6d.	View menu – Set the coordinate system	
6e.	View menu – Set the toolbars visibility	
6f.	View menu – Set the data layers and services visibility	
6g.	View menu – Generate HTML code	
7a.	Measurement menu – Measure area	
7b.	Measurement menu – Measure distance	
8a.	Search menu – Search for addresses and features	
8b.	Search menu – Search for cadastral parcels	
8c.	Search menu – Metadata	
9.	Symbols, rendering, style compositions	
10.	Informative part of the geoportal (e.g. info about the project, news)	
11.	Interactive part of the geoportal (e.g. contact, forum, logging)	
12.	Access to the geoportal's applications	

2.1.4 Amount, duration, nature and level of use

The objective measures of the SDI use includes: frequency of access, the number of SDI users in a firm, the scope of use and the analysis of tasks and work supported by the SDI.

2.1.4.1 Time intensity

In this study the domain for this measure are as follows: daily, weekly, monthly, occasionally, never.

2.1.4.2 Extent user group

The spatial data infrastructure may be used by many (≥10), some (2–9), one or none urban and spatial planners in each firm.

2.1.4.3 Scope of use

The listing of the potential SDI use categories in the area of spatial planning practise includes: (1) participatory, agreements; (2) factors and land use trends analysis; (3) production of a comparative study of variants; (4) field studies; (5) other. The more detailed study includes use assessment (the 0 – 10 scale) of the Geoportal 2 project' software applications: the national geoportal, the INSPIRE geoportal, metadata editor, metadata validator, the mobile application and the statistics module. Taking functions for reading, visualising, and analysing spatial data into consideration four levels of use are suggested: (1) use of the geoportal's map viewer; (2) connecting to web servers in GIS/CAD software; (3) viewing maps; (4) displaying data from different sources (the geoportal's map viewer and/or GIS/CAD software); (5) data manipulation and transformation. Moreover, usefulness (the 0 – 10 scale) of the features and function of the map viewer (1 – 8c, Table 1) is investigated.

2.1.4.4 Decision makers and decision making process

This category is represented by the measures presented in Table 2. The level of the fulfilment of the each criterion is scored on a scale of 0 to 10.

Tab. 2 Measures for the SDI use process

No.	Indicator	Scores
Decision makers		
1.	More confidence in taking decisions	
2.	Better understanding of the objectives of the Geoportal 2 project and its products	
3.	More independent of suppliers, superior, other employees	
4.	Easier/On-line user's authorisation (reduce travel costs)	
5.	Better understanding of problems, factors	
6.	Improve comfort at work	
7.	Improve competencies	
Decision making process		
8.	Detecting gaps in problem analysis	
9.	Better information quality	
10.	Faster access to information	
11.	Access to more sources of information	
12.	Easier tasks/goals formulation and realisation	
13.	Consideration of constraints and alternatives	
14.	Length of time to make decision	
15.	Length of time to acquire data	
16.	Length of time to analyse data	

17.	Thoroughly studies and analysis	
18.	Better data management	
19.	Better quality of decisions	
20.	Better/Easier cooperation with different stakeholders	
21.	Better/easier cooperation witin an organisation	

2.1.5 User organisational performance

The concept of the indicators describing the impact of the spatial data infrastructure on the user organisational performance presents Table 3. The level of the fulfilment of the each criterion is scored on a scale of 0 to 10.

Tab. 3 Indicators for user organisational performance

No.	Indicator	Scores
1.	Length of time to procedure	
2.	Change of attitude towards some procedures/tasks	
3.	Improved procedures	
4.	More executed plans, decisions, studies	
5.	Increase in orders	
6.	Automate manual calculation, analysis, tasks realisation	
7.	Automate data acquisition and collection	
8.	The prompt completion of work	
9.	Reduce costs of data acquiring and processing	
10.	Cost displacement (e.g. software, hardware, people)	
11.	Increase in costs of equipment, the infrastructure	

2.1.6 Strategic alignment and business impact

The impact of SDI use may concern a firm's strategy and its business goals (Table 4). The level of the fulfilment of the criteria is scored on a scale of 0 to 10.

Tab. 4 Indicators for measurement of a company strategy alignment and business impact

No.	Indicator	Scores
1.	Corporate or brand image/public perception	
2.	Improve understanding of competitive landscape	
3.	Increase of the competitiveness of the firm	
4.	Expand of knowledge and offer	
5.	Formalise innovation	
6.	Improve knowledge transfer	
7.	Enhance ICT and GIS/CAD knowledge	
8.	The development of the firm	
9.	Enhance linkages with customers and data suppliers	
10.	Support new communication and distribution channels (e-service, e-administration, e-business)	
11.	Ability of ICT to cope with changing business processes	
12.	Optimisation of workflow	
13.	Flexibility to reflect new business requirements	
14.	Improve coordination in an organisation	
15.	Improve coordination with different participants of the tasks and procedures	
16.	Increase of tasks/procedures/work supported by ICT	
17.	ICT impact on the office/company's organisational structures (new positions)	
18.	Possibility of ICT inclusion in urban and spatial tasks	
19.	ICT impact on efficiency increase of the employees and the whole company	

2.2 Information and support provided

In the following sub-sections the issues of data availability, data scope and user support are presented.

2.2.1 Data availability

Availability is a measure of the ability of a functional unit to perform a required function under given conditions while (1) the necessary external resources for successful operation are provided and (2) the functional unit can be accessed by the user (Weik, 2001). Data availability depends upon content and completeness of datasets on variety of spatial themes (Nedovic-Budic et al., 2004). The data characteristics for data availability measurement: (1) thematic accuracy; (2) completeness; (3) spatial resolution; (4) temporal validity; (5) positional accuracy; (6) distribution format; (7) lineage. The level of the fulfilment of the each criterion is scored on a scale of 0 to 10.

2.2.2 Data scope

Data and services maintained by the Polish mapping agency (GUGiK), among many others, are provided by the geoportal. These data sets are as follows: geographical names, administrative boundaries, land and buildings registration, cadastre, cartographic relief presentation (hill shading and hypsometry), national topographic data bases (BDOT, BDO), V Map 2, orthophotomaps, scanned topographic maps, EuroBoundaryMap (EBM). The web services include: WMS, WMTS, CSW, WFS, ATOM, WCS. The data and web services together with urbanists and spatial planners' tasks and duties are under analysis. The amount (percentage) of the data in the whole spatial planning data set and the level of geoportal's information use and importance (the 0 – 10 scale) in task realisation are also evaluated.

2.2.3 User support

The support and tutorials available for all users of the Polish geoportal are as follows: (1) Help menu-FAQ; (2) Help menu-Video tutorials; (3) Contact menu-email address; (4) Contact menu-telephone number; (5) Forum menu; (6) About Geoportal menu-User's manual; (7) About Geoportal menu-Other materials. The aim is to assess the level of usefulness (the 0 – 10 scale) and point out the support not used by urbanists and spatial planners.

3 Results

In this section the summary of the evidence obtained in the interviews with urban and local level planners is provided.

3.1 Use process and user organisational performance

3.1.1 Use scope and process

All twenty-eight interviewees are aware of the Geoportal 2 project's products, but 10,7 % never use them. Almost 48,2% of planners claim to make use of the geoportal daily, 30,8% weekly and the rest monthly. As the respondents are mainly the representatives of the small or midsize firms they report the user group is some and one or none in their organisations. The most important factors of lack of geoportal and its content accessibility are conditions of the access and use, and

user's authorisation (the average score 9,2). From among eighteen features and functions of the map viewer (i.e.1–8c, Table 1) nine of them (i.e. 5a–6g) are either unknown or known, but have not yet been used in spatial planning tasks. The average score of map viewer's usefulness is 6,3 and its usability is 5,9. Use of the SDI in the area of spatial planning practise includes mainly field studies and factors and land use trends analysis. Reading, visualising and analysing spatial data concentrate on viewing maps in the map viewer and displaying data from different sources (the geoportal's map viewer and/or GIS/CAD software). The planners think highly of the national geoportal (64,3% of interviewees) and also value the statistics module (21,4%), and mobile applications (10,7%). But they have small or no experience in working with the other software applications, i.e. the INSPIRE geoportal, metadata editor and metadata validator.

As the results show SDI has an influence on the decision makers (Figure 1). The total score is 7,2. The most important issues are better understanding of the problem and factors (5.), improved comfort at work (6.) and to be more independent of suppliers, superior, other employees (3.).

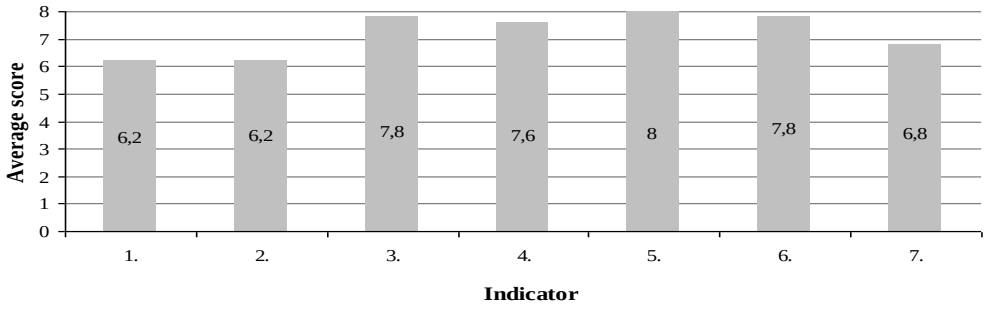

Fig. 1 Effects assessment on decision makers

The content of Geoportal also corresponds to decision making process in the area of spatial planning (Figure 2). From the spatial planners' perspective the merits of The SDI are access to more sources of information (11.), faster access to information (10.), length of time to make decision (14.) and length of time to analyse data (16.).

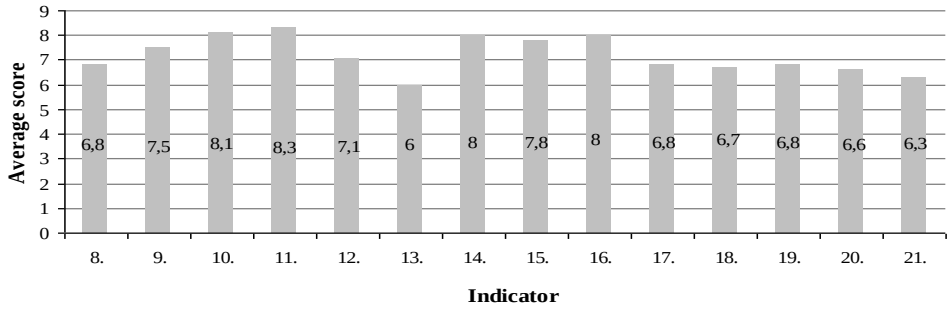

Fig. 2 Effects assessment on decision making process

3.1.2 User organisational performance, strategic alignment and business impact

Use of the Geoportal 2 project's products has some effects on organisational performance (Figure 3) especially in the area of the procedures improvement (3.) and length of time to procedure (1.).

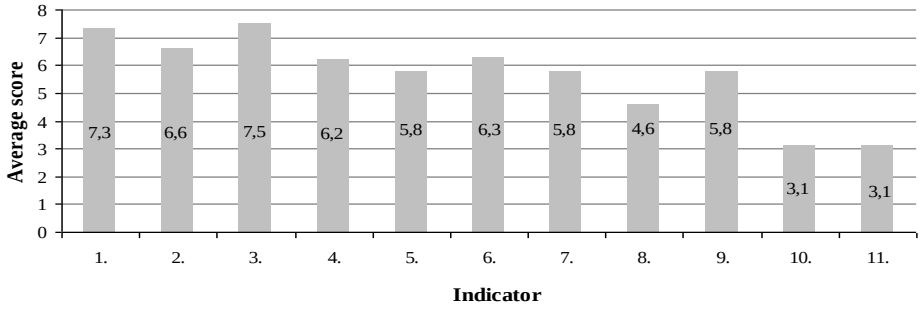

Fig. 3 Effects assessment on user organisational performance

The study finds some evidence of the effects on firm's strategy and its business goals (Figure 4). The most important are the possibility of the ICT inclusion in urban and spatial tasks (18.), efficiency increase of the employees and the whole company (19.), knowledge transfer improved (6.) and optimisation of workflow (12.).

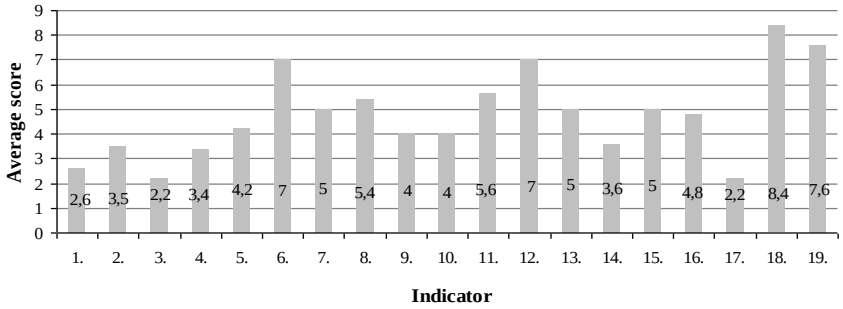

Fig. 4 Strategic alignment and business impact

3.2 Information and support provided

3.2.1 Data availability and scope

On the one hand the users value data for their lineage (Figure 5), but on the other hand underline the need of the proper distribution formats and access to more data sources suitable for spatial planning. The total data availability score is 5,7.

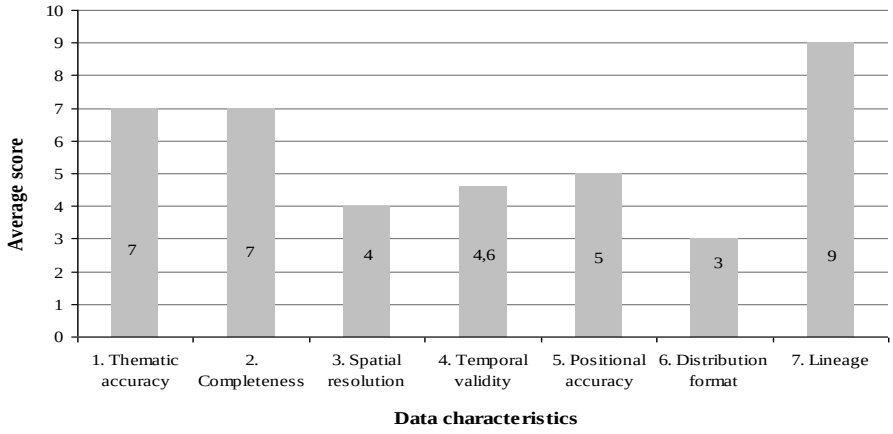

Fig. 5 Assessment of data availability

The most popular data sets are land and buildings registration, cadastre and orthophotomaps, administrative boundaries and geographical names. The eleven (of twelve, except for EBM) data sets are the source of knowledge for spatial plans preparation, study of conditions and directions of spatial management and inventories. The urban and local level planners mentioned of different fourteen tasks supported by the data from the geoportal. They unanimously assessed that these data are between 3 – 20% in the whole spatial planning data set for each work. The average level of the information use is 6,2 and information importance 5,6. The question about web services was not clear for 23,6% of the respondents as services typology is not common knowledge. WMS, WMTS and CSW were marked as being used for spatial planning. One notice was about the complexity of the procedure (e.g. the contact to data provider, legal articles, application) for free download and the lack of WFS access for the most of the users.

3.2.3 User support

Almost 60% of respondents are acquainted with support and tutorials. The average user support score is 3,4. The highest scored source of support is forum and contact email.

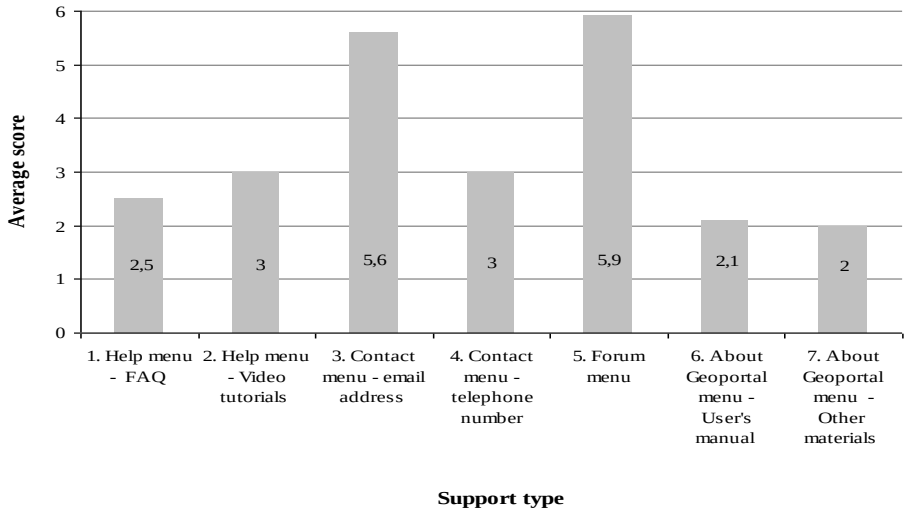

Fig. 6 Assessment of user support

4 Conclusion

In this study the respondent group consisted of the representatives of the Polish firms, which provide professional planning and development advice and expertise to individuals, landowners, developers and local authorities. The paper presents some preliminary findings about use of the Polish SDI and its effects on the planners' tasks. Sudra (2012b) analyses advantages and limitations of the Geoportal 1 project's products use by different stakeholders in the area of spatial planning and only mentions about the Geoportal 2. This research aimed to evaluate the scope of Geoportal 2 products use. The survey referenced to Sudra's assumptions about use process, but also developed knowledge and understanding of the use scope, user organisational performance and strategic alignment from the perspective of one particular stakeholder. The Polish planners value the Geoportal 2 project's products and use them for fourteen different spatial planning tasks. There are also positive effects on decision making process, organisational performance and firm's strategy and its business goals. Although problems with data availability and the geoportal and its content accessibility are underlined.

The methodology developed is based on an extensive review of the literature, the author's expert knowledge elicited from the realisation of the Polish SDI project, the indicator of intensity of use (Vandenbroucke et al., 2013) and eight measures presented in Nedovic-Budic et al. (2004) and is both qualitative and quantitative. The indicators defined reference to the general concept of the SDI outcomes and relate to several aspects of effectiveness described by Nedovic-Budic, Pinto, and Budhathoki (2008). The only difference is data category, which is also considered from the perspective of user needs and effects of data use in this paper. Many indicators presented might be both useful in assessing different SDIs (e.g. that build Infrastructure for Spatial Information in the European Community, INSPIRE) and a step towards the development of some standardised method and measures categories for SDI use evaluation and comparison. Use perspective should matter the most as it allows to verify the SDI objectives and assess usefulness of the SDI products and services. It also assists in the infrastructure development.

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