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Spatial Education for Different User Groups as a Prerequisite for Creating a Spatially Enabled Society and Leveraging SDI *

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Abstract

During recent years spatial data infrastructure (SDI) concepts have developed towards user-centered initiatives, whose creation is strongly driven by user requirements. Closely related to (user-centric) SDIs is the vision of spatially enabled societies where access to and use of spatial data is regarded as relevant support for everyone to organize their activities. Both user-centric SDI models and the concept of spatially enabled societies focus on large and diverse user communities encompassing, besides public and private sector organizations, the general public as well. Although the benefits of spatial data use for professional reasons are widely recognized, awareness of the potential advantages for private life such as activities related to citizenship (civic duties and rights) has only recently been raised. Nevertheless, most citizens, as non-professionals regarding spatial data use, face difficulties when carrying out tasks related to the use of resources provided by a SDI. While capacity building is a long-established feature to ensure effective use by professionals, the need for citizens' spatial education has lately become an important consideration. This asks, on the one hand, for the specification of skills and competencies required on the part of citizens to open up opportunities to benefit from SDIs and on the other hand,

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suitable education initiatives addressing the general public. Therefore, this paper argues that “Spatial Citizenship” seems to be an appropriate education approach to train user groups as pupils/ students and adults (non-GI professionals), who demand for different education initiatives adjusted to their particular situation.

Keywords: user-centric SDI, spatially enabled society, spatial citizenship, spatial literacy, GI education

1. INTRODUCTION

Due to rapid advances in technology in recent years, the use of spatial data and associated applications has gained in importance. Geoinformation has become a crucial component in many domains, for multiple purposes, and at various scales ranging from the local to global level. Furthermore, technological innovations have facilitated the popularization of GI applications and the emergence of the Geospatial Web, i.e. GeoWeb; and based on enhanced usability and accessibility mobile applications empower, enable, and stimulate people to leverage spatial data for personal and private reasons. Prominent examples include navigation systems, digital globes and web mapping applications, spatialized social media platforms, and location based service apps benefitting from GPS enabled mobile devices. Applications like these have gained great popularity and as a result, spatial data is used in a ubiquitous manner by society at a large scale (Enemark et al, 2011; Turner, 2006; Williamson et al, 2010; Thielmann et al, 2012; Rajabifrad et al, 2007; van Leeuwen et al, 2009).

While the benefits of professional spatial data use are widely recognized (e.g. as an instrument of power leading to more robust understanding, faster and better decision-making in many work-life domains), awareness of the advantages for personal purposes has only recently been raised. Nevertheless, this opens also up unique opportunities for the general public to assume (more) citizenship rights and duties, i.e. civic responsibility (see e.g. Kok et al, 2007; Ramasubramanian, 2010; Vartianien et al, 2013).

But, apart from providing users with suitable, user-centered applications, users need some background, knowledge, understanding and expertise to be prepared to use spatial data and associated tools in a competent manner and in an emancipatory way. Here, Rajabifrad et al, (2007) recommend training to make them more literate users. But while a certain consensus on the educational content for professional spatial data use in working environments exists (see e.g.

Goodchild, 2006; van Leeuwen et al, 2009), such initiatives are just hardly available for the lay user training required by most citizens.

To face this gap and thus to increase society's spatial literacy, several open questions exist: (1) Which approaches related to spatial data use and society provide a certain framework to define the need for society's spatial education?, (2) Which skills are required on the part of society?, (3) Which spatial education approach is suitable to skill users appropriately?, and (4) Which different education target groups can be identified to address particular circumstances?

These questions are addressed by this paper. The results presented depend on work done and experience gained in different projects: "AccessibleMap", "Geomedia 55+", and "Nature-SDI*plus*" (Table 1).

Table 1: Selected Projects Providing Input on the Situation of the General Public Using Spatial Data, i.e. SDI Capabilities

Project	**Description and related work related to get to know (lay) users**
Geomedia 55+ (Austria) Duration: 2012-2013 Funding/ Program: University of Salzburg, Senior Studies and the European network "digital-earth.eu"	• This project focuses on identifying and characterizing competences and skills required allowing competent geomedia use and assessing the experience of geomedia use on the part of the general public. • Based on this the development of appropriate teaching materials endowing adults with geomedia skills took place; general recommendation on how to impart needed skills and competences were elaborated. • As background therefore, a workshop with the target group of nineteen highly educated "citizens" aged between 55 and 82, i.e. spatial data lay users was held. The participants were surveyed and observed (qualitative research approach) while using spatial data and associated tools (e.g. geoportals).

AccessibleMap (Austria) Duration: 2011-2013 Funding/ Program: Austrian Federal Ministry of Transport, Innovation & Technology; Benefit program	• The project aimed at developing and improving usability and accessibility of web maps for the visually impaired. • Besides creating a prototype, recommendations on how to design maps (including user interface, map picture, interactivities etc.) to fulfill requirements and needs of the visually impaired including the elderly (suffering from age-related visual impairment) were derived. • Therefore, a user survey fostered a deep understanding of users and allowed specifying user requirements.
Nature-SDI*plus* (Europe) Duration: 2008-2011 Funding/ Program: eContentplus project	• This project targeted at contributing to the strategic development and implementation of the European INSPIRE Directive. Nature-SDI*plus* considers four INSPIRE Annex themes: Protected Sites (Annex I/ 9), Biogeographical Regions, Habitats and Biotopes, and Species Distribution (Annex III/ 17, 18, 19). • 30 partner institutions from 18 EU-countries built the Nature-SDI*plus* Best-Practice Network that aimed to involve new stakeholders, to share data and best practices, to improve and stimulate exploitation and to enable re-use of information on nature conservation. • In the framework of this project a survey was spread throughout Europe in such way that the diversity of today's (potential) SDI users, who besides experts are SDI novices and lay users, could be captured. It resulted in 314 returned questionnaires from 17 European countries. This revealed a general vision on GI use and spatial data handling across the EU.

2. DEFINING THE FRAME: WORKFLOW AND METHODS

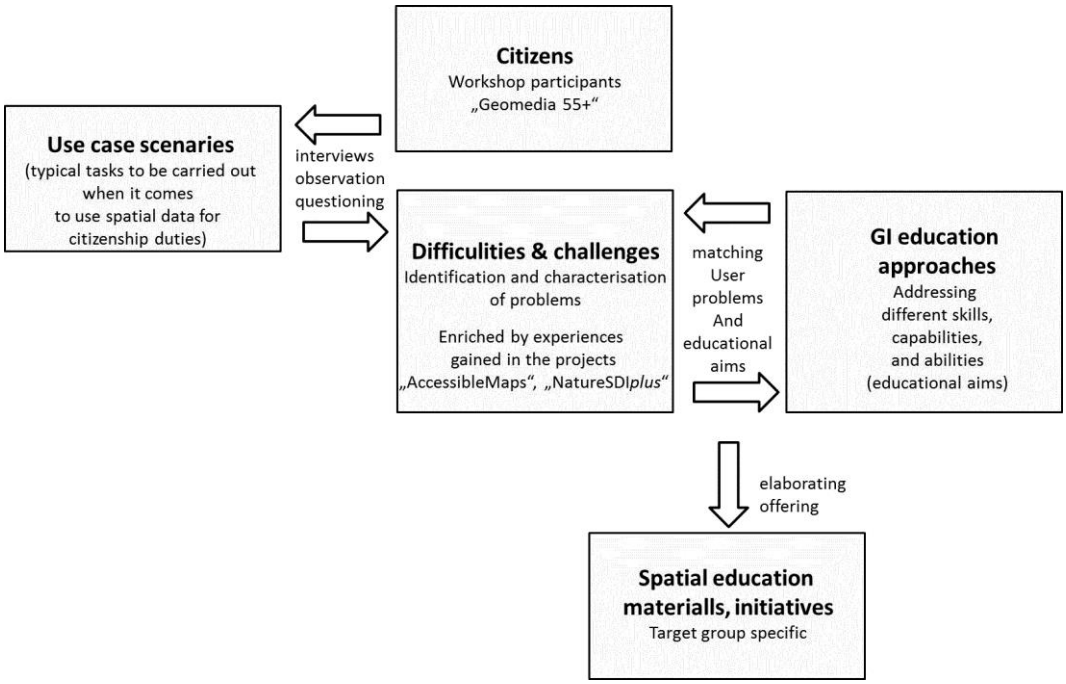
Understanding the users' challenges on the one hand and knowing the skills required to handle spatial data on the other, asks for abundant analysis work concerning the relations between those two dimensions.

Here, it has to be outlined, that people familiar with spatial data handling are often unaware or less conscious about problems and barriers lay users might face when dealing with geospatial resources. This kind of problem is well-known

in the realm of software engineering. In response to growing sensitization to missing knowledge and understanding of user needs, requirements engineering and usability engineering are seen crucial components in software development. Users are not only surveyed and observed (getting to know tasks and working environment, while doing their work, using applications etc.) but they are also increasingly directly involved in all steps pertaining to software development processes (see e.g. Lindgaard et al, 2006; Reeves et al, 2004). So, as software engineering aims at getting to know the needs of users and specify user requirements, the same is true when providing suitable education initiatives for spatial data handling.

Accordingly, methods commonly used in requirements and usability engineering such as user surveys, interviews, identifying target user groups, running through use scenarios of use, task analysis, observations, and analyses of documents, (Nielson, 1994; Richter and Flückinger, 2007) helped to characterize user groups regarding spatial data handling abilities as well as challenges. Based on the elaboration of typical use cases, skills required (and missed) on the part of the users were identified. This work was done in various projects: Most results rely from the project “Geomedia 55+”, and are complemented with experiences gained in the projects “Nature-SDI*plus*” and “AccessibleMap” (Table 2). Checking available GI education approaches against observed user problems helped to identify suitable concepts to address users’ educational needs. They serve as foundation to elaborate initiatives tailored to different target groups. This quite general workflow is illustrated in Figure 1.

Figure 1: Workflow And Methods Applied In Order To Get To Know Users Regarding Spatial Data Handling, Identifying Skills Required, And Offering Education Initiatives Suitable For Different Target Groups



3. BACKGROUND REVIEW

The topic of citizens' spatial education is linked closely to several approaches which put emphasize on the connection between society and spatial data. Most prominent examples are (1) the development of user-centric SDI models, (2) the discussion on building a spatially enabled society, and (3) citizenship activities which are increasingly supported by information and communication technologies (ICT) and geospatial resources.

3.1. User-Centric SDI

Definitions describe SDI as a framework for coordinating the collection, use and implementation of spatial data. These systems consist of a number of components: spatial data, metadata, web services and geoportals, a framework on standards, policies, technological specifications etc. as well as the users and their capabilities (Nedović-Budić et al, 2006; Portolés-Rodríguez et al, 2005, Rajabifard et al, 2002a; Rajabifard et al, 2006; URL 1).

Since their beginning in the 1990s, SDIs have been evolving due to technological advances and social changes. At present, we see three generations of SDIs

(Table 2): From a conceptual point of view, SDI models experienced a transition from product-based (first generation) to process-based (second generation) models. Current discussions are revolving around third-generation, user-centric SDI concepts, particularly those designed to meet user requirements (Craglia et al, 2006; Masó et al, 2011; Rajabifard et al, 2002b).

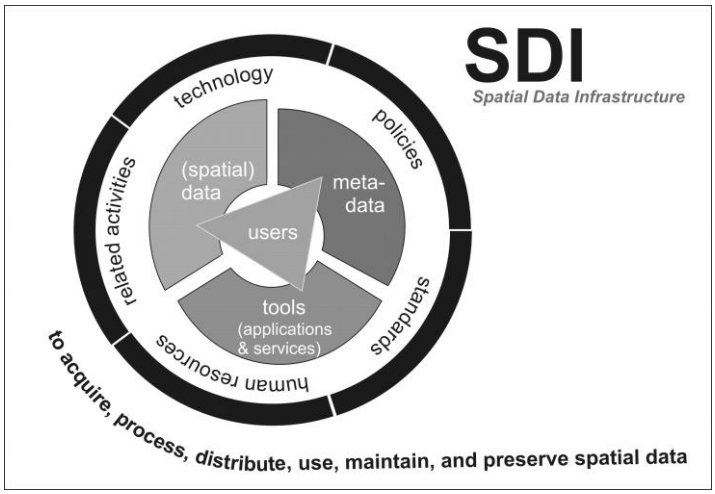
Table 2: Different SDI Generations and Selected Characteristics (Adapted from Hennig et al, 2011)

	1st SDI generation (Product-based)	**2nd SDI generation (Process-based)**	**3rd SDI generation (User-centric)**
Focus	Explicitly national	National; incl. hierarchical context, cross-country	Cross-scale, cross-country, sub-national
Driving forces	Integration of existing data, data management of governmental agencies, Developing a common and fundamental database that collects all available datasets in a single place	Establishing the linkage between people and data; Spatial data application; Creating a community Acting as huge active directory that links metadata, data and people	User-driven Private sector organizations and individuals
Expected results	Linkage into a seamless database	Knowledge infrastructures, interoperable data and resources	Platform for a spatially enabled society
Funding/ resources	Mainly no specific or separate budget	Mostly include in national mapping program, or having separate budget	Incorporating governmental, private initiatives, including crowd-sourcing, volunteered GI; Web 2.0 initiatives
Involved actors	Mainly national mapping organizations	More independent organizational committees, partnership groups	Consortia, representing the target user groups
Number of SDI initiatives	Low	Increasing number	Numerous initiatives
User domain	Government	Stakeholders	Everyone
Tasks	Mainly administrative	Varying but focus for professional purposes	Varying including professional work life

		(e.g. support of decision-making)	(e.g. support of decision-making) and private life (everyday-activities, civic activities, public participation etc.)
Required expertise	Experts	Experts	Every level: expert (i.e. professional work life) to lay users (i.e. private life)
Rel. between SDI initiatives	Low	Increased cooperation	Integrated SDIs
Measuring SDI value	Productivity, savings	Holistic socio-cultural value, expense of not having an NSDI	Usability criteria

User-centric SDI initiatives envision a sustainable framework, in which users (can) cooperate in an efficient, effective, and satisfactory way. Owing to the fact that it is the user who makes SDI efforts a success or a failure, these SDI approaches focus *on* (Rajabifard, et al, 2002a) and are mainly driven *by* the users, their requirements and needs (Figure 2). Thus, the core components, i.e. spatial data, metadata, services, and geoportals, must be well-orchestrated with user-centered design and implementation. Conceptual frameworks (standards, policies, human resources etc.) therefore have to be considered accordingly (Hennig et al, 2011; Rajabifard et al, 2002a; Sadeghi-Niaraki et al, 2010).

Figure 2: User-Centric SDI Development Model



Source: adapted from Hennig et al, 2011

SDI evolution also introduced a disruptive change on SDI user communities. First- and second-generation SDI models are mainly driven by governmental and stakeholder needs (Masó et al, 2011; Puri, 2006; Craglia et al, 2006). They principally focus on supporting data sharing among governmental, research and business organizations. Third-generation SDI models, instead, address a much larger and more heterogeneous user community. This includes data providers and users within all levels of government, the business sector, non-profit / non-governmental organizations, academia and formal education as well as the general public. This vast spectrum of people results in different SDI roles, encompassing SDI developers, suppliers, and managers, (professional) SDI data providers, and general SDI users who range between expert and lay persons (Cooper 2011; Hennig et al, 2011; Richter et al, 2010). Within this community, citizens (being lay users) are a relatively new spatial data user group who receive growing attention (GSDI, 2004; Hennig et al, 2011; Masser et al, 2007; Rajabifard et al, 2007).

3.2. Spatially Enabled Society

Strongly linked to the development and use of SDIs is the vision of a spatially enabled society. This is considered as an evolving cultural and governmental revolution triggered by pervasive spatial information technologies and spatially equipped citizens. It describes societies where spatial information is regarded as a common good available to everyone as a means of helping citizens to organize their activities. The idea emerged in the mid-2000s, when new spatial technologies began penetrating mainstream user groups (Enemark et al, 2011).

As emphasized by Williamson et al, (2011:1), a "[…] spatially-enabled society is not about managing spatial information, it is about managing information, or governing society spatially". Spatially-enabled governments organize their businesses and processes around "place"-based technologies, as distinct from only using maps, visuals, and web-enablement. Ready and timely open access to and use of spatial data lies at the heart of a spatially enabled society and is essential for making well-informed decisions. This is a central issue to encourage and foster creativity and product development across both the public and private sectors, organizations and the general public (Enemark et al, 2011; Wallace et al, 2006; Williamson et al, 2010).

According to the literature, spatially enabled societies require simple geo-browsers and web mapping tools as well as supporting infrastructures, thus emphasizing the relevance of SDIs. As pointed out by Enemark et al, (2011:6) "[…] spatially enabled societies represent the realization of the promise offered by building SDIs"; and as highlighted by Rajabifard (2007), SDI design facilitates spatially enabled societies.

3.3. Citizenship, Civic Rights and Duties

Citizenship outlines the status of a member of a society, who on the one hand enjoys rights but on the other hand accepts the duties of belonging to society (URL 2). According to this, citizenship refers to the ability to act in society in accordance with socially declared rights and duties as well as"[…] civic values such as democracy and human rights, equality, participation, partnership, social cohesion, solidarity, tolerance of diversity and social justice" (Eurydice, 2005: 10). Thus, based on the idea of society as a balance between individual freedom and protection, citizenship addresses two sides of the same coin, both inseparably intertwined: Civic rights (e.g. the freedom to express yourself or to worship as you wish) goes hand in hand with responsibilities (e.g. to participate in the democratic process or to respect the rights and opinions of others). Citizenship requires a broad set of information, knowledge, skills, abilities, and capabilities from each individual to enable participation (Bîrzéa, 2000).

Due to rapid advances in ICT in recent years, tremendous changes have been generated in ways the general public can become involved and perform citizenship activities, i.e. comply with associated rights and duties (see e.g. discussions on digital citizenship; Bennet et al, 2009). A wide variety of (web) applications exist enhancing information and communication processes, fostering openness and collaboration between authorities and citizens, and opening the stage for new forms of societal exchanging, networking, community building, and decision making. Well-known and well- established tools include web sites, online polls, discussion forums, social media platforms and decision-making support systems (Da Trindade et al, 2010; Milovanovic, 2003).

Intimately linked to ICT is geospatial technology; particularly, spatial representations (i.e. maps) as a useful mode to communicate in societal and (public) participation settings. Geovisualisation and geocommunication play an increasing role as underlined by e.g. Goodchild (2007), MacEachren (2004) and Sieber (2006). Prominent examples can be found in the spatial planning domain or citizen science projects (Brown et al, 2011; Ramasubramanian, 2010; Vartiainen et al, 2013).

In contrast to the traditional utilization of spatial data (that is mostly done by experts), current applications (e.g. participatory GIS, web map-based feedback systems) allow everyone to use spatial data – and leverage geovisualization and geocommunication. This allows citizens not only to become spatially informed, but also to enable them to voice salient issues, suggest their own spatial impressions, opinions, and visions, and thus become even more empowered by contributing to decision-making. This is underpinned by the user role shifting from data consumer to so-called data "prosumer" (producing and consuming data). User generated content (UGC) and volunteered geographic information (VGI) open up unique opportunities to deal with many society-relevant concerns and closes certain gaps as today we face a high demand on (spatial) data, which cannot be fulfilled only by the authorities, as previously done (Díaz et al, 2012; Goodchild 2007).

In this context, resources provided by SDIs are very supportive means. They can support the general public to exercise citizenship duties and rights based on well-grounded information in a spatially enabled manner and even taking part in providing information (see e.g. GSDI, 2004).

3.4. Summing Up on the Need for Citizens' Spatial Education

Notwithstanding these promising approaches, reality looks different. While usage of resources provided by SDI is well accepted by experts and professionals, this is not as true for the general public. Despite the growing number of systems and applications which conform to usability and accessibility criteria, these systems are still only being used to a small extent by the general public (see e.g. Díaz et al, 2012; Hennig et al, 2010). The low rate of use and penetration in society might be rooted in a general absence of the literacy on spatial data handling. Attention should therefore be directed towards the spatial skills needed by citizens so they can be empowered to use spatial data and develop SDI capabilities.

In debates around SDI, the aspect of user qualifications is not new. SDI definitions underline human resources and capacity building as a key feature (Masser, 2007; Coleman et al, 1998; Rajabifard et al 2002b; Stevens et al, 2005; URL 1). Both terms, human resources and capacity building, are closely related to the workforce of organizations. Human resources refer to individuals as the

workforce of an organization. Central to human resources is capacity building. The OECD Glossary of Statistical Terms (URL 3) describes capacity building as the means by which skills, experience, technical, and management capacity are developed within an organizational structure.

While SDI research is widely aware of the relevance of well-skilled human resources, i.e. the workforce, the general public is left behind. It seems that non-professional users are not taken into account when it comes to discussions on spatial literacy or skills and competencies required to benefit from SDI capabilities. However, when moving towards the creation of a spatially enabled society, this user group needs to be considered as well. Rajabifard et al, (2007) stress that in developing SDI capacity building strategies it is necessary to recognize the changes that have occurred recently in the nature of spatial data users. Attention must be paid to provide suitable training and education opportunities that fit SDI lay users as well.

Understandably, any abilities and capacities, which need to be built up on the part of citizens, will differ somewhat from those required by professional users. This asks for sensitivity to the problems and barriers faced by the general public when using resources provided by SDIs.

4. TASKS AND CHALLENGES TO BE FACED BY CITIZENS USING SDI RESOURCES FOR CITIZENSHIP ACTIVITIES

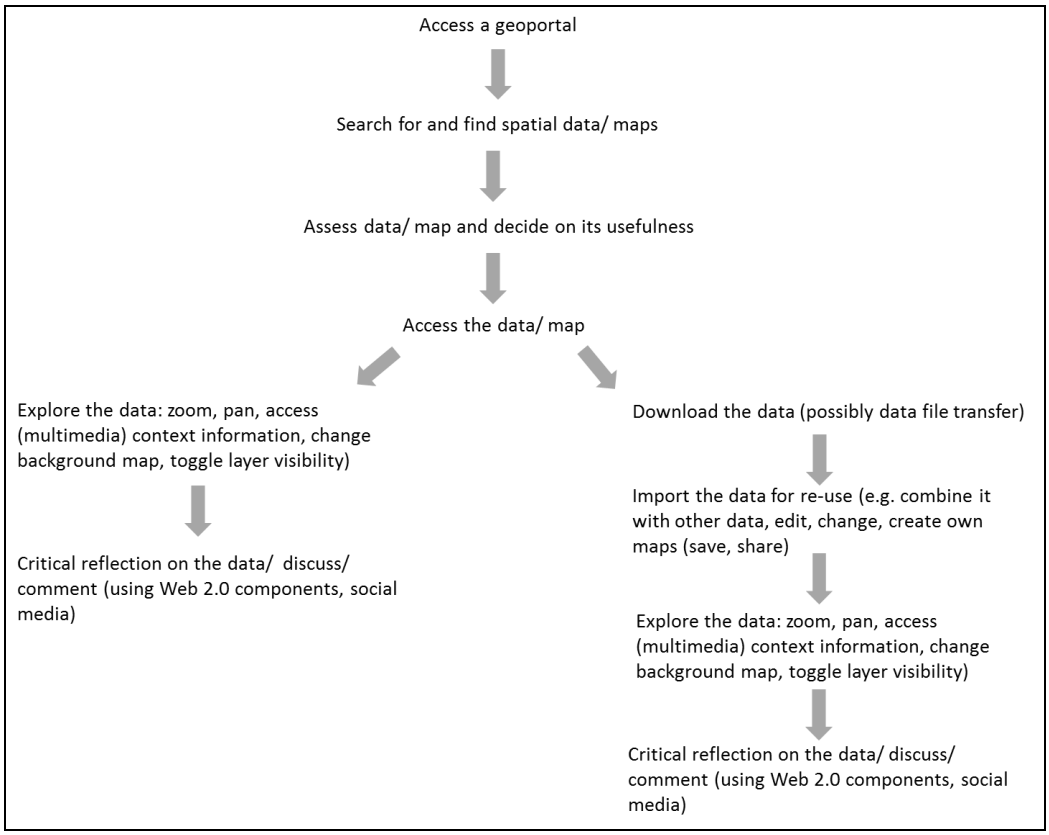
In the following we sketch two use case scenarios illustrating the workflow related to how SDI capabilities are accessed and used while performing e.g. citizenship activities: first, becoming spatially informed and second, contributing own spatial content. Both use case scenarios help to discover difficulties and challenges lay users (might) face when using spatial data.

4.1. Use Case Scenarios

4.1.1. To Become Spatially Informed

As already outlined above, having (spatial) information at hand and becoming (spatially) informed is a prerequisite to get organized, form a personal opinion as basis for social responsibility, as well as active involvement and decision making. Spatial information is a pivotal aspect concerning the knowledge of public facilities as well as environmental, societal, cultural and economic situations. This refers for instance to numerous data sets provided by open governmental data portals allowing citizens to become spatially informed on e.g. urban infrastructures. The workflow that needs to be carried out to benefit SDI resources in order to become spatially informed is described in Figure 3.

Figure 3: Workflow Performed to Become Spatially Informed in the Context Of Civic Responsibility Activities



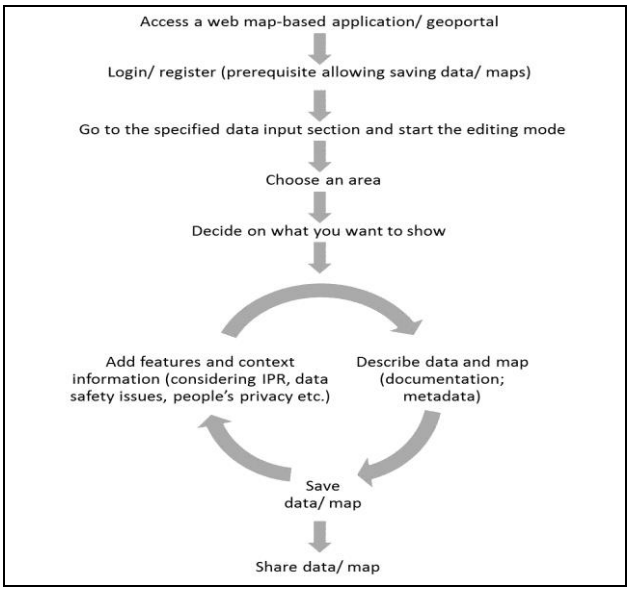
4.1.2. To Contribute Spatial Content

Systems allowing for citizen contributions through web-based mapping platforms (e.g. VGI, PP GIS, web map-based feedback systems) have emerged in large numbers during the last years. Examples include “OpenStreetMap”, “fixmystreet”, “Harava enquiry service”, or “Eye on Earth”. These applications permit consulting, involving, and engaging citizens in contributing to (societal) decision making. They allow everyone to report their own observations, experiences, impressions, needs, or ideas. This input enriches official information (Craglia, 2007; Goodchild, 2010) and is a contribution to help keep society functioning and innovating.

Due to the benefits and impacts outlined above, it is not surprising that SDIs are placing more interest on user generated content and volunteered geographic information. Approaches to leverage user-generated content are widely discussed in the literature. Thus, for instance, Díaz et al, (2012) highlight the disposability of an increasing amount of data at high space-time resolution as

well as (low cost provision) of local knowledge and expertise. Input can occur in two ways: First, by integrating available user-generated content in the SDI context. Second, by rethinking the role of SDI users (Budhathoki et al, 2008), allowing them to participate directly in providing content to SDI (Díaz et al, 2012). The workflow and operations to be performed by the user to provide their own content in web-based map systems are presented in Figure 4.

Figure 4: Workflow And Working Steps Performed To Contribute Spatial Content In The Context Of Civic Responsibility Activities



4.2. Identification and Characterization of Users' Situation and Challenges

Across all working steps and operations presented in Figure 3 and Figure 4 we observed numerous problems and difficulties faced by non-professional users. The findings outlined below have to be considered as a starting point for raising awareness on lay users' challenges and for helping to specify their required skills and competencies.

4.2.1. Spatial Data and Map Use

In society at a large scale, spatial data and associated tools (mostly Google Maps) are widely used today for purposes such as address finding, navigation and orientation, as well as gaming (e.g. geocaching). The users are familiar with basic web mapping tasks like navigating the map, switching background maps, and accessing context information available in information windows. Regarding more advanced operations, it became obvious in the workshop "Geomedia 55+",

that the participants had little or no experience at all on searching and finding spatial data or maps, deciding on usefulness regarding their particular purpose, leveraging the possibilities of interactive legends for map exploration (e.g. change layer order, toggle visibility). However, as Beconytė et al, (2009) indicate, operations such as to find, recognize, select, and use spatial data are important tasks which are most relevant for citizens with regard to e.g. public participation.

Concerning topics like output and the re-use of data (import, export, transfer, assess etc.) and maps (print, save, export, embed), users provided even less experience. The same was true for data production (creating their own map features: points, lines, areas) and related tasks such as documenting data, providing multimedia information (using e.g. information windows, inserting links and images). All these tasks were quite new for the participants, whereas it became evident that users not only lacked relevant technological skills, they also were unfamiliar with basic GI concepts (see also van Leeuwen et al, 2009). During the "Geomedia 55+" workshop it became clear that some basic background and understanding of these concepts would be crucial as they allow users to perform operations in a more competent, self-reliant and successful manner.

4.2.2. Knowledge on Existing Applications

Even if current SDI models (e.g. the user-centric SDI approach; Table 2) focus on the general public as a relevant target group, it has to be stressed that most people are not aware of the existence of such tools. This includes also simple web mapping applications as underlined by results from the "AccessibleMap" and "Nature-SDI*plus*" projects. Furthermore, most people did not know that abundant (spatial) data is available for free on the Internet provided by governments with the purpose to support civic duties and address civic rights.

4.2.3. Domain-Specific Vocabulary

Accessibility to terminology is a barrier that hampers and discourages people from making use of GI applications and make it impossible for some people to use them (URL 4). This includes language related problems: Numerous ICT- and GI-specific terms are unfamiliar to lay users. Domain-specific vocabulary is widely used in geoportals and other web map-based applications. Examples include kml/ kmz, metadata, and even terms like layer. Knowing and understanding such terms, as well as the underlying concepts, provides relevant background to users, similar to knowing technology terms like hard drive, docx or browser when doing basic computer work.

4.2.4. ICT Background and Prior Experience

A certain level of ICT background, experience on computer and internet use constitutes a foundation for the competent use of (spatial) data, applications and

devices (Möller, 2006). Even though this is a crucial prerequisite, related skills and competences vary considerably among citizens. If not using computers at work, these users and particularly the elderly (see discussions on societies' digital divide; Epstein et al, 2011), often show weak or no ICT background at all.

During the workshop "Geomedia 55+" it became obvious that this missing background hampered participants from using the computer and/ or the internet as they were insecure and anxious about destroying or deleting "something". When asked to register, participants refused to enter personal information as they were afraid that third parties could use this data or they could be "signing a contract" they do not understand.

In the "AccessibleMap" project, the interviewed highlighted that even if applications are fulfilling usability and accessibility criteria on a high level, lay users consider these still as (too) complex. Missing the understanding of underlying concepts and the logic of spatial data and web map-based applications, they were e.g. challenged by using interactive legends, finding certain buttons, or other components.

4.2.5. Use of Multimedia and Web 2.0 Components

The participants of the workshop "Geomedia 55+" showed little or no experience of multimedia use and social media tools. In consequence, they were stretched when searching the internet for multimedia elements (e.g. images) and embedding them. The same was true for inserting hyperlinks e.g. in map interfaces.

Further difficulties were linked to the use of social media applications and components (blogs, forums, social media platforms etc.), although these have become omnipresent on the Internet and play a pivotal role for information and communication processes. These tools would allow them to publish and embed (map) objects as well as to comment and discuss (geovisualised) content. Hence, users need to be familiar with social media paradigms: user collaboration, participation, and interaction (see e.g. Richter et al, 2008). Numerous geoportals have already integrated such components to facilitate exchange and discussions.

4.2.6. Critical Reflection and Responsibility

To enable a mature usage of spatial data and spatial representations, they need to be understood as a model of the world and not as the world itself. Spatial representations such as maps are powerful in influencing world views (see Wood, 1993) due to the combination of different modes of processing (pictorial and textual), as explained in the dual coding approach (Paivio, 1990). Map design (e.g. based on cartographic design principles) is an important instrument to

convince the reader (Robinson, 1952). However, most participants had not reflected on different modes of visualization and the power of maps so far.

Moreover, the physical proven existence of a certain point on the earth's surface and its depiction lends credibility to all information attached to this point in a map. According to Critical Cartography (Crampton, 2009; Crampton, 2001; Harley, 1989), the central question is more about what is not displayed in the map, as maps can keep significant information out of the discourse just by leaving it out, following certain, intended or subjectively unaware or socially constructed view of the world. Deconstruction, respectively reflection on the boundaries of significance of a map is a key to using them maturely and responsibly, especially, when it comes to spatially related action oriented at the map (Harley, 1989). Critical GIScience adapts these ideas for digital mapping and spatial data (Pickles, 1995; Schuurman 2000; Schuurman, 2004; Wilson et al, 2009). The "Geomedia 55+" course participants were widely unaware of the need of such a reflective approach to spatial data and map use.

4.2.7. Internet Safety Issues

Another significant weakness emerged out of the missing competence to handle internet safety issues. Participants of the Geomedia 55+" course had an unspecified awareness of the 'dangers' posed by the web, while not being able to identify and understand any threats in detail. The key to internet awareness, concerning both legal and criminal activities, is privacy, as personal data is strongly related to economic interests on the web. When it comes to GeoWeb applications and geolocation (of persons and places related to them), keeping and managing (spatial) privacy in a mature way is an inevitable skill (Armstrong et al, 2005). Moreover, workshop participants were completely unaware of any legal aspects such as intellectual property rights. They associated working on the web merely with technical challenges, ignoring societal components.

5. SPATIAL CITIZENSHIP

Following the problems and barriers identified in the previous section, several aspects need to be addressed regarding spatially enabled citizens: Besides the necessity to enhance the visibility of applications to the public (i.e. geoportals as an entry point to SDIs) it is essential to improve the awareness of ICT multimedia and GI education for lay users To endow needed spatial literacy, several educational approaches already exist. However, in the last decade these have been transferred to school education (Donert, 2010), but they have not targeted creating spatially skilled citizens so far. Summarized under the umbrella-term GI-education these initiatives originally mainly focused on the training of future professionals in GIScience as well as applied GIS. Skills conveyed by these approaches are mainly industry-related, adapted to certain technical and domain-related tasks and purposes (Donert, 2010; Kerski, 2003).

A prominent GI education approach in this framework is the concept of Spatial Thinking (NRC, 2006): This concept focuses less on learning the technological conditions of the tools but more on utilization of GI applications to increase understanding of spatial relations and to further problem-oriented learning in interdisciplinary contexts. “Spatial Thinking” is mainly science-oriented; therefore the social realm of spatial data and its role in societal decision making is not well explained and trained for (Kerski, 2011).

For training to use spatial data in societal decision making processes and everyday needs, the concept of “Spatial Citizenship” (Gryl et al, 2012) can be considered especially fruitful. With a particular link to citizenship education it contributes to the realization of a spatially enabled society, while re-centering the inclusion of spatial information around the everyday lives of individuals, rather than around the requirements of science or the industrial workforce. This link to citizenship education is central as it helps to address the range of duties and rights necessary to act responsibly in society. Referring to Morris et al, (2002), civic education is to be seen as included in citizenship, as the first refers to basal, reactive abilities and the latter addresses the full range of an individual’s mature action in society.

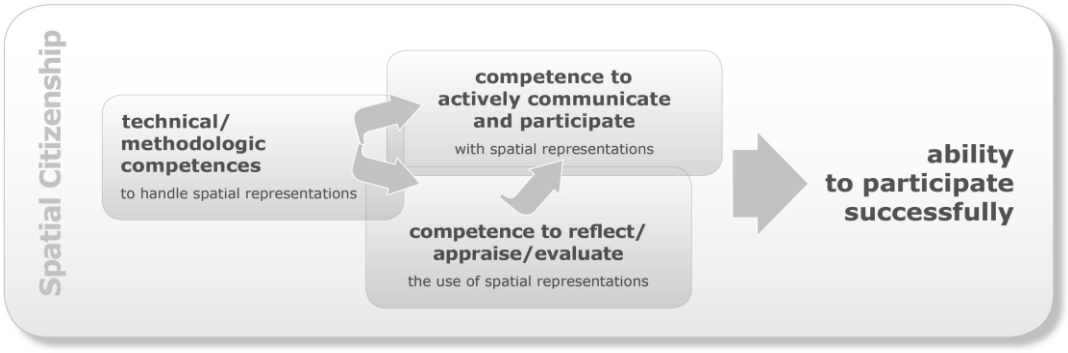
With respect to citizenship theories, specific approaches are selected for the Spatial Citizenship concept, contributing the best to the objectives of a spatially enabled society. Therefore, Spatial Citizenship does not only refer to fluent communities, opening the view for web communities and ubiquitous GI applications (Bennett et al, 2009), but it also follows an activist approach to citizenship (Mitchell et al, 2012), meaning, that social rules are regarded as principally negotiable embedded in fundamental human rights and democratic negotiation processes as fixed values. Such emancipated concepts of citizenship education meet these perspectives.

Linking to the fundamental negotiation of societal rights, spaces (in terms of meanings of spaces) have to be regarded as socially negotiated as well as in coherence with social and social geography theories (Lefebvre, 1993; Paasi, 1986; Werlen, 1993). Meaning is attached to physical matter leading to the ‘construction of space’. In most cases, a certain meaning dominates and others are superseded. Societal decision making on spaces is therefore influenced by the differing spatial meanings. To widen the perspectives involved in such a process, dominant meanings have to be questioned and alternative meanings, i.e. spatial constructions, have to be put on level with these.

Spatial representations are effective tools to communicate spatial constructions using spatial data, highlighting the societal implication of it and making it an essential access to participate in societal discourses on the meanings and utilizations of spaces. This huge potential requires for abilities and capabilities in

three dimensions which, at the same time, form the framework of the Spatial Citizenship approach. In a nutshell, these components empower citizens to establish relevant abilities and capabilities for the critical, reflective and emancipatory handling of spatial data in spatially enabled societies, aiming at their participation in spatially related societal decision making processes. These three components are named in Figure 5 and described in the following sub-sections.

Figure 5: The Concept of "Spatial Citizenship"



Source: Gryl et al, 2012

5.1. Technical and Methodological Competences

The basic limitations identified in the use case scenarios (section 4.1.) is the inability to handle GI and web technologies, including knowledge about the tools, the inability to use and understand adequate terms and application of tools. This component summarizes some technical abilities of (spatial) data access, reading and production of spatial representations. The concept of "Spatial Citizenship" focuses on the appropriate usage of new technologies such as ubiquitous computing and GeoWeb applications accessible to lay users.

5.2. Competence to Reflect, Appraise and Evaluate

Rooted in Critical Cartography approaches (Crampton, 2001; Crampton, 2009; Harley, 1989) and Critical GIScience (Pickles, 1995; Schuurman, 2000; 2004; Wilson et al, 2009), this component addresses the need for reflection on spatial representations and their social realm. As spatial representations mainly illustrate only one meaning out of the manifold of possible ones, and societal decision-making requires the development of a variety of spatial visions, reflecting on existing spatial constructions and thinking in alternatives is essential. Users need to gain insight in and understand the social power relations that deploy around the usage of spatial data. In terms of GeoWeb technologies, privacy issues and issues of intellectual property must be included in the reflection process around

spatial data. They prepare for a mature, sound participation in society with the help of current technologies.

5.3. Competence to Actively Communicate and Participate

Closely linked to active/activist citizenship, this component targets enabling people to devise (alternative) spatial scenarios allowing them to effectively participate in society with the help of spatial information. Such abilities support citizens in carrying out their citizenship duties, access their rights, communicate their own ideas and opinions and represent their interests. This involves the ability to compete and to negotiate on spatial meanings with other stakeholders. Current web technologies and SDIs potentially enable communication and negotiation processes within a broad audience.

In conclusion, these three components involve competencies for two-way communication underpinned by the use of ICT and GI as tools to encourage modern citizenship approaches. They are based on a conglomerate of social, citizenship, and geographical theories. As a result of this, the concept of “Spatial Citizenship” can be considered a suitable answer to the limitations outlined in section 4.

6. CITIZENS AND SPATIAL EDUCATION

Even though the “Spatial Citizenship” approach, at first sight, delivers a suitable framework for imparting spatial literacy to everyone, education efforts, to be successful, must match the situation and needs of the addressed target group. This relates to aspects like age, education level and prior experience with ICT. Paying attention to existing education systems it is reasonable to distinguish spatial education initiatives offered in the framework of formal school education and adult education and teaching. Both of these target groups vary in several aspects: e.g. existing level of ICT background, if and how they can be reached by education initiatives, as well as motivation and suitability to acquire learning concepts. However, regarding formal school education in recent years the inclusion of spatial data took place to a greater extent (Gryl et al, 2012; Kerski, 2008). Adult education and teaching initiatives have only recently started to gain interest.

6.1. Formal School Education

Formal school education includes primary and secondary education. Based on the premise that school education should provide pupils with relevant skills to participate in society, the rapid advance of ICT accounts for an increasing need to include spatial data handling issues in education as well. Teachers worldwide are recognizing more and more that spatial technologies such as GIS, GPS, and remote sensing are important technologies to prepare students to be decision

makers of tomorrow (Donert, 2010; Kerski, 2008). In recent years efforts have been directed towards improving spatial competency by accommodating existing education curricula and developing appropriate teaching frameworks. Today a growing number of courses, teaching material and tools are available. Initiatives in several countries focus at integrating the aim to build up according competences in their school curricula (Donert, 2010). Some developments in teaching approaches, experiences, and materials have been developed as a result of efforts undertaken in interdisciplinary projects like “Geokom-PEP”, “iGuess”, “I Am Here!” or “digital-earth.eu”.

Within the framework of different SDI development processes primary as well as secondary school teachers are identified as SDI target user group (see e.g. “Nature-SDI*plus*”). However, teachers need to be motivated and encouraged to employ spatial data in their teaching and, due to missing skills; they often need to be prepared. Advanced training is required (Forster, 2010). Furthermore, the education sector is questioning how to fully leverage SDI in school education and teaching. This includes the topics such as detailed examples, textbooks, and particularly designed courses and exercise as well as the demand for computers and computer labs (Lindner-Fally, 2012).

6.2. Adult Education and Teaching

Today, adult education is seen as a strong and crucial link in the lifelong learning chain. Rich practical experience and abundant theoretical background on it already exists: Efforts are put both in formal and to informal education (Arnold et al, 2008; BMASK 2010; European Union 2012). Especially for adult education and teaching, self-directed learning plays a crucial role.

For informal adult education lots of material is freely available on the internet for everyone to become spatially skilled: textbooks, courses and training programs as well as online tutorials and webinars, blogs and forums, newsletters etc. (see e.g. Stevens et al, 2005; URL 9). However, like GI literature in general, most of the materials tend to be rather advanced and are designed for expert audiences. Requirements of beginners (i.e. non-professional private users) are often not addressed (Fazal, 2008).

Institutes like adult education centers potentially offer a wide range of different ICT and Internet use courses for adults. However, concerning geospatial resources, such initiatives, including teaching material, seem to be missing. There are demands for projects similar to those realized for school education to foster the development of appropriate teaching material for adults. A first step in this direction was achieved by the project “Geomedia 55+” elaborating some first recommendations on course structure, content and tools levering the “Spatial

Citizenship" concept (Hennig et al, 2013). Selected aspects are presented in Table 3.

Table 3: "Geomedia 55+" Course Structure, Units and Content (adapted from Hennig et al, 2013)

Ex-change	Units	Content	Purpose
Personal and group/ team support (f2f teaching, group discussions, email, blog, consultation hour)	**Introduction**	Collecting participants' perspectives Giving theoretical background Gaining some first own practical experience	Gain insight in participants state of geomedia capabilities and abilities
	Sweetener	Visit of GIS day event hold at University of Salzburg	Provide some insight on the wide range of GI/ geomedia Raise interest and awareness on topics in the context with GI and geomedia Strengthen motivation (corresponding to the fact, that the audience in adult education is considered to be a self-motivated
	Handling data and maps	Theoretical Background Practical experience	Provide basic functions of geomedia
	Critical reflection on maps and data	Theoretical Background Practical experience	Provide a critical view on geomedia regarding (political) power etc.
	Project work **(team work)**	Perform a project work (related to an everyday situation) based on learning transfer (prepare a digital map visualizing a self-chosen topic incl. data	Reflection, recapitulation self-experience (particularly in line with self-directed learning

		gathering and management, and deciding on the map layout)	recommendations)
	Presentation	Presentation and discussion of the projects results	Reflect on the work done (particularly in line with self-directed learning recommendations)

7. CONCLUSION

Owing to an increase in usability and accessibility, SDIs are becoming more and more valuable as supportive instruments for numerous purposes and for everyone including the general public. It is widely accepted that these systems foster the emergence of spatially enabled societies. However, even if simple market driven solutions (such as e.g. the well-known Google product family) 1) gain in popularity, 2) increasingly tune their usability and therefore 3) seem to provide an easy to understand spatiality, there is still a gap between theory and practice (i.e. between everyday spatial data use and being spatially enabled to participate in societal negotiations). Unknown theories behind GI, GIS, SDI, etc. and the use of very specific GI/SDI vocabulary are just two examples for crucial limitations hampering the development towards a spatially enabled society.

As a result of this, centering on user needs and requirements, i.e. improving the usability of applications, is just one side of the coin and therefore not enough. The other side is the user itself, who needs to be not just spatially familiarized but spatially enabled: Lay-persons are still seriously challenged performing operations related to spatial data and especially to the use of SDIs, i.e. geoportals which serve as an entry point to these systems and facilitate the user to discover, display, edit and analyze spatial data. This seems the case for most citizens, who miss certain skills and competences relevant to leverage resources provided by SDIs in a competent, capable and self-directed manner.

Hence, the spatial empowerment of citizens is essential to build up spatially enabled societies. Understood verbatim, to enable everyone in society to handle spatial data and associated tools (including SDIs) on an adequate level is a pivotal component for spatially enabled societies. Providing help and user support implemented in applications, is not enough; people need certain spatial literacy otherwise they become lost and discouraged while starting to work with spatial data and the according applications and systems. Just as professional users benefit from capacity building, information and training initiatives for lay users, i.e. citizens must be made provided. Here it has to be underlined, that spatial education fosters universal literacy that is needed to exploit the

opportunities that will be provided by the creation of spatially enabled societies (NRC, 2006; Rajabifard et al, 2007). Goodchild (2006:11) highlights that "children grow up to function as adults in a world in which the three Rs – reading, writing, and arithmetic – are considered essential as much to basic functioning as to the realization of life's higher objectives. Today, we surely have to add spatial literacy to the list."

The "Spatial Citizenship" concept offers a reasonable framework for educational initiatives by focusing on a variety of competencies being e.g. crucial for activities related to civic responsibility: technics and methods, reflection and communication. In this context both, pupils and adults, formal and informal education, must be considered as crucial components to spatially empower society.

Finally, it has to be underlined that this paper is primary aimed at raising awareness on the situation of citizens when it comes to using spatial data and SDI resources. A lot of work still has to be done to increase citizens' use of SDI capabilities and enhance the development of spatially enabled societies, regarding e.g. the development of competency frameworks, educational material and especially to know and understand lay users and their situation and needs.

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