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Editorial

Citizen participation and Internet GIS—Some recent advances

1. Introduction

The issue of public participation goes back to the late sixties and early seventies. Local and regional authorities made brochures and posters and arranged meetings to really involve the citizens. However, only few people were really involved unless there was a strong opposition against for example against a new motorway in their neighbourhood. Until the nineties public participation continued in the same manner. At that time three important events took place. First, there was a growing awareness of the environment and the importance of making the citizens accountable for a sustainable future. The Conference on Environment and Development (Earth Summit) in Rio de Janeiro in 1992, Principle 10 (United Nations, 1992a) and Agenda 21 (United Nations, 1992b) both called for increased public participation in environmental decision-making and led to the adoption in Europe of the Aarhus Convention (UN ECE, 1998). Besides, Agenda 21 emphasises the role of geographic information in monitoring and analysing the state of environment globally. Therefore, it was clear that governments at all levels seriously considered how to fulfil the obligations stated in these international conventions. Second, the emergence of the Internet and its rapid expansion to millions of users facilitates the spread of information at a rate without any counterpart in history. Furthermore, the Internet—opposed to for example television—supports bi-directional communication. All in all, the Internet had the potential of being a strong medium for involving the citizens in decision-making. Third, Geographical Information Systems (GIS) became a mature technology to be used beyond very technical environments. Generally, public participation is concerned with spatial and environmental planning, and therefore maps—and GIS—play an important role. Accordingly, there is a sense among governments, officials and staff that ''interactive Internet based GIS'' is or could be the solution for a number of concerns including: increasing trust of government, increasing both participation rates and the quality of participation, increasing

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social inclusion and promoting greater democracy, and obtaining more efficient decisions.

An important goal of this extended editorial introduction to this part special issue is to expose the potential of *interactive GIS* as a *tool* for *citizen participation*. Our purpose here is threefold. First, we spend some time discussing what exactly is meant by *citizen participation*? What exactly is meant by *interactive GIS*—and how are these terms interrelated? Second, we present frameworks for categorising existing PPGIS in terms of substantive area as well as level and kind of citizen involvement. Finally, we analyse some recent advances in interactive or participatory systems embedded in this Urban Data Management Symposium (UDMS) special issue of *Computers Environment and Urban Systems*.

2. Public participation

Public participation practice is a growing part of decision-making although it remains troublesome in practice. The main purpose of public participation in spatial and environmental planning is to achieve protection, conservation, and wise management of the land resources. This can only be achieved if the proponent properly collects (and acts upon) evidence, opinions and perspectives from all the interested or affected stakeholders, who are to be fully involved in the decision-making process, and from the earliest possible opportunity. The difficulty lies once again in the ambiguity of the term and its plethora of variations. Two major questions persist: who are the ''citizens''; and ''how do they participate''?

2.1. Who are the citizens?

In its purest form, citizens are all of us. We live our lives; we vote in elections; and we form special interest groups to influence decisions. Ordinary citizens, however, are only part of the network of ''citizens'' that a government faces. Without belabouring the point, these other ''citizens'' are other governments, the business community, and the government's own employees or subcontractors. A specific language has grown up to capture these participatory patterns and interactions. G2G refers to government-to-government communications. G2B refers to government-to-business connections. G2E refers to a government's interaction with its own employees. And, finally G2C refers to how a government is involved with its citizens. G2C is the ''usual'' arena when discussing citizen participation although clearly it is a partial understanding. Citizens participate differentially due to either variation in inclination or skill. This is true for all classes of citizens: government staffers, businesses people, government employees, and citizens. Leaving out for the moment those that are not inclined to participate in governmental affairs still leaves two groups: those with skills and those without skills. Much of the discussion in the Internet era (roughly post 1995) has focused on the ability of the Internet to increase the participatory skills of citizens via the Internet. Citizens are becoming e-citizens. One function of government is to help enable citizens to obtain these skills.

2.2. Taxonomies

The level at which the public is involved varies with the relevant legislation, and the attitude of the other stakeholders. Often it just means informing the public of a previously, made decision and asking for comments, which may or may not be heeded. Sometimes it means informed consultation. For public participation to be effective at any level, it requires the public to be well informed and kept aware of the possibility of participation. This requires a pro-active approach from the relevant public authorities.

Arnstein (1969) has provided the most enduring metaphor of variations in G2C participation. This so-called ladder of public participation has 8 rungs divided into three main groups. The lower rungs represent zero opportunity to participate, whereas the uppermost rung representing *citizen power*, involves public-authority partnerships in which citizens are in control, or can veto agency decisions. Abstracting her participation ladder, Arnstein argues that the bottom rungs represent *non-participation*, the middle rungs *tokenism*, and the high rungs *citizen power* (Fig. 1, left). Based on the Arnstein ladder, Weidemann and Fermers (1993) developed a revised ladder of public participation, where the involvement increases with the level of access to information as well as the citizen's rights in the decision-making process (Fig. 1, middle). According to Weideman and Femers, public involvement increases as an authority grants citizens rights higher in the ladder: the higher rungs can only be reached by fully filling all the requirements of the lower rungs in the ladder. Inherent in this conceptualisation is the view that simply informing the public is a kind of participation, although access to information and participation are clearly different matters!

Considering the current information and communication technologies, Smyth (2001) has updated the traditional ladder concepts (see also Carver, 2001). Climbing

Arnstein	Weideman & Femers	Smyth
Citizen power	Public participation in Final decisions	
	Public participation in assessing risks and recommending solutions	Online decision Support systems
Tokenism	Public participation in Defining interests, actors And determining agenda	Online opinion surveys
	Public participation in assessing risks and recommending solutions	Online discussion
Non-participation	Restricted participation	Communication barrier
	Informing the public	Online service delivery

Fig. 1. Arnstein's (1969) ladder applied to E-participatory environments.

up this so-called e-participation ladder enhances the degree of interactivity and participation. The bottom rung of this participation ladder represents online delivery of public services such as payment of rates and taxes. At the upper rungs of the e-participation ladder, the communication becomes bi-directional facilitating a more interactive participation through the sharing of information, proposals and feedback.

Scholars and practitioners worldwide have used the ladder typology to both *design* and *evaluate* citizen participation processes. Design and evaluation are clearly two distinct activities; the first is pro-active and normally occurs at the beginning of processes, the latter more critical and contemplative and normally occurs at the end of processes.

Tulloch and Shapiro (2003) explored possible combinations that could exist between the presence and absence of access and participation. This resulted in a simplified comparison of participation and access that allowed a quick categorisation of successful and unsuccessful projects into four types.

- The first type describes a combination of no or low level of access and no or low level of citizen participation. A good example of this could be the process of locating a military facility where access to information is limited due to security.
- The second type is characterised by a high level of access to information but a low level of citizen involvement. The traditional way of doing environmental impact assessment is a good example on this category, where huge amounts of information are supplied to the public, but effective participation of citizens is not possible because of the complexity issue.
- The third type represents a perhaps unusual situation where the level of public participation is rather high whereas the level of access to information is absent or low.
- The final category is a combination of a high level of access to information and a high degree of public participation as well. This could be the situation where a group—an NGO or similar—with sufficient expert knowledge retrieves and possibly downloads all available information and makes its own calculations on impact assessment and scenario analysis. Due to the comparatively high level of information and knowledge on both sides, the right foundation for a fruitful active public participation will be present. The taxonomy described by Tulloch and Shapiro (2003) has much more precise definitions and is therefore more suited to categorise various practical implementations of public participation in environmental decision-making than the various ladders of public participation, although it might be difficult in some cases to distinguish between high and low participation.

3. Public Participation GIS

Public Participation GIS (PPGIS) is, as the name implies, the use of the Internet and web-based GIS systems in citizen participation processes (Craig, Harris, &

Weiner, 2002). The name "Public Participation GIS" or "PPGIS" appears to have been first used in 1996 at a conference hosted by the NCGIA in Orono, Maine (Obermeyer, 1998). GIS have been around for nearly three decades, and at the simplest conceptual level, GIS is a way of abstracting geography into five basic elements: maps, geo-referenced data sets, workflow models, data models, and metadata (Dangermond, 2003). GIS continue to evolve from a "back room" elitist single purpose system running on a single machine to its current status characterised by visualisation, interoperability, versioning, and web service networks. "Doing GIS" has become an entire way of thinking and abstracting knowledge and principles about both the globe and the ways in which groups or collections of individuals manage it. Before proceeding, however, it is useful to reflect that Internet and web-based GIS are still not a fully matured technology, but for the most part, we adopt the position of "enthusiastic techno-positivist" (e.g., Carver, 2003) rather than "social critic" (e.g., Pickles, 1995) and focus on the potential for using interactive GIS to improve public participation.

Increased public involvement in the definition and analysis of questions tied to location and geography is the domain of PPGIS. This approach facilitates the meaningful introduction of appropriate forms of spatial information and related technologies for widening public participation in the planning process. As mentioned earlier, the acceptance of GIS as an appropriate technology for handling environmental information is for example recognised in Agenda 21. Many opportunities for public participation are laid down in the environmental legal framework and Internet GIS can support and facilitate citizen involvement in environmental planning and decision-making (Hansen, 2004a). It is important to avoid hearing from only the activists or the powerful elite, and in order to get the widest sweep of opinions and information, authorities must reach out into the community. Internet GIS can surmount at least partly this obstacle although the powerful elite may still dominate the chat room: the use of the Internet at least allows the more cautious and reserved citizens to express their opinions (Kingston, Carver, Evans, & Turton, 2000).

Carver (2001) has illustrated the complicated issue of public participation and geographic information through a SWOT analysis.

- Local people usually know their neighbourhood better than anyone else and they can thus provide detailed insight into local phenomena, which is not available from standard national GI data sets. In this way, incorporation of local knowledge into the decision-making process will be a major *strength*. Additionally PPGIS holds ability to visualise environmental information and communicate this information to interested stakeholders.
- The main *weakness* is related to the fact that the public generally do not possess the required knowledge to understand the generally complicated matters related to for example environmental impact assessment balancing environmental protection against mainly economic matters. Furthermore, the public does not have all the relevant information. As stated in both the Aarhus Convention and Agenda

21 the real *opportunity* for public participation lies in making the citizens more accountable for decisions made by given them more responsibility.
- The real *threats* for the participatory process are related to the antipathy against the politicians and other decision-makers. Although this is not the prevailing situation in for example the Northern Europe if we look at the participation at the general elections, we should not underestimate the potential feeling among ordinary citizens of why they should be involved if their input would simply be ignored or even worse misused or distrusted.

3.1. Interactive GIS

What is the connotation of the adjective "interactive?" Briefly, it might represent the early 21st century concept of instant gratification: plug it in, ask it a question, and get an instant response. True enough, but in the real world, interaction with the electronic knowledge system (i.e., the GIS) can occur in a number of conceptually distinct ways, each of which provides a legitimate use for the adjective "interactive." These include:

- Interacting—individually—across functions or departments. This can be either an employee of the authority or a citizen. The idea is that it is possible to peruse a large amount of data "owned" by many individual departments or functional areas. The ability to share data across units is one characteristic of an "interactive" GIS system.
- Interacting—individually—within a single data set by applying workflow models or data models, usually in pursuit of an analytical response. The ability to perform analytical tasks, such as choosing a site or combining layers of information in a land suitability analysis, within the GIS is a second, but different, characteristic of an "interactive" GIS. Here, the interaction is meant in terms of getting an "answer" to a specific problem.
- Interacting—as a group—either across functions or departments and/or in depth in an intra-agency capacity is a third characteristic example of "interactive" GIS. This typically involves use of newer web-based GIS in an intra-agency setting. Here, the focus is clearly on "intra-agency" efficiency. It is similar to the first type of interaction, but involves groups.
- Interacting—as a group—either across functions or departments and/or in depth in an environment of public access up to and potentially including shared decision-making. Again, an answer is sought or a decision is created and supported.

This last version of what could be meant by "interactive GIS" has evolved, since the advent of the Internet Age (roughly post 1995), into what is now known as Public Participation GIS. Nowadays, it is generally accepted that participatory on-line systems will become a useful means of informing the public and allowing access to data and planning tools (on-line GIS) as an additional means of public participation. These will provide mechanisms for the exploration, experimentation and formula-

tion of decision alternatives by the public in future environmental planning processes and have the potential to move the public further up the participatory ladder, although we must be aware of the weaknesses and threats mentioned above.

3.2. Elements of PPGIS

There appears to be five key elements of PPGIS: (a) some meaningful *inclusion*; (b) a notion of a *PPGIS organisation*; (c) an appropriate level of *interaction*; (d) *Internet* use; and (e) *collective* efforts of the vendor, academic, and professional organisations elements (Prosperi, 2004).

- *Inclusion*. There have been attempts to update the Arnstein ladder to its e-participation analogue (Carver, 2001). The second manner in which inclusion is given priority is like the "guiding principles" developed by Aberley and Sieber (2003) that appear on the home page of URISA PPGIS Conference web site (http://www.urisa.org/ppgis.htm). The notion of inclusion is basic to democratic participation; but governments cannot force individuals to become involved. What they can do is to provide as much information accessible as possible. On the other hand, government may or may not want to undertake specific projects that are better initiated by individuals or groups of individuals.
- *PPGIS organisation*. The design and implementation of a Public Participation GIS framework is an evident action taken by some organisation or agency. There is recognition that PPGIS involves elements of organisational design and change, and Tulloch and Shapiro (2003) encourages treating PPGIS as a "science" (i.e., the science of organisational design) rather than just as a *technology*. Thus, the GIS community recognises the need to go outside their own mostly technologically driven community to get help in understanding and designing GIS based citizen participation systems. Sawicki and Peterman's (2002) describe *PPGIS organisations* as those that: (a) collect demographic, administrative, environmental or other local area databases; (b) prepare the data for general use; (c) provide this information to local non-profit community-based groups at low or no cost.
- *Levels of interaction*. As in the ladder of citizen participation, GIS—interactive or participatory—are built with certain capabilities. At a very gross level of abstraction, these capabilities vary roughly from Viewing → Analysis → Support for Decision-Making. Viewing is akin to passive interaction. It is like searching some travel related web site for information. The fact that the data and maps are available should not be overlooked or downplayed, but this level of interaction is at best minimal in terms of participation in a government process. Analysis involves seeking an answer—usually to a well-defined problem posed by a citizen, singularly or as a representative of a group. The third level of interaction involves some discussion about both the modelling effort being employed and/or some aggregation of preferences in an environment where group decision-making is important. Citizen participation processes are clearly more akin to the last level of interaction

than the previous two. Based on a survey from the Netherlands, Geertmann (2002) concludes that PPGIS should be both more user-friendly and transparent but also flexible and adaptable to the planning situation at hand. These obvious contradictions cannot be removed unless the developers really address the target groups in the PPGIS design process.

- *Internet use*. The open structure and architecture of the Internet provide a rather simple mechanism by which information can be released to the public at relatively low cost for as well provider (the public authority) as the consumer (the citizens). However, despite the general spread of information and communication technologies, large parts of the world remain technologically disconnected. This so-called "digital divide" threatens to cut off populations from good jobs and the chance to participate in the affairs of the broader society. Among the Nordic countries the digital divide exists but perhaps less pronounced than in other countries (Hansen, 2004a). Thus, gender does not have any significant effect on the use of the Internet, but age has more remarkable effects on the use. A more serious inequality is related to education, where Nordic persons with only primary education have Internet user rate at about 50% while academic and advanced professionals have user rates between 70% and 80% (Hansen, 2004a). One important finding is that if a person lives in a household with children he or she will be more likely to have access to computer and the Internet than those living in households without children. Thus children can be considered as the key to close the digital divide. However, solely relying on Internet based system for public participation may have to potential to strengthen the voice of younger, male, higher-income people who have more frequent access to the Internet, and thus possibly overriding the voice of the poor.
- *Collective efforts of the vendor, academic, and professional organisations*. Public participation has evolved into a separate academic research topic with its own conferences like the Public Participation GIS (PPGIS) arranged by URISA. The purpose of the PPGIS conferences is to bring together citizen activists, grass-roots organisations, GIS intermediaries, academics, and government officials from North America and around the world to discuss the current status and critical issues facing PPGIS (Craig & Ramasubramanian, 2004). Besides this, vendors like ESRI has speeded up the development of interactive Internet based GIS like the ArcIMS, thus facilitating the interactive communication between the authorities and the citizens of all kind.

4. PPGIS frameworks and some recent advances

Many public authorities at national, regional and local level around the world have already today published maps related to spatial and environmental planning on their homepages. However, some public authorities have gone further than just putting static maps on the Internet. These authorities have implemented real Internet based GIS using standard software, but in many cases these rather expensive

solutions are used only for dynamic map viewing, enabling the user to pan, zoom and change the map contents. A few authorities have really tried to utilise the power of Internet GIS in the participatory phase of environmental planning. For the most part, they are interactive GIS initiated by and maintained by government units.

4.1. The range of PPGIS possibilities

The widespread adoption of the Internet together with rapid development of software platforms for development of Internet GIS—e.g. ArcIMS and Map Server—has led to enhanced use of Internet mapping for planning purposes. Peng (2001) provides a framework of an Internet based public participation system and categorises the provided level of service based on the information content and interactivity. In Fig. 2, the level of service in a PPGIS ranges from the lowest level at the upper-left corner to the highest level at the lower-right corner. The lowest level of service only deals with information distribution, whereas the highest level of service offer the citizens a much more active role in building scenarios and suggesting alternatives. There is a clear similarity between Arnstein's ladder of public participation and Peng's framework.

To facilitate the description and analysis of the case studies a typology for PPGIS is needed. Table 1 is a matrix of PPGIS possibilities (Prosperi, 2004). On the vertical axis are functional areas of urban and regional planning, beginning with a "general" category and then focusing on more specialised areas of practice. On the horizontal axis are summary descriptors of form of participatory GIS that encapsulate the thinking of Arnstein/Carver/Smyth and Peng, and the functional capabilities of GIS. In addition to the marginal descriptors, each cell is conceptually partitioned into four "micro" cells reflecting the categorisation of "citizen" developed earlier.

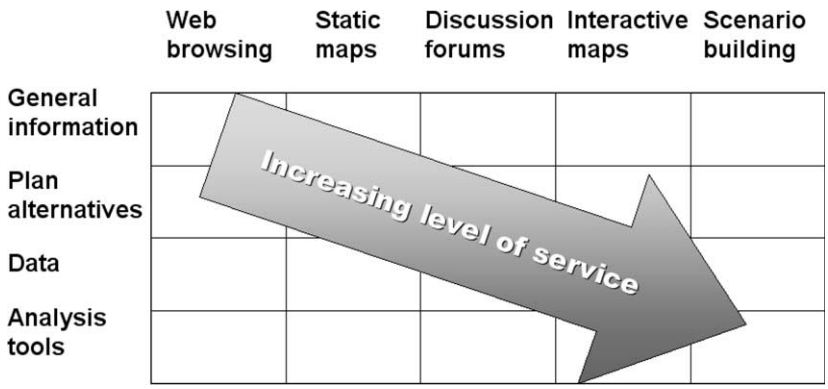

Fig. 2. Framework for web-based public participation systems (after Peng, 2001).

Table 1
The PPGIS possibility nexus (Prosperi, 2004)

Participation/function	Non-participation (viewing)	Tokenism (analysis)	Citizen power (decision-making)
General	G2G	G2G	G2G
	G2E	G2E	G2E
	G2B	G2B	G2B
	G2C: Portland	G2C: Orlando	G2C
Economic development	G2G	G2G	G2G
	G2E	G2E	G2E
	G2B	G2B: Indianapolis	G2B
	G2C	G2C	G2C
Environment	G2G	G2G	G2G
	G2E	G2E	G2E
	G2B	G2B	G2B
	G2C	G2C	G2C: Leeds
Services	G2G	G2G	G2G
	G2E	G2E	G2E
	G2B	G2B	G2B
	G2C: San Diego	G2C	G2C

4.2. Recent advances in PPGIS

Although we should forget the human aspects of PPGIS it is driven by the rapid technological development, which facilitates still more advanced possibilities of citizen participation in spatial and environmental planning. At the 2004 UDMS Conference in Chioggia, Italy, there was strong focus on PPGIS and related fields, and two papers dealing with various aspects of PPGIS are included in this issue of *Computers Environment and Urban Systems*.

Taking what they call a Public Participatory Spatial Decision Support System (PP-SDSS) Barton, Plume, and Parolin (2005) have developed a prototype aiming at public participation for the New South Wales Department of Housing. The system is based on non-proprietary international standards like XML, SVG, GML and X3D. The system is not intended to support advanced urban design functionality, but the rather simple user interface supports the input of points, lines and polygons as well as comments. Navigation through the site is linear, guiding the citizen through the various steps similar to the quite popular so-called wizards included in a wide range of software today. Although this kind of step-by-step approach is slow and even painful for the expert user, it is nevertheless important not to forget the ordinary user. A successful participation implies involvement not only by the powerful elite, but also from a broad range of citizens. However, although the technology is available important ethical aspects of public participation must be considered (Barton et al., 2005). For the detailed neighbourhood planning addressed in their system, it is of critical importance that individuals cannot be

personally identified. Furthermore, the discussion forum has potential for adding false or even malicious remarks. Trying to avoid problems concerning accountability the city council has refused to by participate in the discussion. Of course, an unhappy situation like this is not normal, and at least some experiences demonstrate a fruitful discussion between citizens, professionals and politicians (Hansen, 2004b). Therefore, this kind of anti-social behaviour must be averted by some kind of moderating facility.

The integration of GIS and multi-media will give new possibilities for public participation. Zeiner, Kienast, Derler, and Haas (2005) have developed a geo-multimedia service infrastructure enabling users to store, retrieve and share geo-referenced video. The GIS based multimedia content can provide its users with the advantage of getting additional audio-visual information for areas of interest. According to the authors, additional visual information will simplify the use of geographical information by users. Thus multiple video sequences recorded at the same location but at different times can help citizens—or other specialist users—to observe changes over time by simultaneous playback. Additionally, adding virtual reality video illustrating the future changes of the urban landscape can enhance the system. Although the concept seems promising there is a risk that only the elite will have sufficient Internet bandwidth to handle the video sequences in a proper way.

5. Concluding remarks

Improved decision-making is perhaps the most promising element in e-government, and the central idea in all decision-making is how to make the optimum solution and how to get acceptance by the citizens. The use of interactive Internet based GIS can improve the democratic foundation for the decisions taken, by involving the citizens more actively in the decision-making process. Public Participation GIS has proved to be an effective means to increase community participation in the evaluation process. Based on the level of contents and functionality a PPGIS could have various levels of service representing various levels of citizen involvement and interactivity.

There is an urgent need for a more deeply analysis of the feedback between the users in G2C connections. Most taxonomies and frameworks for Public Participation GIS can be considered as representing overall design goals, but do neglect the important issue of the citizen's capabilities as well as the user's opinion about the technologically rather advanced systems. The example from New South Wales demonstrates clearly the often-wide gap between system designers and ordinary citizens. Further developments in PPGIS research should develop greater focus on those aspects. Questions to be answered should incorporate (a) the user's age, gender and social background, (b) the user's opinion about the systems and how they use them, and (c) and finally how the user's feedback is handled by the authorities. The results will hopefully give us more insight concerning the design of PPGIS to fulfil the citizen's expectations.

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