

Post-Experiment Evaluation of the Use of Geographic Information in a Public Participatory Process

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Abstract: *This paper presents a post-experiment evaluation of a public participatory process that was conducted in a Geneva neighborhood. During the experiment, a set of geographic indicators was used to help residents express their opinions and formulate a diagnosis of the neighborhood. The evaluation is centered on a specific set of considerations that were based on observations regarding others' research using public participation and geographic information systems (PPGIS) in public participatory processes. These considerations, which provide reference points for discussion about the use of geographic information in participatory processes, focus on the following elements: access to information, level of information and decision sharing, the difference between knowledge and values, the choice and design of media and interfaces to communicate information, and the role of information. It was determined that these considerations could both facilitate a discussion of the experiment's benefits and limitations, and enable future improvements. This article demonstrates the importance of fundamental reflection on the use of geographic information in participatory processes.*

Introduction

The complexity associated with sustainable development (Ascher 1995; Hales 2000) presents a specific challenge for urban management professionals. Planners are often obliged nowadays to work with a wide variety of criteria that integrate economic, social, and environmental objectives (Healey 1997). At the same time, social demand for participation in the planning process is on the rise, and many traditional planning procedures are at a standstill because of social conflicts (Couclelis and Monmonnier 1995; Söderström and Cogato Lanza 2000).

Within this context, public participation has become a key issue in land use planning processes. Participatory approaches, which serve to open up discussion to new stakeholders with a different set of territorial issues, provide opportunities for building the consensus needed to carry out urban projects (Dente *et al.* 1998).

Several tools and methods have been developed to provide information and encourage public participation in decision-making processes (Howard 1998; Al-Kodmany 1999; Kingston and Carver 2000, Söderström and Cogato Lanza 2000; World Bank 1996). These include the use of geographic information systems (GIS), which have—by virtue of their geographic information collection, storage, analysis, and dissemination capabilities—served to introduce new perspectives. Given stakeholders' increasing need for information, applications linking public participation and GIS (PPGIS) are becoming more and more widespread (Craig *et al.* 2002).

Based on these findings, the Swiss "CITYCOOP" project, a contributor to the European COST-C9 "Processes to reach urban quality" Action, has spearheaded a research study on the use of GIS and "cartographic indicators" (defined as "cartographic

representations of specific socio-economic indicators") in participatory processes. In order to bolster reflection and facilitate tool development through the use of actual public participation, the CITYCOOP research team decided to conduct an experiment involving residents in a specific district of Geneva. This experiment has been described in detail in other publications (Nembrini *et al.* 2005; Joerin *et al.* 2005). Despite the strong impression of success overall at the conclusion of the trial, we were left wondering how this research could be adequately evaluated: What were the experiment's specific successes and failures? What improvements would be required when conducting other, similar experiments?

Essentially, this paper describes the evaluation process as it was carried out. The first component consists of a review of the literature dealing with PPGIS applications, focussing specifically on the discussion of their respective evaluations. Based on this literature review, we developed our own set of considerations, which are in turn used to evaluate and discuss our application in detail. The application itself is described briefly.

Public Participation And Geographic Information Systems

A large number of GIS based tools and methods have been developed for supporting participatory decision-making processes (Shiffer 1992; Klosterman 1999; Kingston and Carver 2000; Talen 2000; Jankowski and Nyerges 2001a, b; Craig *et al.* 2002; D'Aquino 2002). These tools have been used with different types of stakeholders and in a wide variety of social and political contexts. The result has been an equally wide-ranging diversity of approaches (Nembrini and Joerin 2002). This section summarizes the main trends (and, in some cases, illustrates them

through the use of examples) on the basis of three factors: 1) the tool's contribution to the participatory process, 2) its users, and 3) associated communication methods. We believe that these three aspects represent the main characteristics of PPGIS applications available for use in identifying similarities and differences.

Contribution to the Participatory Process

PPGIS research has led to a multiplicity of diverse uses of GIS and to numerous interpretations of its contribution to the participatory process. *Information availability* is generally the main concern. In this case, the purpose of the tool is to centralize information at a single source and to subsequently distribute it to various locations within the city or community in question. The Internet is being used more and more frequently to improve information availability (Kingston and Carver 2000). Local governments (e.g., Amherst, Poitou, and Quebec City) have set up tools that residents can use to retrieve information about their particular neighborhood or region. Other PPGIS applications focus on *interaction with participants*, which can be undertaken in one of two ways. Some research projects focus on cooperative mapping, which involves working with the participants to develop maps (Talen 2000), while others collect and integrate opinions and preferences expressed by users. Examples of this latter approach are the pilot site developed by the University of Leeds for the village of Slaithwaite (Kingston and Carver 1998) and the *Argumap* concept (Rinner 1999), which establishes interactive links between arguments and map objects.

Users

PPGIS is, by definition, designed to be used directly by the general public, especially in the case of Internet based applications. The system's tools, however, are generally too complicated to be used in group sessions without the help of an expert, sometimes also referred to as a facilitator (Talen 2000; Jankowski and Nyerges 2001b). In these cases, although the information is intended for use by the general public (who then becomes the "information user"), the tools are actually designed for use by experts who must act as mediators between the tool and the participant, and who also help interpret the information thus accessed.

Visualization and Communication

Territory visualization is a key element of participation. Consequently, some tools focus on methods of communicating information about a territory. Developers try to improve spatial perception for the user by creating improved visualization technologies. These technologies can also include video, virtual reality, or 3D (Batty 1999; CommunityViz™)—features that serve to understand territory and provide users with a better understanding of the issues concerning landscape insertion in particular. Virtual reality, video, or 3D could be applied in order to improve spatial perception capabilities. Some tools have multiple technologies working through the same interface. For instance, Shiffer (1992) proposes a *collaborative planning system* that enables the integration of ana-

lytical tools, access to information, and collective perception by incorporating graphic interfaces in various formats (images, maps, video, documents). A very different approach is presented by Al-Kodmany (1999), who proposes translating individuals' intuitions into a usable idea, working in tandem with GIS and an artist who captures and expresses the ideas, discussions, and perceptions by utilizing realistic sketches on an electronic board.

Evaluating The Use Of Geographic Information In Participatory Processes

Although the introduction of PPGIS into real planning practice is a challenge that has not been undertaken to date (Carver 2001), the use of this tool to support public participation experiments is frequently described in the current literature. Unfortunately, evaluations of these applications are rare and only a few studies deal with PPGIS capabilities. Research in this field still focusses on the tool itself, and it places emphasis on the technological aspects rather than the conceptual framework (Onsrud and Craglia 2003).

Discussions about the contribution to the participatory process are rare. Many tools are designed to provide information to the user in a unilateral manner; however, they rarely serve to canvass stakeholders for their opinions and preferences and are even less frequently used for information sharing.

As pointed out by Jankowski and Nyerges (2001b), discussions on the role and the place of spatial information in decision-making processes are generally not included. Tools are designed to do "almost everything" or "as much as possible"; in other words, they are expected to play a key role in the decision-making process and in particular to control all information exchanges between stakeholders. In reality, however, some questions remain unanswered: How would stakeholders react to this implicit hypothesis? Do they really wish to interact through the use of a computer?

One possible alternative would be to design particular tools or create functionalities that would be specifically adapted to the various phases of the decision-making process (Jankowski and Nyerges 2001a, 2003). We believe that information plays a different role in each of the two main parts of the decision-making process: 1) the problem identification component (which includes diagnosis) and 2) the actual resolution of problems (in which different scenarios are compared and sorted through [see "Role of Information in the Decision-Making Process" in the next section]). However, most of the applications focus on problem solving, in order to support the design and analysis of various alternatives, without actually placing the problem in context (Söderström and Cogato Lanza 2000).

These observations illustrate the need for improved interaction between technological means, such as GIS or PPGIS, and research on the participatory processes involved in land use planning (Forester 1994; Innes 1996; Hanna 2000). We believe this interaction should attempt, in particular, to define or specify the role of tools in decision-making processes.

Indicators for the Evaluation of PPGIS Applications

Jankowski and Nyerges (2003) have shown that applications of PPGIS are difficult to compare and evaluate, due to their diverse approaches and contexts. A specific approach may be effective in a particular situation, but may not be so in another context. Furthermore, the lack of post-experiment evaluation makes it impossible to create a learning process that could establish rules linking, for example, context and approach characteristics.

Laituri (2003) proposes a set of indicators for evaluating case studies in GIS application. These indicators place emphasis on the issue of access to information and effectively characterize an application's context. Similarly, Jankowski and Nyerges (2003) outline 25 possible "aspects," grouped under 8 "constructs," that cover the social and technical dimensions as well as the tool's characteristics and the process itself. This proposal allows for a more general definition of both context and approach. However, it focusses more on defining the research axes, identified in the interdependence of these aspects, than on proposing an application evaluation grid.

In other words, a grid has not yet been established for evaluating and making real comparisons of the applications of participatory processes, based on the use of geographic information. We believe, however, that proposing a universal grid could be too simplistic and have therefore chosen to set some considerations or design principles that would facilitate an evaluation or discussion of our application. These considerations are formulated in a relatively general manner, leading us to believe that they could be applied to other contexts.

The following considerations regarding the use of geographic information in public participatory processes were developed from the above PPGIS overview. They do not deal with the technical aspects of PPGIS, which are already extensively covered by other researchers. Instead, they focus on the role played by geographic information and tools such as GIS in the decision-making process. The next section also discusses the potential or required contributions of the tool to stakeholder interactions. The first four considerations focus on the role of information and the communication thereof, and the final one examines the role of the tool in the decision-making processes.

Considerations For The Use Of Geographic Information In Public Participatory Processes

Access to Information

Public participation in decision-making processes is gradually being recognized as a necessary condition for consensus building and as a means to reduce conflicts (Couclelis and Monmonnier 1995; Söderström and Cogato Lanza 2000; Joerin *et al.* 2001). However, the role of information in participatory processes remains largely unexamined.

Participatory decision-making processes often involve a number of negotiation phases. A stakeholder who controls access

to information during a negotiation phase can wield considerable power. For this reason, we should not ignore the possibility that various stakeholders who are involved in participatory processes might try to maintain control of some of the information in order to decide whether or not it should be used in negotiations. Notwithstanding this factor, restriction of stakeholder access to information is much less frequent today. First, most stakeholders in participatory decision-making processes are sooner or later provided with access to all types of information, even of a scientific or technological nature (Joerin *et al.* 2001). For example, most citizen groups will include an individual with the appropriate occupational skills who can help grassroots stakeholders obtain and use information that might even be very specific in nature (Dente *et al.* 1998). Furthermore, the fundamental goal of public participatory processes should be to ensure the local stakeholders take ownership of the project and accept the final decision. A project will not achieve this goal if some of the stakeholders do not possess all of the information required or do not receive it in a timely fashion. It may be unrealistic to hope that every stakeholder will put all of their information on the table at the beginning of a "real" public participatory process; however, each party should at least have access to all essential information.

Access to information must be considered not only at the administrative or legal level, but also—and perhaps particularly—at the cognitive level. Keeping in mind the link between information and power, the use of very specific terminology or of technical maps and diagrams could serve as a means for a specific group of stakeholders (e.g., engineers or architects) to maintain control of the decision-making processes.

It is therefore logical to assume that public participation and empowerment are conditioned by information-sharing processes that allow all members of the general public—whatever their backgrounds—to understand the knowledge and apply it to the decision-making process. In this regard, we believe that information tools such as PPGIS must support this appropriation of information, because the use of this knowledge is intended to support a collective learning process.

Information and Decision Sharing

Various levels of public participation can be identified (Arnstein 1969; Kingston and Carver 1998; Schlossberg and Shuford 2003). On the ladder proposed by Kingston and Carver (1998), statutory procedures for public consultation are considered *low-level* participation, while defining the agenda and taking part in final decision making through partnerships or empowerment would represent the *highest level* of public participation.

Similarly, various levels of information sharing exist; for example, situations in which the public must collect data on its own, or is simply advised of policy decisions, are characterized as low level, whereas providing opportunities for all stakeholders to *add information* are considered high level. These various levels of information sharing have to be taken into consideration, and PPGIS project design should include opportunities for deciding on the level of participation. Another aspect of the process that

should be considered is the fact that public participation can take other forms besides the communication of information. An example would be eliciting information from local stakeholders regarding specifics such as the individual and social reference points of public space users.

Knowledge and Values

Both knowledge and values are an integral part of the decision-making process. “Knowledge” refers to facts and can be considered as more objective, whereas “values” refers to opinions and thus can be considered subjective in nature. The level of noise due to traffic in a particular district, for instance, is a fact and is measurable. For the same level of noise, experts or planners might consider the district to be quiet in comparison to other districts, but its residents might consider this level of noise to be intrusive. In this case, living in a “quiet area” is likely to be greatly valued by residents.

All stakeholders should have an opportunity to bring their knowledge and values to the process. However, integrating their points of view and values into GIS applications that serve to support participatory processes is a fairly recent development, and it remains relatively unused in practice (Jankowski 1995; Joerin *et al.* 2001).

Many research projects or participatory processes revolve around collecting residents’ knowledge of or values regarding the decision’s urban context (Weiner and Harris 1999; Kingston and Carver 2000; Després *et al.* 2003; Repetti and Prélaz-Droux 2003). An important part of the decision-making process would therefore be to establish which stakeholders should be invited to contribute their knowledge and values, and when. Furthermore, the database supporting the process should be designed to permit a clear distinction between these two types of information. Ideally, it should keep a record of the information sources for both types of data. These sources can be stakeholders (e.g., residents) or institutions (e.g., a land use planning agency).

Stakeholders, Choice of Media, and Type of Interface

The medium and the interface must be chosen keeping in mind the decision-making process they are supporting, the role of information in this process, and the users of this information, who can be different segments of the population (GIS experts, urban planners, politicians, or residents).

The media used to disseminate and exchange information can include paper, public meetings, the Internet, etc. If information is obtained through street interviews, a simple hard-copy questionnaire is often easier to use. On the other hand, the use of a computer can make some meetings more attractive and dynamic. It should be recalled, though, that computers may not always support—and in fact can restrict—discussion between stakeholders. In all cases, high technology takes up space (in the room) and time (in the process). Therefore, special attention must be paid to ensuring they bring real, tangible benefits. Furthermore, the media used for information gathering can be adapted to a greater or lesser degree to the type of stakeholder being consulted. These

methods should therefore be diversified in order to obtain an adequate representative sampling.

The issue of interface is closely related to that of computerized information communication. Similarly to the media chosen, the interface has to be adapted to the type of user. In the case of PPGIS, a clear distinction should be made between the GIS user (or mapmaker) and the information user (or map reader). When maps are used to communicate information, the user must possess some knowledge regarding both computer use and map reading and interpretation, the latter of which requires an understanding of the mapmaking process (Barkowsky and Freska 1997). Because maps are the product of a generalization process involving selection and classification, they can never be considered independently of their cultural background or the cartographer’s point of view (Monmonier 1991). Although map readability is a key concern, there is some risk involved in oversimplifying information, due to interface design constraints, for representation on a map.

PPGIS and, consequently, its interface would play different roles in processes depending on the size of the stakeholder groups. A public participatory process with a large group will obviously have to face a great diversity of skills and needs relating to information communication. If the group is not too big, training can be proposed in order to provide all participants with a common basic skill level (Weiner and Harris 1999; D’Aquino 2002; Repetti and Prélaz-Droux 2003).

Role of Information in the Decision-Making Process

Tools such as GIS, along with more comprehensive decision support systems, are all designed to offer a specific set of functionalities. The basic components include information capture (i.e., measurements or questionnaire), information storage (i.e., database management systems), and information transformation and synthesis (i.e., statistical or multicriteria analysis). Research on tool design is too often based on the following—exaggerated—hypothesis: “The more functionalities a tool contains, the more useful it will be.” We believe, however, that these tools could better contribute to decision-making processes if they were instead designed while considering the following questions: Which functionalities should or could be used? By whom? When? And for what purpose within the decision-making process? It would therefore be important to ensure the role assigned to the tool and its functionalities are a match. This role is, in our opinion, defined on the basis of the role played by information in the decision-making processes.

In order to assign the role of information in the decision-making process, reference can be made to the four phases described by Simon (1960). The first is the intelligence phase, during which stakeholders become aware of a problem (i.e., something needs to be changed or improved). During this initial phase, also called the *problem setting* phase, stakeholders express and build their motivations for change. The following phases relate to *problem solving* (Fareri 2000): a) various alternatives are devised and evaluated based on a set of criteria (design) and b) stakeholders compare and choose the best alternative available (choice). The

final phase involves detailed assessment, implementation, and post evaluation.

This linear process is the one most likely to be applied by a rational decision maker, whose focus is almost exclusively on the information available about various alternatives. Other researchers have adapted this model, attaching more importance to the psychological and cognitive aspects of decision-making processes (Festinger and Peterson 1957; March and Simon 1957; Janis and Mann 1977). Nonetheless, this breakdown into four phases is useful in considering the role of information during the process. An information tool can be developed for use during the entire decision-making process or for a particular phase. Depending on the phase to which it is assigned, it can utilize, analyze, and synthesize different types of information in a variety of ways.

Using Information In A Participatory Process: Application At The Neighborhood Level

This experiment was conducted with resident participation in the St-Jean neighborhood, in the city of Geneva. St-Jean represents a diversified urban context in terms of residence types and population. It also features a highly active participatory dynamic, one concrete illustration of which would be the civic forums open to all residents, held almost every month, for the purpose of encouraging discussions of political questions regarding the neighborhood.

The primary objective consisted of designing and implementing a process that would enable residents to develop an overview of their neighborhood, and thereafter to develop a participatory diagnosis. This concept (participatory diagnosis) is based on the hypothesis that wider participation at the diagnostic phase of the decision-making process—considered to be the problem identification phase—fosters the emergence of consensus on any decisions about the neighborhood. It complements diagnoses produced by various experts or public servants on issues such as traffic, pollution, health, and education. Residents involved in the process are given access to this information regarding their neighborhood. They can correlate it with their own knowledge and concerns about the neighborhood, in order to determine priorities. The diagnosis should help them on one hand to provide feedback on future projects regarding their territory, and on the other hand, to propose new actions for a district improvement.

With this experimental approach, our purpose was essentially to learn more about the following aspects:

- The purpose for which geographic information should be used.
- How information should be used in the different phases of the decision-making process (and which type of information).
- How participants' knowledge and values can be integrated into the process.
- How available information, whether received from official sources or provided by residents, can be combined together.

A Four-Step Process

The experiment ran from September to December of 2002, and ended with the presentation of the results at a public forum. It consisted of supporting the activities of a working group, comprised of a dozen residents, that was formed spontaneously at a public forum (in June 2002). This working group, called the Diagnosis Group, took part in the four steps of the process. Each step involved two stages. The first was a working session with the Diagnosis Group. During the second stage, a segment of the population was asked to express its opinion on the results of the working session. Following is a description of the four steps.

Step 1: Collecting concerns. The first step consisted of collecting concerns about the neighborhood's situation and its evolution. Approximately 30 concerns were expressed by the Diagnosis Group at the first working session. A questionnaire was then prepared so that residents could validate and add to these concerns. A total of 190 concerns were collected from residents encountered in cafés, the public library, or shopping centers. Most of the concerns are geographically positioned and can be located on a map.

Step 2: Defining the issues. The Diagnosis Group then defined a set of issues corresponding to all concerns in the neighborhood. Each issue synthesized several concerns relating to the same problem, and as such represented a desired state of the neighborhood and was expressed as a trend. For example, all concerns relating to the lack of parking spaces were reformulated by the *Improve parking space management* issue. The Diagnosis Group defined 16 issues.

Step 3: Assessing the issues. During this stage, our research team created cartographic indicators that could be used to support an assessment of the importance of these issues. These indicators were presented on maps using GIS running on laptop computers. Individuals consulting the cartographic indicators were able to correlate these representations, built from administrative data, with their own representations of the territory. Indicators were dedicated to spatial comparisons. They were assessed on an ordinal qualitative scale and presented in three varying geographic scales (Figure 1). Residents could evaluate the situation in their own street by comparing it with the neighborhood overall (or with the city as a whole) and thus correlate the facts—or rather, the representation thereof—with their own perceptions.

The interviews, which lasted approximately one hour each, were held at diverse meeting points in the district. Some 30 individuals were consulted. After reviewing these maps, the respondents answered a series of questions that were intended to help determine the level of priority for each issue (Figure 2).

Five questions were asked, and the information obtained was coded using the French Abaque de Régner method

Proximity to small shops - Saint-Jean

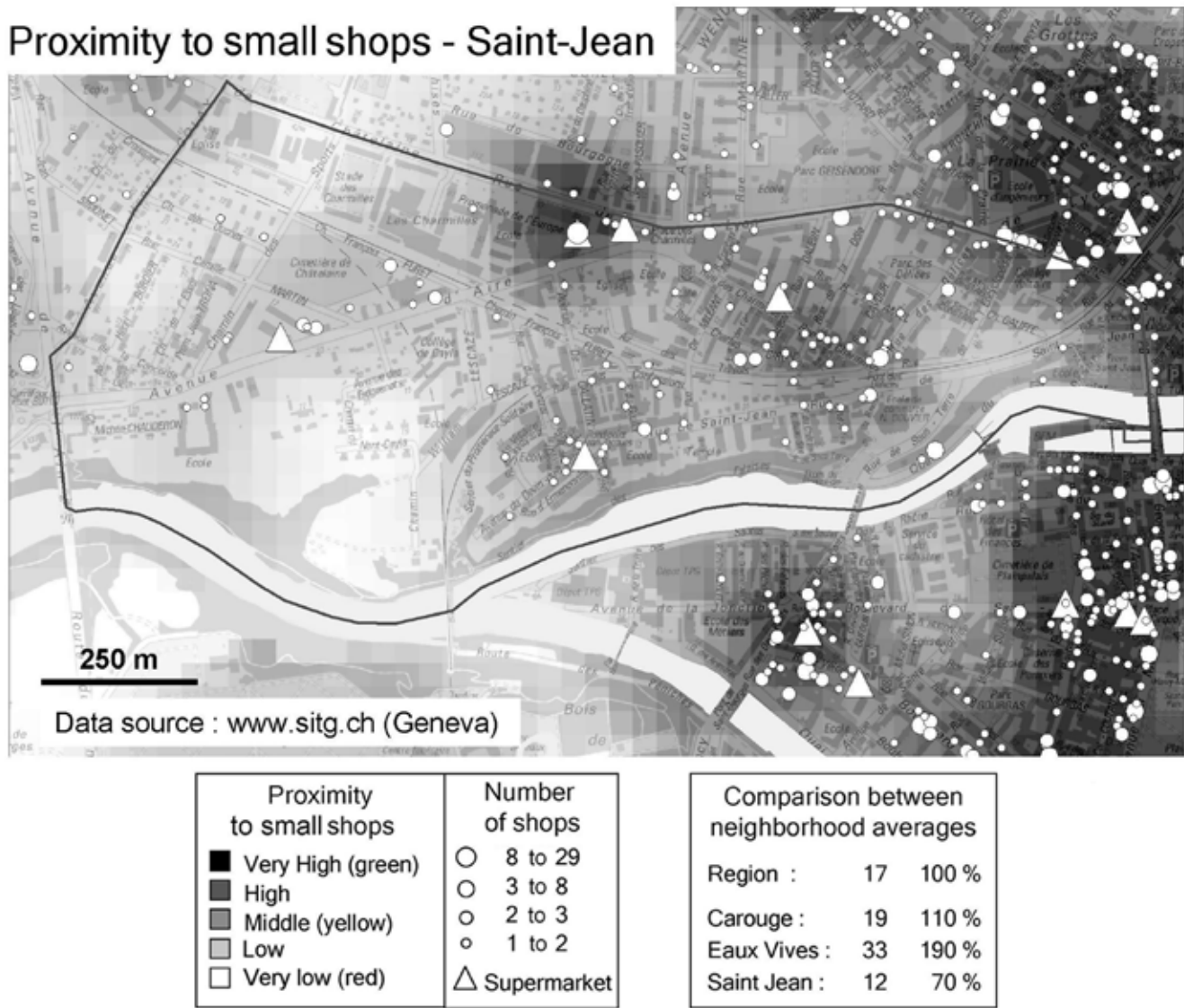


Figure 1. Cartographic Indicator: Proximity to Small Shops. This map depicts the St-Jean neighborhood (in the city of Geneva).

(Godet 2001). This process entails matching each answer (favorable or not) with a specific color in order to obtain a “mosaic” of opinions (Figure 3). This “opinion mosaic,” or “opinion landscape,” can then be used to perform a synthetic analysis of all the answers by simultaneously depicting all positions regarding a specific problem. Although the information is perceived from a global perspective, the “mosaic” depiction shows each individual viewpoint while eliminating the dilution resulting from statistical averages.

Step 4: Developing the diagnosis. In this final step, the Diagnosis Group prioritized the issues on the basis of these assessments. Two working sessions were required in order to synthesize

the opinions expressed during interviews. The Diagnosis Group prioritized the issues according to criteria such as *issues given highest priority, issues of concern to a majority, number of consulted indicators*, etc. This process served to establish the diagnosis, which was comprised of four high priority issues and three medium priority issues; the remaining issues were assigned no priority.

Analysis And Discussion Of The Application

In this section, the experiment is analyzed and discussed in light of the considerations highlighted in the section “Considerations

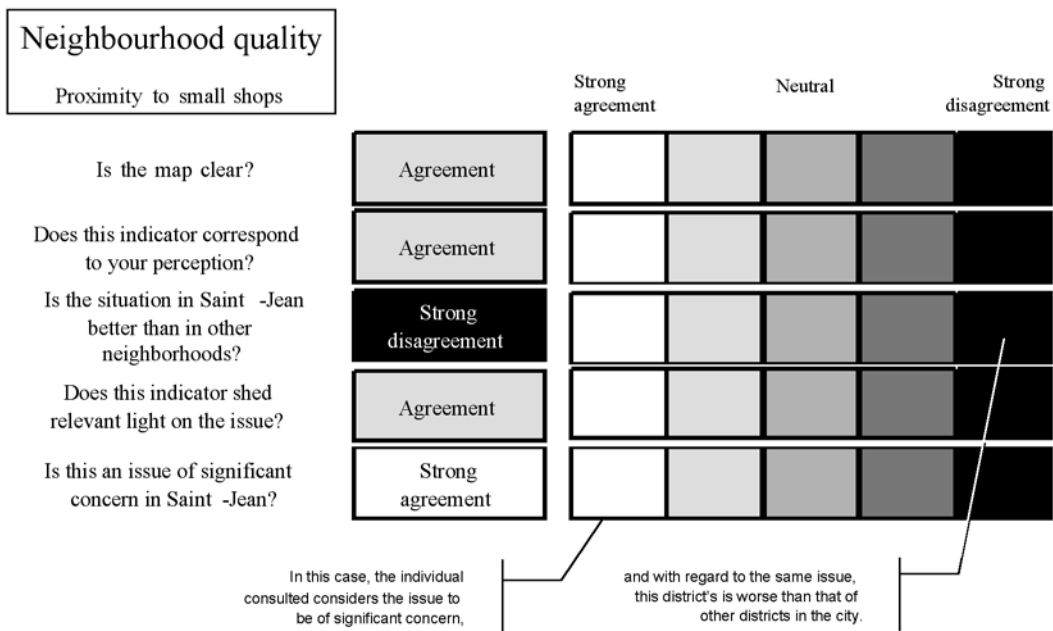


Figure 2. Question Set. Set of questions asked after review of each cartographic indicator, with interface used to collect answers.

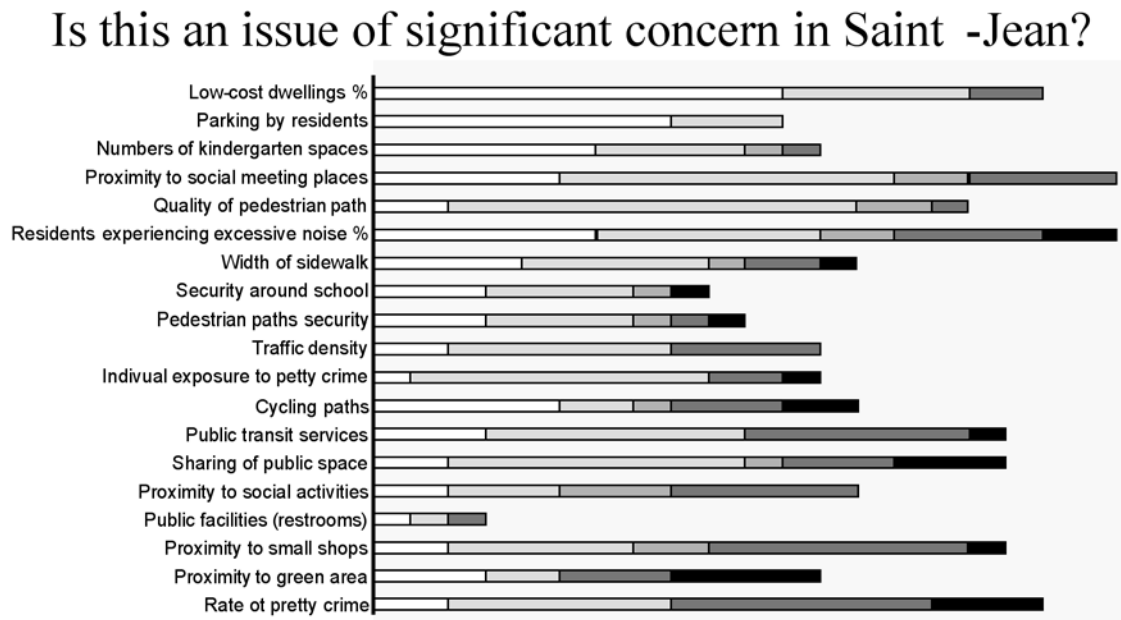


Figure 3. Opinion Mosaic. Opinion mosaic showing all answers collected for the fifth and final question (see Figure 1). Transition from white to black reflects gradations of reaction to the issue in question: white = extremely concerned, black = not at all concerned.

for the Use of Geographic Information in Public Participatory Processes.”

Access to Information

The cartographic indicators should serve as reference points during the interviews for establishing correlations between the representations built from administrative data and those created by users for the territory. For the purposes of this experiment, indicators were limited to spatial comparisons. Thus, they were assessed on a qualitative scale and presented at varying geographic scales (Figure 1).

Several questions can be asked about the significant amount of information presented using maps: Was the presentation of information in this form appropriate? Did it contribute in any real fashion to the appropriation of information? Did local stakeholders really understand these maps? Can cartographic information actually be used in the cognitive process, which should be leading to a decision?

Based on the answers to Question #1 (Is the map clear? [Figure 2]), we were able to conclude that most of the individuals consulted had no difficulty reading the maps. We also observed that the use of geographic information served to support and mediate the dialog between the different stakeholders. It also helped at times to objectify the representations of the local stakeholders and to simultaneously promote the discussion of administrative representations. Thus, we believe cartographic indicators contributed to the collective construction of a common frame of reference.

During the interview, we took care to clarify the influence of geographic information, especially maps, so that local stakeholders would be fully aware of how this information might have changed their opinions. In attempting to achieve this goal during the interviews, we attempted to point out that the maps presented were not fully objective. In particular, color choices or category definitions have resulted from a partly subjective interpretation. Despite our efforts, however, it was noted that this point was often not really understood and maps were generally perceived as an objective representation of the “reality.”

Information and Decision Sharing

Information sharing was one of the main goals of the experiment. Two major sources of information were combined: 1) the residents’ perceptions, which were expressed in the form of specific concerns and issues, and the priority level assigned by residents to each issue; and 2) the official data provided by the administrative authorities (census data, traffic and noise measurements, etc.), which were used to produce the indicators. These two sources of information were pooled together through a series of comprehensive interviews, during which the individuals consulted were asked to observe the geographic indicators before assigning a level of priority to each issue.

For the purposes of decision sharing and determining levels of participation, the research group maintained an ongoing open

discussion about the process with the Diagnosis Group. Our aim was to support each step of the process through the use of information tools, while at the same time minimizing its influence on opinion formation and on the content of the representative diagnosis in order to allow appropriation of the process and its result (the diagnosis) by the participants.

As mentioned above, however, this objective was not fully achieved. First, the indicators were defined and depicted (represented) on maps without the Diagnosis Group’s involvement. In fact, although we asked the Diagnosis Group to take part in the map development process, its members refused, mainly due to a lack of time. Second, we also assumed the role of both expert (mapmaker) and mediator during the interviews, and although we were careful to take a neutral position when presenting the maps, we did inevitably influence the interpretation and appropriation of information. We noted, for example, that when asked if the map was clear, some interviewees felt that a negative answer would imply a criticism of our map development skills.

Knowledge and Values

Some interesting findings resulted when we correlated considerations on knowledge and values with information sharing. For the purposes of our experiment, information obtained from residents was comprised mostly of values and opinions. The range of concerns that formed the starting point of the process (Step 1) was essentially subjective information. The answers given by the individuals who consulted the cartographic indicators (Step 3: Assessing the issues) also expressed values.

At the opposite, information obtained from administrative sources was mainly knowledge-based (data and measurement). For this reason, the participatory diagnosis was not a full collaborative process between the residents and the authorities. In order to be termed “collaborative,” both types of information—knowledge-based and values-based—would have been required from each of the two categories of stakeholders.

Stakeholders, Media Used, and Interface

Two groups of stakeholders were involved in two ways. On the one hand, we had the dozen residents who made up the Diagnosis Group and who stayed with us through the entire process. On the other hand, a group of residents was consulted on the positions taken by the Diagnosis Group. The media and interface used to communicate information to these two different groups have been adapted to their characteristics.

Participants in the Diagnosis Group generally had a relatively high level of education, and most were familiar with computers. Nevertheless, the use of GIS was significantly restricted during the working sessions. Our preferred method was to show a set of maps in hard-copy format or displayed using an LCD projector. Priority was placed on the discussions and social interactions. The GIS system was actually a type of “backstage” tool that was used to store, manage, and synthesize information.

The second group, the interviewees, was much less homogeneous and generally with a lesser level of education. Furthermore, its composition was different at each step. For this reason, we preferred to use a hard-copy questionnaire to record residents' concerns.

When prioritizing the issues, a laptop computer was nonetheless used for presenting the cartographic indicators. However, the interviewees did not have to handle the laptop and no real interactivity was possible. (In fact, the maps were presented with a *PowerPoint* slideshow organized with hyperlinks enabling navigation from one indicator to another). The main reason for using a computer was practical, that is, to conduct interviews as quickly as possible, but its use was also often attractive for the residents.

Role of Information in the Decision-Making Process

In conducting this experiment, we chose to work exclusively on the first phase of the decision-making process (intelligence or identification of problems). Study cases on high-conflict decision-making processes concerning land planning in Geneva (Joerin *et al.* 2002) have demonstrated the influence of this phase on conflict intensity. Our decision to work exclusively on this step would likely have strongly influenced the way information was collected, analyzed, and communicated.

As mentioned above, the main reason for using geographic information was to stimulate a cognitive process, thereby allowing for the integration of opinion building into the diagnosis. Unfortunately, the experimental setup does not allow study of this cognitive process; therefore, this point has to be discussed on the basis of our own impressions.

Our observations are different for the two groups of stakeholders, the Diagnosis Group and the interviewees. The first group had much more time for information appropriation. So when a cartographic indicator proved surprising to them, group members had time for discussions and could ask to consult the map many times during the same working session, or in different ones. We believe, in this case, geographic information actually contributed to the cognitive process. This statement is based on the fact that these particular indicators (e.g., public transport accessibility) have been chosen for inclusion in the set of high-priority issues, and some specific actions, such as a petition, have then been undertaken in order to obtain improvement.

Our impressions concerning the second group (interviewees) are almost the opposite. Although the interviews were quite long (more than one hour in duration), we generally had the feeling that the cartographic indicators did not have a real influence on the issues' prioritization. When a cartographic indicator proved surprising, the interviewee could sometimes dispute the map representation ("This map is wrong."). We also observed some interviewees who did not change their opinions, even if they recognized a contradiction between information received and accepted from the cartographic indicator. We suppose more time is needed for a cognitive process that would lead to an opinion change.

Conclusion

Our paper deals with the use of information in public participatory decision-making processes. Five considerations are presented, which focus on the following aspects: access to information, level of information and decision sharing, difference between knowledge and values, selection and design of media and interfaces for the communication of information, and applications of the information developed. We have used these considerations to discuss our own real-life experiment, which consisted of a participatory process that led to the establishment of a neighborhood-based diagnosis. Our analysis highlights the potential and limitations of the experiment, which was based essentially on the use of indicators that combine knowledge and values.

The experiment shows the feasibility of a participatory diagnosis at the very beginning of the decision-making process, for example, when the object of change has not yet been identified (problem setting). One challenge of this experiment was to convince a group of residents, already involved in their own diverse but very real conflicts, of the usefulness of a diagnostic process. Their active participation in the Diagnosis Group—on a voluntary basis—indicates to us that they were in agreement regarding its usefulness. However, the real usefulness of this local diagnosis will be seen only when residents demonstrate their complete appropriation of information, either by using it in existing groups to make progress on current issues or by creating new groups to continue the decision-making process and propose methods for taking action on the priorities they have identified. To date, two groups have been created: one to solve the parking problems and the other to improve the bus schedule (frequency). The latter group launched a petition that collected more than 1,000 signatures. Some actions have therefore been initiated, but additional time is required to assess whether this diagnosis would actually have a positive impact on efforts to resolve current conflicts with authorities.

With regard to the potential for using information, the experiment shows that geographic information can support participants' efforts to build opinions about the situation in their district and to compare it to other districts in the city.

The limitations of this experiment are related primarily to the level of influence exerted by experts and the participants' level of appropriation or involvement: Who chooses the indicators? Who builds them? Is this part of the expert's mandate or does it fall within the purview of the local population? By participating in the development of cartographic indicators, will local stakeholders arrive at a better understanding of the underlying principles, the limitations, and their possible uses? Does this participation constitute a form of empowerment that would lead to the appropriation of information? These are some of the questions that still need to be investigated.

We subscribe to the view that public participatory processes should not be based on the hypothesis that all stakeholders are experts who possess the same level of ability. Our preference is to conceive of processes that recognize different levels of ability

among stakeholders and experts, in order to assign an adequate role to each of them. This opinion is partly based on our participants' clear refusal to be involved in the map development process. On the one hand, they felt this to be too onerous, and on the other hand, they believed this responsibility should be left to the experts (ourselves). One simple rule of thumb that could be followed when splitting tasks between the expert and the stakeholders could be that complicated tasks (analysis and design, for example) would be the experts' responsibility, whereas complex questions linked to values and subjectivity would be part of the stakeholders' mandate. However, this exercise in establishing "who does what" bypasses an important question: How would experts and stakeholders work together? And more precisely: Are experts and stakeholders able to understand each other?

An interesting approach to investigate could be the introduction of mediators into public participation processes using PPGIS. This new player would have to "translate" the geographic information and convey it to the local stakeholders. Conversely, he or she would "translate" the stakeholders' comments or opinions into a structured format as required by GIS. In fact, certain types of mediators are currently quite frequently involved in public participatory processes. Their objective is to facilitate interactions between the stakeholders and public administrators (i.e., the bureaucracy). A possible new angle resulting from the use of PPGIS would be the need for these mediators to combine competency at both the technical and social levels.

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