Using Neogeography Technology to Support Participatory Spatial Planning

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March, 2010

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By

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Thesis submitted to the International Institute for Geo-information Science and Earth Observation in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation, Specialisation: (Geoinformatics)

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Abstract

Over the time, spatial planning has faced the issue of credible data collection approaches and techniques. Spatial planning typically involves multiple stakeholders. To solve any specific planning problem, those stakeholders collaborate to produce spatial data which is capable to meet demands.

Participatory Spatial Planning (PSP) partially falls within the range of spatial planning and is supported by Public Participatory GIS (PPGIS), as seen in applications of interactive participatory spatial planning. These applications provide a basis for examining the relationship between the public and experts in the context of geo-information use. PPGIS is a well connected component to PSP, if used with an adequate regard for legitimacy, ethical issues and indigenous knowledge, it can contribute to the empowerment of the public in solving spatial planning problems.

New approaches have emerged using interactive systems on the web. Experts can create digital spatial data and maps to interact with the public individually and collectively, to produce new forms of digital spatial data in what is called Volunteered Geographic Information (VGI). On the other hand, neogeography as a utilization of geographical techniques and tools for personal and the public purposes, combines techniques of cartography and GIS to be used by both experts and the public.

This research presents a conceptual framework for interactive participatory spatial planning which supports experts and public participation. The framework combines an integrated system of the different components of the process. After analysing components and relationships of the framework, the research describes an illustrative implementation using a geospatial prototype as an interactive participatory spatial planning system as a proof of concepts. Details are provided of the specific technical and structural aspects of the system.

Keywords: *Spatial Planning; Participatory spatial planning; Public Participatory GIS; Neogeography; VGI*

To all whom I love…

Acknowledgements

This thesis arose out of months of research that has been done. By that time, I have worked with a number of people whose contribution in assorted ways to the research and the making of the thesis deserved special mention. It is a pleasure to convey my gratitude to them all in my humble acknowledgement.

In the first place I would like to record my gratitude to Professor Dr. Menno-Jan Kraak for his supervision, advice, and guidance as well as giving me extraordinary experiences through out the work. His truly scientist intuition has made him as a constant oasis of ideas in science, which exceptionally inspire and enrich my growth as a researcher. I am indebted to him more than he knows.

I gratefully acknowledge Ms. Dr. Connie Blok for her advice, supervision, and crucial contribution. Her involvement with her originality has triggered and nourished my intellectual maturity that I will benefit from, for a long time to come. Above all and the most needed, she provided me unflinching encouragement and support in various ways. Ms. Connie, I am grateful in every possible way.

I also benefited by outstanding works from Mr. Barend Kobben's help with his particular skills in handling technical part of the work precisely. I appreciate you.

I convey special acknowledgement to the lecturers and staff members of Geo-Information Processing department for their indispensable efforts. I really learnt a lot from them. Every one left a special imprint which I can not forget for ever.

Many thanks go to my colleagues, GFM group for scientific discussion and the pleasure working together in the same line. As well for their advice and their willingness to share their bright thoughts with me, which were very fruitful for shaping up my ideas and research.

I was extraordinarily fortunate in having scholarship award from the World Bank Mr. Kamel Braham, Ms. Marie Grosass and Ms. Yumi Ejiri. I could never have embarked and started all of this without the award and thus opened up unknown areas to me. Thank you.

Words fail me to express my appreciation to my wife Ola where dedication, love and warm passions. She shared me as usual her brilliant thoughts. I owe for her continuous encouragement, persistent confidence in me and unlimited intelligence.

Finally, I would like to thank everybody who was important to the successful realization of thesis, as well as expressing my apology that I could not mention personally one by one.

Ahmed
Enschede, 14 February 2010

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1. Introduction

1.1. Background and problem statement

At the moment, the public worldwide participate through a formal way in spatial planning process. According to this process, the public is informed about the intentions that expert has to take action towards their living environment. Meant, that the public deal with the consequences afterward.

During this formal participation, the public have their say on the final spatial plan. Adjustment and adaptation in that stage of the made spatial plans becomes difficult for experts. The experts spend a lot of energy in softening the negative effects of the plan instead of adapting design process and improving the spatial plan itself. Therefore, to reduce spatial data collection consumed time and cost, to offer wider and faster access to required spatial data, it is required to establish a mechanism for collecting spatial data that could be available for every one.

This kind of participation mentioned above will no longer offer solutions to the public requirements. The involved, concerned and responsible public would rather prefer more participation. In this context, experts try to adapt their procedures within the spatial planning process in order to give the public the opportunity to get involved. In this way, widespread knowledge among the public is mobilised and the more important commitment to developed plans are achieved.

For this research, Volunteered Geographic Information (VGI) is defined as using of tools to capture, collect, and disseminate geographic data provided voluntarily by individuals (Goodchild, 2007). Users of VGI represent a sector within domain of the public. The volunteers as a part of the public participate by contributing their Indigenous Spatial Knowledge (ISK) in planning process. Besides, Public Participatory GIS (PPGIS) is known as interacting GIS knowledge with the public to improve spatial planning.

Due to the relationship examined between PPGIS and VGI, participants could also be seen as volunteers within spatial planning (Tulloch 2008). This can explain the movement already has been taken towards increasing opportunities for the public to participate in decision making processes regarding to design and planning projects (Seeger, 2008).

Neogeography is a utilization of geographical techniques and tools for personal and community purposes. It combines techniques of mash-ups and GIS to be used by users and web developers (Turner 2006). It can support communication mediums for this kind of participation of the public. Neogeography is the technological trend for the future.

This research focuses on an approach towards how to find a relationship between VGI and neogeograpphy within spatial planning environment. It concentrates on the following question:

How can the public through VGI participate in spatial planning with neogepgraphy support?

In the context of geo-information, considering the ideas given by above researches and their innovations in such a field, this study is motivated towards developing a facility for VGI and using neogeography to support participation in spatial planning.

1.2. Research objective

The main objective of this research is to set up and evaluate a procedure to facilitate the use of VGI to allow the public to participate in a spatial planning process and to use neogeography tools to support this process. This objective can be reached by defining the following sub-objectives:

- To formulate a conceptual framework of using neogeography and VGI to support participatory spatial planning.

- To design, implement and evaluate a prototype environment to a use case.

1.3. Research questions

- *What is neogeography?*
- *How can neogeography be used?*
- *What is Volunteered Geographic Information (VGI)?*
- *How does VGI work?*
- *What is Public Participatory GIS (PPGIS)?*
- *What is spatial planning?*
- *To what extent can VGI-facility be usable to fulfil the participation concept?*
- *To what extent can VGI-facility support the spatial planning process?*
- *What kind of geo-information is used in participation?*
- *To what extent do volunteers participate in the process of spatial planning?*
- *How can participation in spatial planning be effectuated using neogeography?*
- *How can VGI data be processed and used?*
- *What are pros and cons in the implementation of facilitated VGI in participatory spatial planning?*

1.4. Research methodology

The following phases of methodology (Figure 1.1) have been proposed to meet the objectives of the research:

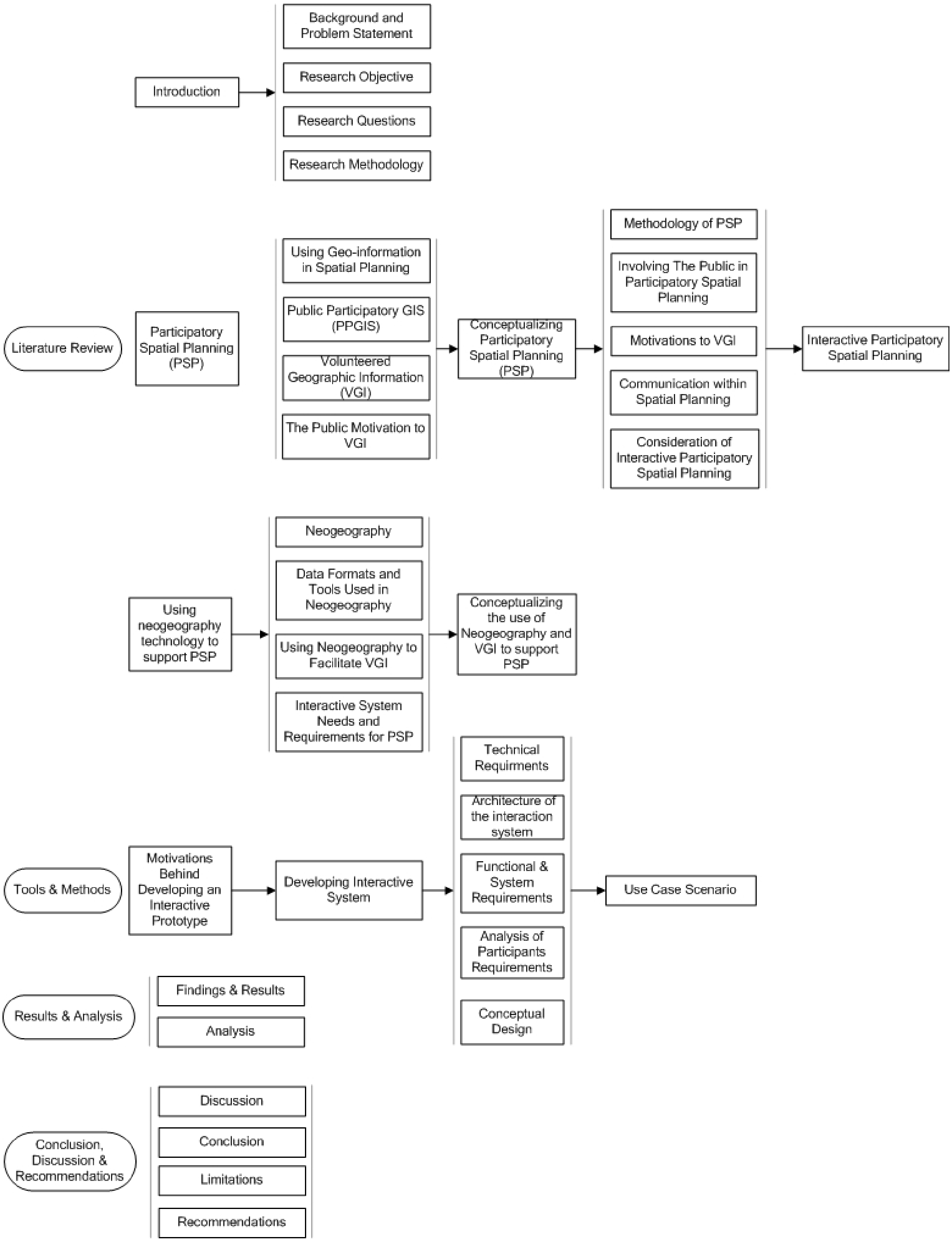


Figure 1.1: Flow chart of the research approach

2. Participatory spatial planning

2.1. Introduction

Participatory spatial planning process requires many components to reach the stage of decision-making. Participation has an important role to implement such process. To formulate the objective of the process, it will be useful to show the relationship between participation and spatial planning from many perspectives. This chapter offers a conceptualization of participatory spatial planning through reviewing related elements; spatial planning, the public participation, PPGIS, and VGI.

2.2. Spatial Planning

Understanding and dealing with spatial planning is the basis to formulate the concept of participatory spatial planning.

The Royal Town Planning Institute (RTPI's) new vision for planning defines spatial planning as '*Critical thinking about space and place as the basis for action or intervention'* while Planning Policy of RTPI statement no1 (ODPM 2005) states (Institute, R. T. P. 2007):

"Spatial Planning goes beyond traditional land use planning to bring together and integrate policies for the development and use of land with other policies and programs which influence the nature of places and how they function. That will include policies which can impact on land use, for example by influencing the demands on, or needs for, development, but which are not capable of being delivered solely or mainly through the granting or refusal of planning permission and which may be implemented by other means."

The compendium of European Spatial Planning defines spatial planning as "*methods used largely by the public sector to influence the future distribution of activities in space"* (European Commission, 1997).

Looking to the above two definitions, a difference of the context could be touched. Regarding to RTPI's definition, spatial planning could be executed practically by planners to formulate new regional spatial strategies and to create a new framework of utilizing available tools to be sure of delivering best results. Therefore, to define the principle of "Spatial Planning", there is a need to meet requirements of the best practice. This practice could be fulfilled by finding a mechanism for the public to deal voluntary with planners.

The definition of the compendium of European Spatial Planning mentions to the relationship between the public and space and how the public use can the available tools to affect that space.

So, it could be seen that each one of the above two definitions looks to "Spatial Planning" from a certain perspective. RTPI's argues the best practice of land uses while the compendium of European Spatial Planning argues how the public can affect space. The definition of the compendium of European Spatial Planning is more close to be used the participatory spatial planning. It can avoid duplication of efforts as well as it can provide the definition of "Spatial Planning" which can promote the public environment through making efficient use of space.

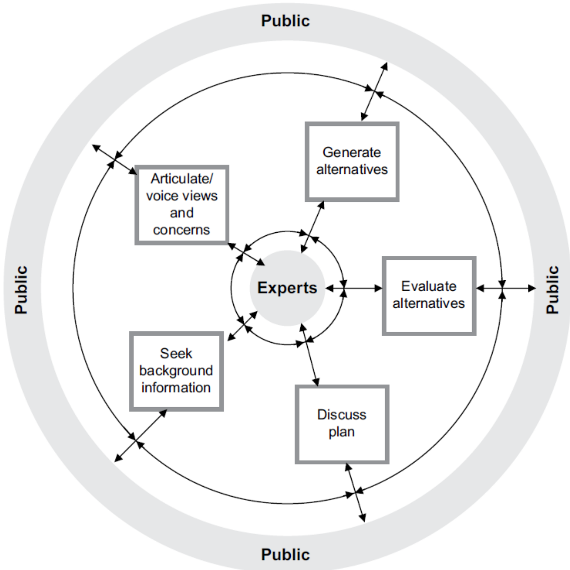


Figure 2.1: Schematic view of the spatial planning process
(Simão and Densham, 2009)

Spatial planning and decision making requires a combination of participation facilities and geographic analysis. Usually, spatial planning problems are complex and require for participants in different levels from different fields. Simão, A., P. J. Densham, et al. (2009) conceptualized spatial planning process (Figure 2.1). Five stages are identified: generate alternatives, evaluate alternatives, discuss a solution, seek background information and articulate or voice views and concerns. Due to this process, participants should pass all the five stages without a specific ranking in experiencing these stages. The straight arrows in the figure depict multiple ways in which experts and lay-persons can engage in the planning process. The circular arrows depict the interaction and interaction nature in which people engage in this planning process. Contrary to early views on planning (MacLoughlin, 1969), it is very rarely that planning process develop linearly; instead, steps forward and backward are often required to adjust the solution.

2.3. Public Participatory GIS (PPGIS)

"The term Public Participation GIS (PPGIS) was coined at the International Conference on Empowerment, Marginalization and Public Participation GIS, Santa Barbara, California, October 1998, to cover a specific geographical context (North America), and for a particular purpose - how GIS technology could support public participation for variety of possible applications. While many changes have occurred both in terms of available Geographic Information systems, technologies, and

processes, the term has rolled over without any action being taken to find a more appropriate one, better embodying the thrust and extent of the practice" (URL2).

Public Participatory GIS (PPGIS) is a practice related to land use implemented by organizations or public sectors. Hence, organization experts exert efforts to involve different marginalized categories of the public in spatial planning process.

PPGIS can be applied to help solving problems in several categories of society, and to provide broader based-placed integrated assessments. The good application of PPGIS could be fulfilled through conceptualizing partnership between individuals, groups of individuals, communities, organizations, academic institutions and private sectors. As a science, PPGIS is linked to social theories and approaches originating in planning.

In terms of Participatory Spatial Planning (PSP), PPGIS widens categories of the participants to include the public, particularly, marginalized groups. It could be seen that PPGIS still include some fuzziness and messiness regarding to participation environment and geographical information required. For instance, level of participation varies and effects the spatial data collected from the overall procedure.

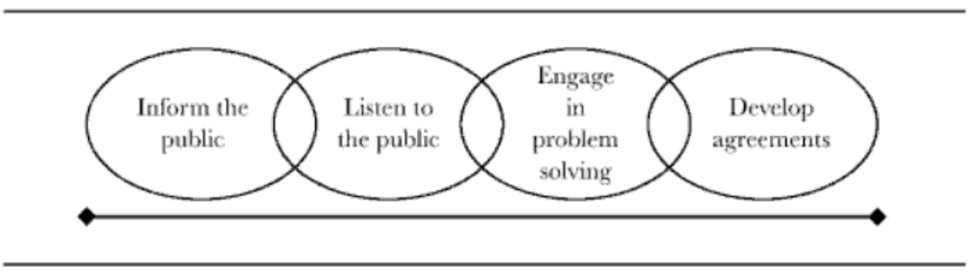


Figure 2.2: Continuum of participation (Creighton, 2005)

The best way to understand participation is by considering it as a continuum. The continuum scale for participation illustrates infinite numbers of points (Figure 2.2). Due to the scale, four categories have been chosen for the public purposes Creighton (2005):

- Inform the public
- Listen to the public
- Engage in problem solving
- Develop agreements

PPGIS can improve communication approaches from face-to-face contact to a kind of web-based interactive applications; this improvement offers easy-to-use participation and developing access to wide range of resources.

2.4. Volunteered Geographic Information (VGI)

The term Volunteered Geographic Information (VGI) is coined as a geospatial data that are voluntarily created by citizens who are untrained in the disciplines related to geography. Goodchild (2007a) and others have termed VGI as *'digital spatial data that are produced not by individuals and institutions formally charged as data producers, but rather, are created by citizens who use the tools described above to gather and disseminate their observations and geographic knowledge'.*

The notion of voluntarily contribution means that volunteers purely have to instigate the process of documentation of spatial features without prompting or invitation. Sometimes, volunteers could be categorized or selected due to specific criteria to give the required value for design team; this approach of VGI is more close to being considered as participatory planning. VGI could be expressed as that form of data resulted from allowing the public to generate their own spatial contributions through web applications which support sharing and collaboration (Seeger, 2008).

VGI emerged from the relationship between the public and Geographic information Systems (GIS). The public contributes their spatial knowledge voluntarily to experts. These volunteers who generate new spatial data represent a part of the public (Tulloch, 2008). The position of VGI compared to GIS could be described as followed; VGI strongly need GIS support as a spatial referencing system, VGI could be used as a facility for visualization and query, GIS utilize the VGI through powerful web servers, VGI and GIS together fulfil the concept of sharing database.

The public can voluntarily communicate individually and collectively through web services with experts to produce new forms of digital spatial data (Elwood S., 2008). Development of web technologies contributed somehow in formulating the meaning of VGI.

2.4.1. The Relationship between VGI and PPGIS

The concept of volunteering could be described by two frameworks; the first framework that volunteering is decided by individual's characteristics while the other one is that community decides the volunteering (Schady, 2001). VGI still has some fuzziness regarding to the fact of that VGI is a subset of PPGIS. In some cases, the volunteers participate in spatial planning process with some restrictions and conditions under specific circumstances. Fundamentally, experts have to know about those volunteers, who they are, what spatial data are expected to be provided (Tulloch, 2008). During practicing participatory GIS, participants could be misused in the wrong direction. This misusing could happen in the absence of surveillance and control.

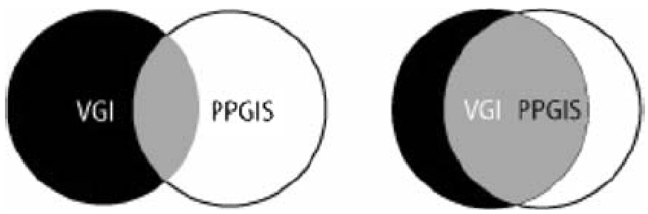


Figure 2.3: Conceptual diagram considers the variability of the overlap between VGI and PPGIS (Tulloch, 2008)

PPGIS includes a wide range of projects, while VGI served by a limited amount of projects. The product of VGI can be reflected to the public as a whole. The overlap between VGI and PPGIS appears from the notion that both of PPGIS and VGI use investigation of the locations. Furthermore, in case of PPGIS, individuals participate within access to spatial planning process, while in VGI individuals contribute their own spatial data without considering restrictions of decision management.

The relationship between VGI and PPGIS emerged from the ability of PPGIS web-based technologies developed by PPGIS to serve VGI through. To explore this relationship, Venn diagram can be used for the two fields, VGI and PPGIS. It clarifies variable overlapped areas between the two fields while it is seen that VGI doesn't completely fit in PPGIS (Figure 2.3). One of concepts understood, that VGI tends more to applications and information supplement while PPGIS seems more concerned with process and results. This relationship could be also reflected somehow on the advantages and disadvantages of the public participation. In one hand, VGI use transferred ISK to accommodate diverse perspectives of the problem, it allows the public to give better evaluation of the problem, and it uses humanitarian aspect of the public. In the other hand, VGI faces the problem of legal coverage also awareness of the public towards participation sometimes enlarged to be a big obstacle.

2.4.2. The Public Motivations to VGI

The growing interests in VGI lead to thinking about what are the motivations of the people to contribute their knowledge voluntarily. One of the reasons is that people volunteer because they are altruistic (Arrow; Becker; Rose-Ackerman), or because they are incentive-driven for doing well (Schady, 2001). People volunteer to gain a greater level of empowerment. This is often treated as specific motivation for participation (Tulloch, 2008). Even if one of driven motivation to VGI is to participate in some thing larger, it still insufficiently characterized as PPGIS. Motivation may have the range from an individual considerations like, reputation, personal learning and enjoyment, to more altruistic motives such as commitment to certain values (Kollock 1999) (Gouveia, and Fonseca, 2008).

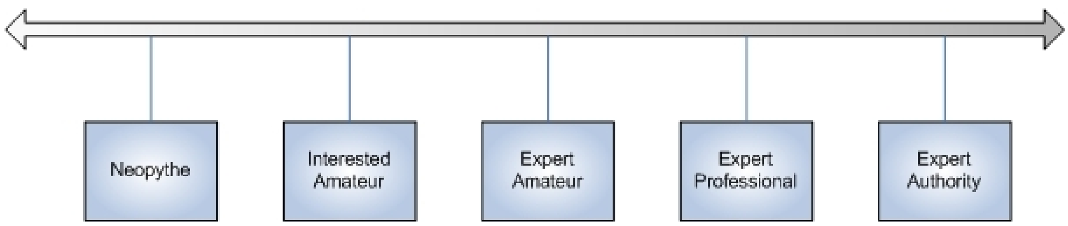


Figure 2.4: Spectrum of the contributors

Coleman, Georgiadou and Labonte (2009) referred to authors who propose that volunteered contributors are distributed over a spectrum of five categories (Figure 2.4): neophyte, interested amateur, expert amateur, expert professional, expert authority. Individual contributors also are categorized into three different contexts: Market-Driven, Social Networks and Civic/Governmental. The most of those contributors fall under categories "Expert Amateur" and "Interest Amateur", without looking to legal issues.

Another scale for characterizing contribution posed empirically by Anthony, Swartz, Ortega, and Priedhorsky, (2007) and others: Humanity, Frequency, type and degree of a contributor's edit operations. Besides, contributors go towards voluntarily contribution for the followings: altruism, professional or personal interest, intellectual stimulation, protection or enhancement of a personal investment, social reward, enhanced personal reputation, provides an outlet for creative & independent self-expression, pride of place [Anthony et al. (2005), Kuznetsov (2006) and Schroer & Hertel (2007)].

A problem could emerge because of contributors who are not reliable. These contributors may be divided into; Mischief who participates by non-legitimate, Agenda who participate according to certain agenda, the concept of volunteering doesn't exist, Malice and/or Criminal Intent of Individuals possessing malicious intent in hopes of personal gain. Therefore, assessing credibility is important to evaluate the overall reliability of the contribution. It could be noticed that anyone from everywhere can contribute by his own information. This leads to setting necessary limitations to control those kinds of volunteers and also to filtrate them if possible.

2.5. Participatory Spatial Planning (PSP)

The term "Participation" in spatial planning is subjected to the relationship between the public and authorized organization within borders of legitimacy and people's rights (McCall, 2003). Eight levels of participation could be a background to understand where does participation fall in participatory spatial planning. The ladder of citizen participation has been used by Arnstein (1969) to describe political power over citizens. It extends from citizens who have traditional power to citizens who have the power to achieve their requirements (Figure 2.5).

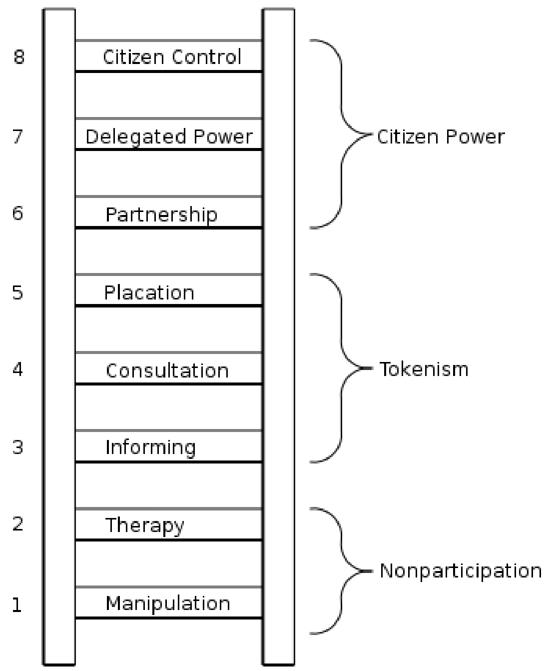


Figure 2.5: Ladder of citizen participation, Arnstein (1969)

This ladder starts from the lower rung where participation is none, to the higher rung which expresses direct participation with ability to change in decision making process. The lower levels of the ladder are described as non-participants, these participants are not able to participate in planning, but they are supposed to be receivers from other power holder participants. As rungs sequence goes towards the top of the ladder, as the topmost rungs express top managerial power which is able to influence decision making (URL3). Two levels of participation ladder are the most relevant to the interactive participatory spatial planning:

- *Informing:* Informing the public about their rights, responsibilities, and options. This is considered as a first step towards legitimate participation. This is placed as one way flow of information, from experts to the public, with no possibility to feedback. The most frequent tools used for such one-way communication are the news media, posters, meetings, e-mail etc.

- *Consultation:* More advanced than informing step towards full participation. Due to this rung of the ladder, the public can be consulted through restricted ideas. Communication becomes interactive when the public responds to a message sent by experts.

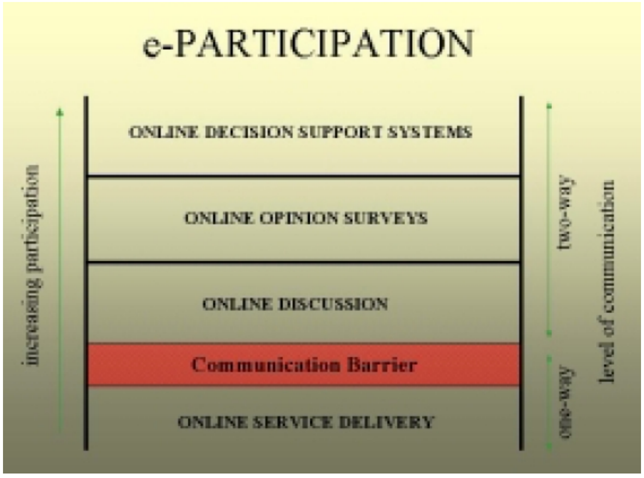


Figure 2.6: The e-participation ladder, (After smyth, 2001)

Information and Communication Technology (ICT) is the main player in evolving new forms of participation, including online discussion, web surveys and online decision support system. Together, these cases form what is called 'e-participation ladder' (Figure 2.6). The bottom rung of this ladder represents online delivery of participation services. In this case, flow of information is one-way; from expert to the public. It does not take the full advantages of the two-way communication. Further up e-participation ladder, communication with public becomes bidirectional and participation becomes more interactive.

There are several advantages offered by e-participation. By using this tool, there is no geographical location restriction. In addition, there is no restriction on this service all the time. These advantages open the opportunity to the public to participate in 'consultation' process (figure 2.4). Furthermore, using ICT in participation breaks down psychological barriers to participation process. Participants may have more perception of reflected advantages to the public (Carver, 2001). It means that dealing with participation in spatial planning leads to understanding the concept of participation levels. Four intensities of participatory spatial planning are related to participation ladder levels (McCall, 2003):

- Participatory spatial planning is a way of ‘Information Sharing’: It could be one-way or two-way communication between experts and the public. It is often based on the public needs which have to be considered in planning. These spatial data collection techniques are set by the authorized agencies.

- Participatory spatial planning as ‘Consultation’: Experts touch a problem and refer to the public, while the public have more ability to determine priorities to solve this problem.

- Participatory spatial planning as ‘Decision-making’: If the public and experts are involved, they together become more able to identify priorities, analyse status, assess alternatives, and implement.

- Participatory spatial planning as ‘Initiating Actions’: It means that independent initiatives are made by empowered local people, e.g. people are self-mobilise to perform community activities.

2.5.1. Methodology of Participatory Spatial Planning

Participation without integration of decision making process is a waste of time for both; experts and the public. A systematic way of public participation planning is set to produce fulfil the requirements of particular decision (Creighton, 2005). Three stages to develop this public participation plan (Figure 2.7). The first stage consists of decision-making context to determine in which program the public should be conducted. Through this stage, tasks would clarify the decision making process, as well as to clarify issues could be considered about the process itself. These issues may affect credibility of the public participation. Besides, to determine whether there is a need to participation or not, most of this stage is about decision making context not about the public participation itself.

Decision Analysis
• Clarify the decision being made. • Specify the planning or decision-making steps and schedule • Describe whether public participation is needed and for what purpose

↓

Process Planning
• Specify what needs to be accomplished with the public at each step of the decision-making process. • Identify the stakeholders, internal and external. • Identify techniques to use at each step in the process • Link the techniques in an integrated plan

↓

Implementation Planning
• Plan the implementation of individual public participation activities.

Figure 2.7: Stages of public participation planning (Creighton, 2005)

The second stage involves the kind of people who could participate in decision-making process. It identifies the public participation activities and checks whether these activities can be fit into the process or not. This stage of planning, which named process planning, involves a careful analysis of what to be accomplished with participants each stage. As well, it identifies the techniques which could be used for decision-making process. The last stage is implementation planning, this stage involves important details of the process.

Wien (2003) stated that, to meet the needs of participants, there are three orientated approaches to know them:

- *Decision-Oriented Approach:* The backbone of this approach is the process of choice in case of uncertainty. Identifying the uncertainty is an indicator of the knowledge of the planning environment. This is relevant to physical and socio-economical structure of that environment, and its action upon the action.

- *Action-Oriented Approach:* In this approach, planning is defined as a result of these actions, which is a part of the socio-spatial system. These actions need to be embedded in the society considering that the planning is not a critical evaluation of the spatial organization itself, but the analysis of the intentions of actions and knowledge of the participants involved in planning.

- *Search-Oriented Approach:* The aim of planning as a search for direction is not directly to prepare an operational decision given a well-defined problem, but to reveal alternatives and new solutions outside the direct scope of the observed problems. It is meant for participants to learn and become wiser (Kleefmann, 1984).

The consequences in spatial planning decision process call for involving public in planning process. This ensures that the public in the second and third stages stage of the public participations planning respond the levels ‘Informing’ and ‘Consultation’ in the participation ladder and the tow intensity of participatory spatial planning ‘Decision-Making’ (Section 2.4). Furthermore, the first two approaches are suitable to know the public needs within PSP environment; the target from the decision-oriented approach is to inform the people about future decision-making and to be familiar with process impacts. The Action-oriented approach is based upon interactions between participants.

2.5.2. Involving Participants in Spatial Planning

Spatial planning involves several kinds of participants; these participants contribute in the spatial planning process by different levels of their knowledge about a concerned problem. Individually, they participate depending on their experience. It is unlikely that individuals are able to build a comprehensive view of knowledge of the problem from all aspects. This situation generates some conflicts about perspective views of the problem as well as about the way to solve it without complete imagination to the output results (Simão, A., P. J. Densham, et al. 2009).

So, the public who are supposed to be involved in spatial planning process have to be in touch with the conceptualization of the problem space, otherwise it will be difficult for those participants to convey their thoughts to experts (Ramsey, 2009). In the same manner, the consequences in spatial planning decision process call for involving public in planning process. Therefore, collaboration between participants and experts should jointly happen to reach the optimum solution.

The involved public in a planning process have their own goals based on political, cultural and economic factors that are relevant for them. Some of these factors could limit participant’s involvement; or could marginalize some of the public; even they cause over-participation (FHWA 1996; Sipes 2002) (Wien, J., A. Otjens, et al. 2003).

There are two participation approaches can be used for involving the public in participatory spatial planning; Participatory Rural Appraisal (PRA) and Geographical Information Technologies & Systems (GIT&S) (Lamptey, 2009):

a) Tools Used in Participatory Rural Approach (PRA)

- *Oral narration:* A mean for sharing knowledge orally of events which have been happened in a location and related to the public. Information shared would be kept in minds of those were on touch with events.

- *Historical timelines:* To provide information about events related to the public exist to the location.

- *Interview:* Transferring knowledge through conversation between experts and the public.

- *Focus group discussion:* A way to know more information about a subject under discussion. In this way, people express their view of the subject.

- *Ephemeral mapping:* Participants have to draw freely by hand their spatial knowledge. The maps have been resulted from this process are temporary. These maps usually drawn on sand or floor, boards. Materials could be used are chalk, stones, etc.

- *Sketch mapping:* Items which are drawn on blank papers, posters, etc. Pencils, chalk or marker pens could be used in the drawing. Participants draw these items by themselves. Legend is used to enable interpretation of the symbol. This information on the drawing transposed on standard maps, satellite image or aerial photo to generate scale maps.

b) Tools Used in Geographic Information Technologies & Systems (GIT&S)

- *Scale mapping:* This way aims to produce geo-referenced map and to facilitate discussion. Scaling offers the possibility to deal with scaled maps.

- *Participatory 3-dimensonal modelling:* This method integrates Indigenous Spatial Knowledge (ISK) with available data to generate scaled and geo-referenced model.

- *Mobile GIS/GPS survey:* A mobile unit used friendly with GIS interface. In this way, recorded data are displayed on a geo-referenced background layers. Using GPS gives the map more accuracy through fitting known points on the ground.

- *PGIS spatial analysis:* In this process, the available spatial and non-spatial data are integrated and analysed to support discussion and decision making.

The tool which would be used depends on circumstances of for which it would be applied. PGIS spatial analysis uses the functionality and data associated with GIS technology to explore community driven questions. This tool can analyse spatial data provided by the public through VGI facility.

2.6. Interactive Participatory Spatial Planning

Spatial planning and decision making requires a combination of participation facilities and geographic analysis. Usually, spatial planning problems are complex and require for participants in different levels from different fields. GIS itself can not solve spatial planning problems, but these problems can be solved by integration with other Information and Communication Technology (ICT) tools.

Both together, give the opportunity to perform a digital platform infrastructure and to develop decision making process. (Voss, A., I. Denisovich, et al. 2004). Besides, the ability to integrate multiple perspectives in a visual spatial media has been argued by Cinderby (1999). This ability gives a powerful presentation by interesting way, enables the public to share spatial decision making with experts and arises the public awareness (Dunn, C. E. 2007). The usual approach of involving the public and experts in spatial planning process is to use traditional means for facilitating such interaction, like community discussions, workshops and hearings.

Communication has an important role within interactive participatory spatial planning process. It could be done by many ways depending on existing circumstances; cost, availability and purpose (Rambaldi, Cooperation, et al. 2006). Collaboration between experts and the public works in forms of interaction and referring to geographical objects. This interaction in spatial planning process needs two things: a map and a means of communication.

The advance of electronic communication opened new ways for interaction. These ways vary from discussing through e-mails and text files to building a website that includes a map (Simão, A., P. J. Densham, et al., 2009). The advantage of these websites is to avoid location and time restrictions.

Spatial information through using a combination of symbols facilitates interpretation of spatial data. In particular, when using a map to support a dialogue, it is important to be sure of full understanding. So, producing visualised Indigenous Spatial Knowledge (ISK) helps the public to be engaged in such dialogue and as well as it helps the public to convey their knowledge and thoughts to the expert. The interactive participatory spatial planning provides a kind of legitimacy for local knowledge and generates a sense of confidence to prepare the public to deal with the process outcomes (Rambaldi, G., C. Cooperation, et al. 2006).

2.7. Interactive Participatory Spatial Planning Needs and Requirements

Regarding interactive participatory spatial planning, there should be a service to facilitate this interaction between the two sides; experts and the public. On this line, the interaction service informs the public about problems, procedures and legislations. The internal communication used by experts should be well organized and structured as well it should be capable to deal with masses of information which should be interpreted to spatial data. Internal and external communication should be complementary and formulate a closed circle of information flow. There are three kinds of services over the interaction process (Kluskens 2000):

a) *Information and documentation service:* This service concerns about two things; to inform the public, and, to provide them by necessary documents which enrol them in the spatial planning process. The information service task is just to inform the public and lead them through certain legal procedures. The documentation service concerns about sharing information and offers the possibility to upload and download data.

b) *Geo-information service:* The geographic information systems have the possibility to deploy on the internet. Many services deal with using geo-information technologies to give the public the access to variety of forms. Web GIS as a service provides geo-information to the public. The public can get information about geometry of spatial feature, and also the thematic information related to this geometry.

c) *Reaction and discussion service:* This service offers the possibility for reaction and discussion between experts and the public. Many participants can share others discussion over the service in a structured web forum. This forum should be constructed as a HTML page as well as articles and replies to be created to these pages. The main advantage of these web-based text conferencing is that they can be deployed using standard browsers and to embed hypertext links in articles to other information.

The main consideration when building an on-line interaction facility through web map is to meet users needs. Therefore, the aim of web map is to provide these users by means of exploring and perceiving the features. In case of dynamic interaction map, there is a necessary need to fast, easy to use tool. As for other requirements, the ability to smoothly manipulate with layers, visualising features and the easy use should be mentioned.

Typical web mapping applications should include map elements as a title, legend, north arrow, scale bar and navigation tools. Besides standard tools set; for viewing object coordinates, printing and exporting maps are required.

An additional requirement is the linking of map feature data to external database, report files, or multimedia data via hyper-links. In a web mapping application, there is a possibility to have hyper-links, which could include many different forms of data.

Web mapping should include information about the procedure within interaction tools as well information for feedback. The public contribute to the web application giving a feedback to experts.

The map application viewer should be capable into existing web sites. Furthermore, web mapping application should include a Graphical User Interface (GUI) to enable users to manipulate map information and layers over the internet. These users should be able to distinguish locations and features correctly. This process of interaction should be simple and seamless.

2.8. Consideration of Interactive Participatory Spatial Planning

Nature and form of participation are critical factors in determining outcomes of the public empowerment process. Each of these factors has its serious implication for the public involvement (Arnstein 1969; Wiedermann and Fermers 1993). For instance, the issue of "scale" as an issue varies due to different communities; the required in this line is to specify a scale of analysis. Also degree of spatial precision and accuracy are required in participatory spatial planning (Minang and Rambaldi, 2004).

Usually, interaction between experts and the public is based on existing maps instead of a plan based on communication. Therefore, to mobilize the knowledge, the public should be active in determining contents of the plan. Hence, the public should participate in early stages of spatial planning. Kluskens (2000) referred to important aspects to be considered in interactive participation:

- The intentions for action towards environment of the public still originate from experts based on national, regional or local policies. Experts have to be more flexible when providing an interactive facility where the completely different intentions become thinkable. Also in next phases of the planning process an interactive facility for ideas of the public is needed.

- The local authorities are still responsible for the end product of the spatial planning process. So, the decision-making process still lies within the power of the governing body.

Te public participation can be formulated in the context of communication. The interaction process has to be more flexible where VGI has to be facilitated for the public to participate and contribute to the content of intentions and plans. The facility should include a map to ease interaction process. Besides, In order to encourage the public to participate, legal and systematic procedures have to be clear.

2.9. Conclusion

To be more close to the concept of using VGI facilities to enable the public to support participatory spatial planning, there is a need to deal with it from all its perspectives. Conceptualizing interactive participatory spatial planning is the first step to reach this objective. Through this conceptualizing, arguments have been done about approaches to involve the public, and how to this involvement could be done through facilitating interaction. Participation in spatial planning is subjected to the relationship between the public and authorized organization within borders of legitimacy and people's rights. The ladder of citizen participation has used by Arnstein (1969) to describe political power over citizens. Two levels of participation ladder are the most relevant to the interactive participatory spatial planning; 'Informing' and 'Consultation'. In term of spatial planning, four intensities of participatory spatial planning related to participation ladder levels (McCall, 2003); information sharing, consultation, decision-making, initiating. Individual participants are categorized into three different contexts: market-driven, social networks and civic/governmental. There are three stages to develop participation plan. The first stage consists of decision-making context to determine in which program the public should be conducted. The second stage involves the kind of people who could participate in decision-making process, identifies the public participation activities and checks whether these activities can be fit into the process or not. The last stage is implementation planning, this stage involves important details of the process which would be taken into consideration. Wien (2003) stated that, to meet the needs of participants, there are three orientated approaches to know them: Decision-Oriented Approach, Action-Oriented Approach and Search-Oriented Approach. The approach which would be used in participation process depends on circumstances of for which it would be applied. The first tool that could be used in this approach is Participatory Rural Approach (PRA) which includes oral narration, historical time lines, interview, focus group discussion, ephemeral mapping and sketch mapping while the second approach is Geographic Information Technologies & Systems (GIT&S): scale mapping, participatory 3-dimensional modeling, mobile GIS/GPS survey, and PPGIS spatial analysis. PGIS spatial analysis uses the functionality and data associated with GIS technology, this tool can analyse spatial data provided by the public through VGI facility. Simão, A., P. J. Densham, et al. (2009) conceptualized planning process. Five stages are identified: generate alternatives, evaluate alternatives, discuss a solution, seek background information and articulate or voice views and concerns. Due to this planning process, participants should pass all the five stages without a specific ranking in experiencing these stages. The collaboration in spatial planning process needs two things: a map and a means of communication. Advanced electronic communication varies from discussing through e-mails and text files to constructing websites including the map. In context of participation ladder, the following two levels are the most relevant to the interactive participatory spatial planning: informing and consultation. Regarding the interactive voluntary spatial planning, there should be a service to facilitate interaction between the two sides of interaction; experts and the public. On this line, the interaction service informs participants about problems, procedures and legislations. Kluskens (2000) referred to three kinds of services over the interaction process: Documentation and information service, Geo-information service and Reaction and discussion service. Some consideration to be taken, like nature and form of participation, issue of “scale” and institutionalizing PPGIS practice within local planning addition to mechanisms for ensuring protection of privacy and intellectual ownership of local knowledge.

3. Using neogeography technology to support participatory spatial planning

3.1. Introduction

Involving the public in the spatial planning process is still in need for more developed methods to be more fast, efficient and credible seeking for support decision making. Experts can facilitate involvement of the public through using digital mapping interface in term of VGI. Experts can also use neogeography to find useful spatial data. Experts match the spatial data collected from both sides. This chapter offers a concept framework to facilitate VGI and using neogeography technology to support participatory spatial planning and the possible solution through adapting available digital participation technologies.

3.2. Neogeography

The definition of the term ‘neogeography’ has been improved gradually by many authors. This definition coined as:

‘*Neogeography means “new geography” and consists of a set of techniques and tools that fall outside the realm of traditional GIS, Geographic Information Systems. Where historically a professional cartographer might use ArcGIS, talk of Mercator versus Mollweide projections, and resolve land area disputes, a neogeographer uses a mapping API like Google Maps, talks about GPX versus KML, and geotags his photos to make a map of his summer vacation. Essentially, Neogeography is about people using and creating their own maps, on their own terms and by combining elements of an existing toolset. Neogeography is about sharing location information with friends and visitors, hel ping shape context, and conveying understanding through knowledge of place.*
Lastly, neogeography is fun….’ (Turner 2006, 2-3)

Coordinates, projection, Points of Interest (POI), extents, tiles, geo-location, Global Positioning System (GPS), Geo-tag and web service, are necessary elements to be known to support the neogeography definition.

Neogeography works to bring all related technologies that cover all parts of data collection, gathering and sharing location information. Geo-location provides coordinates of a location, these coordinates transferred to other devices where they could be processed. The geo-coding also can be used to automate named location and to convert coordinates. Clearly, geo-coding is useful because of a large set of addresses and places.

Neogeography does not have specific hardware tools. Cameras, audio recorder, laptop, etc, can be used for locating, tagging, annotating and viewing created geographic features. Referring to geolocation, to determine where something is, the following data should be known: latitude, longitude, altitude, address, region, country, and named location.

3.3. Using Neogeography to Facilitate VGI

Many categories of neogeoagraphy combined information have been emerged. They are differentiated by the methods of data collection: whether they integrate data or services from other sources or they supply data back by the public.

Using the above techniques, maps can be produced; spatial data can be downloaded or generated freely from web site. Besides, open layers provide an interface to large number of mapping API's and can be used in building a digital mapping interface used as a VGI facility. To build such a mapping interface, locations should be integrated into a web site. There are many tools and techniques for integrating neogeography with a web site. Neogeography websites can be differentiated by the method are which they collect and package information. Hence, users can find geographic location using web sites. Latitude and longitude offer the advantage of positioning where is the location.

The other use of neogeography is non-mapping websites to display spatial information like Flickr. Neogeography offer the advantage to tag and georeference images with geographic coordinates, where this process is called geo-tagging.

Collaborative technologies are attributed as a networked platform which makes it easy to find, share and publish maps. A new approach had been emerged towards constructing on-line communities, with encouraging the public to interact on line. Savari et al. (2005) notes that collaborative technologies could be categorised. One of these categories is 'Peer production network' which is enabling people to work together on a specific task without monetary remuneration (Haklay, M., A. Singleton, et al., 2008). These are often used in open source development projects, where users work cooperatively. The term "volunteers" has been used to describe the participants in such a case

3.4. Concept of Using VGI and Neogeography to Support PSP

Based on the above conditions of interactive participatory spatial planning and how can be supported be neogeography, the hereunder conceptual framework has been developed to this research. It illustrates the relationship between experts, the public, VGI, Neogeography and GIS Data within the environment of participatory spatial planning over the web. The diagram illustrates that participatory spatial planning occupies a part of spatial planning environment. Communication facilities are used in the context of planning process. The work contains various steps of the methodology that could be valid for the process (Figure 3.1).

Due to the diagram, experts initially are forced to take a certain action towards the public based on rules and polices used in the area of interest and regarding to their socio-physical environment. Over the web, experts communicate with the public and inform them of their intentions. 'Informing' targets to give the public the knowledge about their rights, responsibilities, and to explain all about the participation procedure. The most frequent tools used for such a one-way communication are the news media, posters, meetings, e-mail.

The contextual part of the public participation passes through VGI. According to consultation rung of the participation ladder (Section 2.5), the public can be consulted through restricted way where the public respond to experts voluntarily. On parallel, expert uses neogeography databases looking for a related data to be used in the spatial planning process. As seen in the diagram, extracted spatial data are supplied by expert to GIS data in both cases.

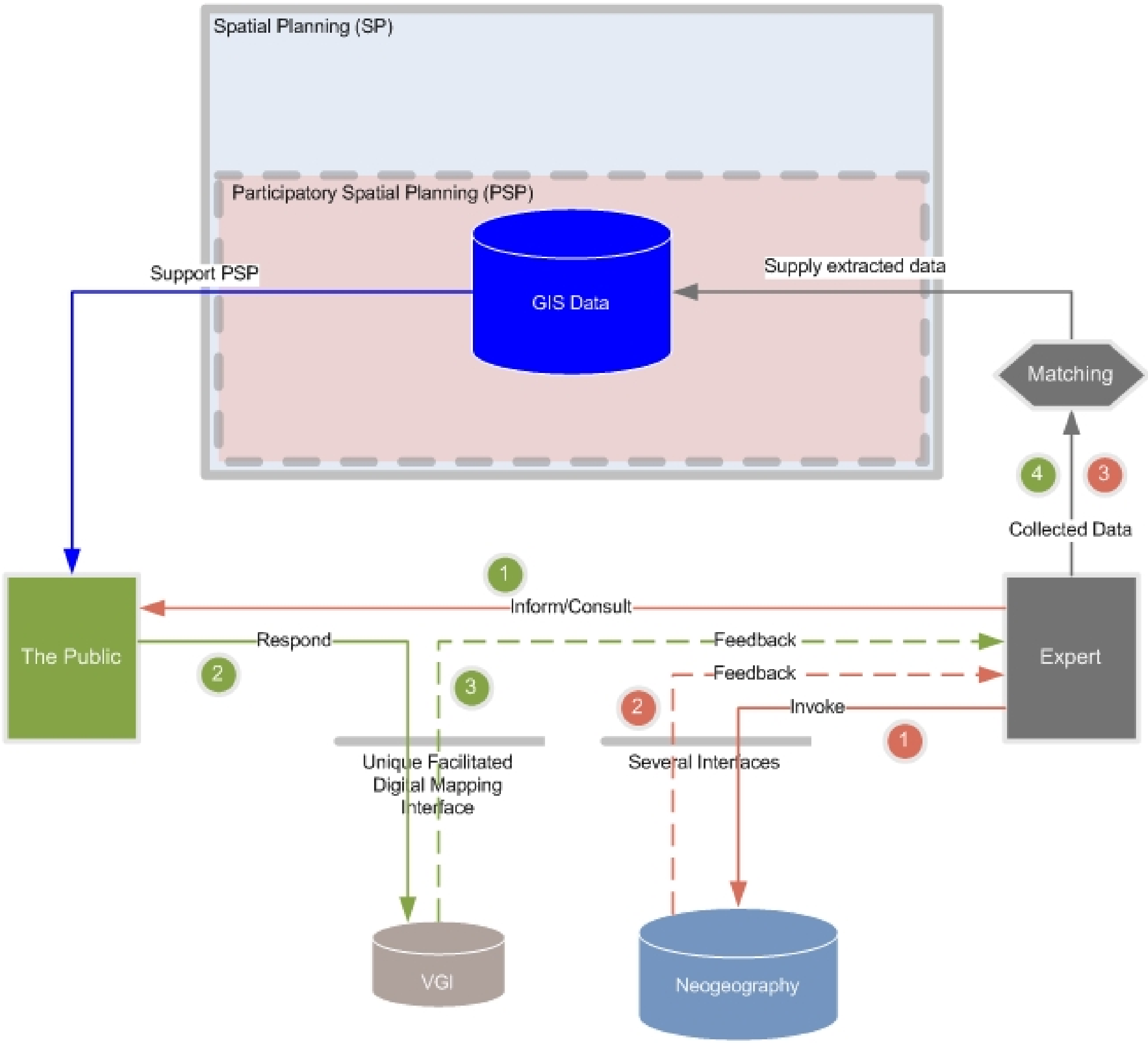


Figure 3.1: Conceptual framework of using VGI and neogeography to support participatory spatial planning

In case of using neogeography, the methodology takes the following path sequence where presented in red colour filled circles:

1) Expert invokes useful data related to the problem from neogeography database through several available interfaces.

2) A feedback link back to the expert through the same used interfaces.

3) Invoked spatial data from neogeography database is to be subjected to matching process with spatial data collected using VGI.

In case of facilitating VGI, the methodology takes a different character as the following path sequence where presented in green colour filled circles:

1) Expert informs the public seeking for a consultation, expert ask the public to participate in the spatial planning through a unique facilitated digital mapping interface.

2) The public respond to the expert by interacting with this interface.

3) A feedback link back to the expert through the digital mapping interface.

4) Collected spatial data using VGI is to be subjected to matching process with the invoked spatial data from neogeography database.

The resulted spatial data from the matching process is to be extracted and supplied as a GIS data. Finally, GIS data is to support participatory spatial planning.

It is seen that the available communication way can be used over the web. The kind of geo-information facility should meet the interaction requirements. Also, the used facility should has the functions for well displaying and navigation over the plan like zoom in, zoom out, pan. Due to the above process, the resulted data would be stored in a database. The used communication way should be capable to save spatial data to GIS data base.

3.5. Conclusion

The term neogeography passed several stages and improved gradually by many authors to reach the final definition. Neogeography uses data formats to be readable and clear. Also it does not have specific hardware tools. These tools used to obtain information could be used for geo-location. Within the social context of collaborative technologies, computer-mediated communication has enabled people to use networked computers to accomplish collaborative activities. Savari et al. (2005) note that collaborative technologies could categorised as: Self-organising mesh networks, Community computing grids, Peer production network, social mobile computing, Group-forming networks, Social software, Social accounting tools and Knowledge collective. A conceptual framework has been developed. It illustrates the relationship between experts, the public, VGI, Neogeography and GIS Data within the environment of participatory spatial planning over the web.

4. Tools and Methods

4.1. Introduction

Developing an interactive prototype map is set to proof the concept of using neogeography and VGI to support participatory spatial planning. The geographic information would be presented and communicated to the participants in such a way that they can understand the plan. In traditional ways, informing and consulting the public as explained before could be done by formal way. The public will be asked by experts to give reactions voluntarily. A case will be used for gathering geographic data and to consult the public voluntarily for using on-line interaction tool. This chapter offer the motivations behind developing an interactive prototype and the methodology used to fulfil an interactive participatory spatial planning process.

4.2. Developing an Interactive Prototype

This section describes the principles for which technical and functional requirements of process are based as well as to understand the developed prototype design and functionalities.

4.2.1. Motivations behind Developing Interactive Prototype

To prove the concept of the developed framework, online interactive system can be used as a web technology. The main goal of this system is to allow the public to generate their own spatial knowledge voluntarily via web applications and to:

- Provide on-line access to the public all the period determined for participation process.
- Provide a good performance and to be easy-to-use for participants.
- Include a customized map presenting POI's.
- Serve as a good interaction interface valid to act as a VGI facility.
- Use OGC standards and specifications and open sources.

4.2.2. Analysis of Participants Requirements

- *Goal of the interaction prototype:* To facilitate VGI by interaction between experts and the public using online interaction tools.
- *Participant needs:* Generally, the participants are interested in interaction though simple, understandable and easy-to-use prototype.

- *Participant's Information Technology (IT) profile:* The prototype will be published externally over internet. It is useful to know related findings; operating system, browser type, version, participants level of education, restrictions, level of information

- *Contents:* the prototype contents should include; short general information to the prototype and its purpose, interactive questions, a dynamic map window to display the use case area, open layers related to the subject.

4.2.3. Conceptual Design of the Developed Prototype

This conceptual design describes how to organise the work, and to take part in the evaluation and subsequent data analysis. This design is an important for experimental aspects. The following three aspects should demonstrate the prototype:

a) *Page design:* The prototype has one page. It includes subdivisions necessary to meet the user requirements.

b) *Architecture:* All prototype elements are in one main folder addition to sub-folders could be needed.

c) *Functionality:* The prototype includes one page. No need for navigation to other locations.

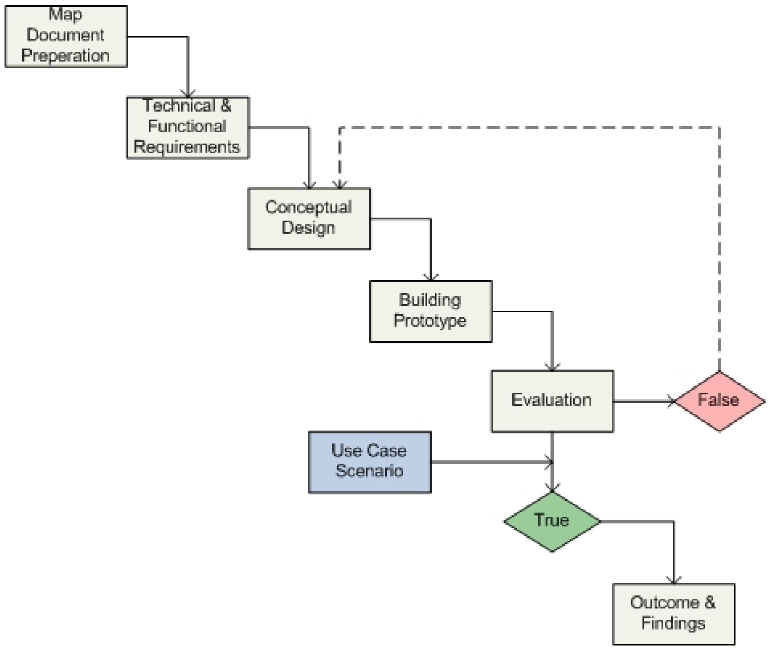


Figure 4.1: Workflow of the interactive prototype

The work starts by preparing necessary map documents. A 10cm RGB ortho image over Enschede is used to digitize shape layers (Figure 4.1). These layers would act as a dataset when establishing Open Layers. The next step is to define technical and functional requirements of the prototype. The conceptual design is to be set to meet the requirements while the prototype is to be built afterward. Evaluation has to be applied to the use case scenario where if it has been implemented successfully (True) it delivers to outcome and findings otherwise (False) it turns back to be re-designed.

4.2.4. Technical Requirements

The interactive system uses available technologies which used to build system architecture tailored to Spatial Data Infrastructure (SDI). The spatial data collected using VGI through system face probability of data error emergence where affect the Spatial Data Quality (SDQ). Also, the system architecture using OGC standards and specification is necessary to interaction procedure. Hereunder is description of these components:

- *Standards and Specification*: Standards and specifications control data transferring over the interaction system. Standards allow applications and technologies to be interoperable (OGC reference model, 2008). The process of geographic data collection, integration and sharing should be concise with OGC standards and specifications. While feeding spatial data through on-line interactive system, participants use several kinds of application and interfaces. OGC manages the interoperability specifications of processing this spatial data and information.

- *Spatial data quality (SDQ) and control:* The interactive participatory spatial planning is a process based on participation and affected by quality of resulted spatial data. Besides, experts have to regulate accessibility to spatial data using a common protocol. The ability for interaction should not be restricted to the public.

- *Interoperability:* It is needed to determine policies of operations when using web-based technologies. Rules and data traffic should be put to control which data can be accessed, by which certain participant and under which condition.

- *Spatial data infrastructure (SDI):* It is a framework of spatial data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way (Maguire and Longley 2005). The good established SDI offer a suitable environment to achieve interoperable interactive system. Using neogeography technology and VGI facility depend on a working SDI. During the process of interactive participatory spatial planning, spatial data need SDI to define policies, arrangements that facilitate the availability and the access to spatial data.

4.2.5. Architecture of the Interaction System

The architecture describes the basics of interactive participatory spatial planning. It connects the information models based on OGC standards and specifications to find, publish spatial data. This architecture is specialized to meet expected spatial data.

Previously, information and standards are defined that serve functionality components of the spatial data deployment. OGC web services utilize the Publish/Find/Bind pattern for dynamic binding between service providers and the interaction process environment (Figure 4.2) (OGC reference model, 2008).

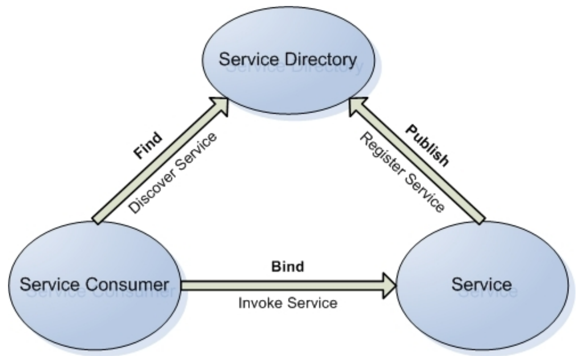


Figure 4.2: Publish/Find/Bind Pattern, (OGC, 2008)

The web simply based on the client–server architecture. It follows that using GIS over the web generally has four major components: the client, Web server with application server, map server, and data server (Figure 4.3).

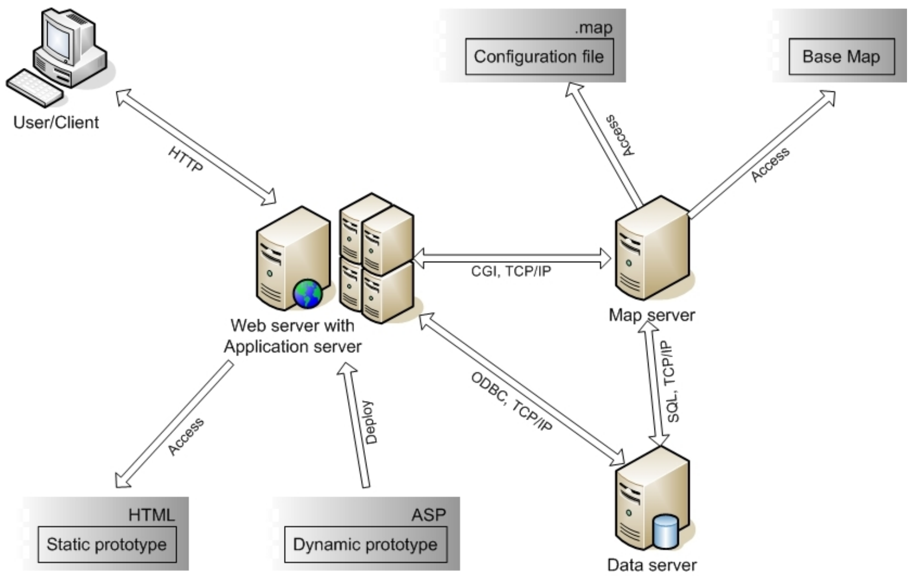


Figure 4.3: Architecture of the interaction system

a) *The client:* The client is a place for the participants to interact with spatial objects and analysis functions and conversely to present outputs. A web interface with HTML is a simple client of VGI.

b) *Web server and Application server:* This component is comprised of the web server (HTTP server) and application server. The web server major function is to respond to requests from web browsers via HTTP. The application server acts as a translator or connector between the web server and map server. The major functions of the application server include establishing, maintaining, and terminating the connection between the web server and the map server.

c) *Map Server:* The map server (Spatial server) is a major component of the system that fulfils spatial queries, conducts spatial analysis, and generates and delivers maps to the client based on the user's request.

d) *Data Server:* A data server serves many types of data; spatial and non-spatial, relational or non-relational database structure.

4.2.6. Functional and System Requirements

The system is expected to provide needed services, to be controlled by the constraints when operating, and to meet available functions and capabilities. Functional requirements capture the intended behaviour of the system and tasks the system is required to perform. The principal element of the architecture is the mapping which meets the operation of consulting the public and receiving respondent data. The mapping element has to be able to access different web services. Many issues could be faced due to the area of the interest; geographical location, language, place names. Therefore, the system should be designed to accommodate diversity, the public heterogeneity and language barriers.

a) *Web server:* There are many available web servers. The web map server used should be an Open Source (OS) platform for publishing spatial data and interactive mapping applications to the web. It should support WMS, WFS and other OGC standards. It acts as a map engine to serve maps as well participants can be able to explore geospatial data.

b) *OpenLayers (OL):* Open Source map based on Asynchronous JavaScript and XML (AJAX) viewing library used to put map tiles from any sources into any web page (http://openlayers.org). OL can be used to build general web mapping among others for OGC Web Map Services. It allows the use of many layers in the same client, coming from different sources.

c) *Firefox:* Firefox is a web development tool to edit, debug, monitor and profile JavaScript in a webpage. It measures performance, finds errors and bottlenecks in a sluggish code.

d) *ESRI Import71:* converts ARC/INFO interchange files ".e00" into ARC/INFO coverage, exports data to themes which then can be used in or ArcGIS.

e) *ArcMAP:* ESRI ArcMAP provides options to access WMS with clients who allow viewing and combining of WMS together with local data (Shape files) and related proprietary ArcIMS services.

f) *Hypertext Transfer Protocol (HTTP):* Is an application-level, generic, stateless protocol for distributed, collaborative, hyper information systems. It is used for many tasks beyond its use for hypertext, such as name servers and distributed object management systems, through extension of its request methods, error codes and headers (Fielding, R., J. Gettys, et al., 1999).

g) *Hyper Text Mark-up Language (HTML):* The description language used to create hypertext documents that can be viewed on the World Wide Web.

h) *PostGre SQL:* An object-relational database management system (ORDBMS). It is released as free and open source software.

4.3. Use Case Scenario

The use case scenario is developed as a simulation to an interactive participatory spatial planning process. This scenario is tailored to the area around ITC building, Enchede (Figure 4.4).

Figure 4.4: Location of the use case area, Source: Google Maps (http://maps.google.com)

This use case focuses on the process how to achieve the scenario by the proposed interaction system. It is also tailored to be able to achieve feedback of spatial data. Therefore, it is important to define the work flow of the interactive prototype (Figure 4.5).

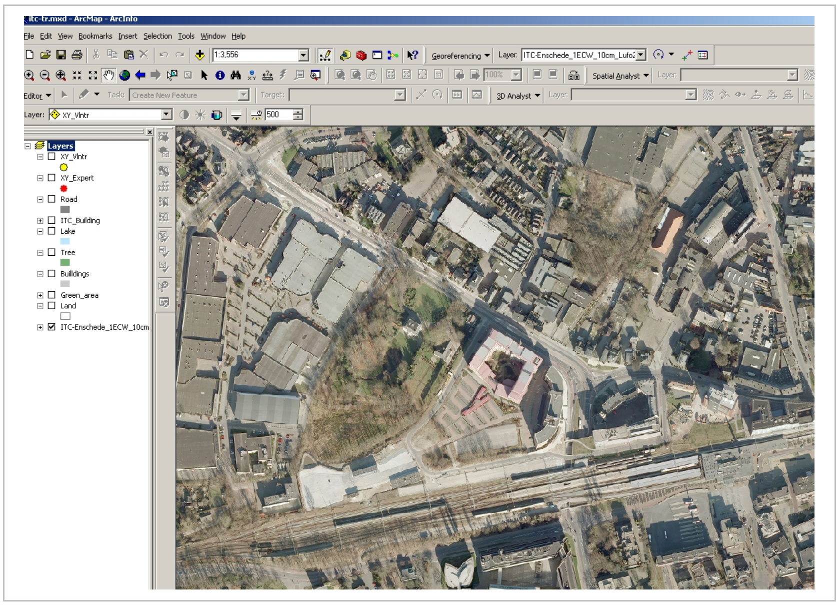


Figure 4.5: Ortho Image over Enschede (2010)

In this scenario, participants have their Indigenous Spatial Knowledge (ISK) to deal with and annotate provided maps. For this case, participants are limited to a group of individuals. This group will be asked to actively participate voluntarily in the simulation process. Those individuals participate in the use case simulation according to their indigenous knowledge. This process has to be done in a very early step towards the participatory spatial planning.

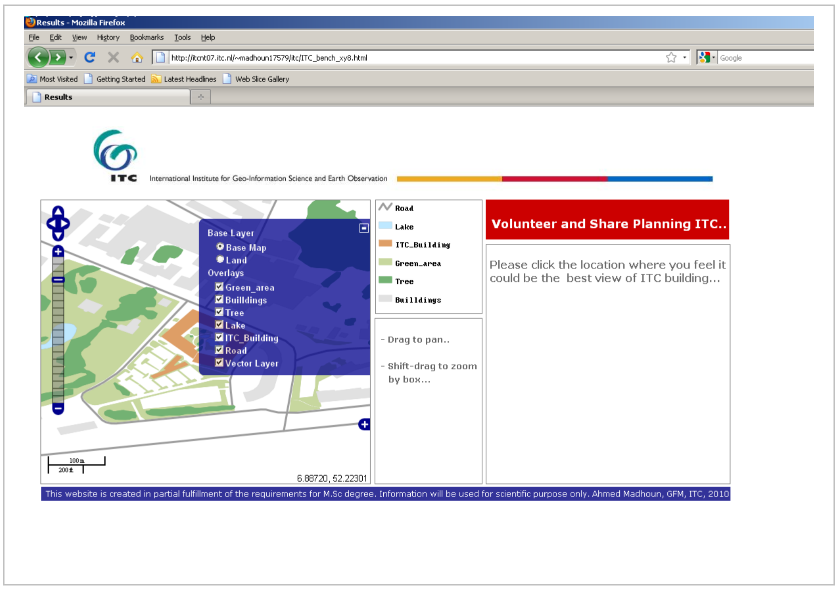
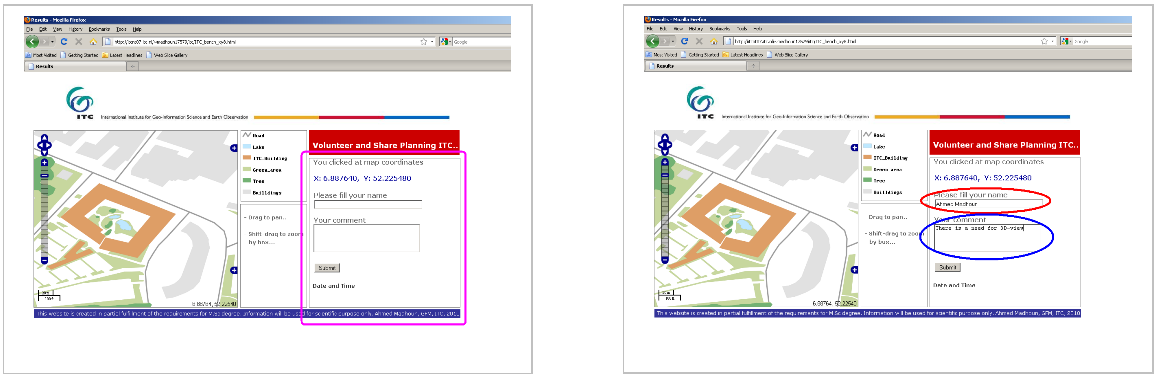


Figure 4.6: Initial participant's interface

Regarding to the use case, informing participants is done by communication over the internet via e-mail. According to this e-mail, participants use the mentioned prototype. This e-mail should be sent timely to all participants. The informed participants follow information that provided by the prototype itself (Figure 4.6). This prototype illustrates that it is restricted to scientific purposes. As mentioned, the overall procedure is simulated to a relationship between experts and the public.



(a) Participants click on a POI, coordinates appear within a form (The Pink rectangle)

(b) Participants fill his name (The red ellipse) and comment (The blue ellipse)

Figure 4.7: Participant's interface while processing

Following this case of participation, the interaction with participants is limited to “Consulting” which is one step more than “informing”. The interaction process starts by asking participants to click the spatial location they think it could be the best view of ITC building. In addition, they will be asked to voluntarily to fill certain spaces related to their personal data and comments (Figure 4.7). In parallel, experts check available open free resources looking for photos of the best views of ITC building available over the web and determine the location of where these photos were captured. The process afterward, the experts collect available points provided by the participants, checks and compares for the suggested locations by themselves. Finally, matching the reflected points to the proposed collected view captured by experts, processed and extracted to GIS data.

4.4. Conclusion

This chapter looked for the tools used in developing web service architecture for interactive participatory spatial planning and the proof-of-concept. A comprehensive overlook of the architecture of interactive system, technical functional requirements, and use case scenario of the proposed architecture are provided. The motivations behind developing this Interactive system are concluded in providing the following conditions of the prototype like: on-line access, a good performance and to be easy-to-use, a customized accessed map presents POI’s, serve as a good interaction and to use OGC standards and specifications and open sources. Technical requirements for developing interactive system include exploring standards and specifications, spatial data quality, spatial data infrastructure and interoperability. The system architecture describes the basics of interactive participatory spatial planning. It connects the information models based on OGC standards and specifications to find, publish spatial data and process client requests. OGC web services can be described, published, located, and invoked within the web environment. The web simply based on the client–server architecture. It follows that using GIS over internet generally has four major components: the client, web server with application server, map server, and data server. System requirements used include tools Web server, OpenLayers (OL), Firefox, ESRI Import71, ArcGIS, Hypertext Transfer Protocol (HTTP), Hyper Text Mark-up Language (HTML) and PostGre SQL. A use case scenario put as a concept proof for the process of interactive participatory spatial planning.

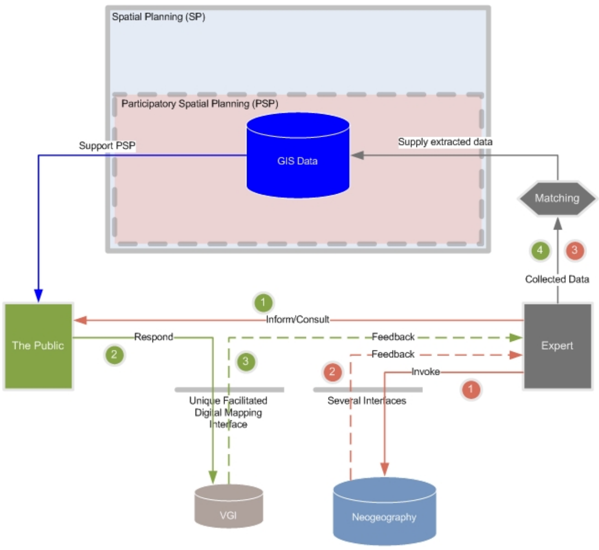
5. Results and Analysis

5.1. Introduction

In the participatory spatial planning arena, strategies may be developed depending on the results of using neogeography or VGI within interactive participatory spatial planning system. These research results could change the trend of using neogeography and VGI. Thus, the system architecture should always be flexible and dynamic to accommodate changes of the interactions approaches. This chapter looks into the results of the developed prototype, the use case scenario output and an analysis of these results. Because the system is open and interoperable, concerned experts can customize it to suits their operations. Therefore, the system can be extended and tailored to any kind of the public that is going to participate in the spatial planning process.

5.2. Findings and Results

Due to the developed conceptual framework for using neogeography and VGI to support participatory spatial planning (Figure 3.1), a simulation already implemented as a simple experiment to prove the concept based to the adopted use case scenario (Section 4.3).



Framework of using VGI and neogeography to support participatory spatial planning (Figure 3.1)

A group of 28 students from the GFM department in ITC was asked for participation in the simulation. They were informed by e-mail that ITC has the intention to fix extra benches in the ITC buildings surroundings. The informed students were asked to participate voluntarily in the process of choosing the best locations for three benches where they think it gives the best view on the ITC building.

For this purpose, participants used a certain URL link mentioned in the sent e-mail. This linked to a developed prototype already tailored for that purpose. To use the prototype, participant used the mouse to click three suggested location in the area surrounding ITC shown in the Open Layer window (Figure 4.4). A form appears in which a clicked point reflects X and Y coordinates directly. The participant is also asked to fill his name and comment in the ad hoc text areas in this form (Figure 4.5). The input spatial data and non-spatial data in one hand enabled feedback to the server; on the other hand it can be reflected and seen by the participant. The data provided can be viewed by experts.

In parallel, experts navigate over the web looking for available photos for ITC building by using open free resources like; Google maps, Panoramio, Flickr etc., The procedure is based on defining the target of the search action. In the use case, the search target is ITC as a building and as a location in Enschede. The aim of the expert is to find the best views of the ITC building that are available and hence to determine the locations where they have been captured. These locations are to be matched to the locations suggested by the participants and together processed and used in the planning.

The designed prototype is deployed using open source software running at ITC server and linked to external networks. Using OpenLayers and map server provides the ability to transfer data stored and to integrate existing Internet Applications used for the process. Also, the elements date and time are incorporated in the system to show the exact date and time of the captured data at both server and client sides to accommodate geographic location time differences of the participants.

The results come from testing the prototype by the students. Those students are familiar with the used technologies and experienced with difficulties could happen during the test. These results show the outcome from running the developed prototype of the use case scenario. Due to the functional and system requirements adopted in chapter 4 addition to the interaction approach, the results show that the public can communicate with experts via a web interface and contribute their indigenous knowledge.

The output proves that bidirectional interaction between experts and the public could be done within the environment of participatory spatial planning. The provided prototype form caters the needs of participatory spatial planning to include a wide range of the public. This system allows feedback of spatial and non-spatial data.

Before Submission **After submission**

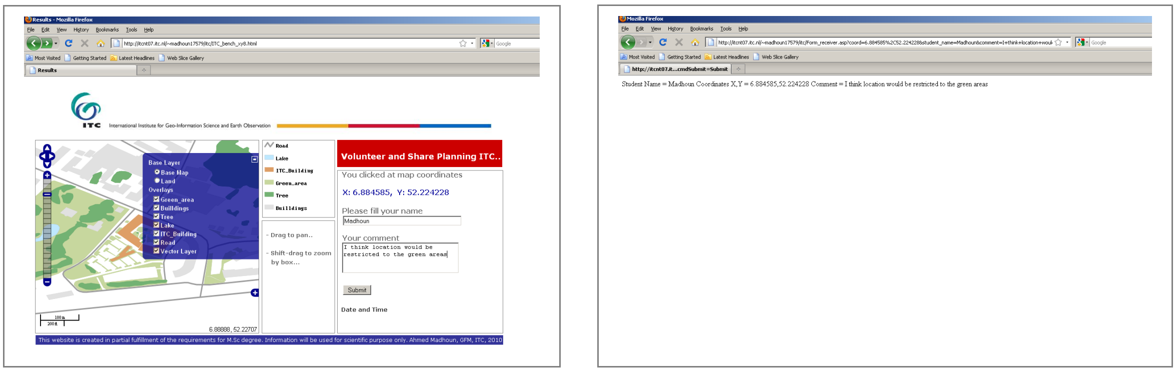


Figure 5.1: Prototype shown to the participant before and after submission

Several tools and applications used to develop the system. OpenLayers is used for making it easy to put dynamic maps in any web page. Utilised JavaScript, HTML and AJAX are used for building VGI-based system, and to transform spatial and non-spatial data into spatial planning applications (Appendix A). The ITC dataset acts as overlay layers on the top of Metacarta online base map where participants can switch on and off layers using a check box list. This dataset is fitted on top of the base layer (Figure 5.1). Other added controls are included in the Open Layer window; for example, pan, zoom, zoom to full extent and coordinate reader. Legend and more tools such as scale bar are also available.

The followings have been implemented in order to evaluate the performance of interaction system. The analysis of prototype shows the followings:

- The prototype used HTML and JavaScript formats with map service include the use case area.
- The prototype provides a good performance; zooming, panning to enable well viewing.
- The overview map of the web mapping application has been set.
- Layers set has been limited to required fields for participants and appropriate names. Layers also are management-enabled.
- The prototype is designed to meet fitness-to-use to all user levels.
- The prototype supports the repetitive spatial locating process.
- Each one of the participants can work individually. Participants put their own contribution without knowing about other participant's perspectives.

The system includes a database infrastructure the prototype is connected to a database created to receive the feedback spatial data using PostGreSQL installed on the server side. A form is designed allows feedback where the participant can click points of interests and submit the data through the form to be stored in the database (Figure 5.2). This form is designed to be easy-to-use and done using Active Server Pages (ASP).

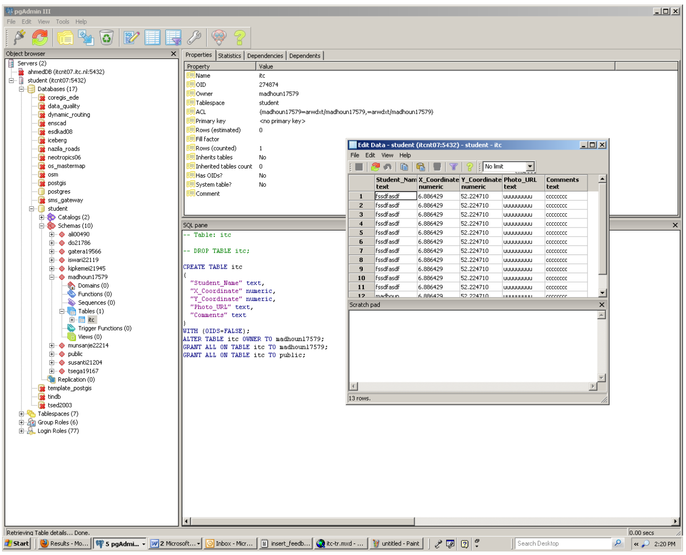


Figure 5.2: Proposed responses using PostGreSQL Database

Analysis of the reflected results from the 28 informed students who are asked for consultation show that 18 of those students responded directly to this consultation while 10 students didn't respond. The anticipated number of points to be collected is 84 while the actual number provided is 53 (Table 5.1).

Number of Approached Participants	28
Expected Response Points	84
Actual Response Points	53
Not-Response Points	27
Number of Response Participants	18
Number of Non-Response Participants	10

Table 5.1: Analysis of collected points

Figure 5.3 shows the expert view illustrating 53 submitted points which are processed as symbolized survey results (Yellow circles) on ArcMAP interface using digitized layers as a background. The web searching procedure has been done using the text “ITC Enschede” as shown in red rectangles (Figure 5.4). This is to find the best views of ITC building as shown in red circles. The selection is done manually upon judgement of the expert.

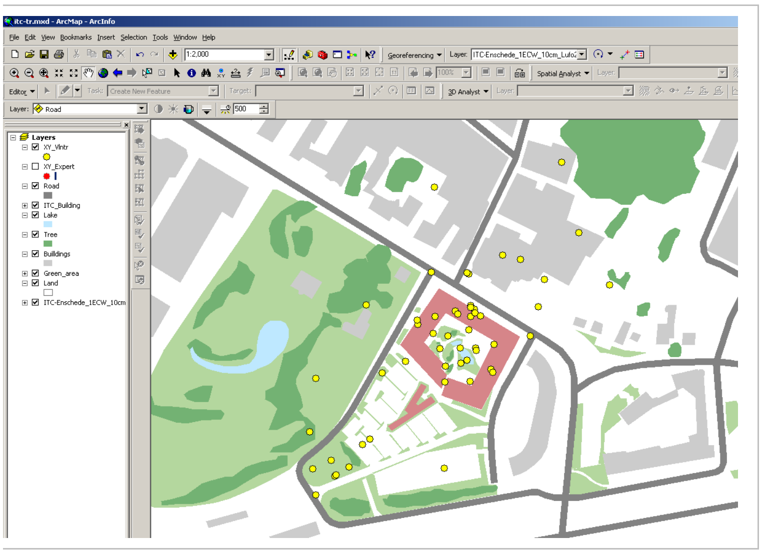
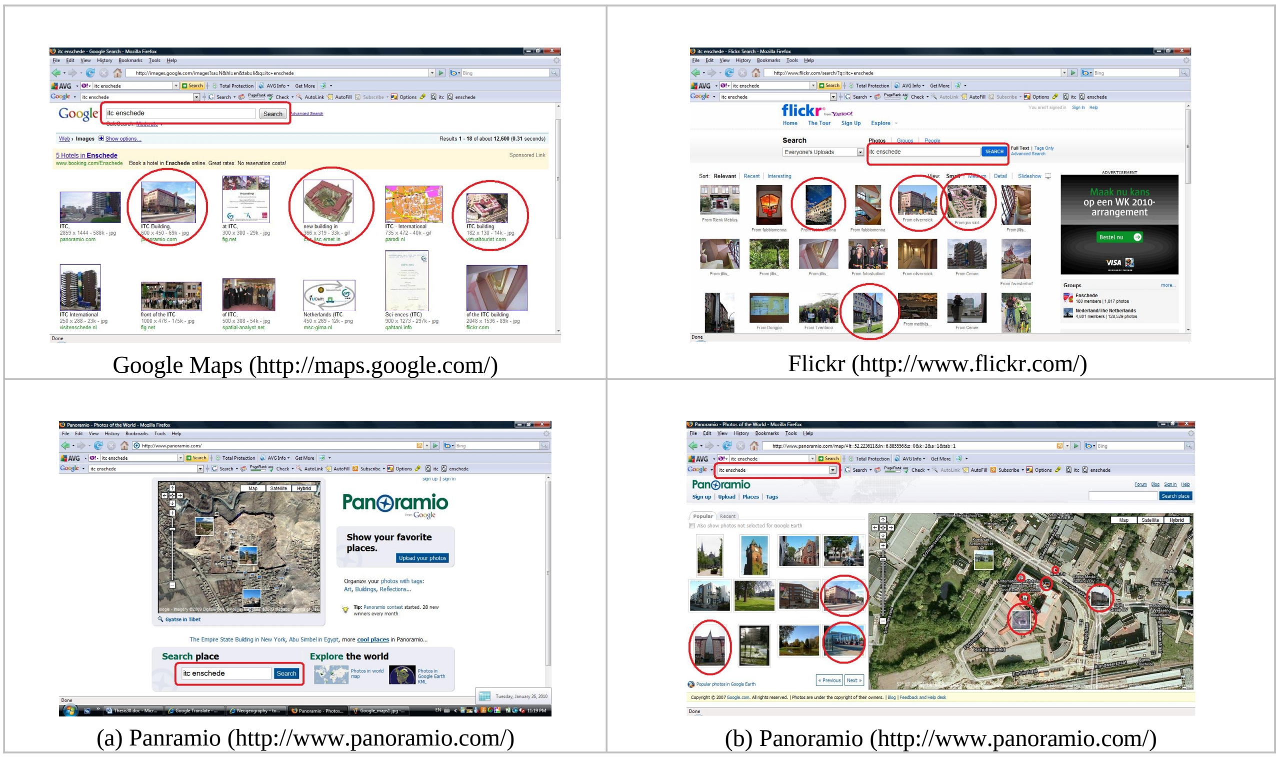


Figure 5.3: Expert view showing location of 53 submitted points

The operation has been run on rich and usable web sites; Google maps, Panoramio and Flickr. Due to experts judgement, time and efforts consideration and validity of the chosen photos, the operation resulted 25 photos could be seen as the best view ITC building-related posted over the web (Appendix D).



Google Maps (http://maps.google.com/)

Flickr (http://www.flickr.com/)

(a) Panramio (http://www.panoramio.com/)

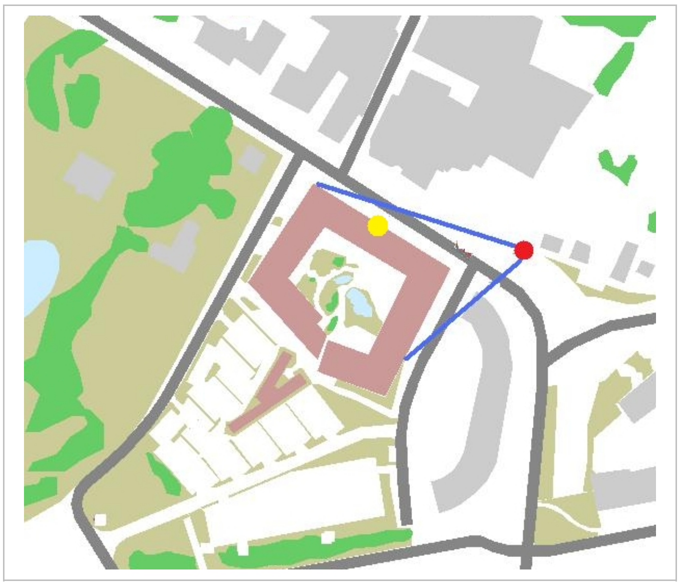
(b) Panoramio (http://www.panoramio.com/)

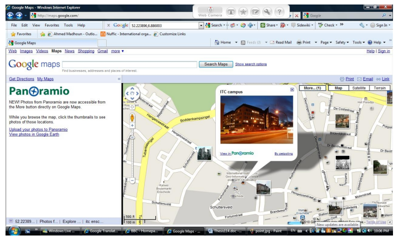
Figure 5.4: Results of searching “ITC Enschede” using Google Maps (Top left), Flickr (Top Right) and Panoramio a & b (Bottom).

These results of searching could be extended to hundreds or thousand regarding to the case used, table 5.2 shows a sample of photos of the best views has been chosen of the ITC building posted on the web. These photos are matched to their geo-referenced spatial locations (Appendix D). Geo-referencing of the photos is still in a need to improved technologies like camera provided by GPS. The capturing location of the posted photo on the used interfaces is not compatible with the viewed photo. Therefore, it is necessary to provide coordinates with the posted photo (Figure5.5).

Google Maps	 http://images.google.com/imgres?imgurl=http://www.panoramio.com/photos/original/3770207.jpg&imgrefurl=http://www.panoramio.com/photo/3770207&usg=__YTHJiqk0bF_Aigp-wAMtz-13ksU=&h=450&w=600&sz=69&hl=en&start=2&sig2=NQAWS0cl2tmkcCyGMDD3PQ&tbnid=RqzX9WEQNcLEmM:&tbnh=101&tbnw=135&prev=/images%3Fq%3Ditc%2Benschede%26hl%3Den%26sa%3DN&ei=l-1iS5PRLcLH-Qai0uDFBw	 http://images.google.com/imgres?imgurl=http://www.itc.nl/Images/Organisation/Building%2520back%2520by%2520Gerard%2520Kuster.png&imgrefurl=http://www.itc.nl/Pub/organisation/Contact-information/Address&usg=__gm4dclwlUfshkrbLceNjrs3DCYM=&h=266&w=438&sz=258&hl=en&start=83&sig2=X-9vNywvkWmkit-3z56L-g&tbnid=Xryxpr4hDQJdOM:&tbnh=77&tbnw=127&prev=/images%3Fq%3Ditc%2Benschede%26ndsp%3D18%26hl%3Den%26sa%3DN%26start%3D72&ei=le5iS72eEtLK-QaUuemxBw	 http://images.google.com/imgres?imgurl=http://www.itc.nl/issdq2007/Images/ITC%2520building.jpg&imgrefurl=http://www.itc.nl/issdq2007/venue.aspx&usg=__eWQOPoTsybGtvgppY_w20AlFj1g=&h=235&w=180&sz=20&hl=en&start=31&sig2=EN3oYqGaAcBHfHe7H2RhxQ&tbnid=usgg98lckJzC_M:&tbnh=109&tbnw=83&prev=/images%3Fq%3Ditc%2Benschede%26ndsp%3D18%26hl%3Den%26sa%3DN%26start%3D18&ei=Pe9iS8CNJJHj-Qbp3ey-Bw
Flickr	 http://www.flickr.com/photos/46323759@N00/186251254/	 http://www.flickr.com/photos/rollsroick/242595335/	 http://www.flickr.com/photos/dongpo/1522445867/
Panoramio	 http://www.panoramio.com/photo/377027	 http://www.panoramio.com/photo/3309381	 http://www.panoramio.com/photo/3309380

Table 5.2: Sample of the selected best views by expert for ITC building using Google Maps (Top), Flickr (Middle) and Panoramio (Bottom).





Posted photo (Yellow point)
Source: http://maps.google.com/

Posted photo coordinates (Yellow point): 6.886003, 52.223896
Photo capturing location coordinates (Red point): 6.887723, 52.225413

Photo Capturing location coordinates (Red point)

Figure 5.5: Illustration of photo geo-referencing problem

Figure 5.6 show the expert view illustrating 25 points express locations of photos capturing (Appendix D). These points added as XY coordinates using ArcMAP software to the digitized map layers. These points are processed as symbolized survey (Red circles) considering the same background used for the prototype.

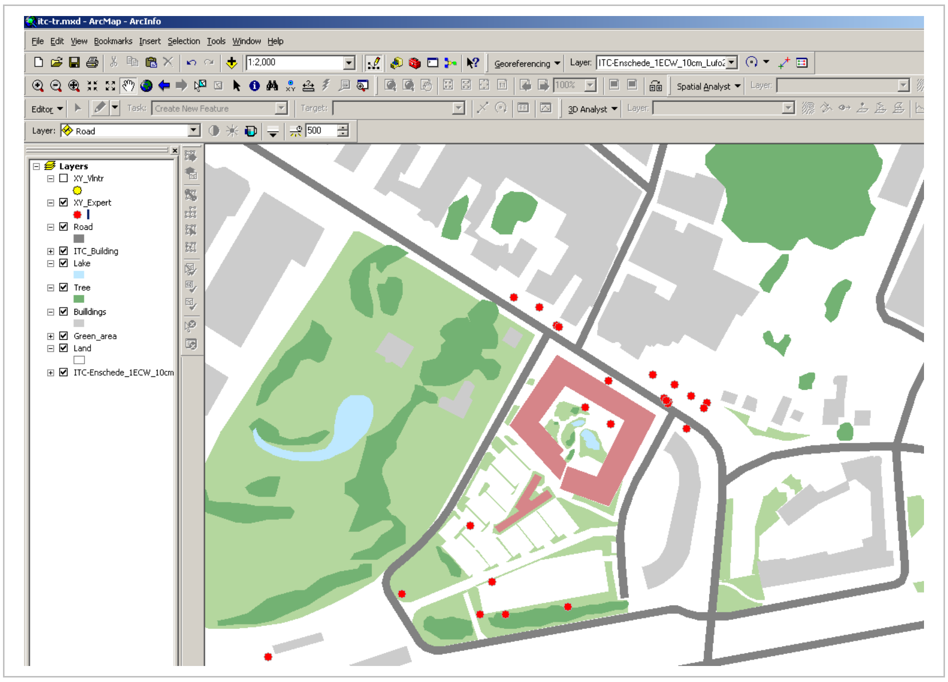


Figure 5.6: Expert view showing locations of 25 inserted points

The aim of the expert is to match the points supplied from the participants and points invoked from neogeography database (Figure 5.6). Figures 5.7 shows the locations of 25 inserted points by the expert (Red points) and the locations of 53 submitted points by the participants (Yellow points).

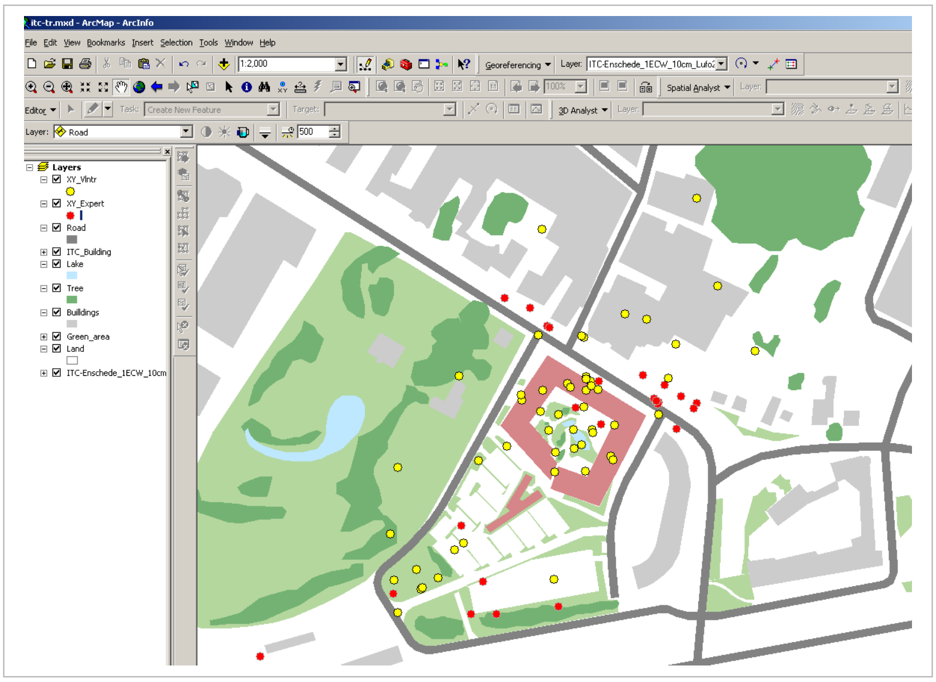


Figure 5.7: Expert view showing locations of 25 inserted points by the expert (Red points) and locations of 53 submitted points by the participants (Yellow points)

The points collected from experts and participants match together. Experts check the results which could give them a good indication to orient decision due to standards and design criteria. Blue circles cluster trends of the points collected (Figure 5.8).

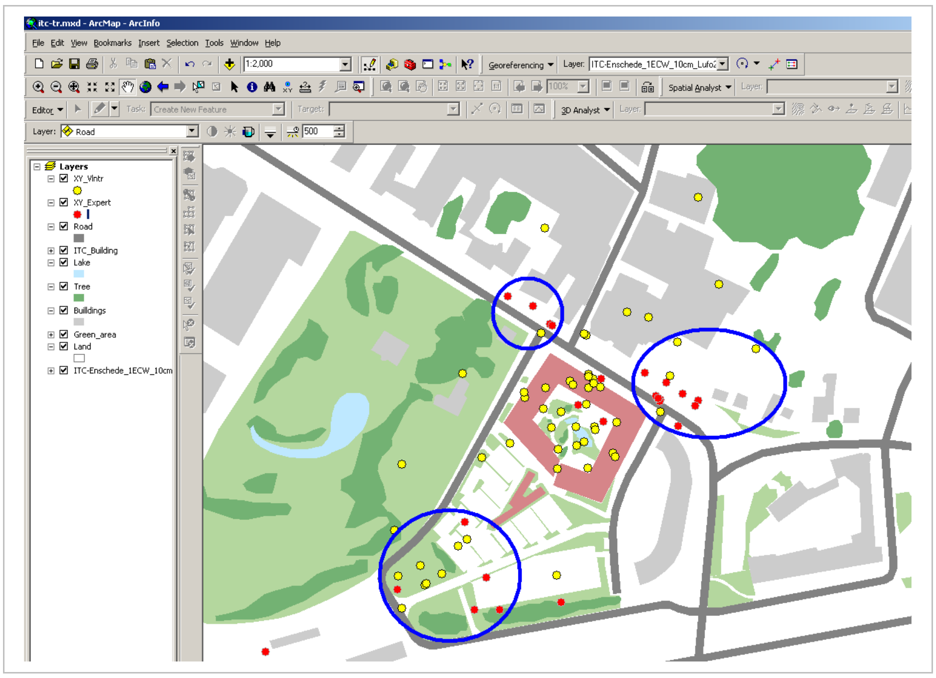


Figure 5.8: Expert view illustrates trend of clustering

5.3. Analysis

The used approaches and technical aspects of the developed interaction system include the following; the public interact with the developed prototype. This prototype helps participants to interact directly with spatial features on the provided map. Participant can view the map and make queries from the map. The used approach allows the public to retrieve spatial data from different sources, specifications define interfaces for data access and process, and web services are compatible with OGC standards (Chapter 4). The conceptual frame work adopted allows understanding mechanism of obtaining spatial data either in using neogeography or VGI (Figure 3.1). It generates a useful spatial data could be used in supporting decision making and easing design processes. In one side, Expert uses his own efforts to invoke suitable spatial data from neogeography databases using open free sources through different interfaces. In the other side, experts communicate the public over the web by using available ICT tools like e-mail to get the public involved in the process of spatial planning. Experts inform the public about running a facilitated digital mapping interface. The public respond by the same interface to produce valid spatial data. The overall spatial data collected from both sides matched together, manipulated and extracted using available geo-information software. Extracted data has to be transferred from to the server side to be stored as a GIS data in a built data base. The GIS data can be used for the spatial planning purposes.

5.4. Conclusion

Developing the system described above and implementing it in the context of participatory spatial planning processes gives the opportunity to know how can facilitating VGI and using neogeography support participatory spatial planning. This system addresses the participatory approach and how to be used in spatial planning. The prototype used available technologies (OpenLayers, HTML, JavaScript, etc.) which let it easy-to-use. This chapter analysed the results from the adopted framework and prototype.

6. Discussion, Conclusion and Recommendations

This chapter discusses results of the research and the impact of using neogeography and VGI within the context of participation in the spatial planning process. It also poses some issues could be researched. An overview of concluding the work has been conducted followed by the recommendations for the future related works.

6.1. Discussion

The main objective of this research is to set up and evaluate a procedure to find a way how to use neogeography to support participatory spatial planning, as well to facilitate the use of VGI to allow the public to participate in a spatial planning process. Over the previous chapters, the used approach is characterised as a researching way for development purpose. The emphasis is to generate a conceptual framework fulfil the concept using tools and methods to reach the objective. This objective has been reached by achievement of the following sub-objectives:

1. Generating a framework of using neogeography and VGI to support participatory spatial planning.
A conceptual framework of using neogeography and Facilitating VGI to support participatory spatial planning has been generated (Figure 3.1). Four main concepts are extracted from the literature to build the framework:

- Data visualisation, processing and feedback occur through web interfaces.
- Participatory spatial planning is a wide range of the spatial planning.
- Neogeography database is continuously available to be invoked.
- VGI could be available due to experts demand and voluntarily have responses by the public.

The conceptual framework illustrates the nature of the relationship between experts and the public (Figure 3.1). This relationship could take a form as a one way and informative in one side, a two way relationship in case of consultation in the other side. This would be closely related to the nature of the case and the stage at which purpose of involvement would take place.

Participation is usually done between experts and the public who are affected directly by the spatial planning results (Section 2.5.2). In some cases, many people found who are interested in the process might not be able to participate because of time and location constraints. Furthermore, participation in such a way is not attractive to many people who could be considered a familiar and has a good value. These difficulties, added to the usual unexpected obstacles lead to think how to use e-participation to deal with these issues (Section 2.5). Involving the public in the spatial planning is related to the ladder of participation where the level of participation varies due to the participant’s value.

VGI used to support participatory spatial planning (Section 2.3.2). It allows contribution of spatial planning and information. On-line interaction system with the public is a complementary step to what could be done by the experts. It mobilizes different people from different places, collects unlimited amount of heterogeneous spatial data within a certain time.

2. Design, implementation and evaluation a prototype within interaction environment to a use case.

This interactive system allows a bidirectional flow between experts and VGI through communication protocols through interfaces while the interaction amongst participation is conducted. The system itself can be improved to connect other experts from everywhere who have a relevant experience in such a case. This is could be done over networks which provide interactive services.

Another aspect appears in the shape of collaboration on the level of experts themselves. A database of those experts can be saved to contact them when a consultation needed. This procedure saves time and efforts during and after running the process. The system is seen as a success step if it completely developed and implemented. The built system can be utilised without restriction to spatial area or time. The succeeded management of the process can lead to credible spatial data from different resources in the right time.

This prototype uses web map service within OGC standards and specifications. The prototype interface gives the ability to navigate over a provided map. The prototype enable anybody to contribute spatial data by filling a form includes name of the participant, comment and providing the suggested spatial location. This form uses Active Server Pages (ASP) to reflect the data collected. A database is created to receive the feedback data on the server side.

The results come from testing experiment where participants dealt with developed prototype. In particular, despite the tool-tips shown on the prototype subdivisions, it was not clear to them what the intention from applying the prototype is. This evaluation is reflected by the interaction results and comments posted by the participants (Appendix C). These outcomes are categorized into three fields; technology, data spatial locations and participation:

a) The first category is related to the used technology which deals with the usefulness and perceived ease-to-use of prototype. For example; some of participants mentioned to the need of 3-dimensional view to give a good results in spite that the provided map is related to ITC building which is well known for the participants. Such a case could be valid for participants who don’t have the indigenous knowledge. Other participants commented about quality degree of the used map. These participants didn’t take attention to the features in map or the controls used.

b) The second category is related to spatial planning which deals with the locations provided and surveyed as yellow points over the system (Appendix C). Some of these locations are located in the wrong places which are logically not accepted, for example on the roof of ITC building (Figure 5.3). This leads to a doubt if some participants understand exactly what the target from the prototype is. The red points reflect the points collected by expert from the free open sources over the web (Appendix D). Spatial data quality as an issue when reflecting the points to the expert interface (Section 4.3.1). The purpose of the interaction process and data collection could be affected if this data doesn’t check spatially. Clustering techniques the points in this case have been skipped due to the small number of points which are controlled.

c) The third and last one is related to participation. Participants can communicate with experts via a web interface and share ISK with comments in the process of interactive participatory spatial planning. Most of the students participate voluntarily in the experiment. Statistics reflects the point’s responses (Table 6.1).

Finally, running the interaction system looking for results overloads the system and causes data traffic jams, especially in case of running the system over external networks. Spatial Data Infrastructure (SDI) is required to be established as a step to a successful interactive participatory spatial planning.

6.2. Conclusion

The previous chapters addressed the need to facilitate spatial data collection and how to be used in the context of spatial planning. A conceptual framework of using neogeography and VGI to support spatial planning has been created. To proof this concept, interaction approaches, tools and data invoking technique has been used. Also, experiment has been done to simulate the interactive relationship between experts and the public. This experiment has been done by running an on-line interactive system over the web. The system considered the interoperability, access to open sources and heterogeneity of the spatial data fed.

As addressed in the framework, in one side, experts invoke spatial data from neogeography databases, data feeding and responding mash-ups using available interfaces. On the other side, experts inform the public over a certain pre-designed interaction system using a facilitated digital mapping interface. The aim of the experts is to consult the public in issues related to spatial planning problems. The public respond voluntarily to the experts over the interaction system to feed them by the required spatial data. Experts process spatial data and extract it to a useful spatial data valid to be stored in form of GIS data.

Participants provide their ISK in a form of spatial data by interaction with experts. This interaction happens in the context of participation process to support decision making towards success spatial planning. These tools and technologies are supposed to increase the degree of participatory interaction over the web. The process of spatial data collection and sharing knowledge and information from distance reduces cost, time and efforts. Interactive participation tools could be used as the optimum solution to face spatial planning challenges.

The architecture adopted in the use case gives the advantage for heterogeneous volunteered participants to communicate with experts in the same geographic context. Experts can put design of a unique facilitated digital mapping interface to be capable to provide all instructions and information needed to the public. Besides, experts use several interfaces in context of neogeography to get the possibilities to use geo-information as a tool to be combined with obtained VGI to solve spatial planning problems. Also, the concerned organizations can have additional capabilities in the on-line tools, web-based facilities, and geo-processing the spatial data.

6.3. Limitations

Despite of the succeeded experiment and proving the concept, the followings are to be considered:

- Assuming that all the public have access to information and communication technology (ICT), specifically the internet and a computer. It means that in some countries the interaction system could not be capable to give good results.

- Overloading the system slows data transferring and generation on the interface. This causes the public to ignore participation which reflected in low rate of the public participation.

- Legal issues have to be developed to ensure wise use of spatial data. Some legal issues arise when using technologies within participatory spatial planning environment; for example licensing process, procedures, form and level of participation, publishing the objectives of participation.

- Ethically, the procedure should respond to the difference in moral rules. Experts and the public are required to make their best judgement to reach to the best results.

6.4. Recommendations

The conceptual framework of using neogeography and VGI to support participatory spatial planning can realize the concept of data collection, matching and extraction. In this context there are some recommendations and thoughts could guide to a successful spatial planning:

a) Publishing geospatial awareness: There is a need to increase the degree of geospatial awareness in the public’s environment. Experts and concerned organizations are asked to put the basis of the geospatial awareness, and adopting steps towards a successful participation in spatial planning. This awareness will contribute to help the public to be engaged in incorporating spatial data in spatial planning. Interactive participation could be fulfilled over the system where the public can deal with the interfaces, interact with experts over the web as well using on-line tools to communicate.

b) Training and capacity building: Each process of spatial planning face usually lots of different circumstances of the area of interest. Hence, training and capacity building are important for the interaction system. Training should enable experts to deal with the designed system to meet adopted spatial planning process requirements. Therefore, experts have to care about this issue by holding workshops with other experts on a hand and with the public to sense the changes on the other hand.

c) Sharing knowledge and ensuring SDI capabilities: SDI is important to ensure completeness of the process of interactive participatory spatial planning. For this reason, experts have to establish a well SDI framework which is capable to meet system requirements. There should be a control for access to spatial data and the way of usage. As well as interoperability has to be kept to guarantee seamless transfer of the spatial data through networks and systems.

d) Developing interaction and spatial data collection mechanisms: There is need to review gaps occur over the interaction system, also to improve new tools of data collection. Updating used interfaces is also important to check validity for usage and suitability for the case used. Practical usage of existing and new technologies should be taken into account.

e) Developing 3D mapping models: To support ISK it could be useful to take modelling the reality into consideration. The modelling should take a form of 3-dimensional environment to be used directly in the VGI facility. The 3D mapping models allow flexible navigation to help in recognizing the features. This gives the advantage of an attractive facility to more public involvement.

f) Developing spatial data quality and security systems: There is a need to control quality of spatial data to reduce errors using available techniques and to ensure data quality, thus to integrate data of good quality. Therefore, experts are asked to build their systems of spatial data quality and system security.

g) Developing mechanisms of data invoke from neogeography databases: there is need to fill the gaps when invoking data to solve full expert judgement and humanitarian aspect. Technologies related to geo-referencing have to be used to ensure spatial data quality as well controls of this data has to be improved and to be more restricted.

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URL2 "Integrated Approaches to Participatory Developement (iapad)", http://www.iapad.org/ppgis_principles.htm

URL3 "A Ladder of Citizen Participation - Sherry R Arnstein", http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation.html#d0e24

URL4 "A short enquiry into the origins and uses of the term “neogeography”- Draft.", http://www.d-log.info/on-neogeography.pdf

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8. Appendix

Appendix A: Page source of the prototype

```
<!DOCTYPE html PUBLIC "-//W3C//DT
D HTML 4.01//EN" "http://www.w3.org/TR/html4/strict.dtd">
<html><head><script
src="http://itcnt07.itc.nl/OpenLayers/OpenLayers.js"></script><script
type="text/javascript">
var queryLayer = null; var baseMap = null;
var Lake = null;
var ITC_Building = null;
var Green_area = null;
var Tree = null;
var Builldings = null;
var Road = null;
var map = null;
var bounds = null;
var map, drawControls;
OpenLayers.Feature.Vector.style['default']['strokeWidth'] = '2';
var resultsDiv = null; function init(){
var itcURL = "http://itcnt07.itc.nl/cgi-bin/mapserv.exe?
map=//Itcnt03/GFM/madhoun17579/www/itc/config.map&";
var bounds = new OpenLayers.Bounds(6.88370,52.22296,6.88902,52.22748);
map = new OpenLayers.Map("map", {controls: [new
OpenLayers.Control.Navigation(), new OpenLayers.Control.PanZoomBar()],
numZoomLevels: 20 });
var baseMap = new OpenLayers.Layer.WMS( "Base Map",
"http://labs.metacarta.com/wms-c/Basic.py?", {layers: "basic"}
);
vectors = new OpenLayers.Layer.Vector("Vector Layer");
landlayer = new OpenLayers.Layer.WMS.Untiled( "Land",
itcURL,
{layers: "land", transparent: "false", format: "image/png"}
);
Lakelayer = new OpenLayers.Layer.WMS.Untiled( "Lake",
itcURL,
{layers: "Lake", transparent: "true", format: "image/png"}
); ITC_Buildinglayer = new OpenLayers.Layer.WMS.Untiled( "ITC_Building",
itcURL,
{layers: "ITC_Building", transparent: "true", format: "image/png"}
);
Green_arealayer = new OpenLayers.Layer.WMS.Untiled( "Green_area",
itcURL,
{layers: "Green_area", transparent: "true", format: "image/png"}
);
Treelayer = new OpenLayers.Layer.WMS.Untiled( "Tree",
itcURL,{layers: "Tree", transparent: "true",format: "image/png"}
);
Builldingslayer = new OpenLayers.Layer.WMS.Untiled( "Builldings",
itcURL,
{layers: "Builldings",transparent: "true",format: "image/png"}
);
Roadlayer = new OpenLayers.Layer.WMS.Untiled( "Road",
itcURL,
{layers: "Road",
transparent: "true",
format: "image/png"}
);
map.addLayers([baseMap, landlayer, Green_arealayer, Builldingslayer,
Treelayer, Lakelayer, ITC_Buildinglayer, Roadlayer, vectors]);
map.setBaseLayer(baseMap);
```

```
map.addControl(new OpenLayers.Control.LayerSwitcher());
map.addControl(new OpenLayers.Control.MousePosition());
map.addControl(new OpenLayers.Control.OverviewMap());
map.addControl(new OpenLayers.Control.ScaleLine());
map.zoomToExtent(bounds);
map.events.register("click", map, queryResults); // end of init() function
} //Query by clicking:
//function init()
function queryResults(evt) {
resultsDiv = document.getElementById("queryresults");
resultsDiv.innerHTML = "Loading...";
var url = landlayer.getFullRequestString({
REQUEST: "GetFeatureInfo",
EXCEPTIONS: "text/html",
BBOX: landlayer.map.getExtent().toBBOX(),
X: evt.xy.x,
Y: evt.xy.y,
INFO_FORMAT: "text/html",
QUERY_LAYERS: landlayer.params.LAYERS,
WIDTH: landlayer.map.size.w,
HEIGHT: landlayer.map.size.h}
);
OpenLayers.loadURL(url, "", this, showQueryResults);
OpenLayers.Event.stop(evt);
}//queryResults
function showQueryResults(response) {
resultsDiv.innerHTML = response.responseText;
}//showQueryResults
</script><style type="text/css">
#output {
  font-size: 0.8em;
  width: 580px;
  height: 120px;
}
.Note {
  border-style: none;
  border-color: red;
  padding: 3px 3px 0px;
  font-weight: bold;
  font-family: Verdana;
  top: 100px;
  left: 1000px;
  position: absolute;
  background-color: #cc0000;
  color: white;
  font-size: 18px;
}
.Instruction {
  border-style: ridge;
  border-color: white;
  top: 100px;
  left: 1000px;
  position: absolute;
  font-family: Verdana;
  padding-top: 3px;
  padding-left: 3px;
  font-weight: bold;
  font-size: 17.5px;
  color: #666666;
  background-color: white;
}
.Msc {
  border-style: none;
  top: 100px;
  left: 1000px;
  position: absolute;
```

```
  font-family: Verdana;
  padding-top: 3px;
  padding-left: 3px;
  color: white;
  font-weight: normal;
  background-color: #333399;
  font-size: 11.5px;
}

</style><title>Results</title><meta http-equiv="Content-Type"
content="text/html; charset=iso-8859-1"></head>
<body onload="init()">
<b>
<span style="top: 572px; height: 18px; left: 26px; width: 1045px;"
class="Msc"> This website is created in partial
fulfillment of the
requirements for M.Sc degree. Information will be used for scientific
purpose only. Ahmed Madhoun, GFM, ITC, 2010</span><br>
</b>
<div style="background-image: url(Volkspark_photo.JPG); width: 1140px;
margin-top: 2px; height: 600px;" id="unrwar"><span style="top: 140px;
height: 57px; left: 702px; width: 364px;" class="Note"><b> <br>
 Volunteer and Share Planning ITC..</b></span></div>
<div id="map" style="border: 1px solid grey; position: absolute; z-index:
1; overflow: hidden; left: 25px; width: 500px; top: 140px; height:
426px;"></div>
<b><br>
</b>
<div id="cloice" style="border: 1px solid grey; position: absolute; z-
index: 1; overflow: hidden; top: 318px; height: 248px; left: 533px; width:
162px;"> <small style="color: rgb(102, 102, 102);"><span style="font-
family: Verdana; color: rgb(51, 51, 51); font-weight: bold;"><br> 
<span style="color: rgb(102, 102, 102);">- Drag to pan..
</span><br style="color: rgb(102, 102, 102);"><span style="color: rgb(102,
102, 102);">
 </span><br style="color: rgb(102, 102, 102);"><span style="color:
rgb(102, 102, 102);">
  - Shift-drag to zoom      by box...</span>
</span><br style="font-family: Verdana; color: rgb(51, 51, 51); font-
weight: bold;">
<span style="font-family: Verdana;"><span style="color: rgb(51, 51, 51);
font-weight: bold;"> <br></span></span></small>  <br>
 
 
</div>
<div id="legend" style="border: 1px solid grey; position: absolute; z-
index: 2; overflow: auto; height: 170px; top: 140px; left: 534px; width:
161px;">
<img src="http://itcnt07/cgi-bin/mapserv.exe?
map=//itcnt03/GFM/madhoun17579/www/itc/config.map&amp;SERVICE=WMS&amp;REQUE
ST=GetLegendGraphic&amp;version=1.1.1&amp;format=image/png&amp;layer=Road">
<br>
<img src="http://itcnt07/cgi-bin/mapserv.exe?
map=//itcnt03/GFM/madhoun17579/www/itc/config.map&amp;SERVICE=WMS&amp;REQUE
ST=GetLegendGraphic&amp;version=1.1.1&amp;format=image/png&amp;layer=Lake">
<br>
<img src="http://itcnt07/cgi-bin/mapserv.exe?
map=//itcnt03/GFM/madhoun17579/www/itc/config.map&amp;SERVICE=WMS&amp;REQUE
ST=GetLegendGraphic&amp;version=1.1.1&amp;format=image/png&amp;layer=ITC_Bu
ilding"><br>
<img src="http://itcnt07/cgi-bin/mapserv.exe?
map=//itcnt03/GFM/madhoun17579/www/itc/config.map&amp;SERVICE=WMS&amp;REQUE
ST=GetLegendGraphic&amp;version=1.1.1&amp;format=image/png&amp;layer=Green_
area"><br>
<img src="http://itcnt07/cgi-bin/mapserv.exe?
map=//itcnt03/GFM/madhoun17579/www/itc/config.map&amp;SERVICE=WMS&amp;REQUE
```

```
ST=GetLegendGraphic&amp;version=1.1.1&amp;format=image/png&amp;layer=Tree">
<br>
<img src="http://itcnt07/cgi-bin/mapserv.exe?
map=//itcnt03/GFM/madhoun17579/www/itc/config.map&amp;SERVICE=WMS&amp;REQUE
ST=GetLegendGraphic&amp;version=1.1.1&amp;format=image/png&amp;layer=Builld
ings"><br>
</div>
<br>
<br>
<div id="queryresults" style="border: 1px solid grey; position: absolute;
z-index: 2; overflow: auto; font-weight: bold; top: 207px; height: 359px;
left: 702px; width: 370px;"><small>
<small><span style="font-family: Verdana;"><big> <span style="color:
rgb(204, 0, 0);"><big><span style="color: rgb(102, 102, 102);"><br>
 Please
click the location where you feel it  could be the
 best view of ITC building...</span></big><br>
<br>
</span> </big>
</span></small></small></div>
</body></html>
```

Appendix B: Open Layers Description Code

```
MAP
  NAME ITC
  IMAGECOLOR 255 255 255
  SIZE 600 800
  IMAGETYPE PNG24 ## use AGG to for anti-aliassing
    OUTPUTFORMAT
    NAME 'AGG'
    DRIVER AGG/PNG
    MIMETYPE "image/png"
    IMAGEMODE RGB
    EXTENSION "png"
  END # outputformat
  PROJECTION
"init=epsg:4326" #latlon on WGS84
  END


  #EXTENT 6.873125 52.222037 6.882406 52.217027 # lon/lat extents of
Volkspark
  #EXTENT 6.87438 52.21839 6.88313 52.22221 # lon/lat extents of Volkspark

  WEB
    IMAGEPATH "/tmp/ms_tmp/"
    IMAGEURL "/ms_tmp/"
    METADATA
      "map" "//itcnt03/gfm/madhoun17579/www/Volkspark/config.map"
      "ows_schemas_location" "http://schemas.opengeospatial.net"
      "ows_title" "Sample WMS"
      "ows_onlineresource" "http://itcnt07/cgi-bin/mapserv.exe?
map=//itcnt03/gfm/madhoun17579/www/Volkspark/config.map&"
      "wms_srs" "EPSG:4326 " #latlon
      "wms_feature_info_mime_type" "text/plain"
      "wms_feature_info_mime_type" "text/html"
      "wms_server_version" "1.1.1"
      "wms_formatlist" "image/png,image/gif,image/jpeg"
      "wms_format" "image/png"
    END #metadata
  END #web


LAYER
    NAME "land"
    TYPE POLYGON
    #MAXSCALE 1000000
    STATUS ON

    DATA data/land
    METADATA
    "ows_title" "land"
    "wms_include_items" "all"
    END #metadata
    PROJECTION
      "init=epsg:4326"
    END
    TOLERANCE 8
    TOLERANCEUNITS pixels
    CLASS
      NAME "Lake"
      TEMPLATE "templates/XYquery1.html"
      OUTLINECOLOR 255 255 255
      COLOR 255 255 255
      STYLE
        COLOR 255 255 255
```

```
        WIDTH 1
      END #style
       LABEL
        COLOR 0 0 0
        TYPE TRUETYPE
        FONT arial
        MINSIZE 6
        MAXSIZE 12
        POSITION AUTO
        PARTIALS FALSE
        BUFFER 4
      END  #label
    END #class land
  END #layer land



LAYER
    NAME "Lake"
    TYPE POLYGON
    #MAXSCALE 1000000
    STATUS ON

    DATA data/Lake
    METADATA
    "ows_title" "Lake"
    "wms_include_items" "all"
    END #metadata
    PROJECTION
      "init=epsg:4326"
    END
    TOLERANCE 8
    TOLERANCEUNITS pixels
    CLASS
      NAME "Lake"
      TEMPLATE "templates/XYquery.html"
      OUTLINECOLOR 156 156 156
      COLOR 190 232 255
      STYLE
        COLOR 190 232 255
        WIDTH 1
      END #style
       LABEL
        COLOR 0 0 0
        TYPE TRUETYPE
        FONT arial
        MINSIZE 6
        MAXSIZE 12
        POSITION AUTO
        PARTIALS FALSE
        BUFFER 4
      END  #label
    END #class Lake
  END #layer Lake


LAYER
    NAME "ITC_Building"
    TYPE POLYGON
    STATUS ON
    #MAXSCALE 1000000
    DATA data/ITC_Building
    METADATA
      "ows_title" "ITC_Building"
      "wms_include_items" "all"
    END #metadata
```

```
    PROJECTION
      "init=epsg:4326"
    END
    TOLERANCE 8
    TOLERANCEUNITS pixels
    CLASS
      NAME "ITC_Building"
      TEMPLATE "templates/XYquery1.html"
      STYLE
         COLOR 232 194 252
         SIZE 1
      END #style
      OUTLINECOLOR 222 158 102
      COLOR 222 158 102
 LABEL
        COLOR 0 0 0
        TYPE TRUETYPE
        FONT arial
        MINSIZE 6
        MAXSIZE 12
        POSITION AUTO
        PARTIALS FALSE
        BUFFER 4
      END  #label

    END #class ITC_Building
  END #layer ITC_Building



LAYER
    NAME "Tree"
    TYPE POLYGON
    #MAXSCALE 1000000
    STATUS ON

    DATA data/Tree
    METADATA
    "ows_title" "Tree"
    "wms_include_items" "all"
    END #metadata
    PROJECTION
      "init=epsg:4326"
    END
    TOLERANCE 8
    TOLERANCEUNITS pixels
    CLASS
      NAME "Tree"
      TEMPLATE "templates/XYquery1.html"

      OUTLINECOLOR 115 178 115
      COLOR 115 178 115
      STYLE
        COLOR 115 178 115
        WIDTH 1
      END #style
       LABEL
        COLOR 0 0 0
        TYPE TRUETYPE
        FONT arial
        MINSIZE 6
        MAXSIZE 12
        POSITION AUTO
        PARTIALS FALSE
        BUFFER 4
      END  #label
```

```
    END #class Tree
  END #layer Tree


LAYER
    NAME "Green_area"
    TYPE POLYGON
    #MAXSCALE 1000000
    STATUS ON

    DATA data/Green_area
    METADATA
    "ows_title" "Green_area"
    "wms_include_items" "all"
    END #metadata
    PROJECTION
      "init=epsg:4326"
    END
    TOLERANCE 8
    TOLERANCEUNITS pixels
    CLASS
      NAME "Green_area"
      TEMPLATE "templates/XYquery1.html"

      OUTLINECOLOR 199 215 158
      COLOR 199 215 158
      STYLE
        COLOR 199 215 158
        WIDTH 1
      END #style
       LABEL
        COLOR 0 0 0
        TYPE TRUETYPE
        FONT arial
        MINSIZE 6
        MAXSIZE 12
        POSITION AUTO
        PARTIALS FALSE
        BUFFER 4
      END  #label
    END #class Green_area
  END #layer Green_area


LAYER
    NAME "Builldings"
    TYPE POLYGON
    #MAXSCALE 1000000
    STATUS ON

    DATA data/Builldings
    METADATA
    "ows_title" "Builldings"
    "wms_include_items" "all"
    END #metadata
    PROJECTION
      "init=epsg:4326"
    END
    TOLERANCE 8
    TOLERANCEUNITS pixels
    CLASS
      NAME "Builldings"
      TEMPLATE "templates/XYquery1.html"

      OUTLINECOLOR 225 225 225
      COLOR 225 225 225
```

```
      STYLE
        COLOR 225 225 225
        WIDTH 1
      END #style
       LABEL
        COLOR 0 0 0
        TYPE TRUETYPE
        FONT arial
        MINSIZE 6
        MAXSIZE 12
        POSITION AUTO
        PARTIALS FALSE
        BUFFER 4
      END  #label
    END #class Builldings
  END #layer Builldings


LAYER
    NAME "Road"
    TYPE LINE
    #MAXSCALE 1000000
    STATUS ON

    DATA data/Road
    METADATA
    "ows_title" "Road"
    "wms_include_items" "all"
    END #metadata
    PROJECTION
      "init=epsg:4326"
    END
    TOLERANCE 8
    TOLERANCEUNITS pixels
    CLASS
      NAME "Road"
      TEMPLATE "templates/XYquery1.html"

      #OUTLINECOLOR 156 156 156
      COLOR 156 156 156
      STYLE
        COLOR 156 156 156
        WIDTH 3
      END #style
       LABEL
        COLOR 0 0 0
        TYPE TRUETYPE
        FONT arial
        MINSIZE 6
        MAXSIZE 12
        POSITION AUTO
        PARTIALS FALSE
        BUFFER 4
      END  #label
    END #class Road
  END #layer Road



END #map
```

Appendix C: Table of Response Data by Participants

Student Name	X	Y	Comments
Participant 1	6.886548	52.225515	The entrance view is the best.
Participant 2	6.886065	52.225869	
Participant 3	6.88525	52.224571	Viewing from behind or an elevated place may give the best view
Participant 3	6.887191	52.225955	To get a fill of view from behind
Participant 4	6.886794	52.225097	The map looks beatiful though with uncertainty in geometry
Participant 4	6.886837	52.22529	
Participant 3	6.886408	52.225268	Viewing from the centre, you are able to see the whole building at once
Participant 5	6.885721	52.225172	This is the place where our cluster is located
Participant 5	6.884488	52.224635	I like this green area
Participant 5	6.885153	52.224528	This is where ITC building can be viewed okey.
Participant 6	6.885421	52.225086	
Participant 2	6.884552	52.224142	
Participant 2	6.887492	52.225794	
Participant 1	6.885883	52.225461	the side view is also nice
Participant 1	6.886816	52.225075	the side view is also nice
Participant 7	6.884756	52.22441	it would be nice
Participant 7	6.886355	52.225558	This is OK
Participant 7	6.886175	52.224327	This place could also be a good alternate
Participant 8	6.886387	52.225536	Thank you
Participant 9	6.886676	52.225515	This side of the building looks good when you are at a distance
Participant 9	6.886207	52.225003	There is no gap at this point
Participant 9	6.885872	52.225494	Looking on this side the building looks bad
Participant 10	6.884796	52.224284	
Participant 10	6.886155	52.225267	
Participant 10	6.886155	52.225267	
Participant 11	6.886553	52.225601	We need to have a 3D view of ITC if we want to see a nice angle where we can view ITC from. Secondly, I think ITC is better viewed from the form entrance since it has the logo and a unique symbol of the front building.
Participant 11	6.886596	52.225569	As I said before a good view should be from the front entrance since there is ITC logo and also the unique structure of ITC building
Participant 11	6.886556	52.225587	Need a layer for road, may be main roads only and also a rotate button which can rotate in different angle. Sucess in your research
Participant 12	6.886411	52.225147	I don't like this view because it's from backside of building. Can I rotate viewer?
Participant 12	6.886103	52.22552	This coordinate is the place I'm doing this.
Participant 12	6.886602	52.225541	Is there any function for zooming by window? It's quite difficult to handle it.
Participant 13	6.886537	52.225848	Good front view
Participant 13	6.88452	52.224346	Good back view
Participant 13	6.887299	52.225354	Angle from the side has nice side view
Participant 13	6.886516	52.225858	Best front view
Participant 14	6.886258	52.225365	Good implementation
Participant 14	6.886601	52.225268	Good implementation
Participant 14	6.886494	52.225171	Good implementation
Participant 14	6.886526	52.225408	Good implementation
Participant 15	6.885239	52.225622	
Participant 15	6.887937	52.226153	
Participant 15	6.884585	52.225054	
Participant 16	6.886966	52.225987	it is ok
Participant 16	6.884981	52.224356	Another one
Participant 16	6.888307	52.22574	3d one
Participant 16	6.886129	52.226534	4f one
Participant 16	6.887739	52.226706	LAst one
Participant 17	6.887406	52.225579	There is a need to 3D view
Participant 17	6.88481	52.224292	best point for back view
Participant 17	6.886612	52.225247	nice place to have a coffee
Participant 18	6.886522	52.225004	It's ok.
Participant 18	6.886072	52.225385	Another good position.
Participant 18	6.886219	52.225128	Here too.

Appendix D: Table of Views Coordinates Collected by Expert

Photo URL	X	Y
http://www.itc.nl/issdq2007/Images/ITC%20building.jpg	6.887299	52.225429
http://www.uu.nl/SiteCollectionImages/middenkolom/7000Geowetenschappen/gima2.1.4enschede.jpg	6.887288	52.225418
http://farm1.static.flickr.com/52/186251254_5836524368.jpg	6.884509	52.224260
http://2.bp.blogspot.com/_MrOQ8IbFlkI/SKf2eXUb0JI/AAAAAAAAIwA/Z_b3lod17dk/s320/I~000031.jpg	6.886687	52.225569
http://www.itc.nl/Images/Study/Student%20life/Enschede%20Copyright%20Bart%20Slot.jpg	6.883115	52.223885
http://www.msc-gima.nl/uploads/images/itc.jpg	6.887267	52.22544
http://www.itc.nl/Images/Organisation/Building%20back%20by%20Gerard%20Kuster.png	6.885571	52.22412
http://upload.wikimedia.org/wikipedia/commons/5/5d/ITC_Space.JPG	6.885722	52.226105
http://upload.wikimedia.org/wikipedia/commons/9/99/ITC_Buil.jpg	6.887256	52.225451
http://www.bpz.nl/images/ITC%20Enschede.jpg	6.885443	52.224324
http://lh4.ggpht.com/__zSOYXX-wVY/R-vdjf1TwYI/AAAAAAAAAeM/k9380QHMXVo/P3250085.JPG	6.886698	52.2253
http://www.sail-international-education.nl/images/ITC-building.gif	6.887277	52.22544
http://media.photobucket.com/image/itc%20enschede/simmerwille/HPIM3978.jpg	6.885228	52.224678
http://media.photobucket.com/image/itc%20enschede/simmerwille/HPIM3810.jpg	6.886162	52.225923
http://www.rnw.nl/data/files/images/Copyright%20Gerard%20Kuster%202007%20Gebouw%20ITC.jpg	6.887363	52.225536
http://upload.wikimedia.org/wikipedia/commons/thumb/5/5d/ITC_Space.JPG/300px-ITC_Space.JPG	6.88599	52.226041
http://lh3.ggpht.com/_2AjnzQCB9r8/SCVJ2E8t9mI/AAAAAAAABNQ/92xAr3TAKVw/DSC04351.jpg	6.88644	52.225408
http://www.utnieuws.utwente.nl/new/fotodb/2000/35/normaal_itc.gif	6.887138	52.225601
http://www.panoramio.com/photo/3309380	6.887535	52.225461
http://www.panoramio.com/photo/3770207	6.887696	52.225418
http://www.panoramio.com/photo/11956885	6.887663	52.225386
http://www.panoramio.com/photo/22631129	6.886183	52.225912
http://www.panoramio.com/photo/4729651	6.885314	52.22412
http://www.panoramio.com/photo/3309381	6.886221	52.224156
http://www.panoramio.com/photo/15445909	6.887481	52.225258