Boosting Public Participation in Urban Planning Through the Use of Web GIS Technology: A Case Study of Stockholm County

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Abstract

Providing citizens with the robust and suitable tools to effectively participate in the planning process is a necessity nowadays. Also, changes in the capabilities and popularity of new technologies have dramatically raised the number of technology-based tools that are potentially available for enhancing public participation in the planning process. This study explores both the theoretical aspect of collaborative planning and the effects that Web-based Public Participatory GIS (WPPGIS) applications and Information and Communication Technologies (ICT) has on the planning process. Findings indicate that the WPPGIS applications have the potential for increasing participation. It is also found that besides the contextual elements like the attitudes of planners and decision makers, the technological features such as proper user interface, price of software, technical and literacy skills are seen as crucial hindrances to bridging the planning process and technology-based solutions. This research also attempts to combine IAP2 Public Participation Spectrum and technological functionalities into a single framework to understand the implementation of WPPGIS applications in Stockholm, the capital of Sweden. Finally, based on the given criteria and assessment of the reviewed applications, this study concludes with the design and implementation of a prototype WPPGIS application using Open-Source Technologies (OST).

Keywords

Urban Planning, Collaborative Planning, Public Engagement, Public Participation, Information and Communication Technologies (ICT), Open-Source Technologies (OST), Open-Source Software (OSS), Web-based Public Participatory GIS (WPPGIS)
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AJAX</td>
<td>Asynchronous JavaScript and XML</td>
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<tr>
<td>CSS</td>
<td>Cascading Style Sheets</td>
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<td>DOM</td>
<td>Document Object Model</td>
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<td>GIS</td>
<td>Geographic Information System</td>
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<td>GML</td>
<td>Geography Markup Language</td>
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<tr>
<td>HTML</td>
<td>Hypertext Markup Language</td>
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<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
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<td>IAP2</td>
<td>International Association for Public Participation</td>
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<td>ICT</td>
<td>Information and Communication Technologies</td>
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<td>NCGIA</td>
<td>National Center for Geographic Information and Analysis</td>
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<td>OGC</td>
<td>Open Geospatial Consortium</td>
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<td>ORM</td>
<td>Object Relational Mapping</td>
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<td>OSS</td>
<td>Open-Source Software</td>
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<td>OST</td>
<td>Open-Source Technologies</td>
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<td>PSS</td>
<td>Planning Support Systems</td>
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<tr>
<td>SQL</td>
<td>Structured Query Language</td>
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<td>TCP</td>
<td>Transmission Control Protocol</td>
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<tr>
<td>URL</td>
<td>Uniform Resource Locator</td>
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<tr>
<td>WCS</td>
<td>Web Coverage Service</td>
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<td>WFS</td>
<td>Web Feature Service</td>
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<td>WMM</td>
<td>WEB-MAP-MEDIA</td>
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<tr>
<td>WMS</td>
<td>Web Map Service</td>
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<tr>
<td>WPPGIS</td>
<td>Web-based Public Participatory GIS</td>
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<tr>
<td>WSGI</td>
<td>Web Server Gateway Interface</td>
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<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
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1. Introduction

After the radical change in planning theories and moving from the rationalistic approach led by planners towards the communicative approach, planning has evolved to a mutual learning and knowledge creation process between planners and citizens.

Although citizens are encouraged to participate in the planning process, still there are some barriers, for instance, selected periods for public meetings. By using digital technologies, one can increase opportunities for citizens to take part in the planning process by enabling synchronous telecommunication, making participation more flexible in terms of time and place and supporting new ways of visualizations. Also, as Ceccato and Snickars (2000) stated, the important reason for using digital technologies is that it increases the transparency of the decision-making process and materials. Also, the web-based technology is an easy and inexpensive way to enlarge and diversify the participant groups into the process of planning (Nuojua et al., 2008).

In the literature a compound term, Public Participatory GIS or PPGIS, which touches upon the various applications, is referred to use the GIS capacities to serve the needs of Participatory Planning (Ramasubramanian, 2010; Steinmann et al., 2004). Recently, PPGIS applications have used the web as a platform for a real-time, bi-directional communication channel between different parties. However, as Nuojua (2010) pointed out, the majority of Web-Based Public Participatory GIS (WPPGIS) applications are supporting e-participation for just offering information to the citizens and failing to provide them with the opportunity to really participate throughout the process of decision-making. Also, the WPPGIS includes some barriers such as: trust and legitimacy, user diversity (Wong et al., 2001), and they may run the risk of providing services that the public does not want (Nuojua, 2010). Interface barrier can be considered as another problem. Needless to say if the user interface is unintuitive and hard to access, there is a great risk of losing users (Östlund, 2009).

Moreover, even though the adaptability of the technology is a significant requirement of participation supporting systems, it is not enough by itself. It is also crucial to change the attitudes of the planners to be more responsive to the knowledge produced by a layman. The discussion on the forums should be made really two-way. Additionally, planners should pay attention to the medium the material will be presented in. The existing practices of planning do not sufficiently support web-based presentation. The plans on the web should be able to present themselves, and this makes web-based visualization challenging, particularly if the material is originally produced for a live meeting with large printed collages (Nuojua, 2010).

On the other side, as Holley (2003) stated, PPGIS discourse contains concepts such as participation, access, empowerment, and marginalization within the context of a community-based GIS. The definition of PPGIS, indeed, is inherently contradictory in scope and tends to vary depending upon the situation within which it is used. Consequently, one question will
arise is that: ‘Whose interests are best served by implementing a PPGIS? Will a grassroots group benefit from using a PPGIS, or will it be further marginalized by the technology? Therefore, it could be concluded that the study on various aspects of WPPGIS applications is a key requirement in this research. It will also argue how the WPPGIS technology can be used to enhance democratic decision-making in the urban planning.

The structure of this thesis is as follows. Section 2 defines the research questions and objectives. This is followed by Section 3, which outlines the research methodology. Section 4 presents a literature review of theoretical fields that contribute to the evaluation of WPPGIS applications. In Section 5, the case study is profiled and the different web-based GIS applications are compared and evaluated. Section 6 describes the software and general prerequisites to design a WPPGIS application. The findings are discussed in Section 7 and the final conclusions and discussion are presented in Section 8. Section 9 suggests several ideas for related future work. The appendix contain a part of source code of application.

2. Research Identification

This research aims to contribute to the planning practice both by exploring more closely the theoretical aspect of collaborative planning and WPPGIS technologies, as well as providing a WPPGIS prototype, which could be used for enhancing public participation in the planning process. Different criteria are going to be selected and a methodical framework for evaluation of WPPGIS applications will be established. Web-based GIS applications in Stockholm County are going to be picked as case study, and they will be evaluated based on the proposed methodical framework. Main research output is contemplated to be identification of the preferred interface for WPPGIS application. Developing the prototype by using Open-Source Technologies (OST) could be considered as an eventual artifact of this research.

2.1 Research Objective

The overall objective of this research is to design and implement a WPPGIS application using OST. More specific objectives are:

- To explore the effect of WPPGIS applications and to less extent, Information and Communication Technologies (ICT) on the planning process.
- To discuss the role of planners and planning institutions in public participation using WPPGIS
• To identify preferred features of an optimal WPPGIS application
• To describe the adoption of WPPGIS in Stockholm, Sweden
• To design and develop a prototype WPPGIS application

2.2 Research Questions

• What are the pros and cons of WPPGIS applications?
• To what extent are the planners/planning institutions responsible for increasing the participation?
• Which parameters can adequately characterize the WPPGIS applications?
• What are the main features of an optimal WPPGIS application for enhancing public participations in the planning process?

2.3 Research Delimitations

Planning process is a complex and multidisciplinary task and public engagement in planning is shaped by specific political, social, and cultural contexts. Therefore, technology adoption and implementation in planning is influenced by a wide variety of contextual elements such as the attitudes of planners and decision makers towards the new technologies, availability of skilled personnel, and resource restraints. Also, there are additional challenges in areas where planning remains in a more technocratic/top-down traditions or where technology is not ubiquitous enough to support broad involvement. In other words, the technology-based solutions must be seen as methods to enhance the current public participation efforts, not replace the conventional methods and there are real barriers, which limit the ability of technology-based solutions to fulfill their goals. Thus, this research must acknowledge that the study about the relationship between degree of public engagement in the planning process and technology-based solutions is a heavy and time consuming task. In order to obtain the proper feedback and verify the outcome of a WPPGIS application, it is necessary to implement the application in real world. Also, application needs to be around long enough in which its influence in different circumstances and contexts can be scrutinized. Lack of time was the main barrier to achieve this goal for the proposed application in this study. Alternatively, a part of the literature review is dedicated to exploring the existing literature about WPPGIS technology. This research is also not concerned with exact implementation of all desirable features of an optimal WPPGIS application because of time constraints.
3. Research Methodology

An outline of the approach adopted in this study is presented in Figure 1. As shown in Figure 1, the study is made up of four main steps: a literate review, the preparation of the evaluation framework, classifying the main functionalities of an optimal WPPGIS, and constructing a WPPGIS prototype.

![Figure 1: Research Approach](image)

The first stage is a literature search. A wide variety of databases are investigated for combinations of search terms: urban planning, collaborative planning, information technology, information and communication technology, OST, OSS, Web-based GIS, Web-based participatory GIS, WPPGIS, PPGIS, public engagement, public participation, e-Government, e-Participation, Information Technology. The goal is to find literature related to the planning, new technologies, and the role of new technology in the planning. A review of the selected literature resulted in a few key decisions. First, approach of planning adopted here falls along the lines of Patsy Healey’s work. Because collaborative planning and public
participation are crucial part of modern planning theory. Thus, as a point of departure, different aspects of these concepts are scrutinized.

The second decision is to take a systemic approach to the topic of public participation. Empirical and theoretical studies of planning revealed that planning and participation have an uneasy relationship. Involvement in planning is something that is more easily agreed in word than in deed. Also, there are a number of interlinked issues in collaborative planning. So, it is decided that it is necessary to study these topics: planners and planning institutions in public participation using new technology, consensus building, exclusion, the role of power and conflicts in planning, goals of public participation, active participation, and methods of engagement in the planning process. The exclusion diagram is depicted as a key indicator to show the main barriers to active participation. The drawbacks of conventional methods of participation like roundtable are reviewed. The research then explores those studies analyzing the goals and methods of public participation (i.e. Ladder of Citizen Participation” and the IAP2 Public Participation Spectrum). It should be noted that the IAP2 Spectrum is applied as a foundation for creating evaluation criteria and passing a judgment on the technological functionalities of WPPGIS applications. Indeed, IAP2 Spectrum is used to gear the phases for effective participation to the observations and arguments, which are made about the technical feasibility of current applications. This is because the IAP2 takes a more pragmatic tactic through linking the goals of public participation with increasing public impact on decision-making.

Then, the past and present trends of technology, mainly ICT and web-based GIS applications, are identified and put into the planning context. Because one possible solution to the problem of conventional methods would be to use the power of Internet and social media. According to the existing literature, development of ICTs has arranged the groundwork for further citizen participation in the process of planning. Among this, the pros and cons of the current WPPGIS are discussed.

As shown in Figure 1, the above steps lead to the next phase where the evaluation framework is generated and the criteria are identified. The evaluation framework is identified as a possible framework to lend a systemic structure the assessment. Also, the prototype of WPPGIS application is designed based upon the evaluation framework. Based upon factors identified in the literature overview and shortcomings of traditional methods, seven and seventeen sub-criteria are derived. As noted above, IAP2 Public Participation Spectrum is used to gear the phases for effective participation to these criteria. Therefore, these criteria and sub-criteria are designated in two categories.

It is decided to assess the current practice in WPPGIS in Stockholm County. The choice of Stockholm County as a case study is made due to its robust ICT infrastructure and planning method. It is decided to use municipalities’ websites as the main empirical source for this study. The web search and analysis of applications provided an overview of web-based GIS activates in Stockholm County, which are categorized along the criteria described above. It is also generated a pilot list of GIS functionalities. Although the corresponding municipality websites did not use the “WPPGIS” terminology, it should be
noted that the listed applications are models of community-oriented geospatial information systems. Furthermore, the municipalities may have some sort of web-based services, which would be likely to disappear once project-specific goals are accomplished, an aspect that this study does not consider.

Finally, based upon shortcomings of traditional methods, technologies and GIS functionalities identified in the literature overview, the selected criteria, and the result of case study, the prototype of WPPGIS application is designed. For instance, this prototype is written using OST, which minimizes the costs, improves the security, allows greater flexibility, and allows avoiding the vendor lock-in. However, almost all web-based GIS applications in Stockholm County are proprietary or partially proprietary.

Also, the web-based GIS applications in Stockholm County support e-participation only for the purposes of providing information to the citizens, while failing to consult, involve and collaborate with them, as well as empower them with tools and means to actively participate in the entire process of decision-making. The prototype of WPPGIS application is designed to comply with the following stages of the IAP2 spectrum: ‘consult’, ‘involve’, ‘collaborate’, and ‘empower’. It enables map-based dialogue activities between citizens and planners, as well as citizens themselves. To avoid, for instance, exclusion based on the lack of time or computer literacy, its interface is simple and easy to navigate to avoid overwhelming users with the complexity of the technology.

4. Theoretical Background

The aim of this section is to demonstrate a brief theoretical orientation. First, it will explain the importance of public participation in the planning process. Among this, the conventional methods of participation and the role of the planner are discussed. This discussion leads us to the next sections where the promise of ICT and WPPGIS technologies and the optimism that the ongoing technical revolution has brought with it is reviewed. Then, these ambitions with reflections on current WPPGIS initiatives aimed at generating online participation are scrutinized. At the end, the proposed criteria for the optimal WPPGIS application are identified.

4.1 Public Participation in Planning

Urban and regional planning theories have experienced a major move in the past decades, which has radically changed the needs of planners in practice. One of the most significant
transitions has been a turn from planning as a highly technocratic practice to one where planning is meant to be responsive to the needs of citizens (Healey, 1996). Meanwhile, it is essential to observe every problem in its particular local standpoints. Indeed, the inevitability of adding expert knowledge and local knowledge to the plan and getting informed about public narratives is now fully agreed upon among planners (Brabham, 2009). Such an approach can only be maintained through dialogues with the local people. Because the planners will be able to gather enough details and facts about the problem fields (Watson, 2003). This fact explains the importance of public involvement and citizen participation at different scales and stages in the planning process, what is termed collaborative planning process (Healey, 1996; Healey, 1997).

A review of the historical background of collaborative planning reveals that it arose in response to the functionalist (rational) planning that dominated the second half of the 20th century. It evolved alongside the concepts of post-modernism and post-structuralism, which were dominating other academic disciplines at the time. Early communicative theorists, including Jean Hillier, John Forester, and Patsy Healy, among others, were heavily influenced by Habermasian philosophy. Healy (1996) writes that she and her colleagues were “searching for ways realizing [his] ideals of communicative process.”

Collaborative planning concept goes by many names, including ‘Communicative planning’, ‘deliberative planning’, ‘inclusionary argumentation’, ‘participatory democracy’, and ‘discursive democracy’, some terms being more closely linked to political science, while others are more specifically oriented to the discipline of urban and regional planning. Collaborative planning concept has dealt with acknowledging and giving voice to difference and discussing issues in the public realm. Collaborative planning theorists, in fact, consider collaborative planning as a way to invite new voices and resolve conflicts, which results in a better way of doing the process of planning (Healey, 1996). The role of the planner in collaborative planning is to mediate and coordinate a process between different interested parties, normally referred to as stakeholders or actors.

As a mediator, the planner enhances communication through which consensus in a democratic society can be achieved. In fact, democratic society respects differences and can live sustainably within its economic and social possibilities and environmental parameters. Consensus is often considered to be the ideal form of decision-making when applying these democratic principles and is discussed in much of the literature that touches upon collaborative planning in practice (Healey, 1996). Indeed, consensus building, the core of the collaborative planning thrust, is “an essential tool for planners and community development practitioners” to “increase the likelihood that the resulting plans, programs, and public policy will be successfully implemented” (Klien, 2000). O’Riorden and Ward (1997, cited in Connelly and Richardson, 2004) define the consensus process as open, participative and non-coercive, which delivers legitimacy, respect and transparency. Also, it should be noted that power relationships have a profound impact on different stages of formation of a consensus (Connelly and Richardson, 2004). Moreover, a fundamental prerequisite during consensus building is that consensus should be slowly achieved during
the decision-making process rather than in the form of output-legitimization after establishing the projects. Otherwise there is a risk that participation may end up in an output that extremely lacks realism or legitimacy or both (Healey, 1996).

While there are empirical samples of collaboration and successful participatory processes, there are also examples of processes that left undesirable results. Two case studies worthy of mention as somewhat of a mismatch between the expectations of planning theory and the realities are described by Watson (2003) and Flyvbjerg (2002). Watson (2003) describes a case in Cape Town, which shows the stark contrast to the expectations of consensus and communication found in the communicative planning literature. Although author describes Cape Town as a place where the “reach of Western modernity is less even” and this is the reason to occur the mismatch, one would find counter-examples in the Western world where the power of rationality is upheld. Flyvbjerg’s (2002) case depicts such critical case in Aalborg in Denmark as a typical Western city with democratic organization. Despite that, conflicting rationalities are evident in the planning process, and it is difficult to imagine a situation where this is not the case. Consequently, it becomes clear that there is a gap between ‘ideal consensus’ and ‘practical consensus’ (Connelly and Richardson, 2004). As a result, one would say that designing the planning procedure is a very significant stage in formation of consensus. Planning process, indeed, should be perpetually scrutinized and monitored to constantly maintain its balance between theories and practice (Connelly and Richardson, 2004).

Some planning theorists have challenged the effectiveness of communicative planning in enhancing public involvement and have questioned the inclusivity of stakeholders in terms of disenfranchised or marginalized citizens in collaborative planning process (Connelly et al., 2008; Innes and Booher, 2003). Thus, the planner as a coordinator is to be aware of the more subtle forms of power that empower or marginalize different voices in the community (Tewdwr-Jones and Allmendinger, 1998). In this role, some planning theorists argue that the planner has a responsibility not only to offer a place at the planning table to all, but also to actively search for and empower the community through education and even additional resources to the disadvantaged (Davidoff, 1965; Krumholtz and Clavel, 1994).

Also, every person, who has a stake, has to be involved in the planning process. In fact, exclusion of any individual actor from a planning process is a latent hazard to the legitimacy of the whole procedure. Another important argument is that force is often used to create consensus through exclusion and manipulation (Connelly and Richardson, 2004). Moreover, social exclusion may leave citizens with a feeling that “participation is not for people like me” (Lowndes et al., 2005). These impediments could diminish motivation and the quality of involvement. The important question is, what leads to the social exclusion during meetings? The exclusion diagram gives an answer to this question and specifies the main causes of social exclusion (see Figure 2). Exclusion can take place through some blurred factors such as the level of detail of spatial identifiers, unverified and problematic information on an area connected with individuals or a group, lack of an inoffensive atmosphere without pre-defined standards for moderation and censorship (Barton et al.,
2005 and Shen et al., 2009). Also, if the citizens are not involved from the first step, then they could feel that they have not influenced the planning because the authorities have already made certain decisions (Yli-Pelkonen, 2005). Exclusion may occur in three areas: exclusion of people (by means of shaping a closed decision-making core and splitting people into outsiders and insiders groups), exclusion of topics (via over-emphasizing few main issues) or exclusion of outcomes. Sufficient caution and negotiation in designing the process of consensus making is essential to avoid any kind of exclusion (Connelly and Richardson, 2004). It is also argued that by allowing citizens to explore issues at different spatial and temporal scales, these citizens are likely to be freed from the restrictions of their particular marginalized situations (Ramasubramanian, 2010).

Figure 2: Exclusion Diagram

Flyvbjerg (2002) criticizes the communicative rationality on other grounds such as power relations and distortion of the planning process by power due to ambiguity of the planning process. In fact, in communicative rationality, the planning knowledge is produced through a communicative learning process between the local community and the planners. Moreover, in collaborative planning process a novel distribution of power and transparency is required. Also, the expert knowledge and the local knowledge have to meet on the same forum and the tacit knowledge of citizens should take an explicit form (Nuojua, 2010). In this way, it can be inferred that public involvement in planning is equal to creation of the planning knowledge as well as a contribution to the decision-making process. The term ‘indigenous’ or ‘local’ knowledge relates to the unique knowledge of a given culture and society and can be considered as the ‘experiential’ and ‘contextual’ knowledge attached to the people’s day to day life as well as to the spaces where they live, work, and act. Since the
experiential knowledge lacks verification of the expert knowledge, the relationship between the expert knowledge and the experiential (or local) knowledge is considered to be a big challenge in citizen participation (Nuojua, 2010).

Regardless of the above-mentioned critics, public participation is still a crucial part of modern planning theory. Critics of collaborative planning do not argue for the dismantling of public participation, but rather discuss for a better understanding of the role of power and conflicts in planning and enhancing ‘active’ citizen participation in the planning process at various scales (Weninger et al., 2010; Kingston, 2007). From this sense, there is a strong need for a planning process, which allows effective participation. Connelly and Richardson (2004) argue that a planning process, which best fulfills our goals of a deliberative process, will be messy, often with areas where no consensus is remotely possible. A dissection regarding the public participation and its objectives in the planning process would be incomplete without consideration of the work of Sherry R. Arnstein. Her “Ladder of Citizen Participation” (1969) has identified how planners conceptualize citizen participation. The eight-rung ladder scrutinizes the extent of citizens’ power in determining the end product. The bottom rungs of the ladder are ‘manipulation’ and ‘therapy’, which describe the level of ‘non-participation’. Rungs 3 and 4, ‘informing’ and ‘consultation’, progress to levels of ‘tokenism’ that allow the have-nots to hear and to have a voice. Rung 5, ‘placation’, is simply a higher level ‘tokenism’ because the ground rules allow have-nots to advise, but retain for the power holders the continued right to decide. The ladder culminates with ‘citizen power’ manifested through ‘partnership’, ‘delegated power’, and ‘citizen control’. For Arnstein, the main aim to involve in a participatory process was to redistribute power and give voice to those excluded from political and economic processes. Although Arnstein classifies information and consultation as tokenism, she writes that “informing citizens of their rights and responsibilities can be an important first step towards legitimate public participation” (Arnstein, 1969). Thus, if a project is restricted to unidirectional information provision, it cannot be considered as a participatory planning activity. In fact, Arnstein’s ladder is a valuable starting point in the discussion of the goal of citizen participation. However, Arnstein’s ladder is quite dated and by framing citizen control of government-led decision making as the only pathway to political power, she ignores the influence and contribution of other influential sectors in shaping democracy (Ramasubramanian, 2010).

The International Association for Public Participation (IAP2) takes a more pragmatic tactic through linking the goals of public participation with increasing public impact on decision-making. Their spectrum of public involvement goals begins with ‘information sharing’ through to ‘empowerment’, demonstrates in Table 1 on the next page.
Table 1: IAP2 Public Participation Spectrum

<table>
<thead>
<tr>
<th>INCREASING LEVEL OF PUBLIC IMPACT</th>
<th>PUBLIC PARTICIPATION GOAL</th>
<th>PROMISE TO THE PUBLIC</th>
<th>EXAMPLE TOOLS</th>
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<tbody>
<tr>
<td>INFORM</td>
<td>To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.</td>
<td>We will keep you informed.</td>
<td>fact sheets, web sites, open houses.</td>
</tr>
<tr>
<td>CONSULT</td>
<td>To obtain public feedback on analysis, alternatives and/or decisions.</td>
<td>We will listen to and acknowledge concerns and provide feedback on how public input influenced the decision.</td>
<td>public comment, focus groups, surveys, public meetings.</td>
</tr>
<tr>
<td>INVOLVE</td>
<td>To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.</td>
<td>We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.</td>
<td>workshops, deliberate polling.</td>
</tr>
<tr>
<td>COLLABORATE</td>
<td>To partner with the public in each aspect of the decision, including the development of alternatives and the identification of the preferred solution.</td>
<td>We will look to you for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.</td>
<td>citizen advisory committees, consensus-building, participatory decision-making.</td>
</tr>
<tr>
<td>EMPOWER</td>
<td>To place final decision-making in the hands of the public.</td>
<td>We will implement what you decide.</td>
<td>citizen juries, ballots, delegated decisions.</td>
</tr>
</tbody>
</table>

Information sharing, to ensure that information is balanced and objective, and for the purpose of assisting participants achieve a better understanding of the problems, alternatives, and/or solutions. Consultation, to guarantee that public feedback on analysis, alternatives and/or decisions is obtained. Involvement, to work directly with the public in order to public concerns and aspirations are consistently understood and considered. Collaboration, acts of partnership in every aspect of the decision-making process, and empowerment to place the final decision-making in the hands of the public (IAP2, 2013).

From this perspective, the overarching goal of any method of public participation endeavor is to keep this spectrum intact. Several conventional methods of participation have been discussed in the literature such as roundtables, dialogues, government-led active participation, citizen-led active participation, sticker map methods, and photovoice (Connelly and Richardson, 2004; Nuojua, 2010). The above-mentioned methods of participation have been criticized by many scholars for several reasons. Communicative planning theorists argue that public participation in practice often fails to live up to our
expectations mainly due to drawbacks of conventional methods of participation. The major methods of participation are nearly always held in a fixed place and at a fixed time, often when people cannot attend.

Also, equality in the communication among citizens and between them and responsible officials is hard to guarantee in fixed places and at certain times. Indeed, fixed places and times can cause social exclusion. Also, the meetings are quite often challenging, they can be dominated by vocal minority groups, it is often difficult for the layperson to understand and prepare, and the whole process quite often involves highly technical and legal ‘jargon’ (Kingston, 2007; Nuojua, 2010). In fact, critics of conventional methods of participation, such as meetings, indicate that citizen prefer selective, focused, and limited local level involvement and it can be concluded that current planning practices require a new way of thinking and more importantly new tools and methods to improve the role of citizens in participatory and collaborative planning process (Kahila and Snabb, 2010). They, indeed, require methods, which can be simultaneously interactive, transparent, and democratic (Nuojua, 2010). In other words, the new methods allows citizens from different walks of life to participate in the planning process.

Substitute methods of participation in planning by making use of ICTs and WPPGIS technologies are being the key focus and gateway into participation in the planning system in recent years. In the mid-1990s, a number of instances were developed, which made use of GIS technology within public participation process (Kingston, 2007). The following sections explain the role of ICT and WPPGIS technologies in the planning.

4.2 The Role of ICT in Planning

The growth of Information and Communication Technology (ICT) has given rise to a wide verity of changes in the society. These changes involve structure, form, and socioeconomic issues of cities (Van der Meer et al., 2003). As it has been portrayed by Manuel Castells (2004), technological development over the last decades has drastically changed our communication patterns and has led to the creation of what has been termed ‘The Network Society’.

In addition, the Internet and the stream of ICT have become the basis of a new technological paradigm, which has caused fundamental shifts in our society towards ‘The Internet Galaxy’ (Castells, 2005 cited in Höffken et al., 2010). The Internet galaxy or information society is demonstrating a new era, which is characterized by diffusion of the Internet as well as the emergence of a new way of communication by which messages can be sent from many to many, in real or chosen time, and with the possibility of using point-to-point communication, narrowcasting or broadcasting, depending on the purpose and characteristics of the intended communication practice (Castells, 2009 cited in Höffken et al., 2010).
However, it should be emphasized that cities vary with respect to manifestation of informational mode of development. In fact, cities have co-evolutionary and dynamic behavior (Portugal, 2012) and to cope with such dynamics we need self-organized systems, which are adaptive and can coevolve with these uncertain circumstances (Batty, 2007). Thus, one would say that the abilities of ICT can assist knowledge circulation through the system and increase system’s intelligence. In fact, electronic content, electronic access, and electronic infrastructure interdependently shape the dynamics or ‘flywheel’ of information societies; and these three aspects of manifestation are fundamentally functions of different economic, social, political and institutional variables of each society (Van der Meer et al., 2003).

Shirky (2008) argues that the rise of Internet in general and recently the emergence of new technologies, which facilitate interactive information sharing, user-centered design, interoperability, and collaboration on the World Wide Web, leads to collapse of the costs of global publishing. Easy to use and free communication technologies have brought about a shift from one-to-many to many-to-many way of communication, challenging the dominance and even the existence of ‘old-fashioned’ media like television, newspapers, and radio. Shirky (2008) also asserts that “we are living in the middle of a remarkable increase in our ability to share, to cooperate with one another, and to take collective action, all outside the framework of traditional institutions and organizations”. Höfken et al. (2010) mention that even though the Internet at first stage was used as information medium, nowadays it is considered as a participatory medium through which to connect, discuss, and participate in nearly every aspect of daily life. In fact, the web is the ideal medium for easing active participation based on its accessibility, anonymity, interactivity, speed and the ability to support any other form of media. Web can be considered as a revolutionary instrument that changes the way we communicate and it can eradicates problems caused by difference in time and space among different participants (Hudson-Smith et al., 1998; Brabham, 2009).

Research also indicates that the Internet has a growing significance for people who find it difficult to socialize due to a detachment from the society in which they live, such as newcomers or the socially excluded (Stockholm län Regionplane- och trafikkontoret, 2007). Brabham (2009) mentions that “medium of the web enables us to harness collective intellect among a population in ways face-to-face planning meeting cannot.” He also argues that the web-based applications may empower citizens to participate and it may give voice not only to those typically excluded from the participation process altogether, but also to those who are typically involved, but are drowned out by polar arguments (Brabham, 2009). Also, the web-based applications might boost participation, because citizens would have the opportunity to participate in ways that fit their interest in the project (Brabham, 2009). Kingston et al. (2000) point out that Internet-based technologies have the potential to amplify participation at least in the UK planning system. Moreover, urban and regional planning practice is mostly map-based and the most efficient way to acquire useful local knowledge would be through a map-based application enabling a good communication between planners and stakeholders.
According to the existing literature, development of ICTs has arranged the groundwork for further citizen participation in the process of planning. In fact, it has provided the new tools for governments, municipalities and planners ranging from online voting systems to web-based GIS applications (Rinner and Bird, 2009; Wallin, 2010). Involvement of citizens and stakeholders in the decision-making process with the help of ICTs in government and governance by benefit of information, voting, polling, and discussion is referred to as ‘e-Participation’, ‘e-Democracy’ or ‘e-Government’. Sæbø et al. (2010) indicate that the idea of empowering citizens and increasing democratic and deliberative traditions with new technological potentials is commonly declared as a goal for ‘e-Participation’ services. In other words, it describes the efforts to broaden and deepen political participation by allowing citizens to connect with one another and with elected representatives and government by the use of ICT. Hence, it meets the needs of both parties, namely citizens who want to be heard and involved and government that seeks new devices to boost citizen participation (Höffken et al., 2010; Nuojua, 2010). With the help of ICTs, indeed, communication between urban planners and citizens can be facilitated. In this way, not only planners, but also citizens can take part in the production and delivery of urban information (Wallin, 2010; Kahila and Snabb, 2010).

In another research, it was indicated that different web-based participation applications have deployed a different set of social media as channels to reach out citizens. The applications were analyzed on the basis of users' interaction and number of users. Variations in the level of interaction and the number of participants turned out to be enormous. Furthermore, Facebook and Twitter have been the most commonly used channels. It was concluded that planners can harness the power of social media for the urban planning process (Höffken et al., 2010).

In sum, the recent trend of Internet use as a mean to affect the planning institution and society indicates that the traditional techniques of public participation will need to evolve and to adapt ICT in order to remain applicable to broad audience. Public participation and ICT go hand in hand, providing an unprecedented ability to collect people’s needs and isolate the most urgent changes that the local or wider communities may desire. The widespread Internet infrastructure, the increased in computer literacy as well as the ability to process huge amount of data quickly and at reduced cost is what makes ICT so vital to modern public participation. Recently, several ICT-assisted applications have been experienced the world over in the field of Planning Support Systems (PSS), Public Participatory GIS (PPGIS) and Web-based Public Participatory GIS (WPPGIS). Especially techniques like PPGIS and WPPGIS, which are outline in more detail in Section 4.3, aim to support the more effective participation of citizens in urban planning practices and rapidly increase over the past 10 years.
4.3 Web-based Public Participatory GIS

PPGIS idea was initiated in 90s based on the critiques about GIS and its ability to deal with social issues and to democratize GIS, which was developed originally for a professional use (Craig et al., 2002). In 1993, the National Center for Geographic Information and Analysis (NCGIA) upheld a workshop called Geographic Information and Society. This meeting was about a series of research questions on a possible bottom-up GIS, and how to incorporate participation into GIS. In fact, PPGIS, which touches upon the various applications, is referred to use the GIS capacities to serve the needs of Participatory Planning (Ramasubramanian, 2010; Steinmann et al., 2004). Its discourse contains concepts such as participation, access, empowerment, and marginalization within the context of a community-based GIS (Holley, 2003). In other words, “the resulting definition of PPGIS focused normatively and ontologically on supply-driven and pragmatic approaches to engage the public in applications of GIS with the goals of improving the transparency of and influencing government policy (Schroeder, 1996 cited in Sieber, 2006)”.

Along with introduction of the PPGIS concept, general awareness of the potential of the web in supporting participatory planning began to arise. Actually, the web was described as a platform for a real-time, bi-directional communication channel between different parties. Compared to conventional PPGIS, web-based applications provide fewer opportunities to draw in the above mentioned attributes without technical skills. On the other hand, the very weakness of conventional PPGIS is that it fails to store, process, and present qualitative information since alternative forms of knowledge presentation such as maps, narratives, and images, which are crucial for understanding issues related to places, have been excluded from GIS (Nuojua, 2010).

However, WPPGIS technology is concerned with a range of issues raised by the intersection of community interests and web-based geospatial technologies. One concern is related to usability of the system. Indeed, WPPGIS practitioners need not only upload a WPPGIS to a web site, but also must design it in an effective, efficient, and sufficient way for users to perform specific tasks. If the system usability is unacceptable, this could cause issues such as wasting users’ time, making them frustrated, and eventually discouraging their engagement in the public participatory process (Meng et al., 2010). Meng et al (2010) also point out that “the system effectiveness has a strong influence on the users’ duration on the web site and interactions with each other” and they suggest that WPPGIS designers “should focus on improving the system features, such as navigating the web site, locating desired documents, and enhancing content; design functions that work with standard web...
browsers; and choose the right resolutions to attract users to stay longer on the web site and interact more with others”. To enhance the system efficiency, they suggest that WPPGIS designers “should advance and highlight certain features, such as using fewer buttons and clicks to get to the destination page, speeding up page loads, reducing steps in the process, and reducing the amount of information to be filled out so users visit the web sites more frequently, view more pages, and interact more often with other participants”. To foster the level of satisfaction, they offer that WPPGIS designers “should modify and enhance some features -such as making the task more obvious and intuitive so it is more easily completed by users- to attract users to the web site more often (Meng et al., 2010)”. One would say that the key element of system usability is user interface. Certainly, if the user interface is unintuitive and hard to access, there is a great risk of losing users (Östlund, 2009). Hopkins et al. (2004) discover that some people often just give up in the middle of the participation process due to learning barriers and complicated interfaces. It is worth mentioning that the result of a survey in the Netherlands indicates that the most significant attributes of a preferred WPPGIS application are to be user-friendly, flexible, transparent, and adaptable to the planning situation. These obvious challenges cannot be removed unless the developers address the target groups during the design process (Türkücü, 2007).

Through the literature and real world examples, it can be seen that proprietary products of web GIS-based solutions have been found very expensive (Nuojua, 2010). For instance, ArcGIS-Server is a proprietary GIS software platform from ESRI. It can manage GIS web server with control over accessibility, functionality, and upload. It is also capable of providing extended GIS functionalities through the Internet such as buffer zoning and network analysis. It can provide good support to mobile devices for data collection and map updating. However, as Møller-Jensen et al. (2012) mention its main “drawback is of course that it is a very expensive solution and more complicated to run and therefore out of reach of urban neighborhood communities without extensive financial and technical management support.” It is worth mentioning that pricing for proprietary software such as ESRI products is based on a number of factors, including how it is licensed. For instance, the price of ArcGIS-Server Enterprise Advanced (up to four cores) in 2012 in USA was $32,643. There are also extra charges for annual maintenance and different extensions (North Carolina State, 2013). Also, there are several arguments against the proprietary software. The pitfalls of proprietary software will be discussed in more detail in Section 4.4 to explain why practitioners prefer the OSS over the proprietary software.

Some other barriers of WPPGIS applications are cost of interactivity, data and copyright costs, trust and legitimacy, user diversity (Wong et al., 2001), and risk of providing services that the public does not want (Nuojua, 2010). At present, WPPGIS uses very limited GIS functionalities and mostly involves digital cartography, which links local (qualitative) and expert (quantitative) knowledge. Utilization of multimedia technologies can assist new forms of integrating citizens into urban planning process. A thoughtful amalgamation of multimedia and interactive functions on the basis of web has the potential to introduce innovative forms of participation (Weninger et al., 2010).
Miller (2006, cited in Nuojua, 2010) suggest that using a mash up, a website that combines data and services from across the web into a single integrated application, with Google Maps displays great potential to be a real-live PPGIS. However, still there are only a few applications, which have utilized truly interactive medium approach in the development of support systems for planning process. An exception is ArgooMap, a simple decision support tool for planning, enabling Internet users to submit location-based comments and respond to contributions from other participants (Nuojua, 2010).

Another example is a WPPGIS application based upon the interactive medium and Google maps mash up called WEB-MAP-MEDIA (WMM), which was introduced by Nuojua (2010) in Finland. The application is based on OSS and claimed to facilitate knowledge creation in the planning process. Map-based discussion forum of this application triggered an innovative brainstorming. Some issues that were neglected by planners during the planning process in two experiments in Finland, evoked public debate and caused the tacit local knowledge take an explicit form. It also lays the groundwork for further participation of marginalized groups of the community. According to the experiments, WMM shows a regular but short-term ‘lunch break’ form of participation during the work time of the day. In this way it can overcome temporal and spatial limitations of the conventional participation method. The results of the research suggest that the web-based technology may provide a means to create knowledge collectively with minimal commitment. The experiments of the research show that different means of participation have mutual relationships. And web-based application can add knowledge to the expert knowledge by providing virtual discussion forums that are independent of the planning formal meetings in terms of time and space. One would say that WMM was found an easy and inexpensive way to broaden the size and spectrum of the participant groups in the process of planning. In contrast, Nuojua (2010) mention that even though the adaptability of the technology is a significant requirement of participation supporting systems, it is not enough by itself. It is also crucial to change the attitudes of the planners to be more responsive to the knowledge produced by a layman. The discussion on the forums should be made really two-way. Additionally, planners should pay attention to the medium that material will be presented in. The existing practiced of planning does not sufficiently support web-based presentation. The plans on the web should be able to present themselves, and this makes web-based visualization challenging, particularly if the material is originally produced for a live meeting with large printed collages.

In another research, a bottom-up initiated application called Nexthamburg, was analyzed on the basis of users’ typology and interactivity with the platform. Three parameters were observed in the research namely posts, comments, and votes. Based on the statistical results, users could be classified into two groups: active and reactive producers and passive information seekers. It was also indicated that most users prefer to contribute in the less time consuming way, in this case by voting (Weninger et al., 2010). Another WPPGIS prototype worth to mention is developed by Bugs et al. (2010) to enhance local participation in Cnela, Brazil. This application is based on OSS. Also, they claimed that they provide a rather reasonable level of interaction by using this application. Another
example belongs to Hedensted Kommune in Denmark, which “enables and facilitates dialogue activities between citizens and the municipality, citizens themselves, institutions and the municipality” (Ghazawneh, 2008). The research shows that during the studied time frame (November 2007 to April 2008), there were a total of 4,041 visitors who contributed 388 ideas and 209 comments of which 70% of the ideas were considered “feasible” (Ghazawneh, 2008).

Stern, et al. (2009) recently evaluated a real-world case of neighborhood revitalization in Israel, which examined whether the potential advantages of the expanding practice of WPPGIS only complement the benefits of the traditional techniques or whether they are empowering enough to replace them. The study compares quantities and contextual contributions of WPPGIS and traditional techniques of public participation throughout the year-long planning process of a multicultural residential quarter in the southern part of Tel-Aviv. They mention that their case study is one of four socially and economically deteriorating neighborhoods undergoing a participatory-based process of urban revival. In their work, comparisons are made at four major planning intersections in order to study the contributions of each technique to the qualities of involvement, trust, and empowerment. They mention that web-based participants not only differ from traditional method participants, but also differ from each other based on the education, age, and religion. For instance, the older and more religious residents participate only in the traditional meetings. They indicate that WPPGIS application increases involvement among those who participate both in the traditional meeting and Internet. The same conclusion also applies to the effects of WPPGIS technique on the empowerment and trust. Ultimately, they conclude that “WPP [GIS] is an effective and affective complementary means for public participation, but it cannot yet replace the traditional unmediated techniques” (Stern et al., 2009).

The above cited case studies reveal that there is a major gap between what is seen as the possibility of technology to influence the political sphere and foster the public participation and what its actual outcome is. While contextual elements like the attitudes of planners and decision makers are seen as primary barriers to bridging the planning process and technology-based solutions, other barriers such as proper user interface, price of software, technical and literacy skills, as well as trust and legitimacy and user diversity have been recognized. One case study above illustrates WPPGIS initiative that have had success and it can be used in the creation of knowledge during planning process, but given the contextual barriers such as the attitudes of some participants indicates that the technology-based solutions should not be considered as replacement of the conventional methods. In other words, WPPGIS applications must be seen as methods to enhance the current public participation efforts.

Thus, it is possible to conclude that an optimal WPPGIS application should be interactive, cost-effective, user-friendly, flexible, transparent, and adaptable to the planning situation. In the next section, a further step will be taken to provide the significant factors, which will be used to evaluate WPPGIS applications.
4.4 Evaluation Criteria for WPPGIS applications

From the review of the existing literature and above-cited practical examples, the following seven main criteria are derived and are considered for evaluation of WPPGIS applications: ‘licensing model’, ‘GIS functionalities’, ‘user friendly interface (or ease of use)’, ‘security implementation’, ‘sharing information’, ‘consultation’, and ‘synchronous collaboration and decision-making’. It should be noted that each criterion is broken into two or more sub-criteria, which are similar to the factors that are adopted by different researchers such as Butt et al. (2012), Zhao et al. (2007), and Steinmann et al. (2004).

Also, as previously mentioned, within collaborative planning theory, the main features of a successful planning process that theorists are concerned with today revolve around the effective public participation. Thus, these criteria are aligned to the IAP2 Public Participation Spectrum cited in Section 4.1. Based upon phases identified in that spectrum, these seven criteria have been designated in two categories. First, in order to touch the first stage of the IAP2 spectrum (i.e. ‘inform’; to provide the public with balanced and objective information), it is necessary to use an application that is cost-effective, user-friendly, secure and capable to keep public informed. So, the first five criteria were selected to represent the ‘inform’ stage.

The other criteria (i.e. ‘consultation’ and ‘synchronous collaboration and decision-making’) are considered as exposure to the four phases of the IAP2 spectrum: ‘consult’, ‘involve’, ‘collaborate’, and ‘empower’. These phases emphasize that public feedback on analysis, alternatives and/or decisions is obtained. Also, planners work directly with the public throughout the process in order to provide feedback on how public input influenced the decision. The technological components to pursue the above objectives can be found in these two criteria: ‘consultation’, and ‘synchronous collaboration and decision-making’. In the following paragraphs, the above criteria are elaborated.

1. Licensing model. We are witnessing a major shift towards OSS as an optimum solution in recent years. There are at least three mean reasons why OSS is the better choice over proprietary software. First, enterprises find that they consistently get great value from OSS. The quality of OSS met or exceeded the expectations of 92 percent of respondents to a recent survey conducted by Forrester Research. Meanwhile, 87 percent of respondents said that OSS delivered the cost savings they were hoping for (Linuxinsider, 2013). Secondly, acquisition cycles and associated entry costs are insignificant for OSS, at least for pilot projects and initial rollouts. Enterprises can use free versions of software to start a project without having to endure the protracted sales and acquisition cycles that often accompany pilot projects with commercial software. There are also scores of companies that build value-added capabilities on top of this freely available code, enabling an easy path to deploy open-source-based applications in production. This more economical acquisition and deployment model allows organizations to devote greater portions of their
budgets to customizations and innovations that really matter (Linuxinsider, 2013). Thirdly, “open-source applications can be even more secure than their commercial equivalents. Open-source communities fixed security vulnerabilities twice as quickly as commercial software vendors did, according to a recent study by Veracode (Veracode is an Application Security Testing Company). Open-source communities may seem chaotic and occasionally fractious, but they can be remarkably agile and cohesive when it counts. They've repeatedly shown they can do an excellent job discovering, characterizing, and patching security vulnerabilities. In addition, these community open-source security practices are often backed by suppliers that provide commercial support and indemnification, which has had a dramatic effect on the rollout of open-source applications in the enterprise (Linuxinsider, 2013).”

In fact, proprietary licensing creates de facto monopolies. Proprietary companies guard their aftermarket monopoly zealously. There is just one company, which can provide support, upgrades, and enhancements for proprietary software, but open-source vests the market power in the software user, not the vendor. License liability is another drawback of proprietary software (Ramsey, 2010).

In a nutshell, OSS has been proven to provide better value, lower costs, improved security, fewer bugs, more modularity, faster release cycles, better performance and addressing the most important enterprise considerations today (Ramsey, 2010, Linuxinsider, 2013).

2. **GIS functionalities.** The basic functionalities of a WPPGIS are indicated by these three features: `map browsing (pan, zoom)`, `spatial query`, and `map printing`. The variables are dichotomous in nature, with ‘Y’ representing the presence of the functionality and ‘-’ the lack thereof.

3. **User friendly interface (or ease of use).** The concept of user friendly interface is represented a range of functionalities that are designed to promote ease of use and productivity. The main elements of this criterion are as follows: `easy to navigate`, `proper speed`, and `completeness and correctness`. Since ‘easy to navigate’ and ‘proper speed’ are qualitative variables, they are evaluated based upon appearance and performance of different applications.

4. **Security Implementation.** Security implementation denotes concern over privacy and security. This criterion is indicated by `login authentication`, and `forum security`.

5. **Sharing Information.** The term of sharing information refers to the components that provide the public with balanced and objective
information to assist them in understanding the problems. This criterion is demonstrated by ‘availability of meeting documents’ and ‘projects details’.

6. **Consultation.** Consultation denotes to the features that obtain public feedback and votes. This criterion is presented by ‘commenting tools (sketches, annotation)’, ‘voting tool’ ‘discussion forum’, and ‘view participants’ feedback’.

7. **Synchronous Collaboration and Decision-Making.** This term refers to components that can be used to work directly with the public in order to public concerns and aspirations are consistently understood as well as to partner with the public in each aspect of the decision. This criterion is represented by ‘real-time messaging’, ‘video conferencing’, and ‘screen sharing’.

The above-cited criteria and sub-criteria, along with their phase of IAP2 Spectrum, are listed in Table 2 on the next page.
<table>
<thead>
<tr>
<th>Phase of IAP2 Spectrum</th>
<th>Criterion</th>
<th>Sub-Criterion</th>
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<tr>
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<td>Licensing model</td>
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<td>GIS functionalities</td>
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<td>- Inform</td>
<td>User friendly interface</td>
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<td>- Consult</td>
<td>Consultation</td>
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<td>- Involve</td>
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<td>Voting tool</td>
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<td>- Collaborate</td>
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<td>Discussion forum</td>
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<td>- Empower</td>
<td>Synchronous collaboration and decision making</td>
<td>Real-time messaging</td>
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<td>Video conferencing</td>
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<td>Screen sharing</td>
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5. Case Study: Stockholm County

This research is intended primarily at community planning in areas where public participation is better treasured as an ideal and where a robust ICT infrastructure to support e-participation services exists. From this perspective, Stockholm, as the capital of Sweden, is a suitable choice of case study for research on WPPGIS technology because it has developed its international reputation for being one of the leading countries in technology and having a robust ICT infrastructure. Also, according to the Swedish Planning and Building Act, public participation in the planning process is emphasized as being vitally important (Hansson et al., 2013).

Stockholm County (Stockholms län) is located on the east coast of the country on the coast of the Baltic Sea. Also, Stockholm County is home to 2,135,865 residents. In fact, Stockholm County is the most densely populated of the 21 Counties in the Sweden with approximately 9.5 million inhabitants. The County is administratively divided into 26 municipalities and Stockholm municipality is the most central of the 26 municipalities in the metropolitan area (USKAB, 2013).

Traditionally, planning in Sweden is a task for the municipalities. Indeed, the relationship between state and municipalities in terms of responsibility for planning is currently undergoing continuous modification. The state is taking less and less of role and responsibilities because the top-down and large-scale tasks and all-embracing solutions are no longer feasible (Alfredsson et al., 2001).

Municipal planning carries out at two levels, detailed planning and comprehensive planning. The comprehensive plan is a flexible, strategic document, which expresses long-term perspectives and reflects public interest. While the detailed development plan is a binding executive planning instrument - a legal agreement between the municipality, the public and the land owners - making it possible to implement the intentions of the comprehensive plan (Alfredsson et al., 2001).

The normal planning process is divided into five stages that lead to a legally binding plan. These five stages are: program, consultation, exhibition, approval and appeal period. The objective of each stage is to promote dialog with concerned stakeholders, experts and organizations because according to the Swedish Planning and Building Act, public participation is a prioritized issue. Furthermore, all decisions concerning comprehensive or detailed plans can be appealed (Alfredsson et al., 2001; Östlund, 2009).

As far as new technologies are concerned, all municipalities in Stockholm County have their own website, but 21 municipalities out of the 26 municipalities have their own web-based GIS application. As noted in Section 3, although the corresponding municipality websites did not use the “WPPGIS” terminology, the listed applications are models of community-oriented geospatial information systems. Furthermore, the municipalities may have some sort of web-based services, which would be likely to disappear once project-specific goals are accomplished, an aspect that this study does not consider. Table 3 shows
a comparison between web-based GIS applications, constructed based upon the evaluation criteria from Section 4.4.

As seen in Table 3, 8 municipalities (38%) use partially proprietary software solutions, which are partially based on OSS (the core GIS functionality is proprietary, but some of the underlying libraries and technologies are open-source). All applications implement the same set of GIS functions, except for one, which lacks support for printing the maps. All applications are easy to navigate and have the ability to complete or correct the search parameters. That being said, it is often difficult to find what you are looking for on the municipalities’ websites. Seven (33%) applications have problems with responsiveness due to lack of smooth transitions during zoom operations and other actions performed by users. It deserves to be noted that all these seven applications are fully proprietary. Five applications (24%) include features (such as commenting tools), which require user registration in order to be used. While the details of projects are accessible through the municipalities’ websites, none of the municipalities publish their ‘meeting documents’. None of the municipalities offer any opportunities to enable synchronous communication and participation, nor do they offer discussion forums or voting tools. Four municipalities (19%) offer the ability to pin comments on the map. It should be noted that all municipalities’ websites have an option for asking questions and receiving answers via email.

The results demonstrate that almost all web-based GIS applications in Stockholm County include the features to support the following two criteria: ‘GIS functionalities’, and ‘user friendly interface’. ‘Security implementation’ and ‘sharing information’ are only partially implemented. Almost all web-based GIS applications have failed to comply with the remaining two other criteria: ‘consultation’, and ‘synchronous collaboration and decision-making’. On the other hand, as mentioned before, ‘licensing model’, ‘GIS functionalities’, ‘user friendly interface’, ‘security implementation’, and ‘sharing information’ are related to ‘inform’ stage of the IAP2 spectrum. However, ‘consultation’ and ‘synchronous collaboration and decision-making’ are linked to the following stages of IAP2 spectrum: ‘consult’, ‘involve’, ‘collaborate’, and ‘empower’.

In conclusion, the above findings indicate that the web-based GIS applications in Stockholm County support e-participation only for the purposes of providing information to the citizens, while failing to consult, involve and collaborate with them, as well as empower them with tools and means to actively participate in the entire process of decision-making. The findings also reveal that development and deployment of WPPGIS applications in Stockholm County is still at its infancy, and that a lot of work remains to be done before it reaches satisfactory levels.
Table 3: Comparison of Web GIS Applications in Stockholm

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Licensing model</th>
<th>Site</th>
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<tbody>
<tr>
<td>Stockholm</td>
<td>Proprietary</td>
<td><a href="http://www.stockholm.se/">http://www.stockholm.se/</a></td>
</tr>
<tr>
<td>Sollentuna</td>
<td>Proprietary</td>
<td><a href="http://www.sollentuna.nu/">http://www.sollentuna.nu/</a></td>
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<tr>
<td>Solna</td>
<td>Proprietary</td>
<td><a href="http://www.solanahms.nu/">http://www.solanahms.nu/</a></td>
</tr>
<tr>
<td>Söderhamn</td>
<td>Proprietary</td>
<td><a href="http://www.soderhamn.nu/">http://www.soderhamn.nu/</a></td>
</tr>
<tr>
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6. Constructing a Prototype of WPPGIS Application

An objective of this study is to design and implement a prototype of WPPGIS application in order to facilitate citizen participation in the decision-making process and meet some of the requirements discussed in Section 4.4. This section documents the architecture, development environment, data description, and implementation. An overview of deployment strategy of created prototype application is provided as well.

6.1 Application Architecture

The application is based on server-client architecture, using the web application paradigm. The main components of application architecture are shown in Figure 3.

Clients display the data obtained from the server, and send out requests for adding new data or modifying the existing data. Server receives the client requests, serves the data to clients, and processes requests for adding or modifying data in accordance with internal business logic.

Figure 3: Application Architecture
The client side consists of HTML, CSS, and JavaScript code running inside of a web browser. The use of standard web browser technologies for connecting to the server reduces the entry threshold, and allows a wider user-base to use the application without the need for complicated installation procedures of additional software. No special plugins are necessary on the client side. The only requirement is that the web browser supports HTML, CSS, and JavaScript.

The server side consists of one or more web servers, which serve data to the clients via HTTP protocol, and database server that provides storage for user data. Separate web servers may be used for running the web application and serving the static files.

The server-side application stores its configuration in a file, while the user data is being written to and retrieved from a database server.

This application is using both client-side and server-side rendering. HTML code is generated server-side, while the maps and map-related data are rendered purely on the client side. JavaScript code is used on the client side to manipulate the generated HTML where appropriate.

The application is written using open-source technologies, which minimizes the costs, improves the security, allows greater flexibility, and allows avoiding the vendor lock-in.

### 6.2 Development Environment

The application has been developed using the following development environment:

- **Ubuntu**: Ubuntu is a GNU/Linux distribution based on Debian GNU/Linux developed by Canonical. It comes with an easy-to-use interface, and a plethora of applications at its disposal that can be used for making the development process easier. It has also a massive base of open-source software, which they can be downloaded for free (Srinivasan, 2013).

- **Git**: Git is a distributed version control and source code management system. Git provides tracking file changes in a repository, with full history, and the ability to revert one or more files to its older state. Git also comes with features that make it easier to test new ideas and implementations without breaking the working code (Git, 2013).

- **Github**: GitHub is a web-based hosting service for software development projects that use the Git revision control system. GitHub is a convenient service for developing, sharing, and improving open-source projects (Github, 2013).
- **Django built-in server**: Django comes with a built-in web server capable of both running the WSGI applications, as well as serving the static files. Due to its ease of deployment (its built-in part of the framework), automatic reloading of code, and low developer overhead, it is the preferred server used during development of Django-based web applications (Django, 2013).

- **Virtual Environment (Virtualenv)**: Virtualenv has been used in order to provide isolated Python environment during the application development.

- **Mozilla Firefox**: Mozilla Firefox is an open-source web browser that comes with a number of useful extensions for both end users and developers.

- **Firebug**: Firebug is a Mozilla Firefox extension that provides some advanced tools useful for developing and debugging client side of the web applications. It comes with an interactive JavaScript console, logging of all HTTP requests, as well as HTML DOM inspector.

- **Firefox Web Console**: Firefox Web Console is a built-in development tool within Mozilla Firefox application. Similar to Firebug, it provides a number of tools for working interactively with JavaScript, logging HTTP requests and responses, and inspecting the HTML DOM elements.

- **GNU Emacs**: GNU Emacs is a versatile extensible text editor. At its simplest, Emacs provides syntax highlighting, automatic indentation, as well as advanced search and replace functionality. In combination with additional plug-ins and extensions, Emacs can be turned into a full-blown IDE for a number of different languages and frameworks (Srinivasan, 2013).

### 6.3 Data Description

The map data, which have been used in this study, are taken from the OpenStreetMap site. OpenStreetMap is a project that creates and distributes free geographic data for the world. It should be noted that most maps people think of as free actually have legal or technical restrictions on their use, holding back people from using them in creative and productive ways. Thus, the OpenStreetMap Foundation, which is an international non-for-profit organization, has initiated the worldwide mapping effort that includes more than half a million volunteers around the globe (OpenStreetMap, 2013).
6.4 Application Implementation

The application has been implemented using the following technologies, frameworks, and libraries:

- **HTTP**: HTTP is a text-based protocol for transferring data over a TCP layer. HTTP can be used for transferring text, multimedia, as well as any other binary data. It is one of the core technologies that power today’s web applications.

- **Python**: Python is a high-level programming language that uses simple syntax and comes with a versatile standard library. Python is a scripting programming language that runs on a multitude of different operating systems. It has diversified community, and a huge base of third-party libraries that cover almost any programming task. The Three files in Appendix -admin.py, models.py, and views.py- have written in python.

- **SQL**: SQL is a specialized programming language designed for managing data in a relation database management system.

- **Django**: Django is a robust, high-level web framework written in Python that encourages fast and clean development process, and pragmatic design. Django focuses on code reusability, emphasizing the DRY (Don’t Repeat Yourself) principles. At its most basic level, Django provides HTTP request processing, including URL routing, ORM (Object Relational Mapping) database-agnostic functionality, and a simple extendable template system for generating web pages (Django, 2013).

- **Django Crispy Forms**: Django Crispy Forms is a small utility library that eases some of the more repetitive and common tasks when creating input forms using Django framework. In addition to allowing better customization of forms, it also comes with a number of built-in visual styles, including support for Bootstrap3 (Django Crispy Form, 2013).

- **AJAX**: is a web development technique used for creating responsive web applications. AJAX is used for increasing the responsiveness of web applications by executing data retrieval and web application updates using asynchronous calls.

- **HTML5**: HTML5 is the latest revision of the HTML standard. HTML is a markup language used for structuring and presenting content for the web applications. HTML5 introduces many new useful features that allow for better-structured and more versatile web pages.

- **CSS**: CSS is a style sheet language used for enhancing the HTML pages. The main purpose of CSS is to provide standard facilities for changing the look and feel of web pages. CSS is often used in conjunction with JavaScript for providing a more responsive user interface. See the CSS code in Appendix, ppgis.css.
• **JavaScript**: JavaScript is a high-level class-less object-oriented programming language mainly used inside of web browsers for providing better interaction and user experience to the end users. See the JavaScript code in Appendix, ppgis.js.

• **jQuery**: jQuery is a fast, small, and feature-rich JavaScript library used for manipulating HTML documents, event handling, user interface animation, and AJAX calls. It supports cross-browser compatibility, letting the developer spend majority of time designing the web application itself (jQuery, 2013).

• **jQuery Cookie**: jQuery Cookie is a small utility plug-in for jQuery that eases manipulation of cookies within a web browser.

• **OpenLayers**: OpenLayers is a versatile JavaScript library for working with maps and GIS data. It provides support for displaying maps from a multitude of sources. OpenLayers also contains tools for manipulating the maps and vector data. Also, OpenLayers implements industry-standard methods for geographic data access and provides support for Open Geospatial Consortium (OGC) standards including Web Mapping Service (WMS), Web Feature Service (WFS), and Web Coverage Service (WCS) protocols (OpenGeo, 2013). It is worth to mention that OGC is a non-profit international industry consortium, which includes companies, government agencies and universities that promote the development of standards for geospatial and location-based services. OGC standards, indeed, provide interoperable solutions that ‘geo-enable’ the web, wireless and location-based services, and mainstream ICT (Opengeospatial, 2013). Furthermore, OGC standards contribute to boost the integration of data coming from a continuously growing number of sources (Tamayo et al., 2012). The WFS allows a client to retrieve and update vector map data and attributes encoded in Geography Markup Language (GML) format across the web. Whereas the WMS allows a user to share and request vector and raster map data in plain image format. The WCS share image/raster data with original data value (Opengeospatial, 2013).

• **Bootstrap**: Bootstrap is a web browser framework for developing responsive, mobile-first user interfaces using JavaScript and CSS. Bootstrap encapsulates support for a multitude of different browsers, letting the developer concentrate on application layout and logic instead on browser quirks and subtle differences (Bootstrap, 2013).

The following technologies and frameworks, which are clarified above, are used on the server side: HTTP, Python, SQL, Django, and Django Crispy Forms.

Also, the following technologies and frameworks, which are described above, are used on the client side: HTTP, AJAX, HTML5, CSS, JavaScript, jQuery, jQuery Cookie, OpenLayers, and Bootstrap.
On the server side, Django web framework is used to implement the backend business logic, and processing of user (browser) requests. In addition to running the application business logic, Django is also used for retrieving data from a database server (in a database-server agnostic way), as well as for generating the HTML pages and dynamic content for AJAX calls, which are then processed by the client. Django also provides an easy-to-use and deploy administrative web interface for adding application data.

The client side utilizes the server-generated HTML pages, and builds on top of them interactive interface by combining application-specific JavaScript and CSS code, and third-party JavaScript libraries. Client side utilizes the AJAX calls in order to provide smoother user experience.

Furthermore, this application has been designed to accommodate display, storage, and processing of the following information:

- **Current situation**, which refers to the contemporary situation of a specific region.

- **Proposed plans**, which describe a possible new situation that is being planned for implementation in a specific area.

- **Opinions**, which are used for providing feedback on the area concerning the proposed plan. Opinions can be positive or negative, and can be used to provide feedback for both the current situation and proposed plan. This allows for more fine-grained decision process, letting the planners compare how their plan fares against the current situation, and ability to avoid removing features that the users have found useful in the current situation. User interface is designed in such a way to allow easy switching between opinions made on the current situation and the proposed plan.

- **Users can agree or disagree with existing opinions**. On one end this allows the end users to provide quicker feedback based on the previous user’s opinions, while on the other hand the planners can obtain a quicker and easier way to process and quantify the feedback.

- **Comments can be made on each opinion**. This provides a more verbose way for users and planners to express their disagreement or agreement with the opinion, as well as to provide clarifications where necessary.

In sum, from the end user perspective, the application implements the following functionalities:

- Display of current situation and proposed plan on a map (Figure 4, 5).

- Mechanism for posting opinions, which can be tied-in to the current situation or the proposed plan (Figure 6).

- Ability to agree and disagree with existing opinions (Figure 7).
• Commenting on existing opinions (Figure 8).

Also, The WPPGIS application can be launched from the following URL: http://ppgis.narooie.se/ppgis/

Figure 4: Current Situation

![Current Situation](image)

Figure 5: Proposed Plan

![Proposed Plan](image)
Figure 6: Posting Opinion

Figure 7: Submitting Feedback

Figure 8: Commenting on Opinion
Also, from the planner perspective, the above functionalities are further enhanced with the following functionalities (mainly through use of Django’s Admin application) (see Figure 9):

- Adding, modification, and removal of proposed plans, opinions, and comments.
- Posting of opinion comments, which are clearly marked as coming from the staff (planners).
- Tabular listing of opinions with some basic information. Opinions can be filtered based on the proposed plan, as well as based on whether they are positive or negative. Opinions can be sorted based on number of agreeing votes, disagreeing votes, total votes, and number of comments.
- A simple user and group-based privileges system for granting limited rights to different staff members.

The WPPGIS Site Administrator application can be launched from the following URL: http://ppgis.narooie.se/admin/

![Figure 9: WPPGIS Site Administrator](image-url)
6.5 Application Deployment

Since the application has been written using Django framework, a number of different deployment strategies and implementations can be used for running the application.

In order to run the application in a production environment, it is necessary to provide the following components on the server side:

- Database server, supported by Django ORM. Django ORM has built-in support for PostgreSQL, MySQL, Sqlite, and Oracle Database. A number of third-party database backends is available as well, such as IBM DB2, MSSQL, Firebird, ODBC etc.

- Application web server with support for WSGI. This server does not necessarily need to be directly exposed to the end users, in which case a proxy server can be put in front of it. A number of different WSGI servers or web server plug-ins is available, including (but not limited to) uWSGI, Gunicorn, mod_wsgi etc.

- General-purpose web server for serving the static files. Static files are comprised out of JavaScript and CSS files, as well as images or any other supporting files. Third-party libraries such as OpenLayers and jQuery are also being served as part of the static files. This web server is commonly used for proxying the (dynamic) user requests to the application web server as well.

- Python environment capable of running the application. Although optional, it is highly recommended to deploy the application using virtual environment.

On the client side, the only requirement is that the user is running an up-to-date standards-compliant web browser, with JavaScript enabled. Currently the application has been tested successfully with the following web browsers:

- Mozilla Firefox
- Google Chrome
- Chromium

For the demonstration purposes of the application, the following components have been used on the server side:

- **MySQL**, as a relational database server.

- **Gunicorn**, as a WSGI application web server. Gunicorn or ‘Green Unicorn’ is a Python Web Server Gateway Interface HTTP Server for UNIX. It has no dependencies and is easy to install and use. Gunicorn handles the dynamic requests (HTTP requests) (Gunicorn, 2013).

- **Supervisord**, for monitoring and running the Gunicorn application web server.
- **Apache httpd server**, as a general-purpose web server for serving static files and proxying the requests to Gunicorn. Apache httpd server offers an open-source HTTP server for modern operating systems including UNIX and Windows NT. It provides a secure, efficient and extensible server that runs HTTP services in synchronization with the current HTTP standards. In fact, the Apache HTTP Server project is a collaborative software development effort intended at generating a robust, commercial-grade, feature-rich and freely-available source code implementation of an HTTP (web) server. The project is jointly managed by a group of volunteers located around the world (Apache, 2013; Ohloh, 2013).

- **Virtual Environment (Virtualenv)**, for providing an isolated runtime environment for the application.

Figure 10 illustrates the deployment architecture for WPPGIS application. All of the above components for the demo application instance have been deployed on a single server. A dedicated database and user have been created on the MySQL database server in order to allow the application to store its data. Python environment has been set-up using virtual environment for running Gunicorn and the application itself. The application has been deployed within its own dedicated Django project.

Gunicorn process is monitored and automatically started as-needed by the supervisord daemon. Gunicorn is being run by a dedicated operating system user in order to have better application isolation and to improve security. Gunicorn serves only the local requests, and is not directly reachable through the Internet.

Static files are being served by the Apache httpd server. Apache httpd server has also been configured to proxy any non-static file requests to the Gunicorn WSGI application server.

![Figure 10: Deployment Architecture](image-url)
7. Results

After the radical change in planning theories and moving from the rationalistic approach towards the communicative approach, the role of planner has been changed from being a leader to being a mediator and coordinator. Furthermore, the planning has evolved to a mutual learning and knowledge creation process between planners and citizens. So, providing citizens with the appropriate and robust tools and methods to effectively participate in the planning process is a requirement.

The findings of this study indicate that the traditional techniques of public participation, such as roundtables and sticker map methods, will need to evolve and to adapt ICT in order to remain applicable to broad audience. In fact, digital tools now make it possible for citizens from different walks of life to engage within the public sphere. Consequently, public participation and ICT go hand in hand, providing an unprecedented ability to collect people’s need, and their local knowledge as well as empower them.

The case studies confirm that the WPPGIS applications have the potential for boosting participation in the planning process. However, there is a major gap between what is seen as the possibility of technology to influence the political sphere and foster the participation and what its actual outcome is. The findings indicate that an optimal WPPGIS application should be interactive, cost-effective, user-friendly, flexible, transparent, and adaptable to the planning situation.

Following the IAP2 Public Participation Spectrum, the steps and criteria associated with an effective participation in the planning process were verified. The selected criteria were applied to compare 26 web-based GIS applications in Stockholm. The results of this comparison are shown in Table 3. The results indicate that almost all web-based GIS applications in Stockholm County include the features to support the following two criteria: ‘GIS functionalities’, and ‘user friendly interface’. However, ‘Security implementation’ and ‘sharing information’ are only partially implemented. Almost all web-based GIS applications have failed to comply with the remaining two other criteria: ‘consultation’, and ‘synchronous collaboration and decision-making’. It should be noted that ‘licensing model’, ‘GIS functionalities’, ‘user friendly interface’, ‘security implementation’, and ‘sharing information’ are related to ‘inform’ stage of the IAP2 spectrum. However, ‘consultation’ and ‘synchronous collaboration and decision-making’ are linked to the following stages of IAP2 spectrum: ‘consult’, ‘involve’, ‘collaborate’, and ‘empower’. Generally speaking, the above findings indicate that the web-based GIS applications in Stockholm County support e-participation only for the purposes of providing information to the citizens, while failing to consult, involve and collaborate with them, as well as empower them with tools and means to actively participate in the entire process of decision-making. The findings also reveal that development and deployment of WPPGIS applications in Stockholm County is still at its infancy, and that a lot of work remains to be done before it reaches satisfactory levels.
In this research, a prototype of WPPGIS application has been designed and implemented. The main goal of this application is to bring together a number of desired features of a WPPGIS, which have already been noted above and clarified in this study. The screenshots of this prototype are presented in Section 6.2. The application is written using open-source technologies, which minimizes the costs, improves the security, allows greater flexibility, and permits avoiding the vendor lock-in. Also, its interface is simple and easy to navigate to avoid overwhelming users with the complexity of the technology. It enables map-based dialogue activities between citizens and planners, as well as citizens themselves. This application has been designed to comply with the following stages of IAP2 spectrum: ‘consult’, ‘involve’, ‘collaborate’, and ‘empower’. Actually, it intends to extend, verify and update the planning knowledge through a communicative learning process between citizens and planners using maps/images and the Internet as the media of communication. In fact, citizen and planner can participate in a map/image-related discussion while annotating map/image features with shared comments can similarly be annotated and discussed by other citizens and planners.

From the end user perspective, the application implements the following functionalities:

- Display of current situation and proposed plan on a map
- Mechanism for posting opinions, which can be tied-in to the current situation or the proposed plan
- Ability to agree and disagree with existing opinions
- Commenting on existing opinions

From the planner perspective, the above functionalities are further enriched with the following functionalities:

- Adding, modification, and removal of proposed plans, opinions, and comments
- Posting of opinion comments, which are clearly marked as coming from the staff (planners)
- Tabular listing of opinions with some basic information. Opinions can be filtered based on the proposed plan, as well as based on whether they are positive or negative. Opinions can be sorted based on number of agreeing votes, disagreeing votes, total votes, and number comments.
- A simple user and group-based privileges system for granting limited rights to different staff members
8. Discussion and Concluding Remarks

A core objective of this study was to achieve a comprehensive understanding of the scope of the recently emerged field of WPPGIS. It was started with a brief theoretical orientation, in order to situate such research within the ICT and planning research context. In order to lay the foundation for a deeper understanding of the WPPGIS agenda, significant concepts which comprise much of collaborative planning discourse were clarified. The results reveal that there is a strong need for a planning process which allows effective participation. While the role of the planner in collaborative planning is to mediate and coordinate a process between different stockholders, it may be also be cause for concern. Building consensus is an essential tool for planners to increase the likelihood of implementing a plan/policy successfully. On the other hand, designing the planning procedure is a very substantial phase in formation of consensus. One would say that planners should be cautious about the power relations and distortion of the planning process by power due to ambiguity of the planning process. Planning process, indeed, should be perpetually scrutinized and monitored to constantly maintain its balance between ‘ideal consensus’ and ‘practical consensus’. Actually, in the planning process a novel distribution of power and transparency is required. Another important argument is that force is often used to create consensus through exclusion and manipulation. Planners should be aware that exclusion of any individual actor from a planning process is a latent hazard to the legitimacy of the whole procedure. The Exclusion diagram was depicted in Figure 2 to specify the main sources of social exclusion. Indeed, exclusion may occur in three areas: exclusion of people (by means of shaping a closed decision-making core and splitting people into outsiders and insiders groups), exclusion of topics (via over-emphasizing few main issues) or exclusion of outcomes. Sufficient caution and negotiation in designing the process of consensus making is essential to avoid any kind of exclusion. It is also argued that by allowing citizens to explore issues at different spatial and temporal scales, they are likely to be freed from the restrictions of their particular marginalized situations. Planners should also be responsive to the knowledge produces by a layman. In fact, the expert and local knowledge have to meet on the same forum and the tacit knowledge of citizens should take an explicit form.

A review of literature in the effective participation methods reveals that IAP2 takes a more pragmatic tactic through linking the goals of public participation with increasing public impact on decision-making. They molded a spectrum, which has five phases: inform, consult, involve, collaborate, and empower. The overarching goal of any method of public participation endeavor is to keep this spectrum intact. However, a first consideration with regard to public participation in practice is the drawbacks of conventional methods of participation, such as meetings. Indeed, critics of conventional methods of participation indicate that citizen prefer selective, focused, and limited local level involvement and it can be concluded that current planning practices require a new way of thinking and more significantly new tools and methods.
One possible solution to the problem of conventional methods would be to use the power of Internet and social media. According to the existing literature, development of ICTs has arranged the groundwork for further citizen participation in the process of planning. In fact, it has provided the new tools for governments and municipalities ranging from on-line voting systems to web-based GIS applications. Therefore, the idea of empowering citizens and boosting democratic and deliberative traditions with new technological possibilities can be considered as a goal for a WPPGIS application. A number of case studies were discussed in this study, in order to illustrate the barriers of WPPGIS applications. Above and beyond the importance of contextual elements like the attitudes of planners and decision makers, other issues such as price of software, proper user interface, technical and literacy skills, trust and legitimacy, and user diversity were significant factors for the adoption of WPPGIS application. Another challenge is the concept of PPGIS. PPGIS concept, indeed, is inherently contradictory in scope and tends to vary depending upon the situation within which it is used. Thus, a WPPGIS application may be seen as both empowering and, alternatively, marginalizing for citizens. One approach would be to design and implement a kind of WPPGIS application that leads to decrease marginalization. However, it should be noted that the WPPGIS application must be seen as a device to increase the current public participation efforts, not substitute the conventional methods.

In the preparation evaluation framework phase, the IAP2 spectrum was helpful in identifying the evaluation criteria for WPPGIS applications. Seven possible criteria were derived and designated in two categories. Then, each criterion was broken into sub-criteria. These included the GIS functionalities, user friendly interface, security implementation, sharing information, interactivity, and synchronous collaboration and decision-making. Many socio-demographic factors could be considered in addition to these seven, such as proportion of users, or age distribution and educational attainment of users. One of the challenges of including additional criteria is the effect of complexity and multicollinearity. Since many socio-demographic variables are correlated with one another, it can be very difficult to separate the influence of one from the other. The selected criteria were determined by theory. However, the risk of omitted criteria must be considered.

The study conducted a comparative analysis between different web-based GIS applications in Stockholm County. Although the corresponding municipality websites did not use the WPPGIS terminology, it should be mentioned that listed applications are models of community-oriented geospatial information system. Also, they are assumed to support e-participation. The findings show that these applications support e-participation only for the purpose of informing people, while failing to consult, involve and collaborate with them, as well as empower them with tools and means to actively participate in the entire process of decision-making.

What is suggested in this research is a prototype of WPPGIS application using open-source technologies, which minimizes the costs, improves the security, allows greater flexibility, and allows avoiding the vendor lock-in. Furthermore, its interface is simple and easy to
navigate to avoid overwhelming users with the complexity of the technology. It enables map-based dialogue activities between citizens and planners, as well as citizens themselves. This application has been designed to comply with the following stages of IAP2 spectrum: ‘consult’, ‘involve’, ‘collaborate’, and ‘empower’. Actually, it is intended to ease active participation based on its accessibility, anonymity, interactivity, and speed. However, this prototype has a couple of deficiencies, which would need to be fixed in order to deploy application for production use. Additional explanations appear in more detail in Section 9.

In conclusion, planning process is a complex and multidisciplinary task and public engagement in the planning is shaped by specific political, social, and cultural contexts. Thus, technology adoption and implementation in planning is influenced by a wide variety of contextual elements such as the attitudes of planners and decision makers towards the new technologies, availability of skilled personnel, and resource restraints. Also, there are further challenges in areas where planning remains in a more technocratic/top-down traditions or where technology is not ubiquitous enough to support broad involvement. In other words, the technology-based solutions must be seen as methods to enhance the current public participation efforts, not replace the conventional methods and there are real barriers which limit the ability of technology-based solutions to fulfill their goals.

9. Future Work

This thesis sought to contribute to the planning practice both by exploring more closely the theoretical aspect of collaborative planning and WPPGIS technologies, using Stockholm, Sweden as a case study. However, there are a number of delimitations with regards to this thesis. First, the complexity of the planning process itself should be considered. Furthermore, public participation in the planning process is shaped by specific political, social, and cultural contexts. It is also crucial to change the attitudes of the planners to be more responsive to the knowledge produced by layman. Further research on technology-based solutions should seek for institutional barriers to the adoption of WPPGIS.

In the preparation of the evaluation framework, the IAP2 spectrum guided the selection of main criteria and sub-criteria. Future research could take a closer look at this particular set of criteria. One approach would be to conduct an interview study.

Future studies may take a closer look at the relationship between degree of public participation in the planning process and technology-based solutions. This research proposed a WPPGIS application, but it is only a prototype. Thus, future research should implement the application in real world. Also, in order to obtain the proper feedback and
verify the outcome, the application needs to be around long enough in which its influence in different conditions and contexts can be scrutinized.

The WPPGIS application, as a prototype application, also has a couple of shortcomings, which would need to be fixed in order to deploy application for production use. The following improvements could be a part of potential future development:

- Porting the GIS-related functionalities of the application to GeoDjango. Benefits would include ability to store more complex geographical objects/shapes in the database, better user interface for staff/planners as well as the ability to perform proper spatial queries.

- Refactoring application RESTful API (Representational State Transfer) views to use one of the available REST frameworks for Django, such as Django REST framework, or Tastypie. They provide more convenient, flexible, and powerful abstraction for creating REST-style interface. It needs to be noted that REST is planned to evoke an image of how a well-designed Web application behaves. REST was initially explained in the context of HTTP, but it is not limited to that protocol. Also, RESTful applications maximize the use of the existing, well-defined interface and other built-in capabilities provided by the chosen network protocol, and minimize the adding up of new application-specific features on top of it.

- Refactoring the client JavaScript code to utilize MVC design pattern (Mode-View-Controller: a software pattern for implementing user interfaces). This would allow the application to be more easily extended client-side to include new (responsive) features. Also, a number of JavaScript MVC frameworks could be used in the implementation, and Backbone.js could be considered as one of the prime candidates.

- Possible integration with social networks, such as Facebook or Google+. This would be an extensive feature for which it would be necessary to first define the goals and functional requirements.

- Adding server-side support for preventing multiple votes, possibly in form of a CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart)

- Adding more features for proposed plans, such as archiving, drafts, and possibly vector data in addition to static images
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Appendix A: Source Code of Application

admin.py

# Django imports.
from django.contrib import admin
from django.db.models import Count, Sum

# Application imports.
from .models import Opinion, Comment, Proposal

class OpinionAdmin(admin.ModelAdmin):
    """
    Customized implementation for displaying Opinion information in the admin site. Implementation includes a number of improvements for having better sorting and filtering capabilities.
    """
    list_display = ["text", "agree_votes", "disagree_votes", "total_votes", "comments", "map_link", "details"]
    list_filter = ["proposal", "positive"]

    def queryset(self, request):
        """
        Generates QuerySet that will be used when displaying the list of Opinions. Implements additional annotations for displaying total number of comments for an opinion, and total number of votes.
        """
        # Call the parent class constructor.
        qs = super(OpinionAdmin, self).queryset(request)

        # Add total comment and vote counts.
        qs = qs.annotate(Count("comment"));
        qs = qs.extra(select={'total_votes': "agree_votes + disagree_votes"})
        return qs

    def comments(self, obj):
        """
        Calculates total number of comments that have been posted regarding an Opinion.
        Returns:
        Total number of comments that were made on opinion
        """
        return Comment.objects.filter(opinion=obj.pk).count()

        # Allow using the comment count for sorting the entries.
        comments.admin_order_field = "comment__count"

    def map_link(self, obj):
        """
        Generates a direct link towards the opinion on the map.
        Returns:
        Direct HTML link towards the opinion on the map.
        """
        return '<a href="%s">Click here</a>' % obj.map_link()

        # Do not escape HTML tags.
        map_link.allow_tags = True

    def details(self, obj):
Generates a direct link towards the opinion details.

Returns:
Direct HTML link towards the opinion details page.

```python
return '<a href="%s">Details</a>' % obj.get_absolute_url()
```

# Do not escape HTML tags.
details.allow_tags = True

def total_votes(self, obj):
    """
    Gets total number of votes for an opinion.
    Returns:
    Total number of votes for an opinion.
    """
    return obj.total_votes

    # Allow using the total votes count for sorting the entries.
total_votes.admin_order_field = "total_votes"

admin.site.register(Comment)
admin.site.register(Proposal)

models.py

class Opinion(models.Model):
    """
    Implements model describing a single opinion. An opinion is essentially a
    positive or negative comment that's tied to specific map coordinates. Each
    opinion can include a number of agreeing or disagreeing votes.

    Fields:
    lon - Longitude coordinate in the EPSG:4326 projection.
    lat - Latitude coordinate in the EPSG:4326 projection.
    text - Text stating the opinion.
    name - User-supplied name.
    positive - Specifies if the opinion is positive (True) or negative
    (False).
    agree_votes - Number of people (votes) that agree with the opinion.
    disagree_votes - Number of people (votes) that disagree with the opinion.
    proposal - Proposal to which the opinion is related.
    current - Specifies whether the opinion is for current situation (True),
    or proposed situation (False).
    """
    lon = models.FloatField()
    lat = models.FloatField()
    text = models.TextField()
    name = models.CharField(max_length=32)
    positive = models.BooleanField()
    agree_votes = models.PositiveIntegerField(default=0)
    disagree_votes = models.PositiveIntegerField(default=0)
    proposal = models.ForeignKey(Proposal)
    current = models.BooleanField()
def __unicode__(self):
    ""
    Create string representation of an opinion.
    Returns:
    String representation of an opinion.
    """
    return "%s: %s...
    % (self.name, self.text[:40],)

def comment_count(self):
    ""
    Determines the total number of comments posted on opinion.
    Returns:
    Total number of comments for the opinion.
    """
    return self.comment_set.count()

def map_link(self):
    ""
    Generates a direct link for Opinion on the map.
    Returns:
    Direct link to Opinion on the map.
    """
    return "%s?opinion=%d" % (reverse('index'), self.id)

def get_absolute_url(self):
    ""
    Generates absolute URL for Opinion details.
    Returns:
    Absolute URL that points to Opinion details page.
    """
    return reverse("opinion_detail", args=(self.id,))

class OpinionDisplayView(generic.DetailView):
    ""
    Implements view used for displaying opinion details, including its comments.
    """
    model = Opinion

def get_context_data(self, **kwargs):
    ""
    Sets-up the context data for template rendering. In addition to opinion
    object, supplies all opinion comments under name "comments", as well as
    form for posting new comment under name "form".
    ""
    context = super(OpinionDisplayView, self).get_context_data(**kwargs)
    # Add all opinion comments to the context.
    context["comments"] =
    self.get_object().comment_set.all().order_by("post_date")
    # If user is authenticated, make the comment poster name fixed.
    if self.request.user.is_authenticated():
form = CommentForm(initial={"name": self.request.user.username})
form.fields["name"].widget.attrs["readonly"] = True
else:
    form = CommentForm()
# Add the form to context.
context["form"] = form

return context

class OpinionCommentView(generic.detail.SingleObjectMixin, generic.FormView):
    
    Implements view for processing posts of new comments for an opinion. The 
    view will also provide rendering of opinion for which the comment is being 
    posted.
    
    template_name = "ppgis/opinion_detail.html"
    form_class = CommentForm
    model = Opinion
    
def post(self, request, *args, **kwargs):
        
        Handles the post requests. Sets self.object to point at Opinion 
        instance.
        
        self.object = self.get_object()

        return super(OpinionCommentView, self).post(request, *args, **kwargs)
    
def form_valid(self, form):
        
        Handles comment creation in case the form validation has passed. Sets-up 
        the comment object with missing information, and saves it to database.
        
        form.instance.opinion = self.object
        form.instance.post_date = timezone.now()

        # If the user is authenticated, set-up the reference to him/her in 
        # comment, and make sure the comment poster name is equal to username.
        if self.request.user.is_authenticated():
            form.instance.user = self.request.user
            form.instance.name = self.request.user.username

        form.save()

        return super(OpinionCommentView, self).form_valid(form)
    
def get_success_url(self):
        
        Generates URL which should be redirected to after successful creation of 
        a comment. The URL will point to the opinion details.
        
        return reverse('opinion_detail', kwargs={'pk': self.object.pk})

class OpinionDetailView(generic.View):
    
    Wrapper class that combines OpinionDisplayView (for GET requests), and 
    OpinionCommentView (for POST requests). Used in order to implement different
behaviour using generic class views at the same url, but with differing request types.

```python
def get(self, request, *args, **kwargs):
    """
    Handles the GET requests by passing them to the OpinionDisplayView.
    """
    view = OpinionDisplayView.as_view()
    return view(request, *args, **kwargs)

def post(self, request, *args, **kwargs):
    """
    Handles the POST requests by passing them to the OpinionCommentView.
    """
    view = OpinionCommentView.as_view()
    return view(request, *args, **kwargs)
```

---

**opinion_detail.html**

{% extends 'ppgis/base.html' %}

{% load crispy_forms_tags %}

{% block content %}
{% if opinion.positive %}
<h1><span class="glyphicon glyphicon-plus-sign opinion-positive"></span></h1>
{% else %}
<h1><span class="glyphicon glyphicon-minus-sign opinion-negative"></span></h1>
{% endif %}

<div>
    <div><strong>{{ opinion.name }}</strong> says:</div>
    <div>{{ opinion.text }}</div>
</div>
<hr>

<a id="comment" class="btn btn-info disabled" href="#">
    <span class="glyphicon glyphicons-comment"></span>{{ opinion.comment_count }}</a>

<a id="agree" class="btn btn-success" href="#">
    <span class="glyphicon glyphicons-thumbs-up"></span>{{ opinion.agree_votes }}</a>

<a id="disagree" class="btn btn-danger" href="#">
    <span class="glyphicon glyphicons-thumbs-down"></span>{{ opinion.disagree_votes }}</a>

<a href="{% url "index" %}?opinion={{ opinion.id }}" class="btn btn-primary">
    <span class="glyphicon glyphicons-globe"></span> Map</a>

<hr>

```html
```

52
{% if comments %}
<h2><small>Comments</small></h2>
<div class="media">
{% for comment in comments %}
<div class="pull-left">
<span class="glyphicon glyphicon-user"></span>
</div>
<div class="media-body">
<h4 class="media-heading">
{{ comment.name }} {% if comment.user %}<small class="staff">[staff] </small>{% endif %}<small>(posted on {{ comment.post_date }})</small></h4>
{{ comment.text }}
</div>
<hr>
{% endfor %}
</div>
{% endif %}

<h2><small>Post a comment</small></h2>
<form role="form" action="" method="post">{% csrf_token %}
{{ form | crispy }}
<button type="submit" class="btn btn-primary">Comment</button>
</form>
{% endblock %}

---

ppgis.css

/* In order to have the #map visible with 90% height of viewport, its surrounding containers must be at 100%. */
html, body, .fill {
  height: 100%;
}

/* Set map height. */
#map {
  height: 50%;
}

/* The following hack must be done in order to allow for .fill to take-up 100% of the viewport, without showing the scrollbar (otherwise the actual body will end-up being more than 100% of the viewport). */
body {
  box-sizing: border-box;
  padding-top: 71px;
  z-index: 1;
  padding-bottom: 21px;
}

.navbar {
  position: absolute;
  top: 0;
  left: 0;
  width: 100%;
  z-index: 2;
}

/* Colour style for marking positive opinion glyphicons. */
.opinion-positive {
  color: #90ee90;
}
/* Colour style for marking negative opinion glyphicons. */
.opinion-negative {  
color: #ff0000;
}

/* For small devices, center the button controls, and make the buttons take-up 30% of container. Similar for form controls. */
@media (max-width: 768px) {
  .btn {  
    width: 30%;  
    margin-top: 4px;
  }
  .ppgis-select {  
    margin-top: 4px;
  }
  .button-controls {  
    text-align: center;
  }
}

/* Make the staff indicator use a distinct red colour. */
.staff {  
  color: #d2322d;
  font-weight: bold;
}

/* Hide the checkbox itself, and use glyphicons to show checkbox status to user. */
#new-positive {  
  display: none;
}
#new-positive:checked+label[for=new-positive] > #new-is-negative {  
  display: none;
}
#new-positive:not(:checked)+label[for=new-positive] > #new-is-positive {  
  display: none;
}

---

ppgis.js

// Initialise the application namespaces.
var ppgis = {};

/**
 * Class: ppgis.Control
 * Extends the OpenLayers.Control in order to implement reliable handling of single-click events in conjunction with double clicks. Should be used as replacement for the OpenLayers.Map.events.register("click", ...) calls.
 * Taken from: https://gist.github.com/cspanring/1091204
 */
ppgis.Click = OpenLayers.Class(OpenLayers.Control, {
  defaultHandlerOptions: {

{'delay': 200,
'single': true,
'double': false,
'pixelTolerance': 0,
'stopSingle': false,
'stopDouble': false
},
/**
 * Initialises the ppgis.Click instance.
 *
 * @param options Handler options. In addition to standard options from the
 * OpenLayers.Control, includes an additional special option 'trigger' which
 * should be used for specifying the click callback function.
 * *
 */
initialize: function(options) {
  this.handlerOptions = OpenLayers.Util.extend(
    {}, this.defaultHandlerOptions
  );
  OpenLayers.Control.prototype.initialize.apply(
    this, arguments
  );
  this.handler = new OpenLayers.Handler.Click(
    this, {
      'click': this.trigger
    }, this.handlerOptions
  );
}));
/**
 * Class: ppgis.Opinion
 *
 * Extends the OpenLayers.Marker to include additional information specific to
 * user opinions. In particular, the following additional properties are being
 * added: text, name, positive, agreeVotes, disagreeVotes.
 *
 */
ppgis.Opinion = OpenLayers.Class(OpenLayers.Marker, {
/**
 * Initialises the ppgis.Opinion instance. Icon is determined automatically
 * based on whether the opinion is positive or not.
 *
 * @param lonlat Instance of OpenLayers.LonLat class that pins the opinion
 * to a specific location on the map.
 * @param id Opinion unique identifier.
 * @param text Text stating the opinion.
 * @param name Name or nickname of person who posted the opinion.
 * @param positive Specifies whether the opinion is positive or negative.
 * @param agreeVotes Number of people who have agreed with the opinion.
 * @param disagreeVotes Number of people who have disagreed with the opinion.
 * @param commentCount Total number of comments made on the opinion.
 * @param current Specifies whether the opinion is for current or proposed
 * situation.
 *
 */
initialize: function(lonlat, id, text, name, positive, agreeVotes, disagreeVotes, commentCount, proposal, current) {
  var iconSize, iconOffset, icon;
  // Set-up icon size, and calculate the offset for its placement (so the
  // sharp tip would point to exact coordinates).

  // Code continues...
iconSize = new OpenLayers.Size(21, 25);
iconOffset = new OpenLayers.Pixel(-iconSize.w/2, -iconSize.h);

    // Determine the icon that should be used for marker.
    // @TODO: The paths are currently hard-coded, this should be fixed.
    if (positive === true) {
        icon = new OpenLayers.Icon("/static/openlayers/img/marker-green.png",
            iconSize, iconOffset);
    } else {
        icon = new OpenLayers.Icon("/static/openlayers/img/marker.png",
            iconSize, iconOffset);
    }

    // Call the parent constructor.
    OpenLayers.Marker.prototype.initialize.apply(this, [lonlat, icon]);

    // Set the opinion-specific properties.
    this.id = id;
    this.text = text;
    this.name = name;
    this.positive = positive;
    this.agreeVotes = agreeVotes;
    this.disagreeVotes = disagreeVotes;
    this.commentCount = commentCount;
    this.proposal = proposal;
    this.current = current;

    // Set-up callback function for showing user opinions (via click).
    this.events.register("click", this, this.clickCallback);
},

showDetails: function() {
    // Set-up reference to this object for callbacks.
    var self = this;

    // Set-up the content and enable voting.
    self.setupContent();
    self.enableVoting();

    // Set-up click handler for agreeing with the opinion.
    $('#agree').click(function() {
        self.agree();
    });

    // Set-up click handler for disagreeing with the opinion.
    $('#disagree').click(function() {
        self.disagree();
    });

    // Display the modal.
    $('#opinion').modal();
},

/**
 * Sets-up the content of a modal that displays the opinion details.
 */
setupContent: function() {
    // Set-up the modal title based on whether the opinion is positive or not.
    if (this.positive) {
        $('#opinion-title').children("span").attr("class", "glyphicon glyphicon-plus-sign glyphicon-title opinion-positive");
    } else {
        $('#opinion-title').children("span").attr("class", "glyphicon glyphicon-minus-sign glyphicon-title opinion-negative");
    }
}
// Fill-in the opinion information into modal.
$('#opinion-name').text(this.name);
$('#opinion-body').text(this.text);
$('#votes-agree').text(this.agreeVotes);
$('#votes-disagree').text(this.disagreeVotes);
$('#comment-count').text(this.commentCount);

// Set-up the comment link.
// @TODO: Don't hard-code the base link here.
$('#comment').attr('href', '/ppgis/opinion/' + this.id);
},

/**
 * Enables voting by setting-up the necessary callbacks and links.
 */
enableVoting: function() {
  $('#agree').off('click');
  $('#agree').removeClass('disabled');
  $('#disagree').off('click');
  $('#disagree').removeClass('disabled');
},

/**
 * Disables voting by removing the callbacks and links.
 */
disableVoting: function() {
  $('#agree').off('click');
  $('#agree').addClass('disabled');
  $('#disagree').off('click');
  $('#disagree').addClass('disabled');
},

/**
 * Sends out an agreement with the opinion to the server, disabling the
 * links for further voting, and updating the number of votes for current
 * opinion from the server.
 */
agree: function() {
  // Set-up reference to this object for callbacks.
  var self = this

  // Disable voting before sending out the request.
  this.disableVoting();

  // Send out a post for agreeing with the opinion.
  // @TODO: Don't hard-code the URL.
  $.post('/ppgis/api/opinion/' + self.id + '/agree/', function(data) {
    if (data.success === true) {
      // If voting was successful, update the vote count.
      $('#votes-agree').text(data.agree_votes);
      $('#votes-disagree').text(data.disagree_votes);
      self.agreeVotes = data.agree_votes;
      self.disagreeVotes = data.disagree_votes;

      // Show the success message.
      self.showSuccess(data.message);
    } else {
      // In case the voting was not successful, show the returned
      // error message, and allow voting again.
    }
  });
self.showError(data.message);
self.enableVoting();
}) .fail(function() {
    // Show an error message in case of server failure, and re-enable
    // the voting.
    self.showError("An unexpected error has occurred. Please try again
later.");
    self.enableVoting();
});
},
/**
 * Sends out a disagreement with the opinion to the server, disabling the
 * links for further voting, and updating the number of votes for current
 * opinion from the server.
 * *
 * disagree: function() {
    // Set-up reference to this object for callbacks.
    var self = this
    // Disable voting before sending out the request.
    this.disableVoting();
    // Send out a post for agreeing with the opinion.
    // @TODO: Don't hard-code the URL.
    $.post("/ppgis/api/opinion/" + self.id + "/disagree/", function(data) {
        if (data.success === true) {
            // If voting was successful, update the number of disagreeing votes.
            var counter = $('#votes-disagree');
            counter.text(Number(counter.text()) + 1);
            self.disagreeVotes += 1;
            self.showSuccess(data.message);
        } else {
            // In case the voting was not successful, show the returned
            // error message, and allow voting again.
            self.showError(data.message);
            self.enableVoting();
        }
    }) .fail(function() {
        // Show an error message in case of server failure.
        self.showError("An unexpected error has occurred.");
    });
},
/**
 * Displays a success message in opinion modal.
 * *
 * @param message Message text that should be shown to the user.
 * *
 * showSuccess: function(message) {
    $('#opinion-message').removeClass("alert-danger").addClass("alert-success").text(message).slideDown();
},
/**
 * Displays an error message in opinion modal.
 * *
 * @param message Message text that should be shown to the user.
 * *
 * showError: function(message){

### CSS Code Snippet

```javascript
$(
  '#opinion-message').removeClass('alert-danger').addClass('alert-danger').text(message).slideDown();
);

/**
 * Callback method used for clicks on the opinion. The callback is used for
 * showing a modal with details about the opinion.
 * @param e Click event.
 */
clickCallback: function(e) {
  this.showDetails();
}
});

/**
 * Class: ppgis.NewOpinion
 *
 * Extends the OpenLayers.Marker to include additional methods specific to
 * adding new user opinion.
 */
ppgis.NewOpinion = OpenLayers.Class(OpenLayers.Marker, {
  /**
   * Initialises the ppgis.NewOpinion instance. Custom icon is set to
   * distinguish the marker from others.
   * @param lonlat Instance of OpenLayers.LonLat class that pins the opinion
   * to a specific location on the map.
   */
  initialize: function(lonlat) {
    var iconSize, iconOffset, icon, self;
    // Set-up reference to this object for callbacks.
    self = this;
    // Set-up the icon, including size and offset for proper centering.
    iconSize = new OpenLayers.Size(21, 25);
    iconOffset = new OpenLayers.Pixel(-iconSize.w/2, -iconSize.h);
    icon = new OpenLayers.Icon('/static/openlayers/img/marker-blue.png',
      iconSize, iconOffset);
    // Call the parent constructor.
    OpenLayers.Marker.prototype.initialize.apply(this, [lonlat, icon]);
    // Reset the modal.
    this.enableSubmit();
    // Reset any validation errors from previous runs.
    $.each(["positive", "x", "y", "text", "name"], function(key, field) {
      $(
        '#new-' + field + '-group').removeClass('has-error');
      $(
        '#new-' + field).tooltip('destroy');
    });
  },
  /**
   * Sets-up and shows the input modal form for new opinion.
   */
  showInput: function() {
    var lonlat4326;
  }
});
```
// Reset inputs where it makes sense.
$("#new-positive").prop("checked", true);
$("#new-text").val('');

// Convert the opinion coordinates to correct projection for storing at server.
lonlat4326 = new OpenLayers.LonLat(this.lonlat.lon, this.lonlat.lat)

// Set position input values to marker position.
$("#new-lon").val(lonlat4326.lon);
$("#new-lat").val(lonlat4326.lat);

// Set the proposal to selected proposal.
// @TODO: Introduce handling of case when proposal has not been selected.
$("#new-proposal").val($("#proposal-select").val());

// Set whether the opinion is referencing current situation or not.
$("#new-current").val($("#current-situation").prop("checked"));

// Finally show the modal.
$("#new").modal();
}

/**
 * Disables submitting by removing the callbacks, links, and making the input fields uneditable. Useful for preventing the user from submitting same data twice, as well in order to let the modal stay open with user's entered data as success confirmation.
 *
 * disableSubmit: function() {
 // Disable the submit button and its click callback.
 $("#new-submit").off("click");
 $("#new-submit").addClass("disabled");

 // Disable the inputs.
 $("#new-positive").prop("disabled", true);
 $("#new-text").prop("disabled", true);
 $("#new-name").prop("disabled", true);
 $("#new-x").prop("disabled", true);
 $("#new-y").prop("disabled", true);
}

/**
 * Enables submitting by adding back the callbacks, links, and making the input fields editable. Useful for re-enabling the user to edit the form data after a validation failure from server.
 *
 * enableSubmit: function() {
 // Set-up reference to this object for callbacks.
 var self = this;

 // Enable the submit button and its click callback.
 // Set-up callbacks for posting data via AJAX.
 $("#new-submit").off("click").click(function(event) {
     self.submit();
 });
 $("#new-submit").removeClass("disabled");

 // Enable the inputs.
$$\text{#new-positive}.\text{prop}(\text{disabled}, \text{false});$$
$$\text{#new-text}.\text{prop}(\text{disabled}, \text{false});$$
$$\text{#new-name}.\text{prop}(\text{disabled}, \text{false});$$
$$\text{#new-x}.\text{prop}(\text{disabled}, \text{false});$$
$$\text{#new-y}.\text{prop}(\text{disabled}, \text{false});$$

```javascript
/**
 * Submits a new opinion to the PPGIS server. The data is read from the
 * form.
 */
submit: function() {
  var self, formData, fields;

  // Set-up reference to this object for callbacks.
  self = this;

  // Get the form data (must be done before disabling the input fields).
  formData = $$\text{#new-form}\text{.serialize}();$$

  // Disable submits before sending out the request.
  this.disableSubmit();

  // Reset any validation errors from previous runs.
  $.each(["positive", "x", "y", "text", "name"], function(key, field) {
    $$\text{#new-} + \text{field} + \text{-group}.\text{removeClass}(\text{has-error});$$
    $$\text{#new-} + \text{field}.\text{tooltip}(\text{destroy});$$
  });

  // Send the POST request for creating new opinion.
  $$\text{.post}(/\text{ppgis/api/opinion/}, \text{formData}, \text{function(data) {}}$$
  if (data.success === true) {
    self.showSuccess(data.message);
    // Add the opinion marker we just created to the map.
    // @TODO: This is such an ugly hack, but I just can't get the
    // triggerEvent to work correctly, possibly due to callback
    // nesting ...-
    self.map.addOpinion(data.opinion);
  } else {
    // Display any validation errors that are present for the form.
    $.each(data.form_errors, function(field, field_error) {
      $$\text{#new-} + \text{field} + \text{-group}.\text{addClass}(\text{has-error});$$
      $$\text{#new-} + \text{field}.\text{tooltip}({$$
        title: field_error
      });$$
      $$\text{#new-} + \text{field}.\text{tooltip}(\text{show});$$
    });

    // Display the (general) error message.
    self.showError(data.message);

    // Re-enable editing.
    self.enableSubmit();
  }
}).fail(function() {
  // Show an error message in case of server failure, and re-enable
  // submitting.
  self.showError("An unexpected error has occurred. Please try again
  later.");
  self.enableSubmit();
});

// Remove click callbacks.
```
$.on("new-submit", .off("click"));

/**
 * Displays a success message in opinion modal.
 * @param message Message text that should be shown to the user.
 */
showSuccess: function(message) {
  $("#new-message").removeClass("alert-danger").addClass("alert-success").text(message).slideDown();
},

/**
 * Displays an error message in opinion modal.
 * @param message Message text that should be shown to the user.
 */
showError: function(message) {
  $("#new-message").removeClass("alert-danger").addClass("alert-danger").text(message).slideDown();
}
});

/**
 * Class: ppgis.Proposal
 *
 * Extends the OpenLayers.Layer.Image to include additional information specific
 * to proposals. In particular, the following additional properties are being
 * added: id, title, description, image.
 * *
/**
 * Initialises the ppgis.Proposal instance.
 * @param id Proposal unique identifier.
 * @param title Proposal title.
 * @param description Proposal description.
 * @param extent Extent that the proposal covers. Should be an instance of
 * @param image Image that should be shown for proposal extent.
 *
 * initialize: function(id, title, description, extent, image) {
  var size, options;
  // Don’t display the layer if it’s smaller than 10 by 10 pixels.
  size = new OpenLayers.Size(10, 10);
  // Set-up some sane options for the layer.
  options = {
    numZoomLevels: 18,
    isBaseLayer: false,
    visibility: false
  };
  // Call the parent constructor.
}
OpenLayers.Layer.Image.prototype.initialize.apply(this, [title, image, extent, size, options]);

// Set-up proposal properties.
this.id = id;
this.title = title;
this.description = description;
}
});

/**
 * Class: ppgis.Map
 * This class extends the base OpenLayers.Map class with additional methods and
 * properties for handling people opinions from the PPGIS application.
 * Map instances of this class will include the following layers by default:
 * - current_situation, an OSM layer showing the current situation.
 * - opinions, an OSM layer showing the user opinions about current situation.
 * - user_opinion, an OSM layer showing the new opinion being added
 *
 * ppgis.Map = OpenLayers.Class(OpenLayers.Map, {
  /**
   * Initialises the ppgis.Map instance. See OpenLayers.Map constructor for
   * more details.
   *
   * @param div Identifier of HTML element that will contain the map.
   * @param ppgisURL Base URL where the PPGIS web application is hosted.
   * @param options Additional options that should be passed i
   * constructing the map.
   *
   */
  initialize: function(div, ppgisURL, options) {
    // Set-up reference to this object for callbacks.
    var self = this;

    // Call the parent constructor.
    OpenLayers.Map.prototype.initialize.apply(this, [div, options]);

    // Add layers to the map.
    this.addLayer(new OpenLayers.Layer.OSM("current_situation"));
    this.addLayer(new OpenLayers.Layer.Markers("user_opinion"));

    // Set-up an object to store the proposal layers in.
    this.proposals = {};

    // Set-up properties for string reference to currently active proposal
    // and its opinions. Default to no active proposal at beginning.
    this.active_proposal = null;
    this.active_opinions_current = null;
    this.active_opinions_proposed = null;

    // Set-up an object to store the proposal opinion layers in.
    this.opinions_current = {};
    this.opinions_proposed = {};

    // Set-up the PPGIS server URL.
    this.ppgisURL = ppgisURL;

    // Register callback for clicks (adding new opinions).
    var click = new ppgis.Click({


trigger: self.clickCallback
});
this.addControl(click);
click.activate();

// TODO: This is for debugging uses. Remove once done with testing.
this.addControl(new OpenLayers.Control.MousePosition({displayProjection: new
OpenLayers.Projection("EPSG:4326")}));

//@TODO: This is for debugging uses. Remove once done with testing.
this.addControl(
new OpenLayers.Control.MousePosition({displayProjection: new
OpenLayers.Projection("EPSG:4326")}));

// Set-up callback function for moving marker overlays to top when
// another layer gets added.
this.events.register("addlayer", this, this.markerLayersToTop);
},

/**
 * Removes an opinion.
 * @param proposal Proposal ID.
 * @param opinion Opinion ID.
 * @return true if opinion has been removed. false otherwise.
 */
removeOpinion: function(proposal, opinion) {
var current, proposed, result;
// Get the layers containing opinions for current and proposed
// situation.
current = this.opinions_current[proposal];
proposed = this.opinions_proposed[proposal];

// Assume no opinions were removed.
result = false;

// Go through the current situation opinions, and remove the one with
// matching id.
for (var i = 0; i < current.markers.length; i++) {
  if (current.markers[i].id === opinion) {
    current.removeMarker(current.markers[i]);
    result = true;
  }
}

// Go through the proposed situation opinions, and remove the one with
// matching id.
for (var i = 0; i < proposed.markers.length; i++) {
  if (proposed.markers[i].id === opinion) {
    proposed.removeMarker(proposed.markers[i]);
    result = true;
  }
}

return result;
},

/**
 * Retrieves a new list of opinions from the server, and refreshes the
 * available opinions on the map.
 * *
 */
refreshOpinions: function() {
// Set-up reference to this object for callbacks.
var self = this;

// Connect to server, get the JSON structure, and add each element
// returned by it.
$.get(this.ppgisURL + "/api/opinion", function (data) {
    $.each(data, function(id, opinionData) {
        self.addOpinion(opinionData);
    });
    $(self).trigger("refreshed_opinions");
});
/**
 * Adds opinion to map. If opinion with same ID already exists, its data
 * will be replaced with new information.
 * @param opinionData JSON structure describing the opinion.
 */
addOpinion: function(opinionData) {
    var opinion, layer, position;
    // Fetch the layer we want to operate on.
    if (opinionData.current === true) {
        layer = this.opinions_current[opinionData.proposal];
    } else {
        layer = this.opinions_proposed[opinionData.proposal];
    }
    // Remove the old opinion if it exists.
    this.removeOpinion(opinionData.proposal, opinionData.id);
    // Add the opinion.
    position = new OpenLayers.LonLat(opinionData.lon,
        opinionData.lat).transform(this.projection, this.getProjectionObject());
    opinion = new ppgis.Opinion(position, opinionData.id, opinionData.text,
        opinionData.name, opinionData.positive,
        opinionData.agree_votes,
        opinionData.disagree_votes,
        opinionData.comment_count, opinionData.proposal,
        opinionData.current);
    layer.addMarker(opinion);
},
/**
 * Finds an opinion and returns it.
 * @param opinion Opinion ID.
 * @return A hash with two keys - proposal (with ID of proposal), and opinion
 * (marker itself).
 */
getOpinion: function(opinion) {
    var layer;
    for (var key in this.opinions_current) {
        layer = this.opinions_current[key];
        for (var i = 0; i < layer.markers.length; i++) {
            if (layer.markers[i].id === opinion ) {
                return {
                    proposal: key,
                    opinion: layer.markers[i]
                };
            }
        }
    }
}
for (var key in this.opinions_proposed) {
    layer = this.opinions_proposed[key];
    for (var i = 0; i < layer.markers.length; i++) {
        if (layer.markers[i].id === opinion) {
            return {
                proposal: key,
                opinion: layer.markers[i]
            }
        }
    }
}

/**
 * Zooms to the specified opinion.
 * @param id Opinion identifier.
 * @*/
zoomToOpinion: function(id) {
    var opinion;
    opinion = ppgis.map.getOpinion(id);
    this.activateProposal(opinion.proposal);
    this.setCenter(opinion.opinion.lonlat);
    if (opinion.opinion.current === true) {
        $("#current-situation").trigger("click");
    } else {
        $("#proposed-plan").trigger("click");
    }
    $("#proposal-select").val(opinion.opinion.proposal);
},

/**
 * Adds proposal to the map. This involves adding two map layers - one with
 * proposal itself, and one for storing the proposal opinions. If proposal
 * already exists, the current data will be replaced.
 * @param proposalData JSON structure describing the proposal.
 * @*/
addProposal: function(proposalData) {
    var proposal, opinions;
    // Remove the old proposal data if already present.
    if (proposalData.id in this.proposals) {
        this.removeLayer(this.proposals[proposalData.id]);
        delete this.proposals[proposalData.id];
    }
    // Create the new proposal, and add it to map.
    extent = new OpenLayers.Bounds(proposalData.left, proposalData.bottom,
        proposalData.right, proposalData.top).transform(this.projection,
        this.getProjectionObject());
    proposal = new ppgis.Proposal(proposalData.id, proposalData.title,
        proposalData.description, extent,
        proposalData.image);
    this.proposals[proposalData.id] = proposal;
this.addLayer(proposal);

// Create opinion layers if necessary.
if (!(proposalData.id in this.opinions_current)) {
    opinions = new OpenLayers.Layer.Markers("opinions_current_"+
        proposalData.id, {visibility: false});
    this.opinions_current[proposalData.id] = opinions;
    this.addLayer(opinions);
}
if (!(proposalData.id in this.opinions_proposed)) {
    opinions = new OpenLayers.Layer.Markers("opinions_proposed_"+
        proposalData.id, {visibility: false});
    this.opinions_proposed[proposalData.id] = opinions;
    this.addLayer(opinions);
}
},

/**
 * Retrieves a new list of proposals from the server, and refreshes the
 * available proposals on the map.
 */
refreshProposals: function() {
    // Set-up reference to this object for callbacks.
    var self = this;

    // Connect to server, get the JSON structure, and add each element
    // returned by it.
    $.get(this.ppgisURL + "/api/proposal", function (data) {
        $.each(data, function(id, proposalData) {
            self.addProposal(proposalData);
        });
    });
},

/**
 * Callback method when user clicks on the map. The callback is used for
 * adding a marker for a new opinion.
 * @param e Click event.
 */
clickCallback: function(e) {
    var position, layer, size, offset, icon, marker;

    // Set-up information about the icon that will be used for the marker.
    size = new OpenLayers.Size(21,25);
    offset = new OpenLayers.Pixel(-size.w/2, -size.h);
    icon = new OpenLayers.Icon("/static/openlayers/img/marker-blue.png", size,
        offset);

    // Grab the layer with user's opinion marker.
    layer = ppgis.map.getLayersByName("user_opinion")[0];

    // Calculate the marker position based on event's click coordinates.
    position = ppgis.map.getLonLatFromPixel(e.xy);

    // Create the new marker.
    marker = new ppgis.NewOpinion(position);

    // Remove all existing markers (there should be one anyway), and add a
    // new marker.
    layer.clearMarkers();
    layer.addMarker(marker);
// Display the input form for new opinion.
marker.showInput();

// Remove the marker when modal gets closed.
// @TODO: Maybe there could be a better place to define this, but for now
this is ok.
$(
  "#new"
).on("hidden.bs.modal", function(e) {
  layer.removeMarker(marker);
});

/**
* Moves the marker layers to top.
*@
*/
markerLayersToTop: function() {
  var userOpinion;

  // Get the user opinion layer.
  userOpinion = ppgis.map.getLayersByName("user_opinion")[0];

  // Move the marker layers to top.
  if (this.active_opinions_current !== null) {
    this.setLayerIndex(this.active_opinions_current, this.getNumLayers());
  }
  if (this.active_opinions_proposed !== null) {
    this.setLayerIndex(this.active_opinions_proposed, this.getNumLayers());
  }
  if (userOpinion !== null) {
    this.setLayerIndex(userOpinion, this.getNumLayers());
  }
},

/**
* Displays or hides the currently active proposal.
*@
* @param display Specifies if the proposal should be displayed or hidden. Default is 'true'.
*/
displayActiveProposal: function(display) {
  // Set input argument defaults.
  display = typeof display !== "undefined" ? display: true;

  if (this.active_proposal !== null) {
    this.active_proposal.setVisibility(display);
  }
  if (this.active_opinions_proposed) {
    this.active_opinions_proposed.setVisibility(display);
  }
  if (this.active_opinions_current) {
    this.active_opinions_current.setVisibility(!display);
  }
},

/**
* Activates a proposal. The map view will zoom to the specified proposal,
* and any opinions being added will be associated with the activated proposal.
*@
* If a previously active proposal is present, its layers (including
activateProposal: function(id) {
    var proposal;

    if (this.active_proposal !== null) {
        this.active_proposal.setVisibility(false);
    }

    if (this.active_opinions_current !== null) {
        this.active_opinions_current.setVisibility(false);
    }

    if (this.active_opinions_proposed !== null) {
        this.active_opinions_proposed.setVisibility(false);
    }

    if (id in this.proposals) {
        // Fetch the layers.
        this.active_proposal = this.proposals[id];
        this.active_opinions_current = this.opinions_current[id];
        this.active_opinions_proposed = this.opinions_proposed[id];

        // Set-up layer visibility.
        this.active_proposal.setVisibility(true);
        if ($($("#current-situation").prop("checked") === true)) {
            this.active_opinions_current.setVisibility(true);
            this.active_opinions_proposed.setVisibility(false);
        } else {
            this.active_opinions_current.setVisibility(false);
            this.active_opinions_proposed.setVisibility(true);
        }

        // Zoom to proposal.
        this.zoomToExtent(this.active_proposal.extent);

        // Trigger display of proposals via simulated click.
        $($("#proposed-plan")).trigger("click");
    }
}

/pgis.csrfSafeMethod = function (method) {
    // these HTTP methods do not require CSRF protection
    return (/^(GET|HEAD|OPTIONS|TRACE)/.test(method));
}

/pgis.init = function() {
    // Get the CSRF token value from cookie.

var csrfToken = $.cookie('csrftoken');

// Configure jQuery AJAX calls to send out CSRF tokens when necessary.
$.ajaxSetup({
    crossDomain: false, // obviates need for sameOrigin test
    beforeSend: function(xhr, settings) {
        if (!ppgis.csrfSafeMethod(settings.type)) {
            xhr.setRequestHeader("X-CSRFToken", csrfToken);
        }
    }
});

// Create the map instance.
// @TODO: Don't hard-code the URL.
ppgis.map = new ppgis.Map("map", "/ppgis" , {
    projection: new OpenLayers.Projection("EPSG:4326")
});

// Fetch the proposals.
ppgis.map.refreshProposals();

// Fetch the initial opinions.
ppgis.map.refreshOpinions();

// Show the map.
ppgis.map.zoomToMaxExtent();

// Fix for being able to use show()/hide() on initially hidden elements.
$('#.hidden').hide().removeClass("hidden");

// Hide the alerts and remove alert classes when opinion modal gets closed.
$('#opinion').on("hidden.bs.modal", function (e) {
    $('#opinion-message').hide().removeClass("alert-success, alert-danger");
});

// Clean-up the modal when it gets closed.
$('#new').on("hidden.bs.modal", function (e) {
    // Remove messages and clear any alerts on them.
    $('#new-message').hide().removeClass("alert-success, alert-danger");

    // Make sure the tooltips get hidden as well.
    $('#new-positive-label').tooltip("hide");
});

// Hide the proposals when user switches to current situation.
$('#current-situation').change(function() {
    ppgis.map.displayActiveProposal(false);
});

// Show the proposals when user switches to proposed situation.
$('#proposed-plan').change(function() {
    ppgis.map.displayActiveProposal(true);
});

// Zoom to user-selected proposal when requested by user via select.
$('#proposal-select').change(function() {
    ppgis.map.activateProposal(this.value);
});

// Show useful editing tooltips when new opinion modal gets shown.
$('#new').on("shown.bs.modal", function (e) {
    $('#new-positive-label').tooltip({
        title: "Click to toggle positive/negative opinion.",
        placement: "right"
    });
$("#new-positive-label").tooltip("show");

// Extract get parameters.
var getArguments, getArgument, key, value;
getArguments = window.location.search.replace("?", "").split(",");

for (var i = 0; i < getArguments.length; i++) {
    getArgument = getArguments[i].split("=");
    key = getArgument[0];
    value = getArgument[1];
    if (key == "opinion") {
        $(ppgis.map).on("refreshed_opinions", function() {
            ppgis.map.zoomToOpinion(parseInt(value, "10"));
        });
    }
}

// Initialise ppgis once the document is ready..
$(document).ready(ppgis.init)