

# ENHANCING ONLINE PUBLIC NOTICES USING GIS TO FACILITATE PUBLIC PARTICIPATION IN MUNICIPAL DEVELOPMENTS

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## ABSTRACT:

By-laws of many municipalities and local governments require certain level of public participation in their decision-making processes for municipal planning and development activities. One of the common practices in Canada is to hold public meetings, during which the proposed developments are explained and discussed, and public opinions are collected. The problems associated with existing practices are twofold: insufficient access to information required for public input and lack of effective, innovative communication channels other than public meetings. Having municipal environmental assessment (EA) process as the application context, this paper presents our effort on developing methodology and software tools, using advanced information technology including GIS, that facilitate information access, understanding of EA study, and proactive participation in public meetings and, eventually, in overall municipal class EA process.

## 1. INTRODUCTION

By-laws of many municipalities and local governments require certain level of public participation in their decision-making processes for municipal planning and development activities. One of the common practices in Canada is to hold public meetings, also named public information centres (PIC), during which the proposed developments are explained and discussed, and public opinions are collected. Based on a survey [Lawndes et al., 2001b], public meetings are still one of the mostly identified forms of public participation.

The problems associated with existing practices are twofold: insufficient prior access to information required for public input and lack of effective, innovative communication channels other than attending public meetings. As stated in Meredith [2000], better access to information, better connection to decision-making process, and better tools for getting input into decision-making process is important questions to answer for efficient public participation.

Recent advances of technology such as Internet and geographic information systems (GIS) have changed many aspects of the old traditional public participation approach [Allen, 2003; Ban, 2003; Ventura, 2003], and promise to provide new information tools to improve participation process. While a rich collection of publications in this area may be found from proceedings of annual public participation GIS conferences, more relevant examples include the electronic town meetings (ETM) using modern computing technology such as laptops, wireless voting pads, and groupware systems [AmericaSpeaks, 2004], web-based GIS applications used to enhance public participation [Evans, et al., 1999], and Web Mapper that allows collection of public input using both HTML forms and maps (comments geo-referenced) [Meredith, 2000]. However, few systems are capable of interactive manipulation of information [Evans,

1999], “what-if” analysis, and participant’s input, together with access to information sufficient to make informed decisions.

Social implications of public participation in decision-making processes have also been extensively discussed in many publications [Lowndes, et al., 2001a and 2001b]. Among these issues, equality in accessing information, using technologies to manage and access information, and influencing decision-making course, in the scope of our research, are some of the most important considerations. Another issue is to identify general technology impediments and provide corresponding strategies to eliminate or reduce them [Allen, 2003; Ventura, 2003]. While the long-lasting projects may provide more suitable testing platform for the public participation, many municipal development projects last for a short period and require a quick turnaround in making decisions. This also imposes some social and economic issues in adopting technology-oriented solutions. The consideration must be given based on two project dimensions: scale and time.

The research reported here concerns a GIS-based online approach to facilitate public participation in collaborative decision-making in various municipal developments, by combining public notices and out-of-meeting support mechanisms. The focus of this paper is on the development of methodology and software tools that facilitate information access, understanding of environmental assessment (EA) study, and proactive participation in public meetings and, eventually, in overall municipal class EA process.

We have examined existing practice of conducting public consultation in selected municipalities in Great Toronto Area in Canada, with respect to EA studies. Spatial requirements have been defined and a framework of a GIS-based Internet public notice system has been developed. It is based on this framework that the initial prototype has been developed using the existing Internet GIS/mapping technologies.

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## 2. REVIEW OF EXISTING PRACTICE

Public participation is vital to municipal class environmental assessment (MCEA) and is currently realized through an iterative process of public meetings and reviews, of which the public and the interested agencies are notified via public notices. The process provides opportunities for public input, gathered through public meetings, telephone inquiries, letters, email and faxes. This section examines class EA background and current practices of notifying the public, holding public meetings, and collecting public input during an EA study.

### 2.1 Environmental Assessment

“Environmental assessment provides an effective means of integrating environmental factors into planning and decision-making processes in a manner that promotes sustainable development”, as stated in the Canadian Environmental Assessment Act [CEAA, 2003]. In Canada, EA activities are regulated by either provincial or federal environmental assessment act, based on the scale of the assessed project.

In the province of Ontario, the environmental assessment is regulated by Ontario Environmental Assessment Act, which forms the basis of the Municipal Class Environmental Assessment process, adopted by many municipalities in the province [OGRA, 2000]. The MCEA process provides a decision-making framework that ensures the requirements of Ontario Environmental Assessment Act to be met. The MCEA applies to public sector agencies that are undertaking common water, wastewater and road infrastructure projects.

The MCEA process includes: identification of the problem, alternative solutions and designs; an analysis and evaluation of the alternatives and their impacts; public participation; and study documentation. Figure 1 shows a modified version of the process diagram that illustrates the key phases and their features of the process for various project types (schedules). The class EA process recognizes three schedules: A, B, and C, where schedule “C” project requires the most comprehensive study by going through all phases.

Work related to environmental impact identification and assessment mainly falls in phase 2 and 3, and lightly in phase 4 and 5 where ESR is prepared and environmental provisions and commitments are monitored. This work includes:

- preparing an inventory of the natural, social, and economic environments;
- identifying the impact of each solution or design on the environments;
- evaluating the alternatives and selecting a preferred solution or design; and
- identifying the impact of the alternative designs after mitigation

Environmental Assessment Acts at all levels emphasize the importance of public participation in EA processes. As stated in Canadian Environmental Assessment Act, “the Government of Canada is committed to facilitating public participation in the environmental assessment of projects to be carried out by or with the approval or assistance of the Government of Canada and providing access to the information on which those environmental assessments are based.” This is also true to municipal and provincial level EA. The involved municipality wants to ensure that anyone with an interest in the study has

opportunities to get involved and provide input before any decisions are made on a preferred alternative.

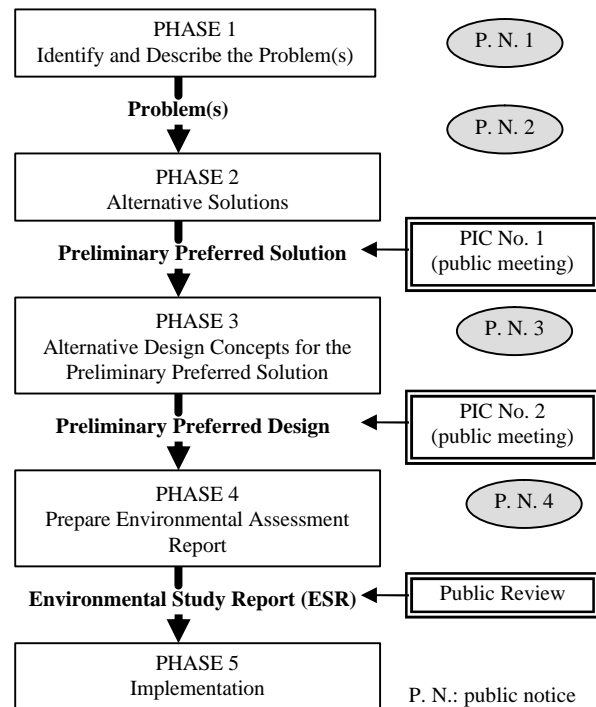


Figure 1 Municipal environmental assessment process (after [OGRA, 2000])

### 2.2 Public Notices and Meetings

Public notices of an EA study are usually published in the local papers, the local government official websites, and mailed out to property owners, residents and government agencies. A typical notice of EA study consists of the following sections:

- a brief introduction (i.e., project/study background);
- an image map showing the location of project/study area and its geographic context;
- the date/time and location of public meetings or public information centres, if any; and
- the contact information for comments and obtaining further information

Depending on the stage of MCEA study, a public notice can be for the commencement of the MCEA study, one or more public information centres, or the completion of the MCEA study. While the mailed-out notice or notice in the newspapers mostly provide limited information as listed above, the web-based notices do hyperlink to study materials such as previous notices, minutes and handouts from previous meetings, and syntheses of public input up-to-date. However, the use of maps in all cases is limited to image maps as insertions in HTML or PDF files. Figure 2 illustrates an image map from the notice of an EA study on road rehabilitation in the Region of Peel.

Public meetings usually involve formal/informal presentations of the proposed project and the results of its MCEA study. The basic meeting procedure is a mix of presentations made by the municipality staff and consultants and interaction between meeting participants to discuss concerns and collect input. Mostly, public meetings adopt an open house format, using a number of panel displays. These panel displays may include background, EA study process, preliminary design, drawings,

the assessment and evaluation of alternatives, the preferred alternative, public input to-date, and other study materials. In addition to regular public meetings, supplementary meetings with affected parties or working groups may also be held for public input. These special meetings are usually more technical or subject oriented, requiring more technical details.

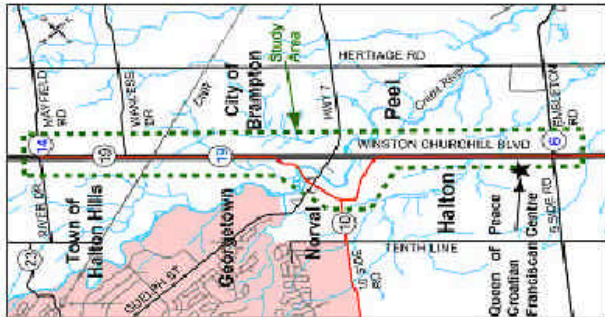


Figure 2 Image map in the notice of class EA for rehabilitation of Winston Churchill Boulevard (source: Region of Peel)

### 2.3 Problems and Potential for Improvement

By examining the existing approach for public consultation in class EA process, a number of problems and potential for improvements can be identified.

**First of all**, the public is often unprepared when situations requiring participation emerge and they react to circumstances determined by project proponents [Meredith, 2000]. In other words, the public very often comes to the public meeting without sufficient background and has to follow whatever decision path presented by the project proponents.

During the process of the EA study of a project, "where the responsible authority has determined that public participation is appropriate, it must provide an opportunity for the public to examine and comment on the screening report [CEAA, 2003]." This requires innovative approaches to support easy yet fully exploration of class EA study results as well as commenting on them before and after attending public meetings.

**Secondly**, interested citizens have to physically attend the public meeting to be able to understand the related issues and voice their concerns and/or comments, which is very often difficult for them given their other commitments. Problems of accessing public meetings have been seen as a deterrent to "having your say" [Lowndes, et al., 2001b]. Existing remedies of providing either contact information in notices for obtaining further information or simple online feedback and /or comment form prove to be not sufficient. For example, for those citizens who cannot attend the meetings, it is difficult for them to get necessary analysis results, alternative scenarios, plans, etc. to form an overall consensus or concern.

**Finally**, but not lastly, the existing approach does not provide a rich platform to support interactive public input prior, during, and after public meetings. Full public participation in class EA processes cannot be completely realized through a few public meetings held at specific locations and time, as well as written communications. Participants need to "play with" various alternative solutions/designs (including their own ones) before making and/or commenting on the preferred alternative.

Technology advances should be well utilized to allow the public input at anytime from anywhere, with support of 24 hours participation services access including tools and information [Lowndes, et al., 2001b]. Such utilization enables interactive, explorative generation and analysis of environmental impacts shown on maps, for instance, and supports multi-criteria decision making.

There may be many solutions to tackle the aforementioned problems. This paper presents an integrated solution based on the Internet, geographical information systems (GIS), database, and workflow technologies. Our solution supports an integrated public participation workflow process that flows from the beginning of a class EA to its end, ensuring continuous public involvement anytime anywhere.

### 2.4 GIS as a Facilitating Tool

The spatial nature of EA study and the increasing role of public input in class EA processes in Canada encourage integration of GIS in EA decision making. For example, GIS is identified as one of the information technology sources in addressing biological diversity in EA process [CEAA, 1996]. Environment assessment includes geographical factors as input and environmental conditions as output, and it is important that the latter be expressed in easily understood forms to the public.

The ability of GIS to physically overlay and perform analysis on selected criteria enables project designers to limit the impact to environmental sensitive areas. However, the potential that computing technology including GIS technology brings to the general citizens for public discourse remains largely untapped. In effect, maps are mostly used to only provide effective visual communication aids (e.g. large-format colour displays) for presentations to the public during public meetings.

GIS output is considered to be highly advantageous in understanding and interpreting environmental impacts [Haklay, 2003]. In order to use GIS as an effective tool to facilitate public consultation in class EA processes, the following environment factors, although not an exhausted list, must be well understood and presented using GIS and maps in an easy-to-understand manner with respect to individual EA study:

- Natural Environment: vegetation and wildlife (habitat and movement); forest areas; groundwater resources/wells; and aquatic/fisheries resources
- Social Environment: property acquisition requirements and frontage impacts; pedestrian; noise; and existing and future land use compatibility
- Cultural Environment: built heritage and cultural features; and archaeological resources

## 3. OUR APPROACH

### 3.1 General Framework: a Big Picture

Our model for public consultation in class EA processes builds on two separate yet inter-connected use cases: GIS-enabled, media rich virtual environments for public notices and collaborative multimedia public meeting environments. These two use cases are conceptually described as follows:

1. Each project undergoing a class EA process possesses a single access point on the web, leading to a public participation virtual space. All the notices of the public

meetings, meeting outputs, public input, and project related documents can be accessed in the virtual space. More importantly, the public can access and review project documents, and provide input online anytime from anywhere, with the capability to explore GIS-based environmental impact analysis results.

2. A public meeting is held for interested citizens and agencies to input on an ongoing EA study of a newly planned development (e.g. a road expansion project), using a large interactive display system to facilitate the meeting. Simultaneously, the display and meeting conversations are shared by those citizens, who are not able to physically attend, from their homes and offices using a Web browser or a handheld display. A group of specialists may respond to questions from citizens and interact with the shared display of the meeting using their desktop PCs which possess powerful GIS capabilities.

The interconnection between these two use cases are reflected by the underlying information flows, decision-making, and participation workflows. Obviously, the public who is planning to attend public meetings at different stages of class EA study sufficiently understands the alternatives prior attending meeting by exploring the information in virtual space. The materials presented and public inputs collected through the virtual space are also synthesized for being used in the public meetings. This two-way information transfer between online public notice system and public meeting system is transparent and, ideally, should be automatic with little human intervention. The decision-making and participation workflows are a set of decision rules, actions, and predefined or ad-hoc procedures. Their roles are mainly to improve and automate existing decision-making processes with respect to public participation.

While research is undergoing to develop GIS-based solutions for the two cases described above, the primary objective of the research reported here is to design and develop methods, software tools, and workflows to provide an online GIS-enabled virtual space for public participation in conducting class EA. Specific objectives of the research are to:

- identify the most useful forms of geospatial data (e.g. 2D or 3D) in relation to other types of information that would help the public participants to participate in EA study;
- identify the most important functional features of online GIS-enabled public notice systems for supporting easy access to and retrieval of EA study data; and
- develop the required methods, software tools, and workflows, and determine if their provision would result in quality improvement and cost/time savings in consulting public input

### 3.2 Design of GIS-enabled Public Notices

Online GIS-enabled public notice systems, hereafter called *GeoNotice*, play two important roles: (1) notifying the public of upcoming public meetings and allowing the interested citizens to explore project information and become prepared for the public meeting; and (2) providing a platform for continuous soliciting of the public input and presentation of the final results. Comparing with time-limited public meeting sessions, this online notice system enables more citizens to participate in decision making process at a flexible period of time.

A preliminary user requirement analysis, based on the literature review and initial contact with parties involved, indicates that *GeoNotice* needs to be accessed by city staff (proponents), consultants, citizens, and agency staff (Figure 3). In addition to

other requirements, the system must at least be capable of supporting the following four groups of public participation activities:

- *Notify*: online public notices and automatic generation of the first-class mails and mailing
- *View and Exploration*: exploring project documents and visualizing environmental impacts on 2D/3D maps, perhaps with orthophoto or images overlaid, as well as interactively proposing new alternatives
- *Prioritization and Decision-making*: prioritizing decision criteria, preferably multi-criteria, and making decisions accordingly
- *Input and synthesis*: collecting and summarizing public input in structured or unstructured formats.

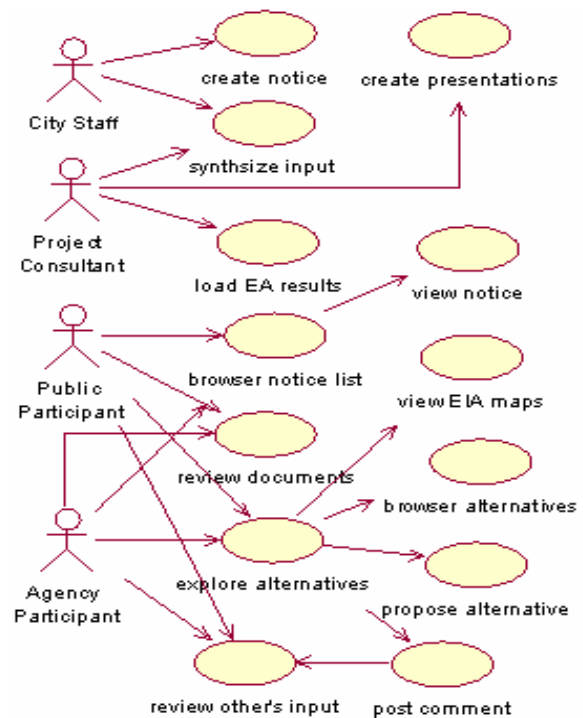


Figure 3 A use-case model for user requirements

*GeoNotice* is designed to manage multiple class EA study projects; hence raising the problem of managing documents and public input of different projects. One way to solve this problem is to organize all documents in different categories, including: (1) documents common to all projects (e.g. legal documents such as by-laws, EA acts, and general statistics); (2) documents common to a project (e.g., official plan in the area); (3) documents related to a particular phase of class EA study; and (4) documents containing public input (e.g., threaded comments, photos, and videos). Such organization allows easy management, sharing, and integration to class EA workflows.

Ideally, each public participant should have his/her own workspace in *GeoNotice* systems which manages individual views, comments, added data (e.g., photos and documents), and output generated. Materials stored in individual workspace may be customized to generate individualized presentations (e.g., PPT presentation) that can be presented during public meetings by individual citizens for discussion. However, the realization of this capacity requires extensive computing resources of the system, and may ask for extra design effort to make sure it does not degrade citizen's empowerment with respect to the familiarity of technology and geography.

In terms of supporting interactive spatial exploration of environmental impact assessment (EIA) results using GIS or maps to answer “what-if” questions, there are two design options *GeoNotice* can adopt. One is to have a set of predefined and prepared EIA maps that can be viewed by the public following a predefined procedure. The other one is to allow the public to interactively explore EIA using some simple GIS analysis functions, such as buffering and overlay. Apparently, the first approach is more suitable for people who do not have any previous GIS experience, or even much with computers. The latter one is more desirable for people who already have some GIS knowledge. Even though, spatial exploration still needs to be simplified, for example, by implementing a model-driven spatial modelling process.

### 3.3 EA and Participation Workflows

As mentioned in the previous section, the workflow includes two types of processes. One type of process describes the information flow that controls what information is required in each step, how the formation is transferred, and who gets access to the information. The other type of process controls participation, decision-making, and actual environmental assessment procedures based on a set of rules. These rules are identified from particular requirements of by-laws and EA Acts, best practices, and special requirements stemmed from the implementation of the new GIS-enabled approach.

As an example, for all projects, all mandatory notices including Notices of a Study Commencement and Notices of Completion are to be directed to the appropriate Regional EA Coordinator, as indicated in Section A.3.6 of the Municipal Class EA [OAGR, 2000]. In addition, municipalities must also submit a Notice of Completion for each Schedule B or C Project to Ontario Ministry of Environment’s Environmental Assessment and Approvals Branch (EAAB). Moreover, an environmental study report (ESR) must be finalized prior to the notice of the completion. The ESR is then available for the public review for 30 days. Figure 4 illustrates an example of how these workflow rules are defined in part in the project workflow process.

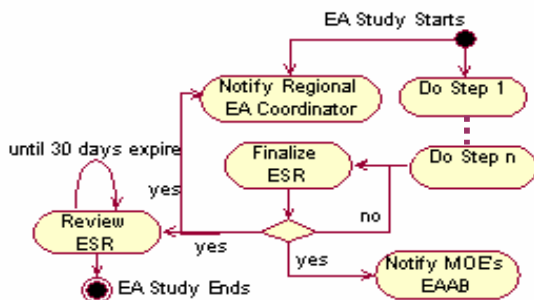


Figure 4 Class EA process rules in workflow model

Workflows can also be modelled for the processes such as generating/mailling public notices and handling public input. These workflows can then be automated using a workflow management component, which is expected to be included in our research development at its later stage.

## 4. PROTOTYPING GEONOTICE

The evolutionary design and development process has been adopted for designing and developing the system. This approach allows us to quickly construct a *GeoNotice* prototype and then test, improve, and expand it to meet all requirements

discussed in Section 3. Currently, we are in the stage of developing an initial prototype which focuses on managing only one project at a time. However, scalability has been taken into consideration for the future expansion to multiple projects.

Figure 5 shows the main web-based interface of *GeoNotice* system that is accessed by the public participants to explore one project. Through this main interface, the public participants can read relevant documents, learn the results from various stages of the project EA study, and explore proposed alternatives and the potential environmental impacts. *Project Info* contains background information and related documents. Both *Study Results* and *Public Input* link to an embedded GIS/mapping component. *Study Results* module presents class EA study results, combining text, statistics, and environmental impact maps, etc., while *Public Input* allows participants to graphically propose alternative design and solutions they perceive more suitable and provide comments as closely as possible related to the particular problem areas and/or issues.



Figure 5 *GeoNotice* interface: main page of a project

Figure 6 shows the interface of GIS component that allows exploration of alternatives and their environmental impacts, as well as anchoring public input to specific geographic features. At the prototyping stage, the system only implements a guided “tour” of a series of “what-if” scenario exploration. However, the participants are still able to interactively query and manipulate map data. The functional feature of this component also enable the uploading of multimedia data such as photos and audio/video clips to support public comments.

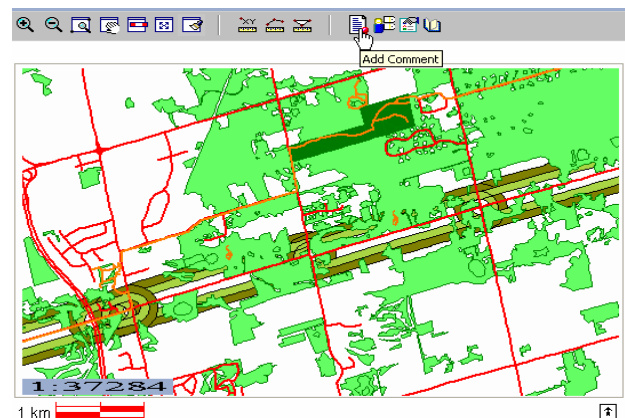


Figure 6 *GeoNotice* interface: exploring and commenting EA results using GIS

To better organize the public input, together with the EIA map displays, all comments are “threaded” and are stored and managed in the system database. This allows easy access to other’s input and comments on that input, with necessary references to both textual and mappable data related to EA study results. The organization of threaded comments is similar to any threaded discussion forum found on the Internet (see Figure 7), which can be accessed through the Public Input link as shown in Figure 5 and map features as shown in Figure 6.

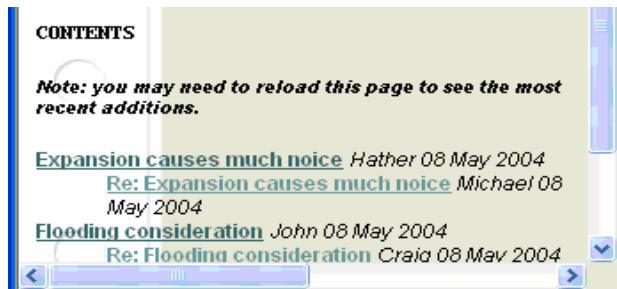


Figure 7 GeoNotice interface: threaded public comments

## 5. DISCUSSIONS

During our preliminary study and prototype development, we have encountered several organizational and technological issues, on top of many social issues. Some of them are briefly discussed as follows:

One of the problems is who is going to run and maintain the GeoNotice system. As described previously, the proponents, normally government agencies are responsible for broadcasting public notices and the external consultants retained are responsible for conducting class EA studies, presenting results to the public, and collecting public input. Ideally, the system should be run and maintained by the municipal government and open to the consultants to load required data and information, following guidelines. However, this needs further investigation together with involved parties.

Public enthusiasm in participation is another big issue to consider in system design in terms of interfaces, service availability, and easiness of using the system. In addition, lower attendance of public meetings makes the meeting system suspicious in terms of cost savings. Special considerations should be given to how easy such networked meeting systems can be setup and whether they help improve the attendance physically or virtually. This also led us to a component-based design, which allows the incremental implementation of the developed methods and tools.

GeoNotice system is an effort of technology integration from a technological perspective. A problem associated with it is the selection of different technology components to minimize potential cost required to implement the system and to maximize (or reduce technology impediments to) public involvement. For example, the software tools developed can depend on large, commercial systems such as Oracle Database, Internet Map Server, Workflow Management System, etc., which will pose a huge initial investment and high license maintenance cost. Other problems, common to all online application development, are the compatibility of different web browsers and Internet connection speed.

## 6. CONCLUDING REMARKS

This paper discusses the application context, design, and some implementation issues of preliminary development effort of an online GIS-enabled public notice system. While we believe the system will help improve the public participation in municipal class EA process, there are still many issues needed to be further studied before this can be realized. Specially, we look for using our initial prototype, simple yet functional, to support selected real-world projects. It has to be pointed out that, given the limited access to the Internet in some areas and some social sectors, the traditional approach should not be replaced. The approach discussed should rather be considered as a good complementary means to facilitate public involvement.

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