Web-Based Geographic Information Systems: Public Participation in Virtual Decision Making Environments

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(ABSTRACT)

Geographic information technologies on the Internet possess the potential to provide tremendous support to citizens by empowering them with information. A Virtual Decision-Making Environment (VDME) is created when GIS on the Internet, or in other words, Web-based GIS, are integrated with different technologies such as multimedia, virtual reality, and visualization, to disseminate information for better public participation. Such an environment can make complex information more easily understandable to people who are not sophisticated in technology. VDME can mold today's society by providing efficient public access, and may support 'empowerment' of the citizens' capacity to work with data to participate in the discussion of community development initiatives.

The objective of this paper is to discuss the role of web-based GIS as spatial decision support systems to aid public participatory community planning, and build on the current research to develop ideas for an effective Virtual Decision-Making Environment. The paper also explores the potential and constraints of web-based tools for public participation. The paper achieves its objective by exploring different approaches to community based decision support systems that have emerged in the electronic agora to improve the social and economic status of the community.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

"The political significance of computer-mediated communications (CMC) lies in its capacity to challenge the existing political hierarchy's monopoly on powerful communications media, and perhaps thus revitalize citizen-based democracy. ... The vision of a citizen-designed, citizen-controlled worldwide communications network is a version of technological utopianism that could be called the vision of 'the electronic agora.' In the original democracy, Athens, the agora was the marketplace, and more -- it was where citizens met to talk, gossip, argue, size each other up, find the weak spots in political ideas by debating about them. But another kind of vision could apply to the use of the Net in the wrong ways, a shadow vision of a less utopian kind of place -- the Panopticon...."

- Howard Rheingold

Technologies emerge out of dynamic social processes, and reciprocally, communities coemerge with new technologies. Web-based interactive spatial decision support systems, the focus of this paper, are examples of such technologies. Spatial decision support systems on the Internet possess the potential to provide tremendous support to citizens by empowering them with information. Citizens are integrated with the 'information fabric' of the Internet age through web-based spatial decision support systems. This integration may enable citizens to collectively participate in the community development process, and in turn help develop trust and ownership of the decisions made by the planning professionals, among the citizenry.

Technological advancements transform the basic nature of information management. Geographic Information Systems (GIS), an example of such advancement, is geographically referenced information management technology. *Geographic Information Systems* (GIS) are "...computer-based information systems that attempt to capture, store, manipulate, analyze and display geographically referenced and associated tabular attribute data, for solving complex research, planning and management problems" (*Fischer and Nijkamp, 1993*). GIS are used are used extensively in various applications like land-use mapping, transportation mapping and analysis, and natural resource assessment. GIS allow efficient and flexible storage, display, and exchange of spatial data. Like all technologies, GIS are a part of the larger society and co-evolve with it.

Research addresses two broad questions on the inter-relationship between GIS and society: First, how can broader and effective use of GIS by the general public be attained?

Second, how can new geographic technologies be developed to address problems associated with the use of current GIS technologies for public participation? (*Schroeder, 1997*) Integration of interactive maps, audio, text, video and other forms of community or city related data with analytical tools on the Internet could help the public access and understand information. Such integration could also aid gathering opinions of the masses on related city or community issues. A Virtual Decision-Making Environment (VDME) is created when GIS on the Internet, or in other words, Web-based GIS, are integrated with different technologies such as multimedia, virtual reality, and visualization, to disseminate information for better public participation. Such an environment can make complex information more easily understandable to people who are not sophisticated in technology. VDME can mold today's society by providing efficient public access, and may support 'empowerment' of the citizens' capacity to work with data to participate in the discussion of community development initiatives.

Different approaches to community based decision support systems have emerged in the electronic agora to improve the social and economic status of the community. For instance, the Blacksburg electronic village has served as a model of first-generation electronic villages since 1992. Many cities and communities borrow this model and customize it to their own socio-economic and physical needs. (*McGarigle, 2000*)

When one explores the potentials of web-based spatial decision support systems for public participation and visualization, the constraints, and possible solutions to those constraints must also be discussed. For example, what if too many people or too few people participate? Certain kinds of information provided on the Internet are seen as a threat to privacy of individuals in some communities. The lack of adequate speed of some Internet connections could be seen as a constraint to access the information and the tools. Because of such constraints, more and more researchers recognize the need for a new kind of spatial decision support system, to provide faster and easier access to GIS on the Internet.

This paper discusses the role of web-based GIS as spatial decision support systems to aid public participatory community planning. The paper builds on the current research to develop ideas for an effective VDME. The paper also explores the potential and constraints of web-based tools for public participation.

CHAPTER 2

PUBLIC PARTICIPATION: PLANNING, GIS AND SOCIETY

Community planning seeks to design and manage the human environment for the benefit of its inhabitants. Public involvement is essential for achieving the goal of community planning. Also, in a democracy, the success of a community plan depends largely on public support. (*Stillwell et. al*) Public involvement also spurs innovative ideas and suggestions and assists in arriving at a consensus among the diverse citizenry. Public participation approaches aim to broaden public awareness of government issues and provide opportunities to the public to exercise control over the decision making process. (*Fonseca et al, 1997*) Public participation thus may serve as a tool from the initial stages of the planning process to reduce conflicts and delay that occur in later stages.

2.1. Public and the Participation Ladder

This paper defines 'public participation' as public involvement in a wide range of decisions made by a planning system. Arnstein (1969) claims that citizen involvement in planning represents a redistribution of power from managers to the public. Arnstein developed a 'ladder of citizen participation' (See Figure 1), in which she describes eight steps of involvement and power sharing typically found in planning. The bottom rungs of the ladder indicate lowest levels of citizen participation. Arnstein divides the eight levels into three classifications: non-participation, degrees of Tokenism and degrees of Citizen power.

According to Arnstein, "*…inviting citizens' opinions, like informing them, can be a legitimate step towards their full participation. But if consulting them is not combined with other modes of participation, this rung is still a sham since it offers no assurance that citizen concerns and ideas will be taken into account. The most frequent methods used for consulting people are attitude surveys, neighbourhood meetings, and public meetings.*

…Public participation is concerned with the redistribution of power that enables the have not citizens, presently excluded from the political and economic processes, to be deliberately included in the future. It is the strategy by which the have-nots join in determining how information is shared, goals and policies are set, tax resources are allocated, programmes are

operated, and benefits like contracts and patronage are parcelled out. In short it is the means by which they can induce significant social reform which enable them to share in the benefits of an affluent society…"

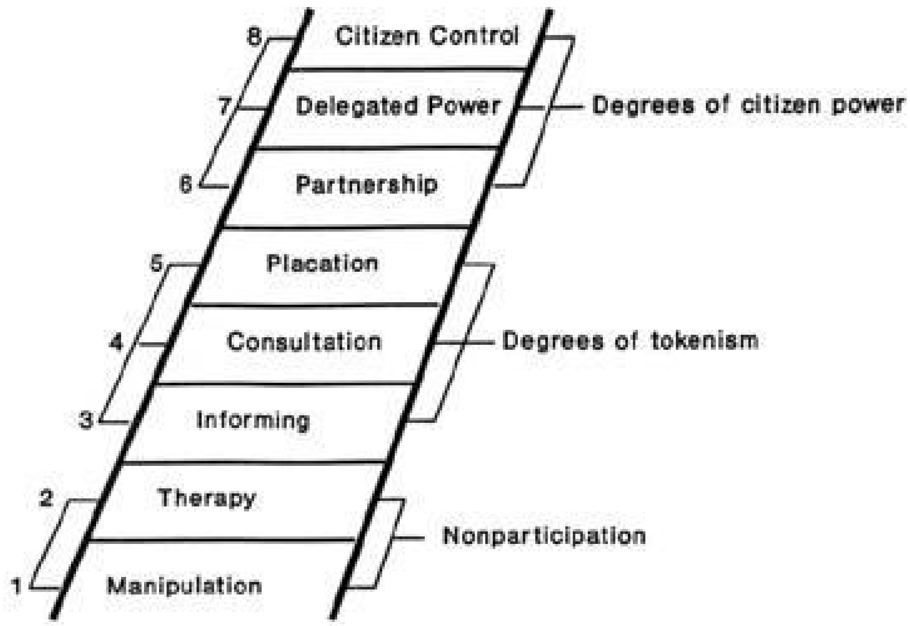

Figure 1. Ladder of Citizen Participation (Arnstein, 1969)

The public participation ladder proposed by Weidemann and Femers *(1993*) build upon the Arnstein ladder and graphically describes different levels of public participation based on the rights provided to the citizens. According to Weidemann and Femer's description, public participation increases with the level of access to information as well as the rights the citizens have in the decision making process. Future discussions of public participation ladder in this paper refer to Weidemann and Femer's ladder. There are different levels of public participation in the public participation ladder, as illustrated in Figure 2:

i) Public right to know (Freedom of information to ensure democracy)
ii) Informing the public, through Public access terminals.
iii) Public right to object,
iv) Public participation in defining interests, actors and determining agenda
v) Public participation in assessing risks and recommending solutions

vi) Public participation in final decision.

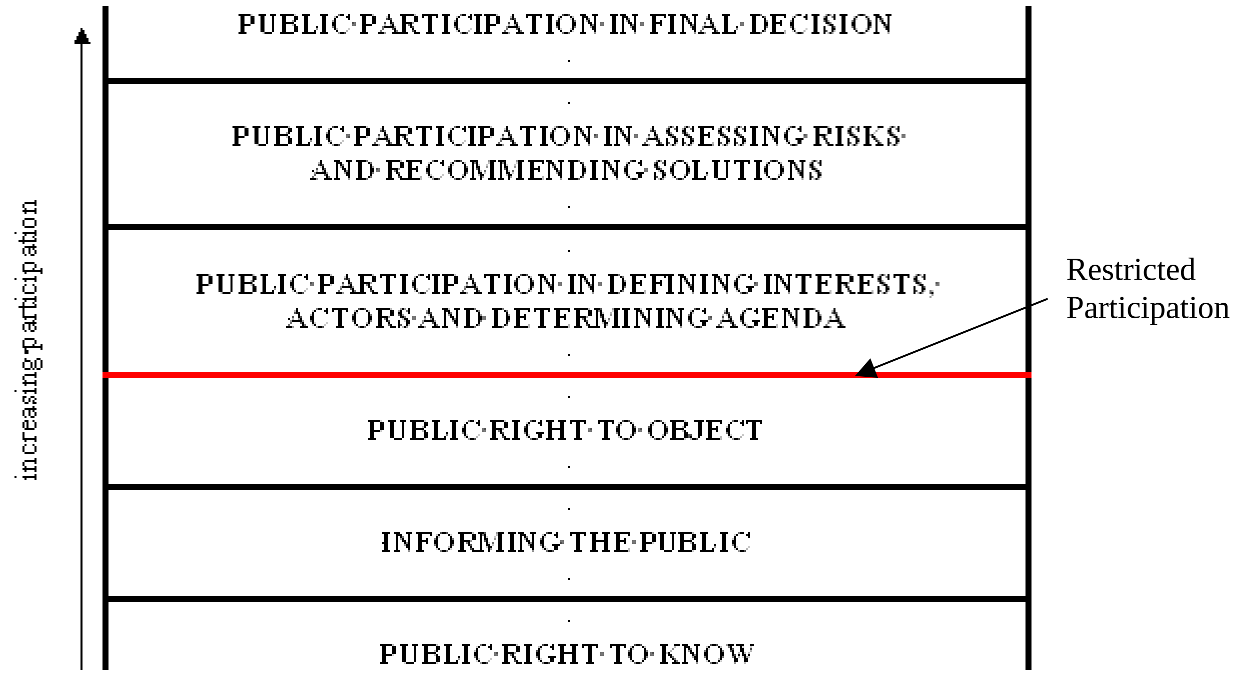

Figure 2. The Public Participation Ladder (*Weidemann and Femers, 1993)*

According to Weidemann and Femers, public participation increases as the government grants citizens rights higher in the ladder. The higher levels in the ladder can be reached only by fulfilling the requirements of the lower steps in the ladder. This means that if a community has the right to '*public participation in final decision'* (highest level in the ladder), it follows that the community already possesses the right to know, right to object, right to assess risks, and the right to recommending solutions. At present, in most cases, public participation is limited to the right to object. But current information and communication technologies may provide opportunities to help public participation move further up in the public participation ladder.

The public can be said to play three different roles in public participation in a planning system's decision making process:

- *The informed public:* The public has access to information and the decisions made by the planning system. The participation level of this role played by the public can be said to be in the first two steps in the ladder. When the term 'general public' is used in this paper, it refers to 'informed public'.

- *Public as a user:* The public uses the government information to participate in the decision making process for the benefit of individuals, social groups or the wider community. In this case, public participation level can be said to be in the first three steps in the ladder.
- *Public as researcher:* When the public is a researcher, public involvement and participation reaches higher levels such as participation in final decisions, recommending solutions, risk assessments etc. The public has to be provided with exploratory spatial data analysis tools when its role is a researcher. In this case, public participation is on all rungs of the ladder.

Many local governments in the U.S. have allowed for public access by distributing their geographic information on the Internet, thereby informing the public of their planning process and the decisions made. Local governments also allow the public the right to object by having email as a link, and allowing residents to send in their comments. For example, Mecklenburg County in North Carolina is moving GIS from a specialized application to an enterprise decision-making tool. The county considers information as one of its greatest resources and aims to distribute information in a manner that saves both time and money – by using the Internet and client-server technology for the web-based GIS. Their web pages, as seen in Figure 3, include maps and tables that contain information specific to the residents of the community.

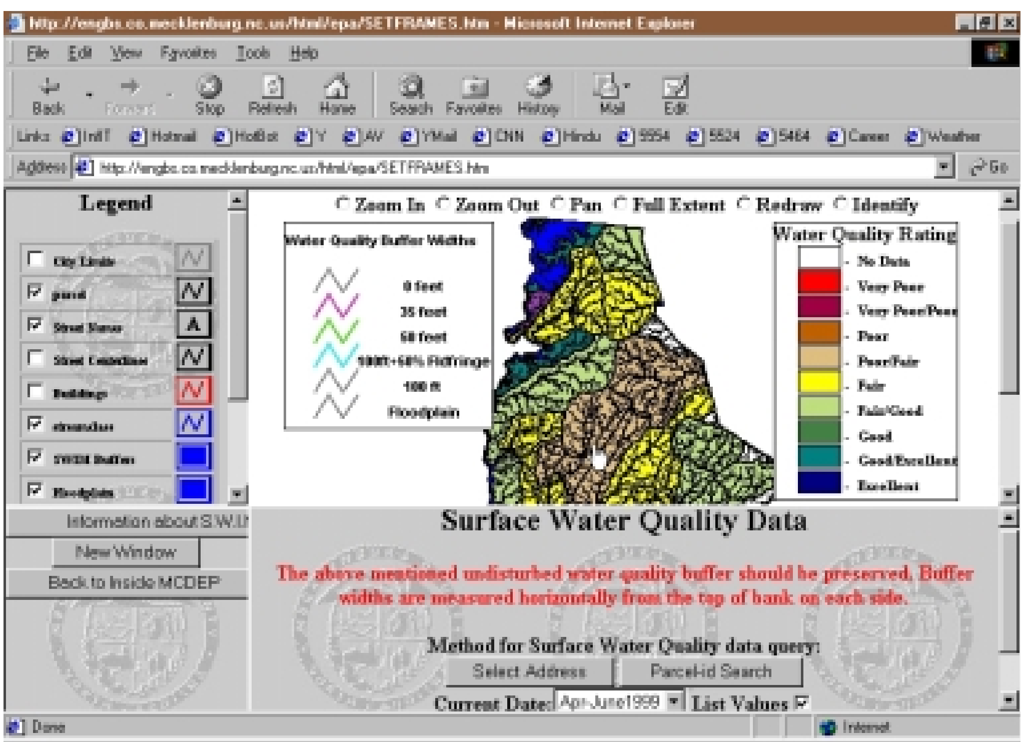

Figure 3. Mecklenburg County Web-based Public Access GIS

(*http://www.co.mecklenburg.nc.us/cogis/Gisnet.htm*)

This level of public participation can be said to be on the third step in the ladder, and can be considered as restricted access. Public participation can said to be richer when citizens have the right to participate in risk assessment, recommending solutions and making final decisions.

Traditional public participation approaches often use the medium of ‘planning meetings’. Often, these meetings involve an atmosphere of confrontation and are dominated by individuals with extreme views. This can discourage the less vocal majority from participating. In these cases, the public’s views may not always represent a wide range of opinion. The venues and times when the planning meetings are scheduled could also restrict people from attending the meetings. (*Kingston et. al, 2000*) Daniel Howard summarizes various approaches for public participation in community centers as media campaigns, guided tours, facilitated meetings and groups, formal neighborhood groups, involving youth in planning, visioning, visual preference survey, design charettes, computer simulation, and simulation exercises. (*Howard, 1998*)

Information technology provides us with modern means of distributing information to the masses. Distributed information on the Internet may also lead to a better-informed public debate. Information has to be prepared and presented in an intelligible manner for the citizens who do not have a technical knowledge of the process. This is especially true in modern societies in which information technology is a part of everyday life. According to Shiffer, “information is only powerful when it is effectively comprehended by those who use it. IT (information technology) can help people to comprehend information, thereby delivering knowledge”. (*Shiffer, 1995*)

2.2. Geographic Information Technologies

Most planning information has a spatial orientation. For example, social, economic and environmental data are related to their corresponding spatial location such as county or city. The spatial feature of planning information is essential for acquiring knowledge necessary for public participation in the planning process. Different geographic information technologies (GIT) can be employed for participatory activities. (*Howard, 1998*) Possible GIT include GIS, digital aerial photography, and hyperlinks to audio or video recordings of public meetings where planning issues are discussed. GIS have the ability to answer spatial queries using latitude and longitude data and other geographic information based on key values (e.g., name, address, social security, zip code etc.), since it manages the relationships and links between different data sets. GIS are also referred to as “intelligent mapping” systems, since it can integrate map (graphic) data with attribute (tabular) data using different matching methods. The ability to integrate information through spatial links aids in decision making for government and private organizations for a wide range of applications. GIS are very powerful tools that enable analysis of enormous amount of information and create new records, which is not feasible to do manually.

In addition to traditional public participation approaches, providing opportunities to employ geographic information technologies in public participation plans may enhance citizen involvement. According to Daniel Howard, “Spatial empowerment of the public requires utilization of appropriate GIT with the appropriate participation technique” (*Howard, 1998*) Howard arrays each traditional participation technique against a GIT to facilitate the consideration of combination of techniques.

	Geographic Information Technologies						
Traditional Public Participation Techniques	**Audio Recording**	**Visual Recording**	**Community Network**	**Automated Visualization**	**Collaborative Planning System**	**Geographic Information System**	**Distributed Geographic Information**
Media Campaign 1	●	●	◎	●	○	○	◎
Guided Tours 2	◎	◎	○	○	N	○	○
Facilitated Meeting 3	●	●	○	●	◎	○	N
Neighborhood Groups 4	●	●	●	●	●	◎	○
Youth Involvement 5	●	●	◎	●	◎	◎	◎
Visioning 6	◎	○	◎	◎	○	○	N
Visual Preference Survey 7	○	◎	○	●	◎	○	◎

Design Charette 8	○	●	○	●	◎	○	N
Computer Simulation 9	○	●	●	●	●	◎	◎
Simulation Exercise 10	○	○	○	●	●	●	◎

Key: N - No Application ○ - Limited Application ◎ - Moderate Application ● - Strong Application

Table 1. Application of Geographic Information Technologies to Public Participation Techniques (*Howard, 1998*)

The array, as seen in Table 1, facilitates the choice of combinations. For instance, combining a media campaign with audio/visual recording could enhance public participation. Similarly, simulation exercises can be more effective when combined with automated visualization, collaborative planning system and geographic information systems. Multiple combinations across the columns or rows increase possibilities. For instance community networks can incorporate GIS to facilitate public participation. Geographic information technologies may also be combined with one another.

The capabilities of GIS can be enhanced by combining it with multimedia to provide a realistic view of applications. This enhancement makes GIS a better tool for decision making because of better access to information relating to the development process (*Fonesca et. al., 1997*) and thereby results in increased participation. (*Shiffer*, *1995*) The combination of GIS and multimedia can also transform various aspects of the traditional decision making environment. The use of multimedia provides the ability to increase the degree of interaction between information and user. So, integration of GIS with multimedia is a powerful tool not only for presentation but also exploration of specific information. (*Parsons, 1995*) The integration attempts to discover and exploit the mental model of the user. (*Gould, 1993*)

In order ensure an effective decision making process, apart from dissemination of information for public access, the planning authority should attempt to clarify and resolve conflicts of interests among the citizens. Collaborative information must be considered in a visual and qualitative manner to enable its better understanding. Developing a geographic information system on the Internet for efficient public participation can support potential discussion and critique of important environmental, ecological, hydrological and other information, and thereby aid in community planning. The use of the Internet also has a potential to break down some barriers to participation by removing certain psychological elements (such as anonymity, shyness or forcing ones opinion on others) encountered by the public when expressing their view points at public meetings.

Current research and applications seek to improve community participation by combining Internet GIS resources with multimedia, which can invigorate the visual expression of the community residents. At present, GIS on the web range from simple display of maps and GIS (the example of Mecklenburg County mentioned earlier), to complex GIS on-line used as decision support systems with functionality suited to the general public as the audience.

2.3. The Institutional Setting for GIS for Public Participation

GIS, like any other technology, is constructed through negotiations between different social groups (Harvey and Chrisman, 1998). The social groups, in case of planning, include professional staff, decision-makers, developers, special interest groups, citizens and other stakeholders. Geographic information technologies have the potential to improve public access to information, and can facilitate public participation in planning and policy making process. The technologies change the economic, legal, political, and cultural status of agencies that adopt the technologies, decision-makers using the technologies, and people and organizations affected by the decisions.

While the early impacts of the technologies are now evident, long term political, economic, legal and institutional impacts are not yet known. However, geographic information technologies possess characteristics, which may impact the society, the planning organization and community-based decision making and political processes. The benefits of the technologies for public participation include increased alternatives, a more informed citizenry, economic growth and empowerment of citizens. Contrary to the expectation that the geographic information technologies will enhance democracy and empower disadvantaged groups, Clark *(1998)* warns that GIS may create a technocratic elite. At the same time, HUD’s ‘Community 2020’ software, discussed later in the paper, is an example of positive effect of geographic information technologies on public participation in the community development process.

2.3.1. Why should citizens have an opportunity to participate in the planning process?

Oregon State Citizen Involvement Advisory Committee (CIAC) states five main reasons why citizens should have the opportunity to participate in planning:

i) The law requires the government to give citizens the right to have a voice in public policy and planning.

ii) Planners need comments and ideas from citizens, who are people who live and work in the community. Citizens can provide information required to develop, maintain and carry out an effective comprehensive plan.

iii) Participation or citizen involvement creates an informed community.

iv) Participation gives a sense of ownership of the plan to the members of the community, and fosters cooperation between the citizens and their government. This may lead to fewer conflicts and litigation.

v) Providing citizens the access to planning processes planning ensures proper application of planning laws.

Above all, given a political framework, public participation serves to build trust among the citizenry. Kheir Al-Kodmany *(1998)* describes the experience of the students of University of Illinois with Chicago's Pilsen neighborhood's participatory planning and design process. The objectives of the students included creating a mutually respectful partnership with neighborhood residents, preserving neighborhood history, providing a broader understanding and context of urban issues, and exploring effective visual communication methods. According to Kheir Al-Kodmany’s experience, *“…building trust was the highest priority in the planning process. Trust arises from consistently meeting expectations and creating outcomes that all partners perceive as beneficial. One of the first lessons that the University team would learn was that effective visualization was a key to building trust throughout the process….*”

2.3.2. Planning for Effective Citizen Involvement

Oregon State Citizen Involvement Advisory Committee (CIAC) provides five major categories of measures to get public involved in the planning process.

- *Planning for effective citizen involvement:* A strong planning for citizen involvement is the best way to have strong citizen involvement in planning. So, a successful citizen involvement program must be carefully designed and managed. The five basic steps to successful management of any program include establishment of objectives, responsibility assignment, allocation of money and staff, scheduling, and performance monitoring. The detailed examples of how this can be accomplished is available at http://darkwing.uoregon.edu/~pppm/landuse/docs/chapte~6.htm.

- *Getting information to the public:* Information can be sent to the public through legal advertisements, sending out notices, and organizing a series of public hearings. Other ways in which information can be sent to the public include mailing notices and information *to the people most likely to be affected*, posting notices about important meetings and proposals in conspicuous places such as the library, city hall, courthouse, community centers, and on or near affected properties, producing flyers or booklets describing processes and procedures such as hearings and appeals.
- *Getting information from the public:* Information and opinions from can be received in many ways, such as holding public hearings in a meeting place that is publicly accessible (which is the main way to request comment from the public), scheduling meetings to avoid conflicting events, mailing surveys to a cross-section of the community, gathering information and views through door-to-door canvassing, conducting on-site interviews in areas affected by a development proposal, rezoning or planning decision, providing a "public comment" period at every public meeting and using flip charts at townhall meetings, workshops, and conducting brainstorming sessions to build a record.
- *Exchanging ideas and information with the public:* Effective communication involves more than just sending or receiving messages. It involves an *exchange* of ideas and information. Though such an exchange is difficult to achieve on a community wide scale, CIAC provides some techniques to handle the problem. The techniques include encouraging developers and permit-applicants to bring their proposals to neighborhood groups early in the application process, so that the citizens are informed about the issues that may affect their neighborhood, following up on summary of new policies and regulations to convey information about the new material to key people and to provide citizens with a sense of ownership, conducting an open house periodically in the planning department.

- *Working with the media.* Treating media people as allies can help the planning organization tell a story about an important planning program or issue. Other techniques include having a planning director appear on local radio or television talk shows, holding news conferences, and arranging important public meetings on the local community access cable television channel.

From the perspective of geographic information technologies, the technologies adopted for public participation must be blended with a community involvement program. Such a blend is discussed in the recommendations section of this paper (Chapter 8).

The next section of this paper discusses integration of traditional public participation techniques with new technologies.

CHAPTER 3

INTEGRATION OF PUBLIC PARTICIPATION TECHNIQUES WITH TECHNOLOGIES ON STAND-ALONE SYSTEMS

In recent years, several planning support systems have been developed that combine a variety of media and geographic information technologies with traditional participation techniques. Many of these systems are based on hypermedia technology. These systems have proved to be effective tools for making complex information understandable to the general public. (*Shiffer, 1995*) 'Hypermedia' combines information in variety of formats, like sound, images, movie clips, maps and documents, in an associative manner. (*Shiffer, 1992*) Some planning support systems are geared toward use by certain community organizations for public participation through exploration and visualization of community data. Three different roles played by the public ('informed public', 'user', and 'researcher') have been discussed earlier in the paper. Planning support systems that are based on hypermedia technology help the public play the role of a researcher. At present, hypermedia-based planning support systems and the systems for exploring and visualizing data, act primarily at stand-alone systems. Stand-alone systems are either individual computers or a group of computers on a Local Area Network (LAN). These systems depend on the hardware configuration of the computers. Public participation systems on the Internet will be discussed later in the paper (Section 4.3).

3.1. Collaborative Planning Systems

Michael J. Shiffer studied the problem of combining the elements of group cognition, access to media, and access to tools in a holistic planning process. (*Shiffer, 1992*) In his paper, Shiffer reasons that information relevant for any planning effort is delivered using the following three 'vehicles':

- Analytical *tools* like personal computers that provide the planners and decision-makers with forecasts, analyses and models often dealing with quantitative information
- *Media* including, but not limited to, documents, news clips, and interviews, those often provide information through both printed and electronic forms of communication.

- *Collective cognition* (knowledge stored in the minds of a group of people, typically facilitated through interpersonal communication) that delivers observations, practical experience, and political savvy.

A cohesive planning process requires close integration of these three 'vehicles' of information. A *Collaborative Planning System* (CPS), according to Shiffer, is a system that integrates activities of tool usage, information access and collective cognition by incorporating graphical interfaces, 'associative information structuring' and Computer Supported Collaborative Work (CSCW). CSCW refers to the use of information technology (which generally involves combining computers, telecommunications equipment, and software) to facilitate communication, expedite and improve decision-making, and support new organizational structure (Heap, 1997). An '*Associative information structuring*' is an association between information available in different forms/media, based on geographic reference. According to Shiffer, the integration proves difficult to achieve in the traditional planning process. Therefore, the traditional planning process often fails to provide a holistic picture. CPS can increase public access to relevant information and data and can lead to better decision making by the planners participating in a group-planning situation.

Figure 4 shows Shiffer's graphic depiction of this model. Point 'A' represents a technician using a computer to access analytical tools. Analytical tools (often implemented as computer software) prove too cumbersome to bring to group planning sessions and fail to easily promote interaction as well. Analytical tools lack the kind of human-computer interface required in group planning processes, and are typically more suited to individuals. Thus, a proper and comprehensive use of analytical tools distances the planner from the benefits of collective cognition as well as access to information in the form of "media".

Point 'B' in the figure represents a group meeting/brainstorming session. This often occurs in a scenario that does not permit the comprehensive use of analytical tools. Group discussions also lack dissemination of information through media. Although information is now available through media like the Internet and CD-ROMs, a proper interface for group interaction is still needed. Shiffer categorizes this the problem as "one of a lack of an adequate group-information interface." Though a researcher in a library (represented at the point C) has the benefit of having a huge database of information in the form of different kinds of media, the researcher is isolated and cannot avail the benefit of collective cognition and analytical tools.

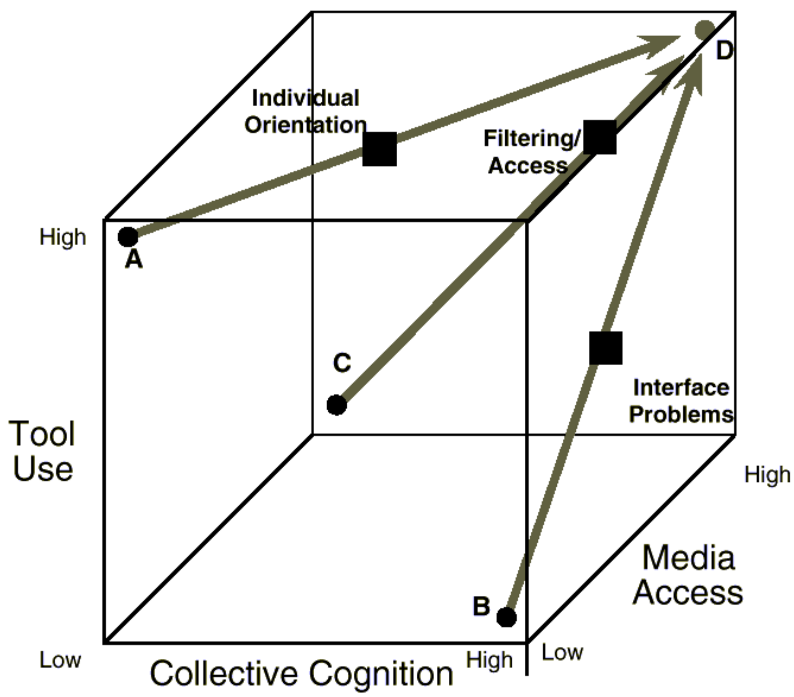

Figure 4. A three dimensional diagram of information use in planning situations (*Shiffer, 1992*)

Shiffer theorizes that increased access to analytical tools, information, and collaboration faces the following three barriers, as seen in Figure 4:

1) the ergonomic difficulties in using tools often caused by inadequate human/machine interfaces,

2) the difficulties in filtering/accessing the vast amounts of information available from a variety of media, and the individual orientation of most analytical tool implementations.

3) the individual orientation of most analytical tool implementations.

The design of a CPS would thus have to take care of these barriers. Shiffer has proposed that these barriers can be overcome by using graphical interfaces, associative information structuring and computer supported collaborative work respectively. The following sections discuss these techniques of overcoming the barriers of a CPS.

3.1.1. Human-Computer Interface

In the information age, analytical tools can be of great help to people who are able to interact and interface with the tools easily. The tools can be used for modelling or understanding planning phenomena. At the same time, the tools can be daunting to someone who is not comfortable using them. This drawback may exclude such people from the planning process. To solve this problem, Shiffer proposes using *Graphical Interfaces***,** which tend to make human-computer interaction intuitive and less dependent on prior training. The graphical interfaces must be designed to be easily understandable by general public. Graphical interfaces must also offer only relevant information to the public. Recent research in the field of Human-Computer interfaces explores the use of *Tangible-media* and *haptic interfaces* to provide a seamless interface between information and the people using them. (*Ishii and Ullmer, 1994*)

3.1.2. Information Filtering/Access Difficulties

Information for planners can come in various media: photographs, video clips, maps, slides, statistical data and newspaper clippings. These data can be organized in a hierarchical form using sophisticated database management systems (DBMS). However, "*…it is often difficult to impose a hierarchical or relational structure on the information without arbitrarily breaking it up into isolated records. This inability to adequately reflect the interrelationships amongst information from a variety of media can potentially hinder the planning process as planning situations often require a sequence of interrelated decisions based on associated information.*" (*Shiffer, 1992*) Associative information structuring has been said to be more suited to the planning process as it can incorporate and make use of information (like the political climate of a place) that defies classification. This can be achieved by using hypermedia technology.

3.1.3. Individual orientation of Tools

Most tools designed to aid the planner have been designed for interaction with only one person at a time, and fail to address collaborative work. Shiffer proposes *computer-supported collaborative work* that allows group participation and can be done in an environment that encourages group interaction and cognition.

Thus, through the use of graphical-interfaces, associative information structuring and computer supported collaborative work as suggested by Shiffer, a Collaborative Planning System can be developed that makes use of all the three dimensions of analytical tools, media and collective cognition.

3.1.4. St. Louis Riverfront: An example of CPS

Derived from the "Riverfront 2000" project, the St. Louis riverfront CPS was originally intended to be an information system for the redevelopment of St. Louis's Riverfront. By inclusion of tools that supported group decisions and tool usage, it developed into a CPS. Figure 5 is an example of one such tool, which adds audio to the CPS. The St. Louis River front project is a prototype of a CPS to evaluate their suitability in real-world planning problems. (*Shiffer, 1992*)

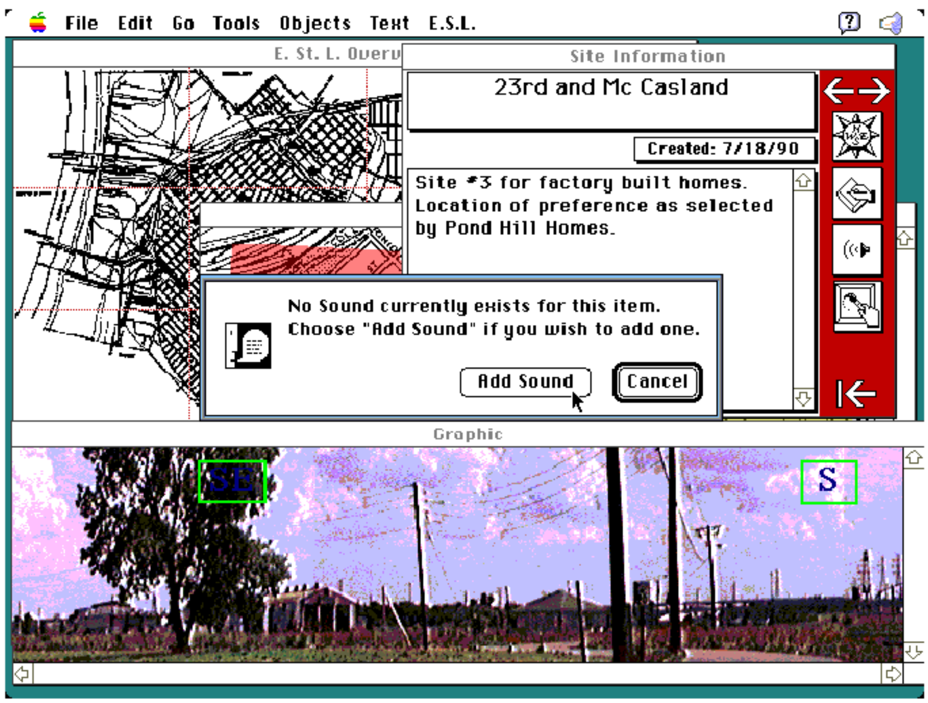

Figure 5. An example of an audio annotation device in use with a CPS (*Shiffer, 1992*)

Initially this system consisted of a "riverfront video navigator". The navigator allowed the users to fly a conceptual helicopter across the riverfront. The riverfront could thus be viewed from various angles. Later, information on a wide variety of subjects related to the city's Mississippi riverfront was added. This added information included "site specific descriptions of potential development, area businesses and industries, residential developments, recreational areas, environmental impacts, past proposals, and general plans." (*Shiffer, 1992*) This information was linked with the map and could be queried using keyword search, or by doing a "geographic search" using hypermedia (which is done by pointing and clicking mouse at specific points on the map), and by using an on-screen video.

The 'collective cognition' component, as mentioned earlier, is one of the three vehicles for delivering planning information. This collective cognition component of the St. Louis Riverfront CPS was implemented using a sketchpad metaphor that supported various media like sound, images, and text. This "sketchpad", as seen in Figure 6, could contain and present relevant information in an organized manner for collective viewing and discussion. Andreas Blaser, in his research, studies different techniques that can be used to take advantages of a pen-based user interface. Figure 7 shows a multi-functional sketch-based computer, on which a pen is replaced by mouse. Such a computer, as mentioned earlier, uses hypermedia technology and is a stand-alone system. (*Blaser, 1997*)

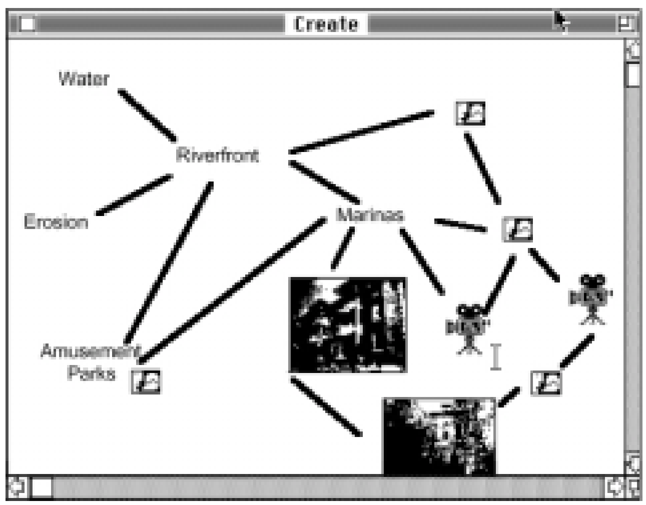

Figure 6. The window that contains electronic sketchpad for "brainstorming" (*Shiffer, 1992*)

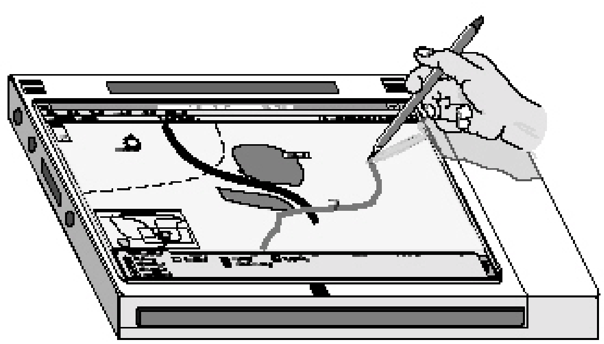

Figure 7. Example of autonomous, multi-functional, sketch-based computer (with a retractable keyboard and multimedia capabilities) (*Blaser, 1997)*

3.2. Exploratory Spatial Data Analysis Tools

GIS tools have remained in the hands of the elite for the last several decades. However, with advancements in technology, information has the potential to reach beyond traditional audiences to reach elite and non-elite alike. The integration of GIS, multimedia and visualization tools expedites the dissemination of information. GIS tools are increasingly being recognized as 'community empowerment tools'. A good example of this can be seen in Community 2020 software developed by United States Department of Housing and Urban Development for use by agencies. As a result of such awareness and advancements in technology, the general public increasingly uses GIS tools. The combination of interactive graphics and numerical methods for exploring the spatial properties of data enables the public to play the role of a researcher in public participation.

"Visualization is the science of representing data visually in order to enhance communication or understanding". (*Rheingans, 1995*) In the context of spatial data, the visualization process translates a spatial database into graphics using cartographic techniques. Geographic Visualization (GVis) results from links among GIS and visual information technologies such as GIS, ViSC (Visualization in scientific computing) and Virtual Reality. (*MacEachren,1994*) GVis tools are used for 'collaborative visualization'. Collaborative visualization is development of environments that facilitate the use of visual displays for exploration of ideas and/or decision making by two or more individuals (possibly located at different parts of the world). Collaborative visualization also allows for manipulation of data. MacEachren conceptualized "space" of map use as "[cartography]^3" (pronounced as 'cartography cubed'), as can be seen in Figure 8. Cartography Cubed is basically a method for understanding different kinds of uses of a map. In this conceptualized space, visualization is considered as the complement of communication. Both 'visualization' (by prompting of visual thinking) and 'communication' (transfer of information) are involved when using maps. But the use of a map varies depending on whether 'visualization' or 'communication' is emphasized. The three dimensions of this cube (which represents the 'use space') involve public versus private communication or visualization, high versus low interaction, presenting knowns versus revealing unknowns.

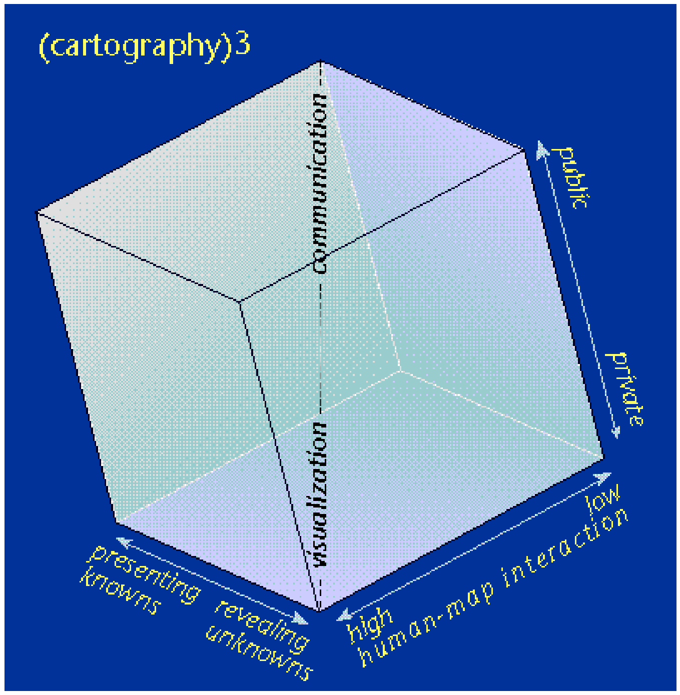

Figure 8. [Cartography] ^{3} (*Mac Eachren, 1994*)

Traditional cartography emphasizes public use, low interactivity and revealing knowns, whereas visualization emphasizes high interactivity and exploring unknowns, in public settings such as the World Wide Web.

3.2.1. HUD's Community 2020 Software

The United States Department of Housing and Urban Development (HUD) is one of the first organizations to realize the potential of GIS as an empowerment tool. HUD developed a software called 'Community 2020'. The department created a program through this software to help illustrate the need for grant money within a district. The software also allows users to create and print maps of their community and has a built in database of 640 census data elements. HUD designed the software in partnership with the Caliper Corporation of Newton, Massachusetts. The software contains data sets tailored to accommodate neighborhood and city-scale analysis. The software requires Windows 3.1 or Windows 95/98, an 80486 or Pentium-based computer equipped with a minimum of 12 megabytes of RAM, and a CDROM drive. The software is essentially a GIS consisting of a planning, mapping and communications package that allows community input. 'Community 2020' software could increase the effectiveness in implementing HUD programs as the public plays the role of a user in these kinds of applications. The

'Community 2020' GIS system is designed to reduce the time necessary to produce reports, provide more cost-efficient reporting and increase the relevance of reported information.

A group of state university students in partnership with local HUD staff and the city of Muncie, Indiana demonstrated the usefulness of this software by conducting a survey. The survey sought to collect information to help the city better target its housing and urban infrastructure funds for economic development. Though the results of the survey indicate the need for improvement in the software, local agencies that used 'Community 2020' were satisfied with the software. The survey results also indicate that computer usage has taken root in most of the country's local housing and community development agencies. (*Henry, 2000*) More information about this software can be found at http://www.hud.gov/cpd/2020soft.html

3.2.2. Cartographic Data Visualization and Dynamic mapping tools

Cartographic Data Visualizer (CDV) is a free software for spatial data exploration and visualization. It was developed by a JISC New Technologies Project, ARGUS (see *http://midas.ac.uk/argus*), in order to publicize and promote cartographic visualization techniques. CDV provides a visual, interactive graphic front-end to a spatial data set. CDV is built using Tcl/Tk, which is a GUI-builder appropriate for rapid application development, and contains a canvas widget on which symbols can be plotted at specific locations. CDV has two versions – one for exploring enumerated data and another for time-space data exploration. Figure 8 shows CDV for enumerated data, which provides control over cartographic representation and dynamically linked views. Features of CDV for enumerated data sets, as seen in Figure 9, include:

- Multiple views which are linked to one another (such as choropleth maps, scatter plots, proportional circle maps, box plots and parallel coordinate plots).
- Local statistics functionality (neighborhood calculation based on contiguity, local z-scores, etc)
- Derivation of new variables

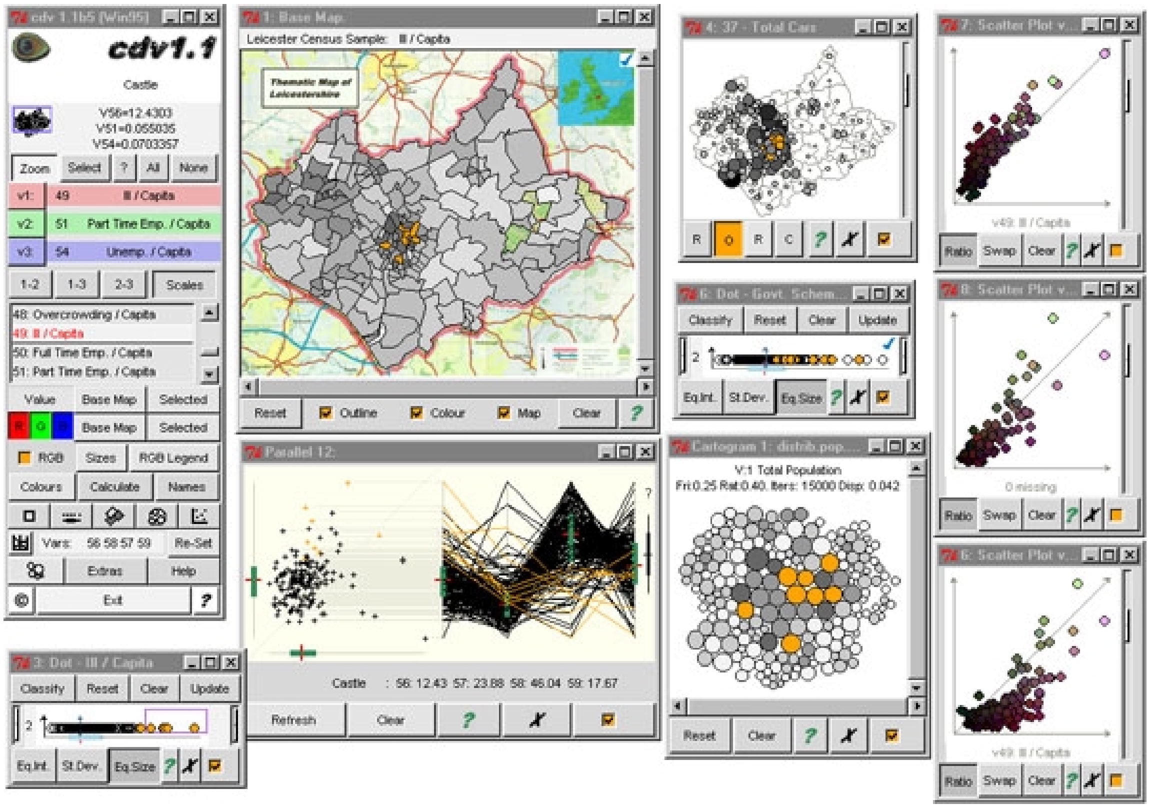

Figure 9. Cartographic Data Visualizer for enumerated data set

CDV for spatio-temporal data sets allows users to generate dynamic maps from two-dimensional spatial data with a temporal component (it has a user interactive progress bar for various time periods). CDV for spatio-temporal data also includes interrogation facilities, control over cartographic representation and selection of attribute criteria. Some features of CDV for time-space data are height exaggeration, resolution, light, colors, and rendered models.

3.3. Future Developments

Collaborative Planning System possesses tremendous potential to display information and analyze data using various visualization and spatial data exploration tools. The St. Louis Riverfront example (Section 3.1.4.) described a CPS that is a stand-alone system. Similarly HUD’s Community 2020 software is designed for stand-alone systems. When such stand-alone hyper-media based systems and spatial data exploration tools are integrated with the World Wide Web and represented multimedia, the true potential of a collaborative planning system can be realized.

CHAPTER 4

PUBLIC PARTICIPATION IN VIRTUAL DECISION MAKING ENVIRONMENTS

The access to and sharing of information around the world has been greatly facilitated by the Internet, an interconnected network of computers. The planning system constantly evolves with the changing technical fabric of the society. Recent developments in client-server technologies and web-optimized languages make Virtual Decision-Making Environments (VDMEs) possible on the Internet. VDMEs allow the general public to explore ‘real world’ problems. The previous chapter discussed combinations of traditional public participation techniques with technologies on stand-alone systems. This chapter discusses how effective VDMEs are developed when different technologies are integrated with the World Wide Web. This integration allows more effective public participation in the decision-making process.

4.1. Background of WWW

One of the major reasons for the increased growth of Internet since 1993 is the conception and implementation of the World Wide Web (also called WWW, W3 or Web). WWW is a project on the Internet that allows hypermedia information retrieval across the network. WWW is a set of software, protocols and conventions for providing easy and consistent access to information on the Web. Various WWW browsers used to surf the Web include Mosaic (NCSA, 1995), Netscape (Netscape Communicators Corporation, 1995), Lynx (Montulli, 1995) and Internet Explorer (Microsoft Corporation, 1995).

In order to understand the relevance of WWW to public participation oriented planning support systems, one must understand and discuss some design structures of WWW. Some of the basic design structures include (*Stillwell et. al*):

Hypertext Transfer Protocol (HTTP): HTTP is a protocol used to send ‘queries’ to a Web Server and transmit the results of the ‘queries’ from the server back to the client. Though it is called ‘hypertext’ transfer protocol, HTTP may be used to access various other kinds of data, and this adds to the advantages of WWW.

Hypertext Markup Language (HTML): HTML documents are Standard Generalized Markup language (SGML) documents that are suitable for representing information from a wide range of domains (*Berners-Lee & Connolly, 1995*). HTML is a markup language that is used to create hypertext documents that are platform independent. HTML also allows embedding of pictures, and other hypermedia information. The hyperlinks in an HTML document define links between a text fragment or image and another document. HTML allows for some interaction through use of menus, text fields, and buttons. These characteristics of HTML among others, contributed to the success of WWW.

Extensible Markup Language (XML): XML is the Web's language for data interchange, where as HTML is the Web's language for rendering. XML is a new technology for web applications, and is a World Wide Web Consortium standard that has the ability to do data interchange, which is the strongest point of XML. XML makes it easy to send structured data across the web ensuring that no information gets lost in the translation.

Uniform Resource Locator (URL): A URL is a compact string representation for a resource that can be accessed through the Internet with well-defined syntax and semantics. URL defines an associated name of a resource on the Internet.

OpenGIS Consortium (OGC) manages consensus processes that result in interoperability among diverse geo-processing systems. (http://www.opengis.org) In August 1999, the OpenGIS Consortium of Washington D.C. agreed on interoperability standards for easy access of GIS on the Internet. These standards would make it easier for people to pan, view and query maps and geographic images on the Web.

Geography Markup Language (GML): According to OGC specification, the features and syntax that GML uses to encode geographic information is defined in XML. "The XML encoding described in this specification (GML) is intended to enable the transport and storage of geographic information in XML, including both properties and the geometry of geographic features." (*OGC Request 11*) OGC anticipates GML to make a significant impact on the ability of organizations to share geographic information with one another, and to enable linked geographic datasets.

4.2. Technological Developments in Integrating GIS and Interactive Multimedia on the Web

When media is merged with technological innovations, it may prove to be an effective tool to gather mass-opinion and aid in decision-support and development of a community. A number of software tools have been developed to integrate GIS and multimedia interactivity with the Internet. Real-time map browsers have been developed to provide access to very large spatial databases and allow the users to query, display, browse and update maps on-line. Different technologies such as ESRI's spatial database engine (SDE), MapObjects and Internet Map Server, Autodesk's MapGuide, MapInfo's MapBasic, and Intergraph's Geomedia WebMap have been developed for interactive browsing, publishing, serving map information. GeoTools (developed by MacGill and Turton in 1998) is a Java map application that allows the user to perform simple spatial queries and attribute input operations.

Interactivity is probably the most rapidly changing aspect of information dissemination. Until at least early 1997, HTML was the most widely used mechanism of technological development. Recent developments in interactivity include plug-ins such as the Shockwave plug-in released by Macromind, which allows stand-alone versions of Macromedia resources created by Director, Authorware and Freehand, to be used within web-browsers such as Netscape or Internet Explorer. Apple has also released plug-ins that enable on-line QuickTime Virtual Reality (QTVR) movies. The Cosmo Player plug-in allows 3D objects to be defined, manipulated and experienced using VRML (Virtual Reality modelling language). Examples of this and QuickTime can be seen at Virtual UCL site – http://www.ps.ucl.ac.uk/vucl/index.html.

Possibly the most significant impact on cartographic data visualization on the Internet will be the swiftly increasing use of Java (Sun Microsystems, http://java.sun.com) on the Internet. Java is a platform-independent, object-oriented language and has the ability to perform true cartographic and spatial data analysis. Java features, such as interactive data communications and multi-threading, allow synchronized control over dynamic variables online. Greater control on graphic variables can be achieved through user interface and graphic handling than can be specified in the language. Sun recently released a plug-in that enables the user-interface language 'Tcl/Tk', to be integrated with the Web. With the Tcl/Tk plug-in, tools such as the as Cartographic Data Visualizer (CDV) can be integrated with the Internet, and the public participation level may increase by allowing the public to play the role of a researcher.

4.3. Various approaches to Public participation on the Internet

The collaborative GIS systems described in the previous chapter are specifically designed to facilitate face-to-face interaction between public and the planning professionals. Today, the Internet is the most popular medium for dissemination of information. (*Faber, 1997*) For example, public input may be required for a land management plan. The plan requires coordination support from regional planning agency representatives and policy input from governing bodies at state or national level. Synchronizing inputs requires a collaborative GIS customized to operate in a distributed mode on the Internet. The issue of integrating collaborative GIS on the Internet has been addressed by various approaches such as *GIS/2*, *Public Participation GIS*, *Community Networks*, *Public forum GIS*, and *Virtual Urban Environments* (which incorporate the integration of GIS and Virtual Reality on the Internet).

4.3.1. 'PPGIS' or 'GIS/2'

The concepts of Public participation GIS (PPGIS) and GIS/2 were initiated at the specialist's meeting for NCGIA (National Center for Geographic Information and Analysis), *Initiative 19: GIS and Society* (*http://www.geo.wvu.edu/www/i19/page*). "Public Participation GIS (PPGIS) have been conceived broadly as an integrative and inclusive process-based set of methods and technologies amenable to public participation, multiple viewpoints, and diverse forms of information." (*Krygier, 1998*) GIS/2 is different from GIS in that GIS/2 is primarily oriented toward integration of process and communication. GIS/2 includes an array of processes of which technology would be one component. The concept involves redefinition of participant inputs and types, of how data is handled, of system outputs, moving away from standard measures of completeness and control. (*Schroeder*) GIS/2 is also called "integrative geographical representation" or "dialogical machine".

GIS/2 manages and integrates all data components with participant contributions from a single interface. The data components integrated by GIS/2 include e-mail, access to data archives, presentation of parallel texts and counter text in diverse media, real-time data analysis, standard base maps and data sets, sketch map, and field note capabilities. However, the use of GIS/2 poses some problems. GIS/2 fails to create incentives for participant contribution; fails to accommodate narratives and other data not in digital form; lacks development of new methods of analysis suitable to arriving at negotiated rather than objective outcomes; inclusion of individual voice, and models of individual interactions and impacts; lacks ability to accommodate constant increase in participant group. (*Gavin, 1997*) Figure 10 illustrates a systematic methodology for community forestry PPGIS for user groups in Nepal. The PPGIS methodology employs an interdisciplinary approach. The methodology combines use of social science participatory techniques with GIS technology and participatory assessment procedures. Noticeably, greater emphasis is placed on the means of collecting and disseminating information than on the technical design of GIS. Since PPGIS depends on obtaining community needs, perception and ideas, aspects of a planning system such as planning, stakeholder needs identification, data collection and information feedback, are placed at equal importance as GIS in its traditional capacity (data input, storage, retrieval, transformation and display of data)

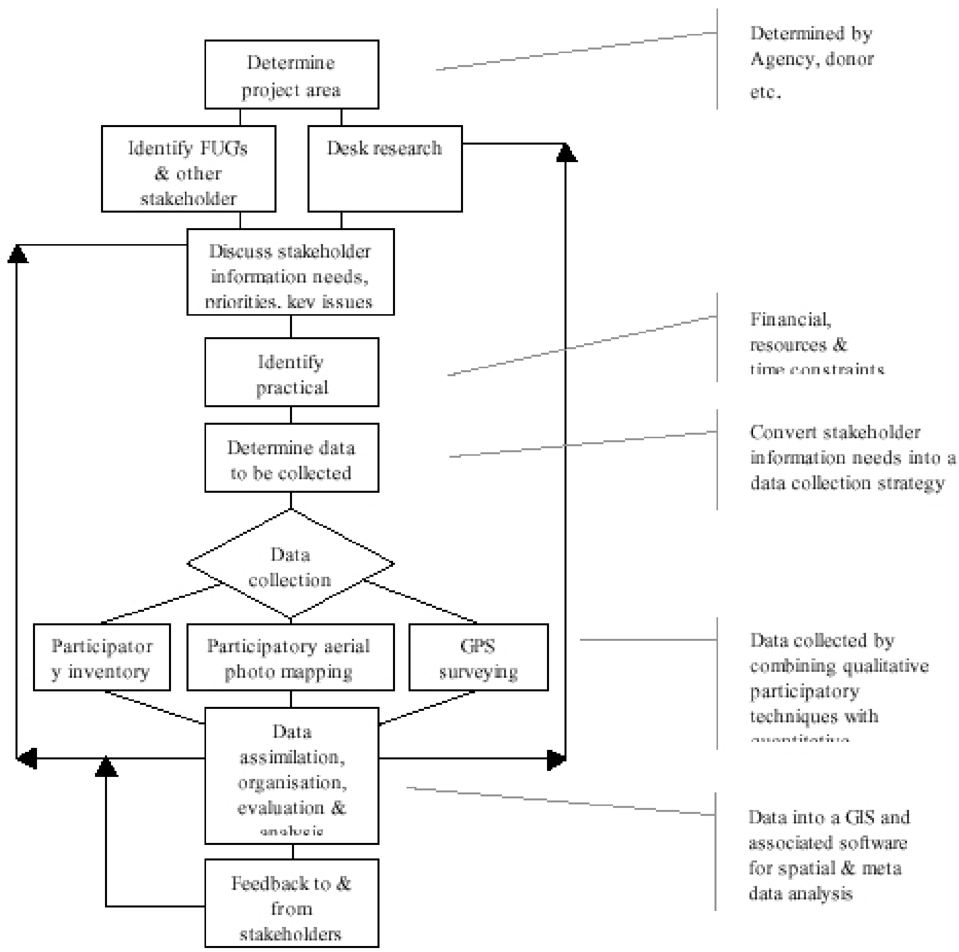

Figure 10. A systematic methodology for a community forestry PPGIS in Nepal (*Gavin, 1997*)

4.3.2. Community Networks

"…Community Networks' third characteristic is the belief that the system with its communication and information can strengthen and vitalize existing communities. Community networks are frequently seen by their organizers as a tool – not very different from tools such as printers, photocopiers, telephones, radio or television that have been used for community organizing in the past. It is believed that community networks can be used by the local community to find and build solutions to their problems…"

- Anne Beamish, 1995

A Community network is a number of computers interconnected to a central computer via modems and telephone lines. The central computer provides community information and a means for the community to interact electronically. Community networks are also called community computing, civic networks, and community bulletin boards. The participants of a community network have cities and neighborhoods in common with each other. Community networks differ from "Virtual communities" and "On-line communities". Virtual Communities and On-line communities refer to groups of people from anywhere in the world who gather electronically to discuss specific topics of common interest, which could range from academic research to hobbies, but do not have any geographic boundaries.

The government can provide its citizens with information through community networks and the citizens can in turn communicate with the officials and interact with each other in a fast and inexpensive way. Though all community networks mostly have similar goals, the use of a particular type of technology while designing the system strongly influences who uses the network, how and why they use it. For example, electronic mail maximizes communication among the members of a community by making it easier to exchange information in a minimal time. When email is used as the system or model, the technology primarily consists of communication channels where content is decided by the users and not by the owners of the system. On the other hand, broadcasting (which is another type of system or model), places more emphasis on content rather than communication. In this model, the owners of the communication channel control the information content and broadcast what is beneficial to them, and do not focus on feedback or communication among the users. (*Beamish, 1995*)

Community networks attempt to bring together people in a community and gather their opinions on the government's decision-making process by means of the Internet. Community

Networks provide the residents with access to community information. Community Networks also offer the residents opportunities to participate in community development initiatives at a low cost. For example, community networks often support public-access terminals in public places and offer Internet and email access to participants. Community networks provide means to discuss community issues publicly through electronic forums. Some community networks are run by non-profit agencies (which either offer free access or charge access fees) while others are run for profit. Most of the community networks rely on volunteer labor and government donations. The concept of community networks centers on effective public participation.

In addition to accessibility of community information and means of communication, general characteristics differentiate community networks from commercial networks:

Local Focus: Focus on local issues is a distinct characteristic of community network. Community networks emphasize local culture, relevance, pride and community ownership.

Access: Community networks ensure access to all residents in the community, which frequently involves placing computers in publicly accessible places such as community centers or libraries. The use of community networks for access by poor people or people who reside in a rural area is yet to be seen.

Social Change/Community Development: Community networks give importance to vitalizing existing communities with their communication and information. Community development forms the focus of community networks.(*Beamish, 1995*)

Community networks seek to strengthen the community (by increasing communication and information, which can increase the sense of community), improve democracy and ensure inclusion of NII (National Information Infrastructure). Inclusion of NII refers to use of network to support economic growth, education and social services. However, community networks have not yet included web-based GIS for public participation. Ongoing research focuses on integration of public participation GIS with community networks.

4.3.3. Virtual Urban Environments: Virtual Reality and Internet GIS for Urban Planning

Many of the Virtual Reality (VR) Systems, which are being augmented to embrace a wide array of virtual worlds, have immediate applicability to urban issues. A fundamental infrastructure for building virtual cities is being provided by the emergence of affordable virtual reality and Internet GIS. Three-dimensional virtual cities on the Internet can provide planners with complex physical and social data required to plan and manage cities, and an interactive simulation environment with analysis tools to explore and perform analysis on these data in more meaningful ways. The virtual cities use web-based Virtual Reality technologies and intend to provide digital-simulation of cities with varying range of accuracy and realism. At present no virtual city provides the people with a genuine sense of residing in an urban place with social interaction. Research in the field of Internet GIS and 3D urban modelling using VR creates foundations for the possibilities of true virtual cities. Most GIS vendors realize that the Internet will be the next-generation GIS platform and provide a powerful medium for geographic information distribution.

*Representatio*n, *modellin*g, and *connectio*n form the key paradigms central to construction of virtual environments (*Batty et. al*):

- *Representation* of environments and users can be visual or non-visual or a combination of both. Non-visual representation includes elements whose form can be visual but whose intrinsic representation is not, like text, sound and numbers. Most of the visual environment-user systems involve users appearing as 'avatars' in a 3D space within which they can see themselves and others navigate (See Figures 11 and 12).
- *Modelling* virtual environments involves several processes that simulate the manner in which users and environments respond to each other. Modelling involves exploration and analysis to be able to respond to the environment. The ability to alter the environment requires design functionality. Therefore, modelling is central to many virtual worlds.
- *Connection* represents the most rapidly changing aspect of VR at present. Probably the largest class of passive VR users are single users connected to their headsets to their virtual worlds, representing direct *immersion.* Semi-immersion involves interaction through point and click in a group context in CAVES (Cave automated virtual environment) and theatres. A CAVE is a multi-person, room-sized, high resolution, 3D video and audio environment). Currently, the cutting edge of VR comes from networked VR, where users are physically in a standalone context, but are virtually in the same environment through the net.

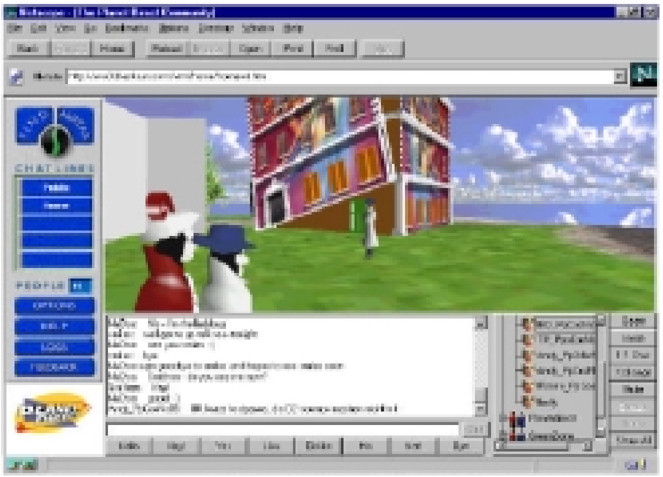

Figure 11. ‘Avatar’ manipulating 3D built form in a virtual world
The three basic components of a virtual world are: 1) a 3-d environment, which is represented in VRML-like form (but which can also be manipulated by users);
2) representation of users who log on remotely as ‘avatars’ and who are able to interact with each other through primitive visual gestures; and 3) windows in which users (as avatars) can converse through text appearing as script which is a record of all that passes ‘conversationally’ within the world.
The chat box and the window that list those within the world are visible below the 3-d representation. Three avatars are shown in the scene and the record of conversation is typical of casual interaction within such worlds. (*Batty et. al*)

Figure 12. Virtual Urban Design in a Wired Whitehall.
In this virtual world, all users log on and navigate the same scene and will appear as an avatar. The user can engage in ‘chat’. He/she can move certain objects within the scene, even if they do not own those objects. This is the basis of virtual urban design. The design takes place virtually if the chat is purposive to locate features within the urban scene, which represent the best designs that those in the scene can develop. In this figure, the object of interest is a telephone box to be located somewhere within the 360 degrees panorama at the junction of Whitehall with Whitehall Place. A combination of cursor keys, mouse and menu items enable the user to control his or her own motion in the scene as well as the motion and location of the telephone box. (*Batty et. al*)

Unrefined 3D city models can be created by adding the dimension of height to building footprint data. Along with attribute information, the model creation can operate in a way similar to GIS operation on 2D thematic data. Adding multimedia to traditional mapping and database GIS functionality has augmented the way in which GIS is used in planning, urban design and decision-making process.

Appropriate VR and GIS technologies are used to create a Virtual London that has a realistic urban form linked to GIS, thereby providing a rich simulation for geocomputation.

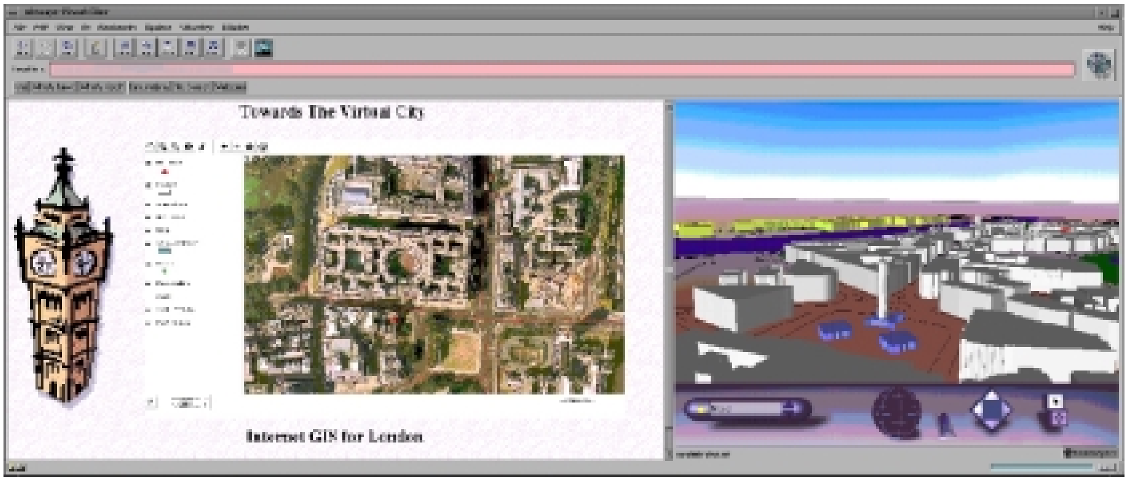

Figure 13 . The Internet GIS for London in the VR Theatre Full Screen Mode (*Batty et. al*)

Figure 13 shows a virtual environment of London, within which mathematical models might be better understood. Solutions to problems involving their optimization could be reached through visualization involving many experts.

Figure 14 shows the map of the town of Wolverhampton where the central area has been set up as a 3-d VRML model generated from ArcView. The existing retail turnover surface generated using spatial Analyst in ArcView is draped over the entire map based on retail turnover data at unit postcode level (at 100m resolution). The model is made available for a related project by the Office for National Statistics. This visualization uses Cosmo Player

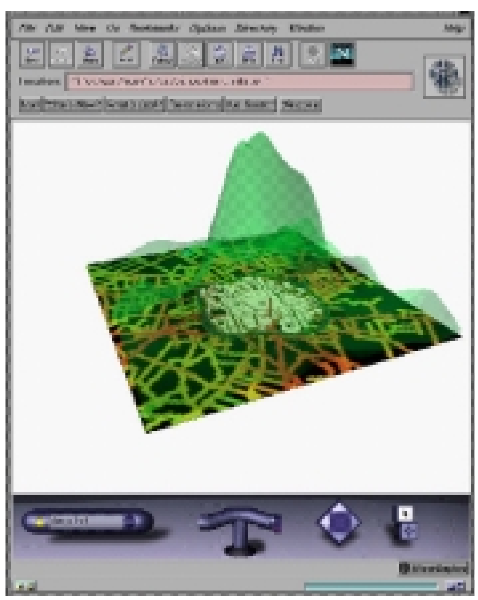

Figure 14: 2-d and 3-d Visualization of the Retail Location Problem (*Batty et. al*)

plug-in to navigate the VRML model within a web browser. When displayed in the semi-immersive context of the VR Theatre, groups of interested experts can examine the surface and make changes to it immediately

The inputs to the model are size and location of center, travel network and density of consumers. All of these inputs can be visualized as illustrated in Figure 14. The surface changes with the change in input. The environment provides the user the ability to manipulate the inputs directly on the screen graphically.

The following section discusses various problems and disadvantages that have to be overcome when using Virtual Decision-Making Environments for public participation.

CHAPTER 5

PRACTICAL AND ETHICAL PROBLEMS OF WEB-BASED SPATIAL DECISION SUPPORT SYSTEMS

The broader consequences of new technologies that are developed and embraced are realized only when society as a whole becomes dependent on the technology itself, leaving little room for change. So technology and its influence on the environment and human sentience has to be understood thoroughly in order to orient the techno-practices better suited for the citizens.

Web-based decision support environments have various advantages. Affordable and widespread access to data, information, and computer systems is provided by decision support systems on the Internet. Web-based decision support systems also increase public awareness and encourage feedback from public regarding important decisions. However, there are some practical and ethical problems associated with web-based spatial decision support systems, which nevertheless are not insoluble.

5.1. Community life harmed?

There is already a concern among some people as to whether electronic communication will replace face to face contact. In a workshop conducted on Information technology and society, one of the participants responded to the concern by saying:

"As the recreational and social applications of cyberspace increases, there will be a greater temptation to extend this time of relative isolation."

The critics of community networks see the use of community networks for public participation as a threat to the society. But the defenders argue that if the residents have the opportunity to know their neighbors better through community networks than through face-to-face contact, participation to actively rebuild community life will only be enhanced.

5.2. Creation of an Information Underclass?

Will the creation of community networks widen the gap between the 'haves' and 'have-nots'? Does "community" in community network only include those who have access to information technology? Though the intention behind creating community networks are positive, some fear that community networks may create a division between those who can participate in discussion of community's development initiatives and those who do not have access to the technology. However, it is very likely that in a few years time, the majority of the population will have direct access to the Internet either through home, work, school, libraries or other community systems. Its more likely that in long term, the Internet will be available to every one, in the same way are telephones or televisions are today. Also, the designers of community networks are addressing such issues by actively trying to create systems that will not isolate residents of the community. (*Stillwell et. al*)

5.2.1. Telecommunications Act

Another solution to the problem of 'creation of an underclass' is provided by the *Telecommunications Act*, which addresses the issue of providing new information technologies to citizens without any discrimination. According to the 1996 Telecommunications Act, new information technologies must have universal access and have to be made affordable to everyone in the society. The Act is particularly applicable to rural and high cost areas. The Act requires consumers in every region to have affordable access to such technologies. The main problem with GIS for public participation in community centers is accessibility and affordability. Mapping functionality on microcomputers is being provided in urban community centers. However, time, cost and distance factors limit the ability of people in rural areas and elderly individuals to access the resource.

Web-based GIS could possibly be one of the most cost-effective ways for providing access to information and analytical tools to people in marginalized communities. Current research in this area focuses on the strategies that these communities need to adopt to provide the functionality of GIS on the Internet to the individuals in the community. The role played by schools, libraries and private sources in providing this functionality is yet to be examined.

5.3. Public Access and Privacy Concerns

One of the fundamental principals of accountable government and participatory democracy is the concept of any person's ability to access government-held information. Since the technology is advancing very rapidly and changing the nature of information management, new and complex challenges regarding public access to government-held information are created. Government organizations should see themselves as custodians of the information they hold and make every attempt to design their GIS applications in a way that enhances public's access right. (*Wrights*) The organizations must also ensure that new information technologies such as GIS applications for public participation on the Internet or at community data centers are made available to all people without any discrimination.

The Electronic Freedom of Information Act and Privacy Act reflect the ideal of participatory democracy. The *Electronic Freedom of Information* Act requires that the information under the control of government be made available to public. The *Privacy Act* requires that the information that's made available to the public should not affect the privacy of the citizens.

5.3.1. Electronic Freedom of Information Act

The Freedom of Information Act reflects the fundamental principle of accountability of government and assurance of democracy. The intention of local governments is to be technologically advanced, and provide better service to people by providing online access to open records. The Electronic Freedom of Information Act Amendments (EFOIAA - 5 U.S.C.A. 552) were signed into law by President Clinton on October 2, 1996. This law requires federal agencies to adopt electronic formats and electronic methods of dissemination of information. A community development plan, in spite of being primarily a policy document, can be used as an effective tool to display and explain information to the public. Methods, which encourage use of visual variety such as graphics, audio and other media, can be used as a substitute for lengthy passages of explanatory text, and hence can act as a useful device to inform public with compliance to EFOIA.

5.3.2 Privacy Act

On the other hand, the privacy of information that is collected by the government is an ethical issue in this new social and technological change, because it is not a problem of individuals singly, but a problem of the community at large. (*Onsrud*) Michael Barndt, in his article "Public Participation GIS – Barriers to Implementation", points out that the enhancements in GIS technology alone cannot empower the general public. (*Barndt, 1998*) For example, Mecklenburg County provided the citizens with their right to know as a first step to their public participation GIS. However, the public raised privacy concerns. Citizens mainly attributed these concerns to the nature of information and the way in which the information was provided on the Internet. For instance, the web pages had information such as land value by parcel lot location, with owner identity, arguably infringing upon the privacy of the citizens. (*Jain, 1999*)

Particular information, which some considered as a threat to privacy, was available prior to the computer age, for public access. The public awareness of the privacy problem in U.S. and Europe has increased with the increase in use of computer technology (*Parsons, 1995*). The ability to 'computer-match' the GIS data sets, which are the records of the individuals, based on key values such as names, address etc. has increased with advances in GIS. The increase in accessibility of such matches could prove intrusive to the privacy of individuals. The government and GIS administrators and designers need to take some measures to promote sound information privacy protection. Data protection should also be considered in an international context, since flow of information across the border requires control.

In the Unites States, the Privacy Act, passed in 1974, provides for control over the amount of personal information that the federal government can collect and how it can use the information. There are state law equivalents of Privacy Act as well. The rights that the act primarily guarantees are:

(i) the right to see and copy the records about oneself (subject to exemptions of the Privacy Act);

(ii) the right to correct that record if inaccurate or irrelevant;

(iii) the right to sue the government for violations of the statute, including permitting others to see one's record, unless specifically permitted by the act; and

(iv) the requirement of public agencies to provide safeguards to prevent misuse of personal information.

5.4. Planning decisions made trivial?

Another disadvantage of web-based spatial decision support systems is their potential to trivialize the decision-making process, in spite of the fact that planning and decision-making are complex and difficult tasks. The main problem comes when certain people who don’t take the problem seriously and give false feedback to decision-makers. Such feedback may lead to misrepresentation of the real views of the public.

5.5. Future developments

Presently, decision-making systems operate through a series of elected representatives, over whom an individual of a community has little control. Through web-based spatial decision support systems the individual can make representations directly to the decision-makers. Potential exists for major advances in the operation of the democratic decision-making systems. For example, small and medium size communities have begun investing in public telecommunications infrastructure, which would solve the problem of speed of Internet access. (McGarigle, 2000) The above mentioned problems are not insoluble. Rather they must be seen as challenges to the development of true participatory planning systems, which can be resolved with time and technological advancements.

CHAPTER 6

CASE STUDY: *'Planning for Real'* Exercise at the local community in Village Slaithwaite in Europe

Most of the online Web-based GIS tend to be demonstrative in approach and academically oriented. They use simple data that is not problem specific and do not deal with complex real world issues. They do not implement interaction with the information in the sense that the user does not get to play with the data and send information back to the server. In order to test a Virtual Decision making environment (VDME) on the Internet, *Planning for Real (PFR)* exercise was conducted in June 1998 in the village of Slaithwaite group (in Europe) by a local community action called Colne Valley Trust (CVT). This idea was developed for getting local people more involved in local planning decisions through active participation and interaction. The planning consultants coordinated the PFR exercise. A three dimensional model of 2 square kilometer area of Slaithwaite constructed at a scale of 1:10000 by CVT, was used as a focus for local discussion about planning issues in the village. The local residents were invited and encouraged to discuss their views about particular issues by placing flags with written comments on appropriate locations of the model. The results of the exercise were organized, analyzed and fed back into the planning process through appropriate planning policy documents. This served as a perfect opportunity to develop a simple VDME that mirrored PFR exercise. The VDME '*Virtual Slaithwaite'* was launched on the web along with the physical PFR model. The design of the system was done using Geo tools, which is a Java map application. The Java map applet can be viewed using a web-browser such as Netscape Navigator. The users can view the map of Slaithwaite, perform zoom and pan operations for navigation, perform spatial queries and make suggestions about the specific features identified from the map, or in other words, provide attribute input. The user input is stored in the community database for feedback into the planning process as well as for future analysis.

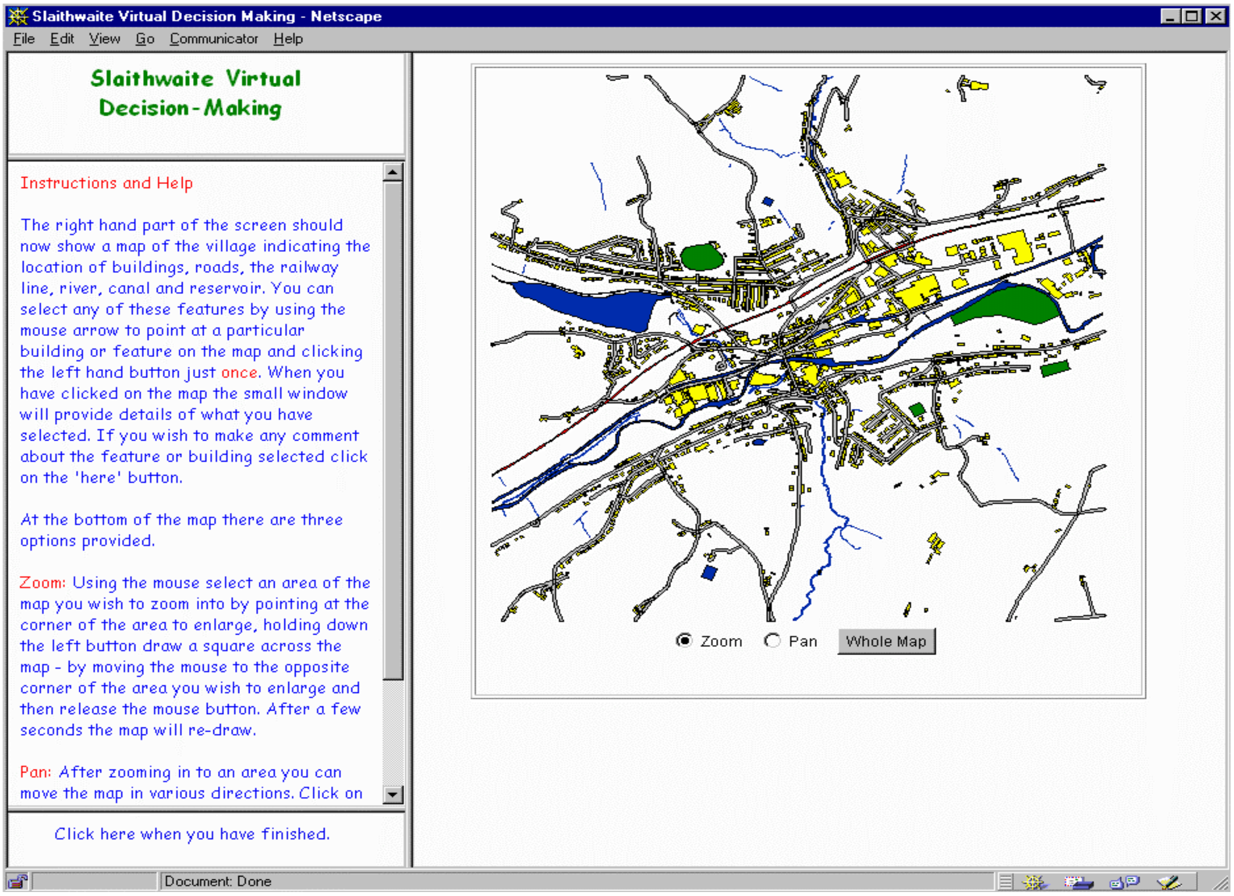

Figure 15: Shaping Slaithwaite (http://www.ccg.leeds.ac.uk/slaithwaite/)

Figure 15 is a snapshot of the VDME in which the window on the left hand side displays the help and instructions for selecting features and navigating the map, or for reading the comments posted by residents in the community on various issues on the comments map. Figure 16 is another snapshot of the VDME, which illustrates how citizens can input comments and view other comments on policies pertaining to features in different geographic locations.

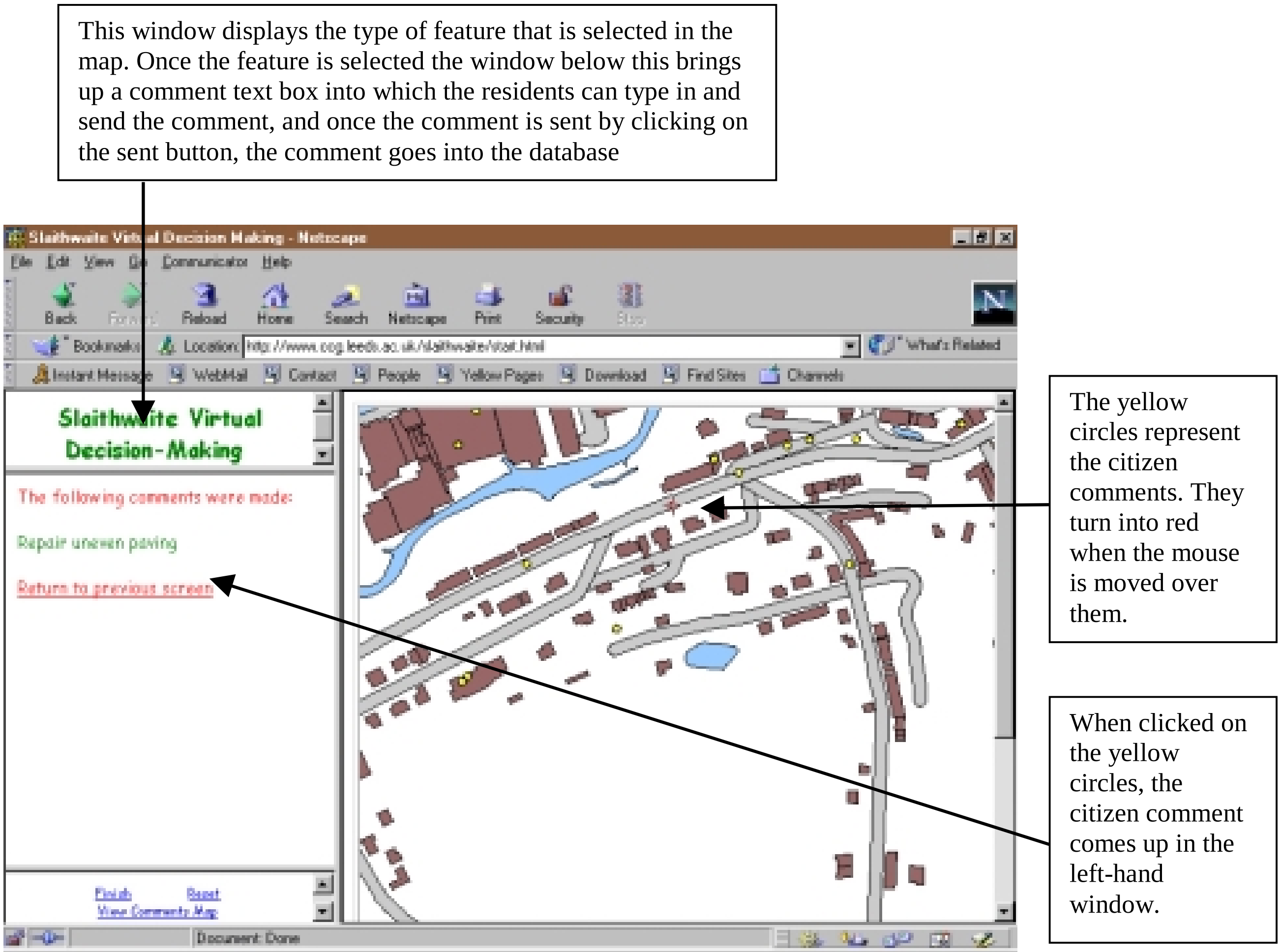

Figure 16: Shaping Slaithwaite: Public comments (http://www.ccg.leeds.ac.uk/slaithwaite/)

Several advantages were seen to the use of VDME over the traditional techniques used for public participation. The results seen from the Web-site's log files showed an increased public awareness and interest in the decision-making process. The accuracy, appropriateness and accountability of decisions also improved through the use of VDME. The most useful advantage was seen as the ability to instantaneously update the database and profile users online. Since the Web is used for public participation, interest and awareness seemed to be generated among members of the community who did not usually participate. The younger generation particularly seemed to be excited by the use of Internet as the medium of public participation. (*Kingston, 2000*)

CHAPTER 7

RECOMMENDATIONS FOR IMPROVING PUBLIC PARTICIPATION USING WEB-BASED GIS

Planning is a problem solving process involving problem definition and description, analysis, prediction, and design. It involves evaluation of alternative solutions to problems. Every stage of the planning process involves design and analysis, and the process of implementation of a chosen plan or policy involves this sequence once again (i.e., it is 'iterative').

The design of a Web-based GIS for public participation also undergoes such an iterative process. Figure 17, shows a suggested Spiral Model for Web-based GIS for public participation. The model is spiral because Web-based GIS improves in quality and also possibly in size with feedback from the stakeholders, who include the citizens as well as the planning professionals.

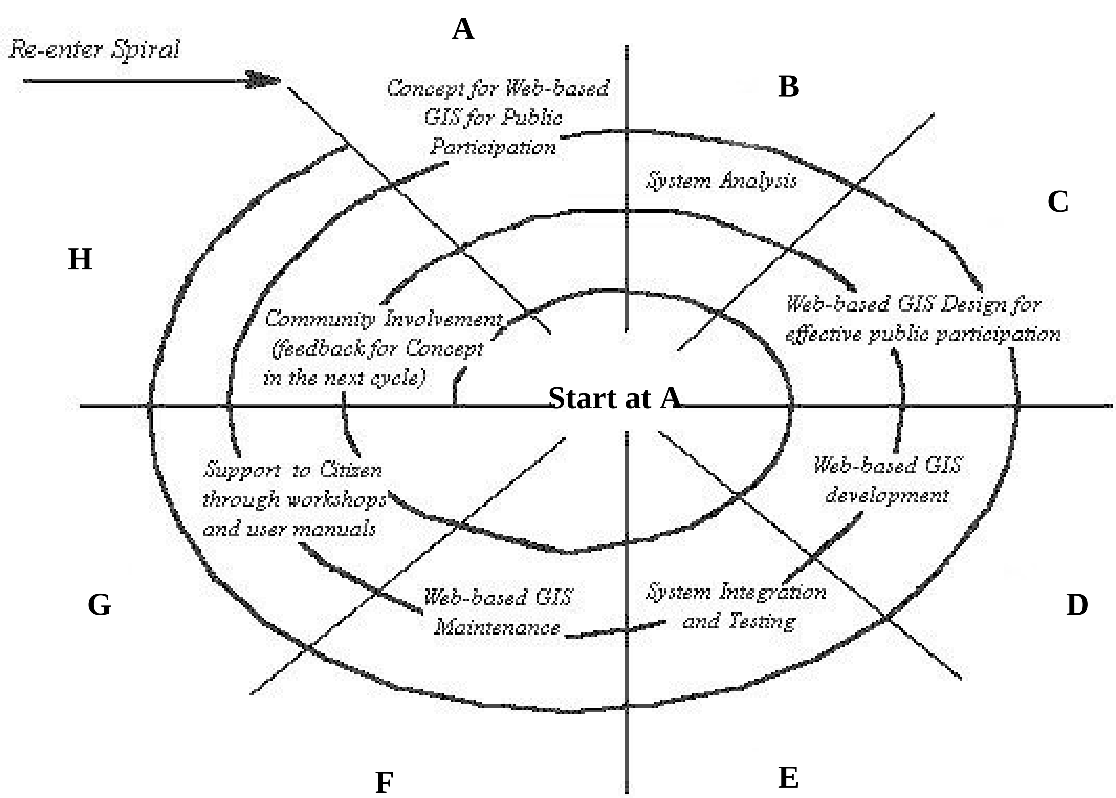

Figure 17. The Spiral Model for Web-based GIS for Public Participation

In stage A of the spiral model as seen in Figure 17, Web-based GIS for public participation should be conceptualized. In this stage, the objectives, alternatives and constraints must be identified. The next stage (Stage B) involves system analysis, in which risks are identified based on objectives and constraint. The required databases must also be identified and analyzed. Stage C, involves Web-based GIS design for effective public participation. In this stage the user interface is designed and the amount of information to be presented to the public is also decided. The development of this design is done in Stage D. Stage E involves System integration and testing, in which various parts of the web-based GIS design are integrated and tested. Stage F involves maintenance of this system by a technician. The stages of development of the system till this stage are very similar to any other system development process. The last two important stages merges the organizational setting of GIS (discussed in Section 2.3) for public participation with the system development setting. The development of a Web-based GIS for public participation involves citizen support and citizen feedback. In Stage G citizen support is provided through user manuals workshops, and community involvement programs. Stage H involves a second facet of community involvement program, in which relevant feedback from the citizen goes back into the system for re-conceptualization, which is stage A for the next life cycle of the Web-based GIS for public participation. Adopting such a model for development of Web-based GIS for public participation would integrate the important organizational context of GIS development in a planning organization into the system development process.

GIS technology evolves and develops at a rapid pace. Certain other factors should be incorporated along with Web-based GIS development for public participation, which include:

- Management of shared resources, urban databases created by different teams, constant updating of data, and synchronization of the updated data. Such management will change planning processes and improve public access to parts of urban VR models to both professionals and public, allowing them to input their suggestions. The suggestions can be presented in many electronic/virtual meetings simultaneously. Such processes may increase the participation level among the public.
- The ability to share and manipulate data across different geographical databases in different locations in a faster and more efficient manner, taking security issues into consideration, should be improved. GML could possibly increase the ease of implementation of geographic information online. Also, communities must invest in public telecommunications infrastructure to provide faster and more efficient access to community information.

- Users of web-based spatial decision support systems are often interested in knowing not only where certain events occurred but also when they occurred. Therefore, temporal and other on-spatial data must be incorporated.
- Traditional public participation techniques discussed earlier must not be abandoned, since Web-based spatial decision support systems are not a panacea. The traditional participation techniques must be employed in addition to web based spatial decision support systems for public participation.
- Future research must implement new tools (such as online sketchpad) for increased public participation and qualitative data analysis, with increased interactivity.

CHAPTER 8
CONCLUSION

Our system of government gives citizens the right to have a strong voice in all matters of public policy, including planning. The law requires that citizens get the opportunity to have a say in the decision making process, in a way similar to 5th Century BC Athenian democracy. A web-based GIS can provide a Virtual Decision-Making Environment (VDME) which will be 'the electronic agora' of today where citizens will meet to *talk, gossip, argue, size each other up and find the weak spots in political ideas by debating about them.* This paper has discussed the issues involved in building such an electronic agora.

Web-based Geographic Information Systems may provide greater and higher quality public participation and thus help build trust among the citizenry. Public participation is a means of decreasing tension and conflict over planning decisions. The long-term effects of Web-based Geographic Information Systems are still under study. Distributing geographic visualization tools on the Internet to develop a Virtual Decision-Making Environment (VDME) may encourage public participation and provide a focus for a community's discussion of design ideas, and guide them through the planning and design process. When combined with a community involvement program, it may raise awareness of planning, design and decision-making issues among the citizen and facilitate better communication. A number of visualization techniques such as virtual reality, multi-media, decision-support systems, and spatial data exploration tools are available to planners to encourage public participation in VDMEs. This paper has discussed development and application of collaborative planning systems, exploratory spatial data analysis tools, GIS/2, community networks and virtual urban environments. The paper has also provided recommendations to improve public participation using web-based GIS.

Public participation is encouraged by dissemination of information. Each combination of techniques for dissemination of information on the Internet works in specific situations. No single method works for all situations. Planners must explore different methods that are most suited and effective for the situation under consideration.

There are some problems in using Web-based Geographic Information Systems as discussed in the paper, which include creation of an information underclass, and public access and privacy concerns. However, the problems are not insoluble. The problems must rather be seen as challenges to the development of true participatory planning systems. Technological advancements and time can resolve the problems. Advancement in hardware and software technology will further alter the way planning is viewed and practiced all over the world. The most dramatic effect would come through improvement of communication. Legal and privacy issues arising out of such a scenario have also been discussed, and a legal framework in the form of the Electronic Freedom of Information Act and the Privacy Act has already been laid out by the government.

In conclusion, the brick and mortar required to build ‘the electronic agora’, mentioned in the Introduction, is ready in the form of technology and the political will. Dynamic social processes, in the form of interaction and participation on the Internet, are in the process of shaping new technology. ‘Virtual communities’ are co-emerging with Internet technologies. This paper has drawn an architectural plan for the agora by studying the parameters involved and providing the guidelines to be followed in building it. The synergy produced by harnessing the power of GIS and applying its principles to the Internet can crystallize the electronic agora in the form of a Virtual Decision-Making Environment actively bustling with public participation, and improving public life.

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