PERGAMON

Computers, Environment and Urban Systems
24 (2000) 109–125

Computers, Environment and Urban Systems

www.elsevier.com/locate/compenvurbsys

Web-based public participation geographical information systems: an aid to local environmental decision-making

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Abstract

Current research examining the potential of the World-Wide Web as a means of increasing public participation in local environmental decision making in the UK is discussed. The paper considers traditional methods of public participation and argues that new Internet-based technologies have the potential to widen participation in the UK planning system. Evidence is provided of the potential and actual benefits of online spatial decision support systems in the UK through a real environmental decision support problem in a village in northern England. The paper identifies key themes developing in this area of Web-based geographical information systems (GIS) and provides a case-study example of an online public participation GIS from inception to the final phase in a public participation process. It is shown that in certain UK planning problems and policy formulation processes, participatory online systems are a useful means of informing and engaging the public and can potentially bring the public closer to a participatory planning system.

Keywords: GIS; Web; Public participation; "Planning For Real"®

1. Introduction

In recent years geographical information systems (GIS) have begun to appear on the World-Wide Web (WWW or Web) ranging from simple demonstrations and references to GIS use, through to more complex online GIS and spatial decision support systems (Carver & Peckham, 1999). The level of functionality among these

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0198-9715/00/$ - see front matter
PII: S0198-9715(99)00049-6

GIS systems is variable giving the general public, or at least those with a connection to the Web, access to a variety of both GIS systems and data of varying degrees of sophistication. The availability of GIS via the Web is becoming a reality in many fields (Doyle, Dodge & Smith, 1998); thus, the previous criticisms of GIS being an elitist technology (Pickles, 1995) may no longer be valid in the same context. GIS and the Web are ever-evolving technologies and hold great potential for public use, allowing wider involvement in environmental decision making. It was noted as early as 1993 that "they can design GIS primarily for expert use or they can make them accessible to the lay professional and even to the general public" (Innes & Simpson, 1993, p. 231) and it is suggested that the research has moved a step closer to realising this aim of increased accessibility. The rise of the Internet and the WWW over the past decade has created many opportunities for its use in local, regional and national democratic processes. Almost every city, town and district in the UK now has a presence on the Web which offers the potential to deliver public goods and services through this relatively new media. One area where the Web can be used to great advantage is for the enhancement of participatory democracy in local environmental decision making. As Graham (1996, p. 2) argues, the Web will "generate a new public sphere supporting interaction, debate, new forms of democracy and 'cyber cultures' which feed back to support a renaissance in the social and cultural life of cities".

The research discussed here has very applied characteristics and has developed through collaboration with a local urban authority in West Yorkshire, northern England, a local regeneration trust and the residents of a village called Slaithwaite (pronounced 'Slawit') to develop the village-based case study. The use of a real decision-making problem is seen as the key to the proper development of Web-based GIS as this provides both a substantive focus for the research and development work and it also helps to secure widespread public interest by being grounded in something *real*. This research is part of a wider programme of work currently being undertaken in UK universities and funded by the Economic and Social Research Council's (ESRC) Virtual Society? Programme. The aim of the research programme as a whole is to examine if there are fundamental shifts taking place in how people behave, organise and interact as a result of emerging electronic technologies such as the Internet and the Web.

2. Traditional versus Web-based public participation methods

Public participation in environmental decision making and the planning system in the UK has a relatively lengthy history. Ever since the first Town and Country Planning Act in 1947 varying degrees of public participation have existed in the UK planning system, although it was not until 1969 (Skeffington Report, 1969) that widespread public participation became embedded in the process. Public participation in the UK planning systems tends to be based in two areas, that of plan making in the first instance and in the development control process. While this paper does not intend to analyse the methods of the public participation process in the UK, a brief description of a typical scenario is outlined below. For a more detailed account

of participation in both the development control process and the development plan process see Thomas (1995).

Common practice in traditional methods of public participation involves the public, or at least those with a particular interest, in attending planning meetings that quite often take place in an atmosphere of confrontation. This can discourage participation by an often less vocal majority resulting in public meetings being dominated by vocal individuals who may have extreme views. These views may not necessarily represent the wider opinions of local people who may have equally, if not more, valid points to make, but who refrain from expressing their concerns, opinions and viewpoints, and "rarely if ever emerge as definable actors in the development process" (Healey, McNamara, Elson & Doak, 1988). Planning meetings often take place in evenings at specific times. This can limit the numbers of people who are able to attend. The restricted time and also the actual location of public meetings can further restrict the possibility of widespread attendance. Physical access to such meetings can lead to the exclusion of certain sectors of society, e.g. those without access to transport, the disabled and infirm.

In contrast to traditional methods new forms of participation are beginning to evolve and, while these are in their infancy in the UK, experience from North America (Howard, 1999) suggests that there are many advantages to Web-based approaches at participation. The meetings are not restricted by geographical location. Access to the information about the issues being discussed is available from any location that has Web access. The information is also available at any time of the day thus avoiding the problems associated with holding meetings in the evenings. The concept of "24/7" access (i.e. 24 h a day, 7 days a week) opens up opportunities for more people to participate in public consultations. With a Web-based system the public is at the end of a telephone line that enables them to make comments and express their views in a relatively anonymous and non-confrontational manner compared with the traditional method of making a point verbally in front of a group of relative strangers.

Many people do not instantly recognise a location when it is presented to them as an areal view. Several researchers have in the past questioned the public's ability to understand a map that is essentially a 'birds-eye' view of a place (e.g. Keates, 1996; Monmonier, 1996). With this in mind it will be shown later in the paper that this did not seem to be a problem with the online system developed and presented here. One explanation for this is the ability of the user to click on a feature on the map and find out what that feature is (e.g. a road, restaurant, community building, etc.). This capability in the system helps users to familiarise themselves with the map. The fact that the case study covered a local area and was intended primarily for local use may also have helped. The use of a map as the central theme of the Web-based system can potentially provide instant familiarity with the location in which the public participation process is taking place and can thus relay a lot of information quickly and understandably to a wide audience. Using a 'dynamic map' that is interactive and provides particular pieces information about features on it, allows the user to elicit greater detail about issues and problems in hand such as the relative location of features and proposed developments, the spatial and topological relationships

between objects on the map and simple measures of area and distance. This type of information allows a much richer environment for the user to interact with at their own pace and is more difficult to provide on a traditional paper map.

3. Web-based planning for real

Before discussing a Web-based "Planning for Real"® (PFR) initiative it may be helpful to have a brief introduction to the traditional PFR model. PFR is an idea developed and patented by the Neighbourhood Initiatives Foundation (NIF), as a means of involving local people more closely in local environmental planning problems and decision making. NIF is a National Charity, based in Telford and founded in 1988, with the main aim of maximising the participation of local people in decisions that affect their neighbourhoods and quality of life. The founding director, Dr. Tony Gibson, devised PFR in the 1970s as a technique that is now employed by the NIF fieldwork team. This is achieved through active participation and interaction with large-scale maps or physical models of the area. NIF has continued to develop and adapt this primary tool to meet both local and strategic consultation needs and as an essential process in community development programmes.

The Slaithwaite PFR exercise was co-ordinated by Colne Valley Trust (CVT) with assistance from NIF fieldworkers and was funded by Kirklees Metropolitan Council (KMC) and the Rural Development Commission. CVT is an independent rural agency, which promotes, facilitates and supports the economic, social and environmental regeneration of the Colne Valley near Huddersfield in West Yorkshire. The Trust manages projects, supports local people and community groups, helps to form local working partnerships and provides a local free information service. It is a valuable point of contact for a wide variety of activity in the Colne Valley. The organisation is part of a network of independent community development trusts affiliated to the Development Trusts Association, a national umbrella body. A 1:1000 scale three-dimensional model of a 2-km square area of Slaithwaite and the surrounding valley was constructed (Fig. 1) with the help of local school children. This was used as a focus for local discussion about planning issues within Slaithwaite. Particular planning issues of interest included plans to re-open the canal through the centre of the village and problems arising from commercial traffic and access to industrial sites. Local people were invited to register their views about particular issues by placing flags with written comments on to appropriate locations on the model. The results of this exercise were then collated by NIF with the potential to feed them back into the planning process via the Local Authority.

One of the main aims of CVT is to consult with local people to find out their views, and involve them in local decision making and actions. The main features of the method are:

1. the provision of a large-scale model of the chosen area on which the public can place ideas and comments about their community now and in the future;

Fig. 1. Part of the Slaithwaite "Planning for Real"® (PFR) model.

2. a completely open-ended approach — anything can be said or suggested;
3. it is ideally led from within the community;
4. it is open to all members of the community at a time when most can participate; and
5. it provides information which can be of use to both the local community and the wider local authority in terms of future planning and knowledge of local opinion.

With particular reference to Slaithwaite, which has problems and concerns in common with other villages in the area, it was decided that the village would be the first in the Colne Valley to have the opportunity to undertake the PFR exercise. Additional problems being faced ranged from disruption caused by canal restoration coupled with the serious traffic problems caused by limited access options to local mills and industrial premises. There were also many issues surrounding public buildings, with many of the old buildings in disrepair, and the potential uses to which local green space may be put. With a diverse set of issues and views potentially being expressed by residents in the village conflict would appear to be inevitable. One of the advantages of the PFR method is that compromise and consensus become easier as all participants' efforts become focused on the physical model. This allows practical non-threatening modes of interaction by being anonymous. The placement of a flag on the model expressing a view point has no attachment to an individual, unlike in a public meeting where people can attach a face to a point of view. From a statutory planning point of view the Colne Valley and Slaithwaite are covered by the KMC Unitary Development Plan (UDP). The UDP has the following main aims (KMC, 1998):

1. provide new opportunities to breathe life into those areas of Kirklees which are run-down and contain the unwanted legacy of the past two centuries of industry;

2. balance the recycling of unused land and redundant buildings with proposed releases of greenfield sites for business, industry and housing;
3. safeguard urban open land which is too valuable as open space to be released for development;
4. increase and diversify job opportunities, in particular by allocating land for business and industry in a variety of locations to meet varying market requirements;
5. ensure that there are sufficient homes available to accommodate all who may wish to live in Kirklees;
6. improve accessibility to jobs, shops, education and recreation for all residents, especially those without the use of a car; and
7. address issues concerned with 'sustainability', such as the desirability of the efficient use of energy and the recycling of finite resources.

Unfortunately, many of these policies have been targeted at the more urban parts of the Authority. This had led to a feeling of abandonment by those living in the more rural areas of the Authority. With this in mind a public meeting was held in Slaithwaite in November 1997 and approval was obtained to create a community-led initiative to investigate what the villagers really wanted for the future. The aim of the PFR exercise or "Shaping Slaithwaite" as it became known, was to provide a foundation for the people of Slaithwaite to be heard, and to take effective action on issues which concerned them all. The purpose of the event was to:

1. raise awareness of the possibility for development and change within their own community;
2. to help individuals express their opinions on social, economic and environmental issues that concerned them; and
3. to help the local community work towards a consensus on such issues.

Finally, there was a need to co-ordinate and report on action taken, so that change brought about within and by the villagers would have the greatest impact upon the Local Authority.

The PFR initiative provided the research project with an ideal opportunity to test out new methods of public participation by running a parallel exercise over the Web. Notwithstanding the current limited access to the Internet in the UK, the Slaithwaite PFR exercise provided the research project with a real world example with which to develop, pilot and live test a simple public participation GIS (PPGIS) that mirrored the functionality of the physical PFR model. The 'virtual' version of the exercise was launched on the Web alongside the physical PFR model at a local village event organised and run by CVT. Using the same 2-km^2 area of land around Slaithwaite the project developed an online model of the village which allowed the local community to interact with a digital map giving them relatively instant access to queries which they pose and, soon after the PFR event, access to the ensuing results.

The numbers of people who can potentially benefit from effective public participation make such a process worthwhile. It can benefit the whole community and provide the necessary input into difficult problems. Too often in the past the public

have been seen as getting in the way of implementing and driving policy forward. It has often been the case, however, that a lack of public consultation has led to future problems within communities when they are ignored and not asked for their views. Exercises such as PFR in the traditional sense, where complemented by the type of system developed for Slaithwaite, can provide a community with a voice with which to express their opinions and ideas about the places where they live and work. Community groups and organisations such as CVT, other non-governmental organisations, pressure groups and the Local Authorities themselves can all benefit from the use of effective public participation techniques.

Collaborative public consultation in local decision making and planning, whether relating to conservation, development or conflict resolution, can take place through Web-based systems allowing increased public use. It is envisaged over the next 5 years that due to the Web's ability to provide information at any time and without any geographical constraint, greater participation by all communities will be possible. Since the PFR day in June 1998 several Local Authorities throughout the UK have increased the amount of information they provide on the Web. While very few have the interactive two-way capabilities of the system developed here, many of them are actively investigating the potential of undertaking similar kinds of Web-based public participation processes. For example, Bradford Metropolitan Council are investigating the feasibility of providing Web access to some of their internal GIS data.

4. Web-based PFR in practice

The Virtual Slaithwaite system is an online PPGIS facility and was arguably among the first such systems available to the general public in a real public participation process. To facilitate access to the Web application the authors took eight PCs to the "Shaping Slaithwaite" event. The Web browser window consists of four frames each containing particular pieces of information (Fig. 2). Members of the public can view a map of the village, perform zoom and pan operations to assist in visualisation and navigation, ask such questions as "what is this building?" or "what is this road?" and then make suggestions about specific features identified from the map. All user input is stored in the Web access logs and is then used for future analysis and feedback into the planning process. In this manner a community database is created, representing a range of views and feeling about planning issues in the village.

When the user first enters the site, after an initial welcome window, they are prompted to fill in a profile. This was seen as an essential part of the system design as it could be used to build up a database of users to help validate responses and analyse the type of people who were using the system. Of course this relies on users putting in the correct information about themselves and collated evidence suggests that not everyone was truthful. However, it is possible to cross-check certain questions such as age and occupation for example. A 9-year-old professional can be assumed to be an invalid profile. Then again, on this evidence alone should the suggestions provided by this person be ignored? It may be a genuine error or may be

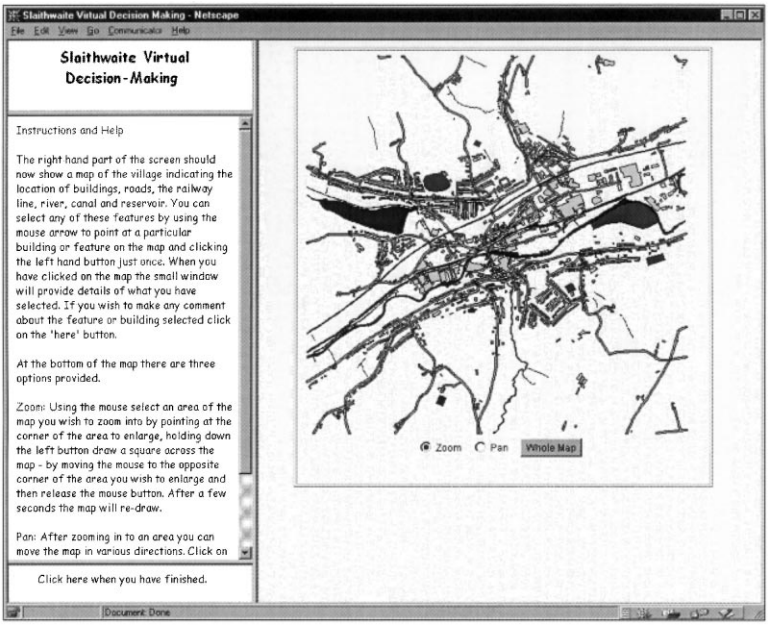

Fig. 2. Virtual Slaithwaite (Available: http://www.ccg.leeds.ac.uk/slaithwaite/).

a person feels that requesting this information from them is too personal and they therefore fill in the form incorrectly.

Once the profile is completed and submitted, the map of the village and the associated attribute datasets are downloaded. Initially the large window to the left of the screen contains "Instructions and Help" information which can be read while the map loads. Once the map is displayed the user is free to select any feature on the map. When a feature on the map is selected the small window in the top left hand corner of the screen displays what this is and the original "Instructions and Help" window changes to a form which can be filled in with the comments and suggestions regarding the selected feature. If a building feature is selected a form is provided allowing the input of text relating to that building. Any other features which are selected, such as open spaces, the river or canal also provide a free-form text box allowing the user to type in comments. Once they are happy with their comments the user can submit their comments to the system for future analysis. This effectively registers their views with the local planning authorities. When the user has finished, they exit the system and are provided with a series of questions asking them how they felt about using the system. They are also given the opportunity to make any further comments.

There were several advantages to this method over the traditional PFR exercise. The ability to instantaneously update the database and profile users online was seen as one of the most useful advantages of the system over the traditional PFR technique. The online system has a long residence time allowing people to use the system anytime, anywhere. The public do not need to attend a meeting at a particular time or place. This is often the single most inhibiting factor in participating via

traditional methods. The system allows faster collation of results from log files and the Web-site can be used to disseminate results/feedback. The traditional PFR requires facilitators to remove participants' suggestion flags periodically from the physical model and then put this information into a database for future analysis. The online system avoids this problem and in doing so facilitates the quicker turn around of results. Unlike the PFR physical model, it was decided not to allow users to view other people's comments to encourage imaginative responses. This avoids 'leading' members of the public into making particularly common suggestions in response to seeing a cluster of flags on the model where many other people have made the same or similar comments.

The design of the system revolves around a Java map application called GeoTools (1998) that allows the user to perform a simple spatial query and attribute input operations (Fig. 2). Using this Java map applet, users can view a map of Slaithwaite, perform zoom and pan operations to assist in visualisation and navigation, perform simple spatial queries and then append attributes to specific features identified from the map. All user input is stored in the Web access logs for future analysis and feedback into the planning process. In this manner a community database can be created, representing a range of views and feeling about planning issues in the locale. The user responses were handled using Perl server-side scripts and html forms

The map applet used displays a set of ESRI Arcview shape files, allowing pan and zoom operations, and retrieval of attribute information from the associated .dbf file.

The shape files to be displayed are determined by PARAM tags in the applets HTML file.

The program needs a few general details:

1. The number of layers required (starting counting at one).
2. The target script to pass the attribute data to from the .dbf file.
3. The name of the frame associated with the script (defaults to _top but in this case is called cvtheader.pl).
4. Whether default information needs to be passed from areas with no associated information (defaults to "true").
5. The default information, with spaces replaced by plus symbols (defaults to nothing, NOT an empty space).

PARAM Name = "NumOfLayers" Value = "6"

PARAM Name = "targetScript" Value = "cvtheader.pl"

PARAM Name = "targetFrame" Value = "header"

PARAM Name = "processDefaults" Value = "true"(or false)

PARAM Name = "defaultString" Value = "Open + space"

The details for as many shape files as required can be given by repeating the following PARAM tags, but replacing the 'X' with the layer number, counting up from zero and consecutively.

PARAM Name = "shapefileX" Value = "buildings"

PARAM Name = "shadeByX" Value = "use"

PARAM Name = "labelByX" Value = "name"

PARAM Name = "lutX" Value = "buildings.key"

PARAM Name = "lightX" Value = "true"(or false)

The shapefileX param is the name of the ESRI .shp and .dbf file (the program adds the extensions itself). The shadeByX value is the first value (the 'title' if required) in the column of attributes required to shade by, and similarly the labelByX is the attribute data column. The lightX value allows the highlight and search routines to be turned on or off such that when the mouse moves over a polygon it is highlighted and its attribute displayed at the top of the map window. The lutX value is the filename for a .key text file of the format:

integer, 'XXXXXX', 'description'

The integer represents the value looked for in the shadeByX column of the .dbf file, the #XXXXXX is a hexadecimal colour code and the description value can be used for a key. The full implementation of the Java-based package can be found in the GeoTools (1998) on-line documentation.

5. Web-based advantages

In the Slaithwaite example the entering of comments by the public directly into the system saves time and money. With the physical model comments made by the public have to be collated manually and put into a database (in this instance by CVT) which can take several weeks to compile and analyse. With the Web-based system the response database is continually being updated as the public use the system and input their comments. The system also offers a high degree of flexibility in that buildings can be altered or updated with more relevant information throughout the public participation process. Several people commented while using the "Virtual Slaithwaite" system that a road and some buildings had been named incorrectly. This information allowed the system to be updated immediately by the operators.

In a traditional PFR setting the public are encouraged to place flags on the physical model at locations where they wish to express views and opinions. This places limitations on the amount of information that the public can put across in the form of the flags which, by necessity, are relatively small. The Web-based system allows people to express more articulated views or comments about issues. NIF found the Web-based method useful and believe that there may be potential to incorporate a stand-alone (i.e. non-Web-based) system into their own PFR process.

While a Web-based system may not be necessary for a small-scale village-sized study, a similar process for a more geographically dispersed population could play

an increasing role in future public participation processes. It should also be noted that these systems are seen as ways to enhance, not replace, current methods.

A feature that was not included in any of the systems developed so far, but would have provided improved understanding for the public, would have been visual images such as photographs or even video footage of parts of the village to improve the familiarity of locations within the village. For example, photographs or artists' impressions of the new canal through the car park could have been provided allowing the public to gain a better understanding of how the new canal will look in the village centre. The noise from traffic along particular roads could also be incorporated into any future systems. Examples of this can be found in the work of Al-Kodmany (1999) who uses sketches and real images from local neighbourhoods of proposed developments and Shiffer (1995) who includes digital examples of noises generated from the proposed re-opening of a disused airport.

Widespread use of the Internet and the WWW is still some time away although the speed at which business, government and, to a certain extent, the public have adapted to using the technology is arguably faster than any other technology preceding it. As computers become more widespread, especially in schools and the workplace, the ability of the general public to use and feel comfortable with computers and technology will increase. As the Internet and more specifically the WWW develops and becomes a more widespread and accepted technology, its use in public consultation exercises is likely to increase. The use of animation and 'real-world' images incorporated into such a system will become familiar to users and overcome some of the problems highlighted earlier in relation to map cognition. One encouraging aspect gleaned from this case study was the relative ease with which the people of Slaithwaite seemed to grasp the concept of using the WWW. This appears to go against some of the work done by others in the past on public interpretation of maps.

During the "Shaping Slaithwaite" event, the authors had the opportunity to view the public using the system. There was a high degree of proficiency in map usage amongst all the users. Users who could not immediately locate the area they wished to comment on simply found a prominent building or road and moved along the path that they would on the ground, querying features by clicking on them until they reached the area. Far more trouble was actually experienced using the computers themselves, particularly the mouse interfaces. When one of the research staff was not available, this was often rectified by the younger members of the community, who either taught those with difficulties, or entered data for them. All the users preferred the fact that they could type any amount of information on any subject into the comment areas, in contrast to the traditional PFR method which limited contributions to a few lines which were classified into categories based on the types of problems estimated for the area by NIF. One noticeable feature was the way parents and their children used the system. This was an interesting phenomenon noted on the actual day. While many children used the mouse competently to navigate the system the parents and grandparents of the children were the ones telling them what to type in to the comment boxes. This is something which would never have been discovered had the authors not been present on the "Shaping Slaithwaite" day.

Preliminary results available for the Slaithwaite study suggest that among certain sections of the population the Web-based system was found both useful and popular. At least 126 people used the system, largely during the "Shaping Slaithwaite" event. However, there is still a considerable skew in the people prepared to use such systems, even when easily available. There is a strong (70.6–30.4%) male bias among the users. The occupation information suggests strong weighting towards those in professional/managerial and educational positions, while the age distribution shows a heavy skew towards schoolchildren (Fig. 3). The latter is partly a result of educational trips to local primary schools made by the authors prior to the event, and partly reflects the inability of schoolchildren to use the three-dimensional map, which was too high and wide for them to reach. Although data were not collected on the mobility of the users, it was clear at the event that the PC-based maps also attracted a number of adults who found the three-dimensional map difficult to use. Given the age distribution of the users (Fig. 4) it may be worth noting that once the age data were stripped from the comments, it was impossible in most cases to guess the age of the users from their suggestions, reflecting the genuine interest of all the users in their local environment.

On the whole it appears that the public response to the system was positive, particularly with the ability to type in comments at great length, as opposed to being restricted to a short sentence. When the user has finished, they exit the system and are provided with a series of questions asking them how they felt about using the system. This is similar to how the traditional PFR exercise is conducted whereby users are asked to tick a box next to a statement which reflected how they felt in the "Shaping Slaithwaite" event. Seven alternative statements were listed. From the traditional method only 29 people responded to these questions out of 1063 suggestion cards placed on the model. This poor rate of return was in part due to a lack of constant supervision of this part of the process with many people going once they had made their suggestions (CVT, 1999). For the Web-based version there was a slightly better response rate to the feedback section as Table 1 shows.

6. Difficulties encountered

One of the most important issues relating to online GIS concerns the actual data that are central to the system. The actual ownership of all the different pieces of information and data can cause major problems in relation to who controls and owns the information. Any system that is map based could potentially be tied up in complex copyright and legal issues. The major problems encountered so far relate to Ordnance Survey (OS) maps being distributed via the Internet. The OS is the UK's national mapping agency that holds the copyright over most maps. Current OS thought relating to this matter is suggesting that a copyright fee should be paid to OS every time one of their maps is viewed or downloaded online (Ordnance Survey, 1997, 1999). As well as the initial expense of buying the OS digital data in the first instance, the need to pay a fee every time someone visits your Web site to look at a map could make the whole exercise impractical, particularly for a public organisation such as a local authority or trust. The situation for private business is different and it

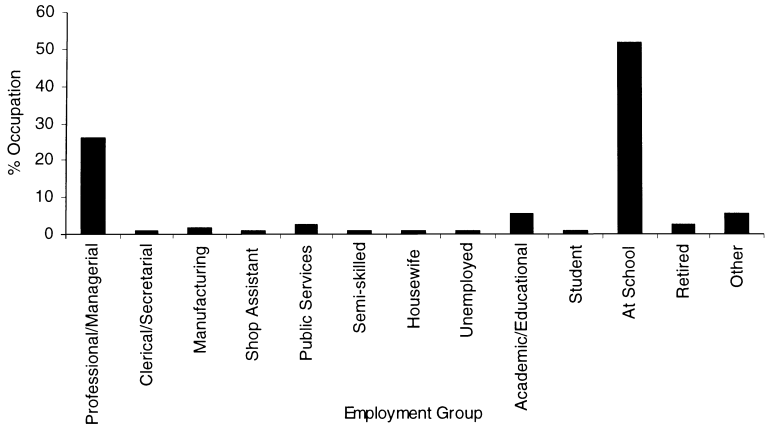

Fig. 3. Occupational breakdown.

is not suggested that they should have free or at least 'at cost' access to the data. The copyright issue is probably the single most important factor which will prevent publicly funded organisations and projects from developing Web-based GIS. Imagine a scenario where a public body has a set budget to run a public participation exercise. If this was successful with lots of members of the public participating and using online maps, the copyright costs owed to the OS could quite feasibly cost more than the initial budget set for the consultation in the first place.

While in our project we have had the necessary skills and infrastructure for putting a Web-based PPGIS together, other organisations may not have these skills. If an organisation intends to develop a PPGIS, personnel will be required who can take responsibility for putting the site together and who also have the necessary skills required for doing this in the first place. Someone with GIS, Internet and IT understanding is required.

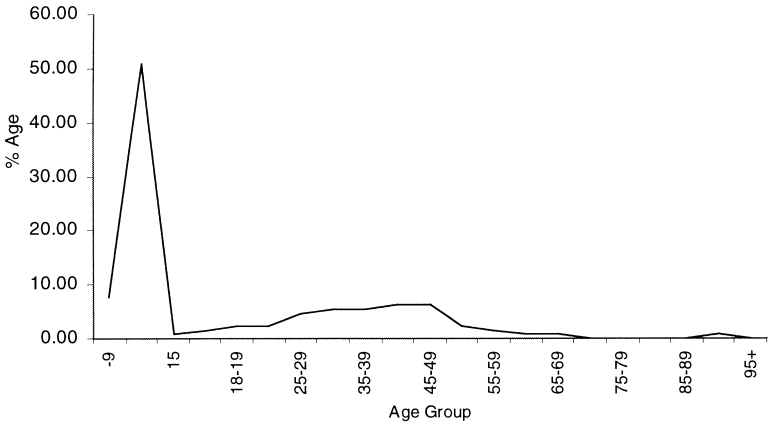

Fig. 4. Age structure.

Finally, consideration needs to be made for the public who will eventually use these systems. Do the public understand how the system works and are they comfortable using IT? As more and more people become IT aware this will become less of a problem but some people will be unsure of the technology and may need assistance and training.

7. Some PPGIS principles

Some of the thoughts in this section draw on the findings of the specialist meeting on "Empowerment, Marginalisation, and Public Participation GIS" (Craig, Harris & Weiner, 1999) attended by the authors at the National Centre for Geographic Information and Analysis (NCGIA) (Santa Barbara) in October 1998. Particular basic assumptions relating to what a PPGIS should contain and look like have started to develop. These are:

1. a Web-based PPGIS should provide equal access to data and information for all sectors of the community;
2. it should have the capability to empower the community by providing the necessary data and information which matches the needs of the community who are, or potentially, participating; and
3. a high degree of trust and transparency needs to be established and maintained within the public realm to give the process legitimacy and accountability.

With these issues in mind several key principles have begun to emerge from the research we have undertaken.

7.1. Accessibility

The most important issue relates to access. If the public do not have easy access to a Web-based PPGIS the whole process becomes ineffectual. It cannot be assumed

Table 1
User evaluation

I have...	Traditional		Web-based	
	No.	%	No.	%
full control	0	0	3	9
some power for making changes	8	28	9	26
voiced my opinion, but have no power to make changes	9	31	13	37
been asked what I think	7	24	10	28
been told what changes will happen	5	17	0	0
no involvement in changes	0	0	0	0
no opinion	0	0	0	0
Total	29	100	35	100

that everyone will have Web access. A great deal of thought needs to be given to this fact. How will people access a Web-based PPGIS? Will there be suitable public access points, and if so where should they be located within the community?

7.2. Understandability

Certain types of maps may be difficult for the lay person to understand. Standard cartographic techniques may need to be redefined and new approaches developed. While simple maps showing roads and building outlines may be understandable, other formats such as choropleth maps of income or unemployment may not.

7.3. Accountability

What organisational aspects might ensure that the community is well represented and few people are marginalised? It is possible for one group within a neighbourhood to take control and use a Web-based PPGIS to promote their interests over the interests of other groups. There need to be effective ways of protecting the interests of the minority. How do we ensure that those in power will act on the decisions and outcomes from a Web-based PPGIS process? If the process is community-led there could conceivably be no impact upon those in power as local officials have no responsibility to take on board the proposals of local people. Contrary to this outcome is that if the community or the public's viewpoints, opinions and proposals are ignored by those in power it is the community which has the ultimate power to give rise to changes through the ballot box. With this in mind local politicians may be more receptive to the types of issues raised by a community-led Web-based PPGIS process.

8. Conclusions and further research

Four key conclusions can be drawn from the research thus far undertaken:

1. *The human–computer interface*: there is lack of basic computer skills in some social groups and issues of interface design need to be addressed. Systems need to be developed which can be set to different levels of skill dependent upon the user's knowledge.
2. *Spatial cognition*: there is a varied public understanding of maps as described earlier and definitely on the understanding of GIS principles which may influence people's use of PPGIS. Then again the question must be asked, do the public really need to know that they are using a GIS?
3. *Trust*: the public's trust of the system, the data contained in it and the purpose of the exercise needs to be made extremely clear. There is the potential for (mis)information and abuse of the system by people who may have other motives. The Web is world-wide and thus accessible by anyone which can lead

to abuse. Results can be misleading if they are not checked to see who has been looking at the Web site and from where. Are comments/views from, for example, Perth, Australia, on a public participation exercise being held in Lisbon as valid as those from the locality?

4. *Apathy*: maybe the glitzy hype of the Web will encourage more people to participate. We have good cause to believe that these kinds of schemes can result in the formation of powerful communities who have a message to put across to those who govern them. However, probably the most important question is do we need greater public participation? Do the public really want to participate? Do we have the right to encourage the population to participate if the will to enact those decisions is not there on behalf of those in power? While this is an academic research programme, it obviously has a strong political agenda. As educationalists and researchers we can but stand by our *raison d'être* and hold that, at the very least, an educated public is better than an ignorant one, and policy that is implemented with the public is better than one that is implemented behind closed doors and in fear of the public.

A further aspect of the problem concerns the distinction made between discrete and fuzzy definitions of spatial objects or regions. Many aspects of peoples' everyday lives involve fuzzy entities which are not bounded by neat lines which are the mainstay of traditional maps and digital representations. Possibly the single most important element of a future PPGIS scenario is how to elicit this soft, fuzzy, possibly non-spatial information from the public. Most often people talk about everyday issues in vague, non-stringent terms. When attempts are made to represent these types of entities in fixed linear terms, difficulties are encountered. Methods need to be developed which allow aspects such as "kind of over there" or "up there somewhere" to be represented on maps. From a technical aspect the crisp, clean data represented on a traditional map can now be distributed on the Web as more 'off the shelf' packages become available such as ESRI's Internet Map Server and MapObjects and AutoDesk's MapGuide. The real challenge of future of Web-based PPGIS, and an area for further research, is how to elicit, represent and handle user-defined fuzzy information which is in people's minds but is difficult to represent on a map.

Public involvement can be maximised by Internet-based approaches and the Web should be seen as a means of enhancing current practices, not replacing them. It has an extremely valid use particularly in dispersed rural areas where it can be difficult to attend at a particular time or place — the Web is available anytime, anywhere so long as access is made easily available to the public.

Acknowledgements

This research is funded by the ESRC's Virtual Society? Programme award No. L 132 25 1014 from November 1997 to December 1999. The GeoTools package was partly developed by James Macgill.

Appendix. Relevant web sites

Colne Valley Trust	http://www.digitalhighway.co.uk/colne-valley/
ESRC Virtual Society? Programme	http://www.brunel.ac.uk/research/virtsoc/
Kirklees Metropolitan Council	http://www.kirkleesmc.gov.uk/
PPGIS Santa Barbara Meeting	http://www.ncgia.ucsb.edu/varenius/ppgis/
VD-MiSP Research Project	http://www.ccg.leeds.ac.uk/vdmisp/
Virtual Slaithwaite Case Study	http://www.ccg.leeds.ac.uk/slaithwaite/

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