MODELS FOR MAKING GIS AVAILABLE TO COMMUNITY ORGANIZATIONS: DIMENSIONS OF DIFFERENCE AND APPROPRIATENESS

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The research agenda addressing public participation GIS is, broadly speaking, evolving in two different directions. First, there is research examining the conventional use of standard GIS technologies by organizations with strong traditions of direct democracy; addressing issues of access and whether or not this GIS can empower such groups, particularly those already occupying a marginalized social or geographical location. Second, some researchers, concerned that such GISs are not necessarily empowering, are beginning to examine alternatives to conventional use of GIS. These alternatives extend from the integration of narratives and local knowledge with current GIS software, to multimedia GIS, the design of collaborative decision support systems, and the use of non-hierarchical systems of information flow.

While the latter body of work was the inspiration for theorizing GIS2 and then PPGIS, beginning in discussions at the NCGIA Initiative 19 specialist meeting (Harris and Weiner, 1996), this paper is within the former tradition. We seek to investigate the appropriateness of current GIS technologies for neighborhood and grassroots organizations (henceforth 'community organizations'), in their tasks of articulating and pursuing the interests of those whom they are supposed to represent. The work reported on here is based on a variety of experiences with models making GIS available to community organizations in Minneapolis and St. Paul (cf. Elwood and Leitner, 1998). Rather than reporting in detail on experiences whose effectiveness is difficult to judge thus far, we seek to abstract to some degree from them, and to position our experiences within a conceptual framework. The paper is organized as follows. We discuss in general terms different ways in which the appropriateness of GIS for community organizations can be assessed; we conceptualize and describe different models for making GIS available to community organizations; and we discuss the putative advantages and disadvantages of these models for empowering community organizations seeking to use GIS.

The appropriateness of GIS for community organizations[1]

The appropriateness of GIS for advancing the interests and concerns of communities can be assessed at at least three levels (Leitner, McMaster, Miller and Sheppard, 1996). First, is the question of making GIS available to community organizations (Yapa, 1991; Hutchinson and Toledano, 1993; Barndt and Craig, 1994; Sawicki and Craig, 1996; Barndt, 1998; Clark,

[1] Note that we are assuming, for the purposes of this discussion, that the technology is more-or-less given, something with which community organizations must come to terms. This rather static view of the technology neglects the ways in which users can change the nature of the technology itself, to their advantage or disadvantage. Considerations of this aspect– the influence of society on GIS– suggest that there may be limitations to the 'appropriateness of technology' way of thinking about this issue (cf. Harvey and Chrisman, 1998)

1998; Elwood and Leitner, 1998; Harris and Weiner, 1998). Availability will be governed by financial considerations, the ability to purchase and maintain the appropriate hardware and software; by the expertise available locally, the geographical and technical skills necessary to make use of GIS; and by the availability of data, often depending on the openness of government agencies and freedom of information regulations. Some of these barriers are falling, as computing costs fall and expertise spreads, although this is mitigated by an increased tendency of local governments to charge for the use of their databases.

Second, once the availability problem has been solved, is the question of how successful implementation of the technology affects democratic processes in the community. The literature on organizations is full of cases where a new technology or body of expertise creates divisions within the organizations adopting them. Adoption of GIS may reduce the cohesion of the community organization, as rifts develop between the new experts and other, often longer-term members of the organization. These rifts can be particularly acute in community organizations where goals often are negotiated through communicative action rather than being given by bottom-line imperatives.

Third, apparently successful and democratic implementation within the organization need not advance the participation of all of those that the organization is supposed to represent. Increased use of GIS may alter the priorities of the community organization such that it becomes less and less representative of the community at large. This is more likely to happen when the community is heterogeneous, and when diverse local concerns and understandings cannot easily be made consistent with the technology. Rundstrom (1995), for example, expresses the fear that use of GIS by Indian organizations is inconsistent with Indian understandings of space and place (see also Brown, Alechandre, Sassagawa and Aquino, 1995; Jarvis and Spearman, 1995; Kemp and Brooke, 1995; Nietschmann, 1995).

Since we are reporting at a time when community organizations in Minneapolis and St. Paul are just beginning to use GIS (Craig and Elwood, 1998; Elwood and Leitner, 1998), it is too soon to make any judgments about the second and third aspects of appropriateness sketched above. Instead, in the sections that follow we will examine issues affecting the first dimension; the availability of GIS to community organizations. We recognize that in practice community organizations will, of course, use a variety of ways of assembling the expertise they believe to be advantageous to their goals, constantly shifting this mix as circumstances change. Furthermore, the efficacy of different ways of making GIS available will vary with the context of the organization concerned, with no single way of providing GIS to community organizations being necessarily superior. In this sense, the

evolution of GIS-related practices within community organizations would be characterized by the path dependent dynamics associated with the development of any social technology in use, conditioned by the particular context of those using it, as addressed more generally by those examining the intellectual history of GIS (Chrisman, 1988; Sheppard, 1995; Harvey and Chrisman, 1998). Nonetheless, in order to gain insight into why certain ways of making GIS available may be favored in certain circumstances, in this paper we abstract from this dynamic and contextual complexity in order to compare and contrast different models for making GIS available to community organizations. In the following section we suggest a conceptual framework for distinguishing between different models of access, a framework that can be applied to categorize models already in use and to think about other possibilities. We then apply this to six models, drawn largely from our experiences to date in the Twin Cities.

Conceptualizing models of availability

In our assessment, there are five important, inter-related dimensions along which models of making GIS available to community organizations can be differentiated: The communication structures connecting neighborhoods with GIS facilities; the nature of the interaction with the GIS; the physical (geographical) accessibility of the GIS to the community organization; the other stakeholders involved in making the technology available; and legal and ethical ramifications (see Table 1).

Communication structures range from independent nodes, whereby each community organization operates its own GIS in relative isolation from one another; to a radial structure in which community organizations' use of GIS centers on separate use of a common facility, to a network structure, in which community organizations communicate directly with one another as they use GIS. The *nature of interaction with the GIS* can range from no direct use at all; to passive use by individuals, where use is dictated by the maps and databases available, and by standardized GIS procedures; to active use, whereby the user is free to develop their own operations and classifications of given databases; to proactive use, where users can input their own data and benefit from a variety of information technologies best suited to those data (cf. Harris, Weiner, Warner and Levin, 1995; Weiner, Warner, Harris and Levin, 1995). It can also vary from individual to collaborative user interfaces, with the latter facilitating collective negotiation and decision-making (Couclelis and Monmonier, 1995; Nyerges, Barndt and Brooks, 1997). Different models also differ in the *geographical location* of the GIS, ranging from local access in the community, to virtual access over the information networks (e.g., Web-based GIS), to remote access, where physical travel to a location outside the community is necessary to

use GIS. These three dimensions relate directly to questions raised within research into public participation GIS (Dangermond, 1988; Brown, Alechandre, Sassagawa and Aquino, 1995; NCGIA, 1996; Barndt, 1998; Obermeyer, 1998).

Stakeholders include external individuals and institutions (such as local and non-local state agencies, private industry and educational institutions), whose degree of involvement can affect the responsiveness of the GIS to community organization needs. Each external stakeholder has its own institutional priorities (which themselves are often complex and multi-dimensional), which will be reflected in different ways in the GISs which they participate in, and also has different experiences with, and knowledge and perception of, GIS within that organization. This dimension relates directly to research addressing the institutional perspective on GIS and Society (cf. Onsrud and Rushton, 1995; Ventura, 1995; Tulloch and Niemann, 1996). In addition, community organizations often represent diverse communities within which there are different local stakeholders with conflicting understandings and priorities.

Legal and ethical issues, a separate area of research in GIS and Society (Onsrud and Rushton), refers in general terms to questions of intellectual property rights in spatial databases, access rights of citizens to publicly held information, privacy rights and principles, liability in the use and distribution of geographic information system data and products, and ethical issues in the use of geographic information (Onsrud, 1992; Onsrud, 1992; Onsrud, 1995; Couclelis, Graham, Harrington, Onsrud et al., 1998). Models for making GIS available to community organizations will differ in terms of: who has legal ownership of, and responsibility for the accuracy of the spatial databases used or created by these organizations in GIS analysis; whether the communities represented by community organizations have access to publicly held information; the potential for abuse of the privacy of those in the community; and the checks and balances that can guard against this and other unethical activities related to the use of the GIS.

We contend that models of making GIS available to community organizations will differ from one another along one or more of these dimensions. These represent a means for differentiating and classifying models that are currently in use, as we attempt to demonstrate in the subsequent section. They can also aid in normative reasoning; in conceptualizing the desired attributes of other models not net developed. One might speculate, for example, that a model might be particularly advantageous for community organizations if it were characterized by: a network communication structure; a collaborative proactive use of GIS; no other stakeholders with conflicting interests or goals; local accessibility; where community organizations carefully regulate legal and ethical

responsibilities for the use of freely available public data and rigorously collected community information.

Table 1: Differentiating models of availability

DIMENSIONS	ATTRIBUTES
Communication Structures	Independent Nodes
	Radial Connectivity
	Network Connectivity
Nature of Interaction with GIS	No Direct Use
	Passive Use
	Active Use
	Proactive Use
Location	In-house GIS
	Virtual (Web-based GIS)
	Remote GIS (outside the community)
Stakeholders	Local & Non-local State Agencies
	Non-governmental organizations (NGOs)
	Educational Institutions
	Private Sector Institutions
	Within community stakeholders
Legal and Ethical Issues	Ownership of/responsibility for spatial databases
	Access to publicly held information
	Issues of privacy and surveillance
	Checks and balances governing appropriate GIS use

Six models of availability

In the first column of Table 2 we list six models for making GIS available to community organizations. In this section we discuss the nature of these models, and the differences between them based on the conceptual framework of the previous section.

Table 2: Six models for making GIS available to community organizations

Community-based (in-house) GIS (e.g., Powderhorn Park, Prospect Park)
University/Community Partnerships (e.g., Urban GIS class, Macalester Action Research, University Neighborhood Network)
GIS facilities in universities and public libraries (e.g., ACIC)
"Map Rooms" (e.g., City of Minneapolis Map Room)
Internet Map Servers
Neighborhood GIS Centers

Community-based (in-house) GIS

The establishment of an in-house GIS technology and databases by community organizations for community-based planning is still a rare and rather recent phenomenon in the Twin Cities. For example, in the city of Minneapolis there exist only a handful of neighborhood organizations that have an in-house GIS. In some cases, neighborhood organizations have been able to accomplish this fairly independently, in other cases is has been facilitated by the Minneapolis Community GIS project. This collaborative project between the University of Minnesota and four Minneapolis neighborhoods, has as one of its major goals to help neighborhood organizations to establish an in-house GIS and GIS-databases.

A community-based GIS is usually designed as an independent node located within the community organization, usually at its office. Neighborhood organizers and residents do not have to physically travel outside the neighborhood, but rather are able to gain direct and immediate access to information as needed for neighborhood planning and organizing purposes. Furthermore, an in-house system may be tailored to the specific needs of community organizations because it allows them to create and interactively manipulate their own databases and maps, rather than relying on pre-defined data sets or maps.

The responsiveness of an in-house GIS to neighborhood needs is potentially enhanced by the fact that neighborhood organizations are the primary stakeholders in an in-house system. This does not imply, however, that there exists a consensus among

neighborhood residents regarding neighborhood priorities, or that the community organization will represent all of these priorities. Rather, the diversity of neighborhood residents usually means that there are a variety of stakeholders with often differing agendas. Thus the responsiveness of an in-house GIS to meeting community needs must also be evaluated in the context of these diverse internal stakeholders.

While neighborhood / community organizations do not assume primary legal responsibility regarding the ownership, control, and accuracy of public data, they do have to face legal issues regarding neighborhood-generated databases. For example, local governments or the media might try to gain access to sensitive neighborhood generated databases which the neighborhood organization, or stakeholders in the neighborhood, might not want to release. Or, there might be differences among different stakeholders in the neighborhood as to what constitutes legitimate information to include in a GIS database (privacy issue). At this point it is unclear to us, who, and to what extent assumes legal responsibility for these issues.

Community/university partnerships

Increasingly universities, through a variety of mechanisms, are attempting to assist community organizations with their mapping needs. One common approach is to provide assistance through course projects, where a course--often an advanced course in GIS--through some identification process establishes a relationship with one or more group(s) in need of GIS assistance. Based on the overall objectives of the project, students, faculty, and community organization leaders then work together to identify more specific goals, sources of spatial data (both community-based data and publicly available data), and specific mapping needs. The end result is often a group class presentation and delivery of a series of maps. Different models of university / community partnerships include basic community service, service learning and action research. Basic community service in the broadest sense represents volunteer work with a curricular link. An example would be an on-going student volunteer placement related to a course that produces a set of map products desired by the community.

Service learning involves faculty and students in providing a service to the community, such as developing a GIS application based on a community request, and then reflecting on the lessons learned from the experience. Its primary goal is to enhance learning through the service experience with less emphasis on changing social systems or generating new knowledge although it can provide the opportunity for both to happen. Recent activities in the Urban GIS and Analysis class held at the University of Minnesota provide an example. Through what is called the University Neighborhood Network (UNN)

which attempts to link neighborhood-based organizations, and faculty and students at local colleges / universities in research partnerships, seven GIS-based projects were selected as case studies for the class. In one case study, the addresses of those individuals involved in a "contract-for-deed" arrangement, allowing individuals to bypass the normal banking mortgage process, were mapped to examine the geographical spread of loans.

Action research differs from the previous two models in that it is a fully collaborative, inclusive, longer-term approach and emphasizes the importance of full participation by community members in research and the generation of knowledge. A key aspect of this approach is to involve community members in defining, examining and deriving solutions to problems generated by social systems, i.e., the community is actively involved in research and generating social change. Thus community members could participate in various stages of GIS project development relating to an issue of concern in the community, potentially empowering the community to affect change in public policy. An example of this is Macalester College's action research project involving neighborhood. Its Geography Department has been assisting the Eastside St. Paul community with their GIS and mapping needs as part of a larger Action Research Initiative involving faculty and students at Macalester College, along with other partners (i.e., other colleges and universities, community organizations and local government agencies). The specific GIS and mapping applications undertaken by students and faculty in the Geography Department (e.g., via the cartography and GIS courses and independent studies) relate to educational, economic, social and development issues that concern the community.

A longer term approach to Community / University partnerships often occurs when faculty research projects are linked into community-based problems. Here, faculty and student research teams often work with a community organization over a longer period of time, not only assisting with basic mapping problems, but also with analysis and interpretation of data. Increasingly, such linkages involve the attempt to implement GIS within the community-based organization, resulting in even longer term commitments of time for hardware / software training, acquiring data, and mapping.

The communication structure for University / Community Partnerships involves radial connectivity, where information and data tend to flow out from the university to the various community organizations. It is the university faculty / students who provide expertise in solving neighborhood problems using GIS. In our own experience, neighborhood organizations tend to focus on the relationship with key faculty and students, not with each other. Because of this strong reliance on university expertise, community organizations rarely maintain their own systems, but receive maps / analysis from students involved in the class and have no direct use of the technology. For similar

reasons, this relationship often does not result in the participation of additional stakeholders other than the obvious linkage to the university itself. Our experiences with this model also leads us to believe that most neighborhood organizations seeking such University / Community Partnerships have no existing experience or expertise with GIS, but use the relationship to acquire basic information on establishing in-house capability. Initially, the technology is located outside the community. Finally, since the university provides data for community organizations, there are no significant concerns with ownership and accuracy of databases.

Publicly Accessible GIS facilities at universities and libraries

Community organizations also gain access to GIS and spatial data through publicly accessible GIS facilities at universities and libraries. Typically, the facility creates and maintains basemaps and spatial data and makes these available for use with GIS software. Community organization staff or volunteers must travel to the facility to create or print out maps, or work with the database. Such publicly accessible GIS facilities rely on a radial type communication structure in which community organizations separately make use of the same facility. While such an arrangement may mean that the GIS facility staff develop and disseminate expertise about how to solve standard problems, it also may mean that community organizations are not communicating directly with one another about solving common problems.

The nature of interaction that users have with a GIS at public GIS facilities varies. Specifically, these facilities differ in the extent to which users can manipulate the database or enter individualized data for their community. At some, like the St. Louis Public Library GIS, users select from predefined data sets and maps (Krofton, 1993). At other facilities, like the University of Minnesota's Automated Cartographic Information Center (ACIC), users can manipulate existing data or bring in their own data for mapping and analysis.

Publicly accessible GIS facilities in universities and libraries involve at least two major stakeholders in addition to the community organization and the community it represents: The organization which manages the facility, and the agency which provides funding. These stakeholders influence a GIS and its use by community organizations in several ways. The organization managing the facility determines which data are available, or which predefined maps or data sets they will provide to users. They also determine what role staff will play and what services they will provide to users. At most facilities, staff is available to help with technical problems in operating hardware or software.

However, these facilities differ with respect to the amount of guidance or advice provided by staff in analysis of data or maps and application of them to community concerns.

The involvement of multiple stakeholders in community organizations' GIS use at public facilities presents a complex set of legal issues. At one level, we might assume that primary responsibility for legal issues related to data and map ownership is removed from the community organization. Agency staff must resolve these issues before releasing data and maps publicly. Responsibility for accuracy of data is less clear, however, given that the GIS facility is likely not the primary source of these data. Finally, with respect to the application of these data, it is also unclear which actors are liable for irresponsible or detrimental uses of the data.

Map Rooms

There are several examples of what we call map rooms that are used by community organizations to acquire spatial information. A simple model is the city planning office, which provides citizens with land use / land cover, taxation, and other maps relevant to their planning mission. Many other city and state offices--such as departments of natural resources and pollution control agencies--create and distribute maps. In Minneapolis, the city maintains what is called the Map Room, operated by the City Engineering Department (which is responsible for maintaining the city's spatial database). For a fee, this facility will create custom maps on demand for community organizations and citizens. As an example, a community organization could order a parcel-based map of neighborhood housing condition, boarded up housing units, planning zones, and crime activity--all large scale-large format cartographic representations. Many of the community organizations in Minneapolis make extensive use of this facility as a surrogate for lack of in-house mapping capability.

The map room represents radial connectivity in that information--in the form of maps--flows out from the map room to citizens. In most cases, those who use map rooms are unlikely to interact, or even know, others utilizing the facility. The users of this facility have no direct interaction with the system and thus gain no expertise with GISs--that is, there is no direct interaction. Local and non-local state agencies represent active stakeholders in that the facility is owned and maintained by the city and extensively utilizes city-generated data. As with other models, the neighborhood only has remote access to the system, as city employees actually manipulate and map data on request. Ownership of data for map rooms lies with government, thus is not a significant concern to community organizations. Although the city does maintain confidential information, it is normally not released unless strict confidentially agreements are signed as in the case of

public housing, certain public health variables, or data based on economic measures (e.g., Minnesota's ES-202 data used for tax purposes).

Internet Map Servers

Internet Map Servers make pre-defined maps available to community organizations over the Internet, most often residing at web sites. This model requires that some existing institution, such as city-government, colleges and/or universities, private companies, non-governmental organizations (NGOs) or even another community organization, establish a Web site with a series of already designed and symbolized maps. Increasingly, although most sites are still oriented towards cartographic display, certain sites also now allow users to make simple spatial queries or perform analyses. For instance, one can identify several sites, such as the 1990 census analysis of the Twin Cities Region that allows community organizations to meet some of their basic spatial data needs, lessening the potential requirement for a fully functional in-house GIS. And, as more and more Web sites are created with richer, more detailed and even modifiable maps, Internet Map Servers could become the major source of spatial information for community organizations.

The communication structure for Internet Map Servers represents, theoretically, one of the most egalitarian of the methods for distributing spatial information to neighborhoods--a method of ubiquitous (both in terms of space and time) access. With relatively low-level equipment, neighborhoods' access to this rich source of information will be filtered by those who design the site. Interaction with the server can vary from passive use--where spatial information is "served" in a typical server-client model--to a more active model where users can query and manipulate data remotely. The related stakeholders most often involve local or non-local public or quasi-public agencies, who often are the Web-site designers. Since GIS software and hardware is not needed on site, this represents a virtual interaction with the "system." Often, however, the server is simply maintaining already designed and manipulated maps and does not represent a true GIS. Ownership of data lies with the data provider, such as public agency, university, or increasingly even the neighborhood itself.

Neighborhood GIS Centers

A neighborhood GIS center, a model with which we have no empirical experience, would be the result of neighborhoods pooling their expertise and resources, to provide a central facility that all affiliated community organizations could use. The funding to maintain such a center could come from the community organizations themselves, but continuity of

funding probably is best provided by a non-profit foundation, by the private sector, or by the state. Community organizations can have short life cycles, and vary greatly in their financial solvency, meaning that a self-funded center would not have a stable funding base and is likely to come under the influence of the wealthiest members. The governing principles of a neighborhood GIS center would be that its goals are set by the community organizations which it serves, and that it provides those organizations with the capacity not only to gain access to pre-existing databases but to input information gathered by the communities themselves.

Such a center, if successfully implemented, would be characterized by a network communication structure, since the collaboration of communities in the development and use of the center will encourage the sharing of knowledge and expertise, and joint action to address emerging problems. It would have the capacity for proactive use. Communities could bring their own information into the GIS; and the shared infrastructure and expertise might create the capacity for innovative integration of other kinds of information with GIS. It could also be an ideal environment for collaborative participation and decision-making, without waiting for the implementation of sophisticated technologies allowing individuals at different terminals to work on a common GIS, as representatives of different communities can gather around a single computer terminal. Access would likely require community representatives to travel to the center, however, limiting the degree to which all members of a community can participate in this process. The role of other stakeholders will depend a great deal on the details of funding and financing the center. If the center is based on a 'block grant' and agreements which give neighborhoods wide-ranging access to local databases, free choice of GIS software, and suitably equipped physical space, then the influences of other stakeholders will be less. At the other extreme, local governments may make only limited data available; external funding may dictate the software that can be used and thereby the GIS capabilities and the types of data that can be input; and the center may have to be housed in space owned by external stakeholders who thereby exert control over how that space is used. There is also a sense in which different community organizations become stakeholders in, and thus may attempt to exert influence over, each other's GIS-related activities as a result of collaboration in the center. This can occur when community organizations are compelled to use GIS in ways that go against their best judgment, as a result of majority decisions about how the center should operate. It also can occur by means of day-to-day influence over each other's analyses.

The legal and ethical dimensions associated with such a center will also depend on the details of its development. Reliance on databases and / or software provided by stakeholders place responsibility for their accuracy in the hands of those providers. The

active collaboration between community organizations within such a center can also make it easier to develop mechanisms of checks and balances which are sensitive to community issues (i.e., based within the community organizations rather than subjecting them to the control of external stakeholders), but which avoid self-interested regulation by community organizations of their own activities. This could occur, for example, if the center were to implement a board of ethics which all communities belonged to, charged with developing standards based on legal and ethical considerations for all community organizations, and taking up any complaints about the misuse of GIS by individual organizations. This board should include individuals from those communities who are not involved in the GIS analysis or in the organizations doing that analysis. The neighborhood center structure can also encourage abuse, however. The sharing of expertise and data between community organizations creates the possibility that information about individuals from one organization are inappropriately made available to other organizations. In addition, as the center becomes the center of GIS practices for its member organizations, it can develop a culture of practices and standards that become progressively separated from, and imposed over, the diverse interests of the communities whose organizations are participating in that center. In other words, a center furthers the separation of GIS practices from the communities which they are intended to serve.

Assessing the appropriateness of the six models for community organizations

Table 3 lists a variety of possible advantages and disadvantages associated with each of the six models of making GIS available to community organizations. These lists, elaborated on in Appendix A, are based on our own informal assessments, and are yet to be cross-checked against the evaluations of community organizations themselves, and thus remain necessarily tentative. Broadly speaking, these advantages and disadvantages seem to be of two types; those addressing the question of how flexible and responsive a model is likely to be to the needs of community organizations; and those addressing the difficulties of implementing and maintaining GIS provision. The former in some sense represents the potential benefits of that model: Its capacity to make GIS capable of addressing the complex needs of organizations who have had no influence over the development of currently available GIS technologies, and whose vision of GIS use is more participatory than that of many other user communities. The latter represents its potential costs; the difficulty of successfully implementing that model. Difficulties of maintenance are very important because community organizations are often resource poor, in terms of the financial, political and human capital that they can bring to GIS use.

Flexibility and responsiveness attempts to capture the various ways in which a particular model can be flexible and sensitive to the particular context and needs of different organizations. Community organizations are highly heterogeneous, making flexibility an important feature enhancing the appropriateness of GIS for the organization. This will depend on ease of use; on any geographical or social barriers reducing access to GIS; and on the degree to which the user can direct how the GIS is used. These aspects all contribute to the capacity for a broadly participatory and inclusive use of GIS; which can contribute to empowerment and democratic decision-making within the community itself.

Difficulties of implementation and maintenance . These difficulties have can have both a number of aspects. On the one hand, it is important to distinguish between the costs to an individual community organization, and to a group of organizations simultaneously seeking to use GIS. Because of economies of scope, the cost-minimizing solution for a single organization is not necessarily best for the organizations as a group. A cost-minimizing solution for single organizations may result in unnecessary duplication of costs in different community organizations that could have been avoided. Secondly, it is important to distinguish between difficulties of commencing operation, or set-up costs; and difficulties of keeping the GIS operating successfully over an extensive period of time, or maintenance costs. The failure to plan for maintenance, resulting in technologies not being use after they have been made available, is a classic barrier reducing the appropriateness of technologies, that is particularly challenging for community organizations whose own budget base and organizational structure are continually under threat. Thirdly, it is worth distinguishing between human and non-human aspects of these difficulties. On the non-human side are economic costs, but also social and political costs that must be overcome for successful operation. On the human side, are questions of the expertise necessary to implement and maintain a system, and its availability within the community; the likelihood that extended use of GIS by the community organization will build up skills and expertise within the community (a positive side-effect which can reduce maintenance costs as well as having a broader developmental impact within the community); and, on the other hand, skills-development which results in the out-migration of community members who have developed these skills and prefer to take them elsewhere (increasing maintenance costs, as the community risks losing investments it has made in skills development).

Table 3: Advantages and disadvantages of the six models

	Advantages	**Disadvantages**
Community-based (in-house) GIS (e.g., Powderhorn Park, Prospect Park)	Can be tailored to local needs Can be made directly available to neighborhood organizers and residents Allows direct monitoring of neighborhood change by community group Allows for quick and flexible response to neighborhood issues Potential for community-based employment and related skill-building	Difficulties in long-term maintenance of GIS due to personnel turnover (struggles over neighborhood priorities) Requires skilled neighborhood organizers and/or residents Difficulties in raising funds to purchase hardware and software (struggles over neighborhood priorities) Unnecessary duplication of effort across neighborhoods Independent data access reliant on political connectedness (differs between groups)

University/Community Partnerships (e.g., Urban GIS class, Mac Action Research, University Neighborhood Network)	Easier access to expertise about GIS and data collection/availability Can be made responsive to specific data and application needs of neighborhoods Costs to neighborhood are lower (both monetary costs and time necessary to learn and maintain the system) Possibility of improved communication and interaction between participants	University has limited capacity to provide services; to only a few neighborhoods University or research project agenda may not fit with that of neighborhood Faculty/students may not fully understand neighborhood needs Neighborhood may not understand limits to what can be done with GIS Timing - university help may not be available when needs help Lack of long-term commitment of university to neighborhoods Unnecessary duplication of efforts across neighborhoods Hard to directly involve community members in analysis
GIS facilities in universities and public libraries (e.g., ACIC)	Neighborhood residents may have direct access to GIS and databases, and to expert advice in how to use these Lower costs for neighborhoods Reduces duplication of effort (expertise about how to solve standard problems is developed and hopefully retained within the facility) Longer-term resource	Analysis is limited to publicly available data sets, unless neighborhoods have capacity to enter their own data Can be intimidating to use such facilities (particularly university) Use requires travel outside the neighborhood and is limited to times when facilities are open

"Map Rooms" (e.g., City of Minneapolis Map Room)	Relatively easy availability of basic mapped neighborhood data (little expertise needed) Pay as you go; no up-front investments required	Limited to the databases maintained by the city; only a fixed menu of maps is available Use requires travel outside the neighborhood and is limited to times when facilities are open Services available reflect priorities of institution maintaining the map room Limited advice from map room staff regarding which maps to use or what these maps mean with regard specific neighborhood context, concern or area of interest
Internet map servers	Allows direct access to spatial data Potential 2-way interactions	Dependent on computer capacity of community organization (people and hardware/software) Limited ability to manipulate data according to specific needs No access to external expertise to interpret maps and data or apply to neighborhood concerns
Neighborhood GIS center	Provides economies of scale, in terms of expertise and resources Continued operation does not depend on the fortunes of individual community organizations Responsive to neighborhood needs Promotes collaboration among neighborhood organizations, including problem-solving	Conflicts between neighborhood organizations about priorities can reduce effectiveness Difficult to realize because it requires collaboration in advance of GIS implementation Significant external funding must be secured GIS facility is not located in neighborhood

Conclusions

In this paper we provide some tentative tools for conceptualizing different models for making GIS available to community organizations, and for assessing their efficacy for such

organizations. We note that this is just one of the issues that must be addressed in discussing how GIS can empower and / or marginalize community organizations and the communities that they represent. Yet, even for this issue many questions remain. First, we need to determine whether the conceptualizations, models and provisional assessments reported on here are robust. On the one hand, we will engage in a survey of the community organizations working with a variety of these models in the Twin Cities, to discover their evaluations and cross-check those against ours. On the other hand, we hope for feedback from the participants at this meeting:

- What other models have been employed, and are they consistent with the framework developed here?
- Are our conceptual frameworks and assessments of advantages and disadvantages sound?
- How should a conceptual framework for assessing advantages and disadvantages relate to a conceptual framework for categorizing and differentiating between models?

Second, it is necessary to examine empirically the relationship between these models and the evolving practices of community organizations. Based on our experience thus far, community organizations do not choose just one model, but draw on different ways of gaining access to GIS; changing their strategies over time and perhaps developing novel ways of making GIS available which differ from preexisting models. One test of the utility of an exercise such as this is whether it helps make sense of such strategies and their implications for empowerment and / or marginalization.

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Appendix A: Advantages and disadvantages of the Six Models

Community-based GIS

In-house GIS has certain advantages for neighborhood organizations, including the following. First, it allows neighborhood organizations to create and interactively manipulate their own databases and maps needed for planning, monitoring and organizing purposes. Second it provides quick and easy access to this information as required. Third, it offers the possibility to build up skills and expertise within the community and thus has the potential for broader development impacts. Based on our observations in the Minneapolis Community GIS project we also identified a number of obstacles for a successful implementation of an in-house GIS, primarily related to the institutional characteristics of neighborhood organizations. Specifically rapid turn over of staff and participants, unstable funding sources, and lack of expertise, seem to impede both the implementation, operation and long-term maintenance of software and data. Given the monetary and human resource constraints of neighborhood organizations, the in-house GIS may also constitute an unnecessary duplication of effort and resources across neighborhoods.

University/Community Partnership

This model has four primary advantages. First, it provides easier access to the rich potential sources of GIS expertise at the university. Second, this expertise can be focused on the specific data and application needs of the neighborhood. Third, both monetary costs and costs associated with learning and maintaining the system are lower. Finally, this approach can improve the level of communication and interaction between the academic institution and community. There are also a number of disadvantages associated with this model primarily with respect to establishing and maintaining a true long-term partnership. Fully communicating the neighborhood's needs to the faculty and students, as well as the limitations of GIS to the neighborhood, can be difficult. Directly involving community members throughout the process, e.g., in the analysis, can be challenging. Also the university as an institution may have limited capacity to provide services or to maintain a long-term commitment to a neighborhood and the provision of services may not match with its research agenda, or coincide with academic scheduling of courses. There is also a danger of unnecessary duplication of efforts across communities.

Publicly Accessible GIS facilities at universities and libraries

There are a number of advantages and disadvantages for community groups who gain access to GIS through such public facilities at universities and libraries. At the most basic level, use is limited to hours when the facility is open and users must travel to the facility, a disadvantage for staff or volunteers with time conflicts or transportation difficulties. The location of the GIS in a separate facility may also be disadvantageous if community groups feel intimidated to seek assistance there, feeling that a project is not legitimate or that they need to know more a great deal about GIS or about a particular project before seeking advice. By seeking external assistance at such a facility, however, community groups have the advantage of receiving expert advice in the use of GIS and

databases, rather than investing a tremendous amount of effort in creating and learning to operate their own GIS. Furthermore, publicly accessible facilities decrease the duplication of effort across community groups, and expertise about how to solve standard problems is developed and retained at the facility.

Map Rooms

Map rooms are advantageous due to the relative ease with which communities can acquire basic maps of pre-defined thematic variables that require minimal cost. Such map rooms normally have the resources to maintain large numbers of maps at a variety of scales and resolutions. Several disadvantages are associated with this model. First, the maps and services available are limited to the databases maintained by the city and the priorities set by the institution maintaining the map room. Second, community members must travel to the facility during the hours that it is open to the public. Finally, there is limited or variable advice that can be provided by staff regarding which maps to use or how suitable they are for the communities' needs.

Internet-based Access to Maps

This model of access allows for direct access to spatial data and offers the potential for facilitating two-way interactions depending on how the site is designed. It represents the most egalitarian of the approaches in that, assuming the server is dependable, neighborhoods can gain nearly any time from multiple nodes--including individual residences. Accessibility can, however, be limited depending on the computer capacity of the community organization and the degree to which data can be manipulated to meet a community's needs. Another major disadvantage is that the community does not have access to external expertise in terms of interpreting maps and data.

Neighborhood GIS center

There are several advantages to such a model. First, a center provides economies of scope, making GIS facilities, expertise, and databases available to community organizations that they cannot afford themselves. Second, the center would be designed to meet the needs of the member organizations, not of other stakeholders. Third, it would provide a place where community organizations can network with one another and share experiences, speeding up their ability to make the most of the technology. There are also some disadvantages. First, those providing the funding have subtle influences over the center, over who has access to it, the kinds of databases available or the kinds of software used, which may reduce its appropriateness for community purposes. Second, it will be less accessible geographically than community-based facilities (although more accessible than the other models). Finally, as a communal facility, there will inevitably be conflicts between the diverse community organizations over its priorities, resulting in reduced effectiveness or in compromises that may reduce its utility for certain activities promoted by certain community groups.