International Journal of Geographical Information Science
2007, iFirst Article, 1–20

Grassroots groups as stakeholders in spatial data infrastructures: challenges and opportunities for local data development and sharing

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(*Received 12 January 2006; Final form 3 January 2007*)

This paper investigates the unique challenges of an expanding group of stakeholders making demands upon shared geospatial data resources: non governmental organisations participating in local governance. In spite of efforts to improve local data integration in spatial data infrastructures and development of strategies from public participation GIS to expand access to geospatial data and technologies, grassroots data users still experience difficulties with the accessibility, quality, and usefulness of local government data resources. Drawing from extended ethnographic research conducted in Chicago, Illinois, I illustrate these problems and how they are shaped by grassroots groups' resource constraints, knowledge systems, and socio-political positions; and assess the feasibility and impacts of proposed alternatives for better meeting grassroots spatial data needs. I contend that the needs and challenges of these stakeholders are unique from those of other users, but are nonetheless rooted in central dilemmas of spatial data handling, and so might be addressed through stronger engagement with GIScience research in this arena.

Keywords: PPGIS; Spatial data infrastructures; Local knowledge; Data sharing

1. Introduction

The needs and applications of geospatial data users continue to grow in diversity, presenting new challenges for data development, dissemination, and administration. From local to multi-national levels, spatial data infrastructures (SDIs) remain the dominant framework for fostering access to distributed geospatial data developed and administered by government, but clear challenges remain. SDI implementation is partial in most national contexts, and local government participation is often problematic (Williamson *et al.* 2003, Nedovic-Budic *et al.* 2004, Georgiadou *et al.* 2005, Harvey and Tulloch 2006). In the US, the Federal Geographic Data Committee (FGDC) and the Department of Housing and Urban Development (HUD) have called for more consistent integration of local urban data into existing SDIs, arguing that such a step is essential in fostering more effective planning and policy making (Committee on Review of Geographic Information Systems Research and Applications at HUD 2003, FGDC 1994, Ryan *et al.* 2004).

Simultaneously, shifts in local government practises in the US have created a new stakeholder group making demands upon SDIs. Associated with a so-called devolution of government toward localised decision making, local level non profit

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International Journal of Geographical Information Science
ISSN 1365-8816 print/ISSN 1362-3087 online © 2007 Taylor & Francis
http://www.tandf.co.uk/journals
DOI: 10.1080/13658810701348971

agencies, voluntary associations, and non governmental organisations are increasingly involved in local planning, problem solving and service delivery (Lustiger-Thale and Shragge 1998, Lake 2002, Bright 2003). A growing number of these groups are beginning to use geospatial data and technologies as they strive to carry out their new responsibilities (Sawicki and Peterman 2002, Elwood and Leitner 2003). These organisations have not been recognised by researchers or policy makers as clients or participants in local data sharing efforts, so little is known about the specific challenges they encounter in gaining access to distributed data resources, nor the feasibility and implications of possible solutions to these challenges. This paper is intended to begin addressing this silence in existing research, contributing also to GIScience research that seeks to understand the social, political, and technological structures that shape distributed data access and data sharing.

I draw on ethnographic data from an ongoing case study to detail some of the problems that grassroots users encounter in their efforts to gain access to and use existing local government data. I argue that these challenges stem from socio-political relationships, from semantic and epistemological differences in data needs and resources, and from some of the assumptions that underlie SDIs as a model for data access and sharing. This approach extends research detailing how grassroots groups develop their own spatial data resources. As well, the paper shows how socio-political relationships, data structures, and models for data sharing affect the accessibility and usefulness of existing distributed data resources for grassroots data users.

The second half of the paper is devoted to considering alternative approaches for addressing the unmet geospatial data needs of grassroots groups. These alternatives are developed inductively, based on ideas articulated by the grassroots data users and local government officials participating in the case study. Several different data access and sharing solutions emerge from these actors' ideas and their critiques of existing arrangements. In the final section of the paper I assess the implications of these alternatives for dealing with the epistemological and socio-political complexities of local data sharing among government and grassroots actors. Throughout, it is important to bear in mind that the phenomenon of grassroots groups acting as stakeholder in local spatial data development is specific to the US context for the most part, and that the notion of local citizens playing a role in SDI development is not widespread. In many national and local contexts, governmental data are not readily accessible to non-governmental institutions or to local citizens, and SDIs are conceived as strictly governmental. However, the case discussed here illustrates the potential significance of local citizens' knowledge for strengthening SDIs, a proposition that has wider resonance across different national contexts.

A key contribution of this paper is its incorporation of evidence from grassroots data users themselves regarding the challenges they face as stakeholders in local data development, and the ways that existing models for distributed data access might better meet their needs. Of course there exists a rich body of ethnographic and survey-based research in GIScience that has explored the social and political construction of spatial data, SDIs, and data sharing (Harvey and Chrisman 1998, Harvey 2001, Craig 2005, Georgiadou *et al.* 2005, Harvey and Tulloch 2006, Rajabifard *et al.* 2006, Schuurman 2006). However, these studies have relied primarily on evidence from spatial data producers, data stewards, and policy makers involved in data administration. An important additional piece in creating more effective local data integration and distribution is to understand the experiences of

grassroots data users directly, especially as the diversity of stakeholders in spatial data infrastructures continues to expand.

2. Geospatial data challenges at the grassroots: propositions from related research

The question of how and with what challenges grassroots groups gain access to distributed data resources is informed by two main areas in GIScience: public participation GIS (PPGIS) research and SDI research. Both research areas draw strongly upon themes from the 'GIS critiques' of the mid 1990s, including concerns about unequal access to geospatial data and technologies, and whether existing data models could incorporate diverse forms of spatial knowledge. Within these discussions, scholars called for research investigating the social and political relationships and processes of GIS application, and of geospatial data development, representation, and access (Lake 1993, Harris *et al.* 1995, Pickles 1995, Sheppard 1995). PPGIS research has sought to understand the unique epistemologies, technologies, and socio-political strategies that characterise grassroots GIS and spatial data use. SDI research contributes to elements of this research agenda through its efforts to understand the institutional, technological, cultural, and political structures that shape distributed data access.

PPGIS encompasses a wide array of initiatives, institutional structures, and political practises, ranging from GIS use in collaborative governance activities such as those described in this paper, in activism and protest, in counter-mapping projects, and in neighbourhood level asset mapping initiatives.[1] Not all PPGIS initiatives need to use spatial data gathered from governmental sources and many groups reject it for political and ideological reasons. None the less, in a US urban context, a plethora of case-based research has documented grassroots groups' need for spatial data from local government, and illustrated the difficulty that many face in gaining access to these data (Sawicki and Craig 1996, Leitner *et al.* 2000, Elwood 2002, Ghose and Huxhold 2002, Merrick 2003). While PPGIS research has tended to consider GIS and data access together, several specific propositions about data access at the grassroots have emerged. Researchers emphasise that data access is an important precursor to grassroots groups' effective participation in planning and policy making, but that data access alone does not guarantee an active and influential role (Craglia and Masser 2003, Onsrud and Craglia 2003, Tulloch and Shapiro 2003).

Current research identifies several kinds of barriers that inhibit data access at the grassroots. Grassroots groups may have difficulty gaining access to geospatial data because many are relatively resource-poor or because organisation staff and volunteers tend to have less expertise or formal training in obtaining and using these data. Some groups may not know about data availability and sources (Elwood and Leitner 1998, Ghose 2001). Many do not have financial resources to purchase data even at nominal cost-recovery rates; sufficient expertise to define data requests; or the hardware, software, and network capacities to obtain online data (Barndt 1998, Niles and Hanson 2003, Smith and Craglia 2003). But researchers have also shown that grassroots data access is shaped by political and institutional structures, relationships, and cultures. In many cases, grassroots groups are not afforded a formally recognised role in local governance, but function more as 'adjuncts' to local government. Thus, government data stewards may refuse to release data to them; or

[1] See also Craig, Harris and Weiner 2002, Obermeyer 1998, Sieber 2004, Sieber 2006.

these groups may be excluded by existing data sharing and usage policies, cost structures, or data standards (Leitner *et al.* 2000, Ghose and Huxhold 2002, Elwood and Ghose 2004, Elwood 2006a). De Man (2003) illustrates that political and institutional cultures around freedom of information and government–citizen relationships shape data access and sharing practises from local to national and international levels. These local political and cultural contexts have been shown to be an especially important determinant of data access for grassroots groups, because these groups tend to be less powerful, not able to compel or coerce local government actors to share information (Barndt 1998, Elwood and Leitner 1998, Tulloch and Shapiro 2003).

PPGIS research also suggests that existing public databases may not be appropriate for meeting grassroots groups' spatial data needs. Grassroots groups' strategies and priorities are often different from those of government actors, leading to a mismatch between grassroots data needs and data that are made available by different tiers of government. Data may not be available at a scale or resolution that is meaningful for the very small service areas typical of grassroots groups. Or, these groups may need attributes that are not available from existing public sources (Ghose and Huxhold 2002, Elwood and Leitner 2003, Warren 2004). Local government data may fail to represent the perceptions and priorities of grassroots groups, articulate spatial attributes in vocabularies unfamiliar to these users, or rely on semantic systems for describing spatial conditions that differ significantly from those of grassroots groups (Rundstrom 1995, Elmes *et al.* 2004).

Responding to evidence that existing government data often are not appropriate for grassroots groups, a major emphasis in PPGIS research has been developing alternative approaches to representing spatial knowledge in a GIS (Obermeyer 1998, Craig *et al.* 2002, Sieber 2004, 2006). Far less attention has been given to the question of how local government spatial data might be more accessible and useful for these institutions. Consequently, after a decade of PPGIS research and practise, there is still abundant evidence that spatial data access and appropriateness continue to be a problem for grassroots groups (Elmes *et al.* 2004, Elwood 2006b, Ghose 2007). To more fully understand these continuing challenges, it is important to also consider research that has examined the socio-political and technological practices of existing structures for distributed data access, such as SDIs, data clearinghouses, and geoportals.

While research on SDIs and other spatial data sharing structures has not specifically considered the challenges facing grassroots data users, a strong theme throughout this literature is the need for local data integration and accessibility to local users. Onsrud *et al.* (2005) call for research exploring ways of increasing public participation in identifying, producing, and sharing spatial information, and Tombs (2005), touting the societal value of public geospatial data dissemination, calls for stronger coordination of national and local efforts. Martin (2003) notes that devolution of governance to highly localised levels necessitates research examining how appropriately scaled data for these efforts will be integrated into SDIs. Onsrud *et al.* (2005) argue that local organisations and the general public are ideally positioned to contribute local spatial data, and to identify errors, omissions and inconsistencies in these data. This focus on integrating local knowledge into SDIs extends beyond the academic literature. In the US, a recent evaluation of local data accessibility and integration in the NSDI argues that improvement in these areas will empower local level governments, organisations, and individuals with necessary

spatial information (Committee on Review of Geographic Information Systems Research and Applications at HUD 2003).[2]

Throughout this literature, researchers note pervasive challenges to implementing SDIs as a model for distributed data access. Empirically grounded evaluations in several national contexts suggest that the spatial data needs of local government are not met by national SDIs (Committee on Review of Geographic Information Systems Research and Applications at HUD 2003, Nedovic-Budic *et al.* 2004, Craig 2005). Harvey and Tulloch's (2006) extensive survey of local government data sharing practises in the US illustrates that local participation in the NSDI is partial and that the degree of local data sharing is highly variable. Other research suggests that ensuring completeness and accuracy of local framework data, its integration into national-level data infrastructures, and open access to distributed data resources are even more challenging in places where resources are limited or information access is restricted (Crompvoegs and Bregt 2003, Georgiadou *et al.* 2005).

This research points to the importance of both socio-political and technological factors in shaping the functionality, administration, and content of SDIs, and their accessibility to a variety of potential users. Governmental structures and citizen expectations for public data availability can influence the data collected and made available, as can laws and policies for data access, acceptable uses, and fees (Onsrud *et al.* 2005). Craglia and Masser (2003), for instance, illustrate vast differences in spatial data collection and dissemination policies in the US and many European countries. They explain these differences as rooted in differing social contracts between citizens and state with respect to freedom of information and privacy. Relationships between different tiers of government can also affect the integration of local data. Craig (2005) and Nedovic-Budic *et al.* (2004), for instance, note that local data integration within the US National Spatial Data Infrastructure is made difficult by the non-hierarchical relationship between federal, state, and local governments.

Other explanations of local data integration and access have focused upon SDIs as a model for data sharing, noting that many of its basic assumptions tend not to play out in practice. For example, SDIs are predicated on an assumption of openness to data sharing and exchange, conceptualising data as a public good and assuming institutional and individual openness to sharing. But in practice, researchers illustrate many disincentives for data sharing, including liability concerns, desire for cost recovery, and the power of data in creating political or economic influence, especially when not freely available to all (Openshaw and Goddard 1987, Craig 2005, Harvey and Tulloch 2006). Political and legal structures, societal expectations of privacy or freedom of information, and individual and institutional attitudes also have a demonstrated capacity to impede the notion of free and open data sharing that underlies the SDI model (Campbell and Masser 1995, Evans 1999, Nedovic-Budic and Pinto 2000, Harvey 2001, Craglia and Masser 2003, Crompvoets and Bregt 2003, Nedovic-Budic *et al.* 2004, Craig 2005).

SDI implementation efforts have tended to seek common vocabularies among and across user communities and have focused on data and metadata standards as one way toward enhancing data accessibility and sharing (Bowker 2000, Schuurman 2002, Shin and Landis 2004). But here too, existing research suggests the difficulty

[2] While I focus on the US context here, efforts to foster stronger local data integration and accessibility in SDIs are also evident in other national contexts (Crompvoets and Bregt 2003, Van Loenen and Kok 2004).

of achieving these goals in practice. Data integration and interoperability research illustrate the challenges posed by semantic and schematic diversity between data systems, and by epistemological and ontological variability among user communities (Harvey and Chrisman 1998, Goodchild *et al.* 1999, Schuurman 2006). Particularly important for the question of meeting grassroots groups' needs through existing models for data sharing, Harvey and Tulloch (2006) suggest that as shared databases expand and new users seek access to them, epistemological and ontological diversity are becoming ever greater.

Together, PPGIS and SDI research have identified some factors in common that influence local level data sharing and accessibility. These include institutional and political cultures, power relations among participating actors and institutions, and resource constraints. PPGIS research suggests the need to consider the unique circumstances facing grassroots data users, particularly differences between their knowledge systems and those of government. SDI research suggests the need to examine socio-political and epistemological assumptions underlying SDIs or other models for distributed data access. In the discussion that follows, I draw on these frameworks to consider why shared public data resources tend not to meet the needs of grassroots data users. I show how these challenges are rooted in the socio-political and epistemological dimensions of existing infrastructures for local government data access and sharing, and weigh the opportunities and challenges of alternative approaches that might more effectively meet the geospatial data needs of this growing user community.

3. Grassroots stakeholders and geospatial data resources in the Chicago region

My discussion of the accessibility and usefulness of public geospatial data resources to grassroots stakeholders is developed with evidence collected over four years, in an ongoing participatory GIS project. This collaboration involves two non-profit community development organisations in a northwest Chicago neighbourhood called Humboldt Park. This area is grappling with a mix of challenges that face many inner city neighbourhoods in the US, including affordable housing problems, aging housing stock, higher crime and unemployment rates, and inadequate public health and education resources. The Humboldt Park GIS (HPGIS) Project is a university–community collaboration that seeks effective strategies for fostering sustainable GIS capacity in small community-based non profits and a better understanding of how and with what impacts these organisations use geospatial data and technologies. The HPGIS Project also examines geospatial data needs of such groups, how these data are developed or acquired, and what these needs and practises reveal about socio-political and technological structures that influence local data sharing.

The project relies on an inductive research design and multiple data sources to investigate an intersecting mix of social, political, and technological factors that affect the way grassroots actors develop and gain access to geospatial data, and the problems they encounter in doing so. From 2002 to 2005, I conducted over 300 hours of participant observation, observing community meetings, GIS work sessions, and spatial data development and acquisition efforts undertaken by both groups. Over this same time frame, I conducted approximately 30 semi-structured interviews with community organisation staff, neighbourhood residents, and local government officials. The interviews included questions about spatial data development, acquisition, and use by the two organisations, as well as the content

and impacts of the GIS and mapping activities in which they have used these data. I analysed interview transcripts, field notes, archival documents, and community-produced maps by coding their content around central themes, connections, and contradictions, in an effort to develop broader analytical and interpretive propositions. These techniques for developing conceptual propositions from case studies and qualitative data draw on two approaches widely used by social scientists, the extended case method (Burawoy 1991) and grounded theory (Glaser and Strauss 1967).

The two case study organisations are community development organisations whose activities include affordable housing development, economic development, crime reduction programmes, and social service delivery. Both are funded by philanthropic organisations and federal agencies such as HUD, but a growing proportion of their funding comes from local government in the form of service contracts to deliver neighbourhood-level urban improvement projects. In carrying out this new role, the case study organisations have begun to use GIS for local-level analysis and mapping, as they examine neighbourhood needs and conditions, prepare funding proposals, and plan and implement appropriate neighbourhood improvement activities. Local government data they rely on include property boundaries and built structures (with a range of attribute information such as assessed values, zoning and land use); streets, bus routes, train lines and other elements of the transportation infrastructure; publicly licensed facilities such as health care centres, child care centres, or schools; and boundaries for a variety of City-administered programmes and services, such as tax increment finance districts (TIFs).

The position and roles of these organisations are complicated. Their mission is primarily to identify, represent and meet the needs of neighbourhood residents. But they also undertake activities at the behest of local government, such as providing homeownership counselling or disaster response planning. Neither organisation has a formal mandate to provide the community with geospatial data access or GIS capabilities but in practice they have begun to do so. Perhaps most significantly for the questions pursued in this paper, they have no formal recognition by local government as clients or participants in geospatial data development and sharing, in spite of evidence suggesting that they are already doing both on an informal basis.

Both groups began using digital spatial data and GIS as part of the HPGIS collaboration. With help from undergraduate students in my GIS courses, project research assistants, and myself, several staff members at each agency have developed a digital library of spatial data, learned to use GIS software, and explored several approaches for obtaining data from local government, including direct data requests to local officials and the use of online data resources and GIServices developed by the City of Chicago. The participating staff members have a wide range of educational levels and backgrounds, though all had computers skills from the outset. They had limited experience with spatial data from local government sources, but their knowledge about available data and means of obtaining them have expanded greatly over the course of the project.

None the less, obtaining consistent access to local level geospatial data that are appropriate and useful for their work has proved to be an ongoing problem. In the following section, I will describe these challenges in more detail, explaining how they emerge from the unique capacities, socio-political positions, and knowledge systems of grassroots groups. But first, I frame the shared spatial data resources that are

available for the Chicago region. This broader context defines not just what geospatial data are shared, but how and whether grassroots groups gain access to them. Local efforts to integrate, share and disseminate geospatial data for the Chicago region consist of a loosely linked group of data clearinghouses that have limited participation from local governments in the region.[3] The partial participation of local governments and the fragmented nature of connections between local data producers in the Chicago area reflect similar problems documented in other US contexts (Harvey 2001, Harvey and Tulloch 2006), so it is a useful case in which to examine the implications for grassroots stakeholders' access to appropriate and useful spatial data.

The Chicago Region Clearinghouse Cooperative, an FGDC-funded collaboration between the Northeast Illinois Planning Commission (NIPC) and the University of Illinois at Chicago, maintains a catalogue and clearinghouse of data shared by local governments in the Chicago region. The State of Illinois' Natural Resources Geospatial Data Clearinghouse includes limited framework data for the Chicago area. The City of Chicago's web-based geoportal provides a few political and administrative boundaries and selected transportation networks. These files are freely available for download by the general public, with agreement to a usage policy and liability disclaimer.[4] At the time of writing, the Chicago Region Clearinghouse Cooperative's catalogue does not include data from either Cook County or the City of Chicago, and the Natural Resources clearinghouse contains very little data useful for urban applications. Both case study organisations have obtained all spatial data available from the City of Chicago's website but find these data too limited in thematic content and not sufficiently detailed for highly localized applications. Of course there are many national level data and metadata clearinghouses that these organisations could turn to, but we have encountered similar difficulties as with the local and regional clearinghouses: limited local participation or data that are not sufficiently detailed in spatial scale or attributes.

4. Characterizing spatial data challenges for grassroots stakeholders

Against this backdrop of partial local government participation in data and metadata clearinghouses, the HPGIS participants have none the less been able to obtain some public domain data from local government. We obtain these data primarily through direct data requests to local data stewards or by asking other local government staff to make requests on behalf of the community organisations. This strategy has been successful to the degree that the organisations now have framework and administrative data beyond those files made available through the City of Chicago's website, but it is difficult for several reasons. Problems include inconsistent data access, data quality problems at highly localised levels, and data content that either does not fit or is difficult to integrate with grassroots

[3] State legislation in the 1990s established the Illinois Geographic Information Council to coordinate data integration and sharing from local to state level, but at the time of writing ILGIC has not yet launched its centralized data clearinghouse.

[4] The City of Chicago's GIS division also hosts an interactive mapping website that enables users to create and customize maps showing zoning, supportive housing resources, public transit stops and their accessibility, fire stations, schools, and a host of other public facilities and community resources (http://www.cityofchicago.org/gis). The site does not allow data download and only supports single record retrieval from queries, so I do not discuss it in detail here. Staff members from both case study organisations have reviewed these interactive mapping services and rejected them for their applications because of these limits and because they do not enable users to integrate their own data.

groups' knowledge systems. These problems stem in large part from the unique socio-political positions, capacities, and epistemologies of grassroots data users. Of course issues of data access, content, and quality in local spatial data resources are problematic for many users, but grassroots stakeholders are especially strongly affected by them. Understanding how and why these users struggle with problems of access, data quality, and appropriate content is important not just to considering strategies that will help meet the need of other non-traditional or novice users of shared data resources.

As Martin (2003) notes, the devolution of responsibility for planning, problem solving, and service delivery to highly localised levels has implications for the spatial data that are needed to support these efforts. The HPGIS Project suggests additionally that we need to consider whether these data are accessible to the new actors and institutions carrying out these activities. Both case study organisations are active in neighbourhood-level planning and service delivery in Chicago, but have inconsistent access to highly localised spatial data. This is largely because of the informal nature of local government data sharing, and because they are not yet recognised as stakeholders in local data development, sharing and use. There are no consistent arrangements or existing policies through which the City of Chicago shares data with community-based organisations. The absence of such structures is not particularly surprising, especially given Harvey and Tulloch's (2006) evidence of a strong preference for informal data sharing in local governments, and reticence of many data stewards to share data with other public servants or local governments. But for non-governmental actors, informal data sharing arrangements are likely to result in inconsistent data access because these institutions tend to be under-resourced and less powerful in local political relationships. Data requests made by both case study organisations in the HPGIS project have been refused by local data stewards, even when the data were in the public record or the request was routed through the offices of elected officials representing the area. When data stewards are willing to share, the informal nature of these arrangements makes them time and resource intensive, requiring renegotiation with each request or with new staff members. All stakeholders, not just grassroots groups, must carry out these kinds of negotiations when data sharing occurs on an informal basis. But in the absence of such structures, grassroots groups have inconsistent access to needed data. Also, given the pervasive under-funding and limited staff resources of these organisations, negotiating data access and sharing poses a significant barrier.

Another problem that disproportionately affects grassroots stakeholders is the inevitable data quality problems in highly detailed local government data, such as cadastral data in rapidly changing urban environments. The most consistent criticism raised by HPGIS participants throughout the project is the accuracy and currency of highly localised data. For instance, they encounter frequent discrepancies between data obtained from the City of Chicago or Cook County and observed conditions in the neighbourhood. For example, one of the community organisers describes a common problem of trying to link data collected in the neighbourhood with the City's boundary file of property parcels:

> We went out and photographed the properties and recorded [land use] for a big stretch of blocks. When we came back and tried to map them [to the parcel boundaries], it looked like there were different structures already there sometimes … and we couldn't

> match up the addresses between what we saw and what is actually listed [in the public record]. (Alonso, 2004)[5]

A parcel observed in a field survey as a single property may be represented in the City's database as several smaller sections, sometimes in an accurate reflection of the actual platting, but just often not. Both groups also encounter consistent errors in attribute data describing ownership, tax status, address, or other variables. Of course, in a major metropolitan area, updating public records will lag significantly behind changes in the built environment, and the sheer volume of data is likely to lead to a high number of errors. But these inconsistencies in local spatial data are uniquely problematic for grassroots groups because of their role in local governance. These groups are on the front line of negotiating parcel-level urban change, such as brokering collaborations between city officials and private developers to build affordable apartment units. This highly localised *scale of action* is precisely the *spatial scale* at which errors in cadastral data, land use, ownership, structures, are most obvious and problematic, as evident in the examples above. Here too, the difficulty that grassroots groups have in securing consistent access to government data resources and a recognised role in local data sharing are compounding factors, since they mean these groups often do not have access to the most current data.

Finally, the HPGIS participants frequently find that spatial data obtained from local government are not immediately useful to them because of semantic, schematic, and epistemological differences between government and grassroots information systems. Grassroots groups tend to characterise local conditions and spatial phenomena using different classifications or attributes, and often have different perceptions of them than public officials. As one HPGIS participant describes these differences in this way:

> when you're at the table with the Department of Housing, or when you're at the table with the Department of Planning, sometimes you're like, 'Oh, okay, you have that. Well, these are our maps and this is the reality that *we* saw'. (Hector, 2005)

The divergent perceptions of local spaces and conditions that may be held by grassroots groups and local government have implications for the accessibility and usefulness of local government data resources. For instance, a staff member at one of the case study organisations noted the difference between the County's detailed land use categorisation system, and his need to simplify these data by reclassifying them into a more generalised category:

> There's like 20 different codes just for an empty parcel. At one time there may have been a single family home and it had just been vacant, and there may have been a structure in the back of the lot. So it would have a different code like 'vacant structure with detached structure' or whatever, something like that. Or maybe it's just a totally vacant parcel that may have been used for who knows what, and it may just be recorded as something else. There's so many different codes that the county uses … [For us] if it's vacant, it's vacant. That's pretty much the code we use. If it's vacant, we just code it as vacant. (Alonso, 2004)

[5] All quotes are drawn from participant observation and interviews with research participants. In keeping with my confidentiality agreements with these participants, they are identified by a pseudonym.

In this instance, his organisation reclassified the County's highly detailed categorisations into a simpler scheme. In any data clearinghouse or other shared data resource, we can expect that not all data are appropriate for all users. Users will commonly need to reclassify data for their own use, integrate with other data, or modify to incorporate additional perspectives. But these transformations require time, greater software expertise, and the ability to understand the original schema and develop an appropriate transformation. These requirements pose a challenge for grassroots groups and other novice data users. In many cases, the diverse users who most need to transform data from shared data resources are also those who face the greatest limits in doing so. If shared data resources are to successfully meet the needs of an increasing diverse clientele, we must give special consideration to their flexibility and transparency for these users, especially those with less experience and fewer resources.

In some cases, modifying the semantic content or classification of existing data may not be enough to represent grassroots perspectives when these differ dramatically from the 'official' perspectives captured in most public data. For example, the close involvement of grassroots groups with local spaces and residents may mean that for them, a single place has multiple meanings. Humboldt Park's Division Street is one such space, understood by some as a dangerous declining place, while community organisations in the area typically emphasise successful economic and cultural development along a section known as 'Paseo Boricua'. As one staff member explains:

> People talk about 'Division Street, that's a horrible place'. But then other people talk about, 'Paseo Boricua is such a wonderful place'. They're the same physical space, but psychologically, they're two different environments, two different realities. And the problem is how do you show [both]. (Rey, 2005)

These multiple meanings have implications for grassroots groups' spatial data needs, particularly with respect to what they need from local government data resources. Most data gathered and disseminated from local government resources are best suited for representing problems or deficits, such as lower assessed property values, housing conditions, or utility shut-off orders. Data representing assets or positive characteristics are rarely available from existing public sources. As a result, grassroots groups frequently need to incorporate their own data together with local government data if they hope to represent multiple meanings. As with efforts to modify semantic content or classification schemes of local government data, such efforts to integrate governmental data with local knowledge data require greater resources, experience and specialised expertise, presenting special challenges for grassroots data users.

In sum, the problems that grassroots groups experience with local government spatial data resources include consistent access, data quality at highly localised levels, and appropriate content. On one level these problems are mundane and unsurprising. Highly detailed databases representing rapidly changing conditions can be expected to have data quality problems. Data interoperability and appropriateness for diverse users are a longstanding concern in development of distributed data resources. The reliance of local government on informal rather than formal data sharing practices is similarly widespread. But this discussion of the experiences of grassroots data users suggests that these problems are especially challenging for this expanding user community. Further, it identifies key structures

that underlie these additional burdens, including their unique socio-political position as stakeholders in local data development and sharing, their diverse knowledge systems, and their lesser experience and formal expertise with digital spatial data. These factors are a useful framework in assessing different alternatives that might begin to address the spatial data needs of grassroots stakeholders, as I explore in the following section.

5. Envisioning solutions: alternatives for grassroots data users

PPGIS has developed a host of innovative and successful strategies for grassroots groups to create their own digital spatial data, enabling alternative data development outside of official government data, infrastructures, and data sharing arrangements. But this emphasis on alternative data development practices has meant that existing SDIs and local government data resources still do not meet the needs of grassroots users, even as this user community continues to expand. It is imperative to consider how local data infrastructures and data sharing activities might be re-imagined and restructured in ways that address the problems and unique circumstances detailed in the previous section. One useful starting point that has not been pursued in other research is to consider possible alternatives based on grassroots data users' own observations and suggestions. In this section, I consider different possibilities for strengthening local government data development and data sharing that emerge from HPGIS participants' own critiques of and suggestions for local data sharing structures and practises. The needs and functionalities articulated by the case study organisations and by local government officials imply two very different approaches, one of which would attempt to more closely involve grassroots groups in local government data development, and another which would support users modifying data for their own applications. These alternatives have different implications with respect to their capacity to address epistemological and socio-political challenges inherent in data sharing between government and grassroots users.

One approach to addressing the access, content, and quality problems experienced by grassroots data users is to seek a greater role for these groups in local spatial data development. Many of the HPGIS project participants argue that their contributions to local data resources would significantly improve the reliability and completeness of these data, an idea that is remarkably similar to calls by academic researchers for stronger involvement of the general public in local data development (Onsrud *et al.* 2005, Tombs 2005). For instance, one of the community organisation staff members notes the valuable potential of residents' local knowledge for addressing gaps and omissions in local data resources:

> The nice thing about [the regional planning commission's data] is that they've got a bunch of existing databases. So they have all the licensed health care facilities from the State [of Illinois]. That is probably not going to include everything that is in our area, but if they give us that basic data, then our health committee can say, 'Wait, there's that clinic there, there is that source there'. (June, 2005)

This possibility that grassroots groups might play a greater role in local data development is echoed by City of Chicago government officials interviewed as part of the HPGIS project. One local official, reflecting on problems of accuracy and currency in the City's geospatial data, echoed the assertions of the community participants about the potential of local observations:

> I mean, [local government data] is not as updated. I don't think they have the manpower to update these things at the same level that a community organisation can. A community organisation is always in that community. They're always in and out of streets and alleys, and so they're able to tell you the most current information. (Julio, 2005)

The HPGIS Project illustrates that, at least in some cases, community organisations are already playing such a role, but on an informal level that is disconnected from local government databases or data stewards. Local elected officials frequently request such information from the case study organisations, as do City departments involved in housing and business development or service provision in the neighbourhood. The fact that these officials regularly seek spatial data directly from grassroots groups in addition to or in lieu of existing government data is strong evidence that the local knowledge held by grassroots groups is potentially quite important in policy making.

In practical terms, local government officials and community organisers in this case are envisioning a system whereby grassroots groups and local residents could contribute data to existing infrastructures (with the presumption that they would be allowed access to these data, an outcome that is by no means assured). Such an approach raises challenging questions about how grassroots data contributors would be identified, and how to efficiently and equitably manage data collection and revision. Securing a formal role for grassroots groups in local data production and sharing might be one way of addressing the difficulties that informal data sharing arrangements pose for grassroots groups. But there are several other socio-political and epistemological challenges that this approach would leave unresolved.

In a context of unequal access to information, political power, and other resources, data are a powerful source of influence. Staff members at the case study organisations are well aware of this phenomenon, and describe how they use their own locally collected data as a kind of currency to leverage favourable policy decisions, obtain grant funds, or cultivate advantage by illustrating organisational expertise:

> If you have information like we do (and we try to dig out as much information as we can), you're influencing things … That's ultimately what is the biggest deal, is us having more information than [government officials] … Documented, statistical, and proven data is hard to argue with. That's how we influence policy, like all the other groups now. (Fernando, 2004)

The political influence that may accrue from data when they are not equally accessible to all can result in reticence to share, not just on the part of local government but on the part of community organisations. This unwillingness to share data has been evident in the HPGIS Project at various moments, even while participants call for improved access to local government data. One staff member argued that local government should rely upon its existing resources instead of requesting information produced by grassroots groups:

> Now the maps [showing vacant properties and land use], I kind of didn't want to give it to them because they have that resource already as part of their services through [the City]. (Teresa, 2005)

Involving grassroots groups in producing local geospatial data may be a useful way to improve data quality at the micro-scale, thereby raising the usefulness of these data for grassroots groups, but such an approach does not alter pre-existing power differences that may inhibit open data sharing by both grassroots and governmental actors.

This approach would also have to grapple with the epistemological diversity of grassroots groups' knowledge systems. A simple notion of involving grassroots groups as contributors to existing infrastructures assumes a common data model into which grassroots groups might contribute information. That is, the HPGIS participants' call to establish ways for grassroots groups to add their information to local government data resources implies retaining existing data models and simply incorporating local knowledge contributions. Given the evidence that diverse epistemologies, priorities, and attribute schemes are precisely why governmental data resources often do not meet grassroots needs, it seems likely that many groups would be unable to contribute information because it would not fit with existing data models. Thus, involving grassroots groups as data producers could improve data quality and currency, but would not shift some of the socio-political struggles and epistemological differences that create challenges for grassroots groups and preclude participation by some groups.

However, the efforts of HPGIS project participants make local government data more appropriate and useful suggests that a common applications approach might be another alternative. The earlier example of a staff member transforming complex property attributes into a more useful scheme is a simple example of this sort of solution, one that may reflect current directions in rethinking the structure and administration of shared data resources. While not addressing the case of grassroots data users specifically, Harvey and Tulloch (2006) and Rajabifard *et al.* (2006) suggest that next-generation SDIs are moving toward a client services model that emphasises flexibility for diverse client data and application needs. Given the diverse knowledge systems and attribute schemes of grassroots data users, an approach that more strongly supported their ability to transform data for their own use would seem to be an especially appropriate possibility.

But this solution to meeting the needs of grassroots data users would have to be carefully tailored with direct attention to the unique constraints of this user group. Locating, obtaining, and modifying data for user-specific applications requires more expertise and time, and may require additional software resources, for a user community that has demonstrated limitations in these areas. Such an approach would have to grapple with how the browsing, query, and selection interfaces of existing SDIs and clearinghouses might be made more accessible for users with a range of expertise and knowledge systems. Discussion in the previous section suggests that these resources must enable users to browse and retrieve data at multiple levels of complexity, and to make it easier for novice users to understand institutionally-specific data content.

Metadata may be one possible entry point for increasing the accessibility and usefulness of local government spatial data for grassroots groups, in part because of the role that metadata already play in efforts to enhance data interoperability (Plewe and Johnson 1999, Shin and Landis 2004). Relatively simple interventions such as adding 'non-expert' or vernacular descriptions of spatial data to existing metadata could make the process of locating and retrieving appropriate data more manageable for less experienced users. Such a strategy need not alter existing

metadata standards, but rather, could extend these to include parallel translations of existing metadata content into terminologies more readily understood by the general public. Grassroots data users might be well-served by Schuurman and Leszczynski's (2006) proposed system of ontology-based metadata, which includes fields containing information about institutional, social, and technical influences on the data—all common reasons why government data tend to be problematic for grassroots users. Implemented with an eye toward explicitly representing these influences upon government data resources, ontology-based metadata could function as what Harvey and Chrisman (1998) refer to as boundary objects, defining the areas of divergence between different schematic and semantic data systems.

Thus, drawing from grassroots actors' own suggestions and existing practices for making local government data resources more accessible and useful, this case illustrates two kinds of approaches—one that emphasises grassroots collaboration in local data development and another that would involve supporting data users' capacity to modify, supplement, or transform data for their own applications. These approaches differ significantly with respect to the user skills and resources that would be required, the extent to which they imply shifts in existing socio-political relationships, and their robustness in grappling with the epistemological challenges of data sharing across diverse knowledge systems. Allowing grassroots users to obtain and modify governmental data for their own applications would require data stewards to relinquish far more control over data than facilitating grassroots contributions to local government data, but both approaches are predicated on government actors recognising grassroots groups and local residents as legitimate data users and producers. In Chicago and in many other localities such a shift is a significant departure from current conditions. In terms of the epistemological diversity of different user communities, a common applications approach in which grassroots groups modify data for their own purposes is far more flexible than a strategy of incorporating grassroots groups as contributors to existing data structures. But enacted alone, the common applications approach gives up the possibility of bringing grassroots spatial knowledge to bear upon 'official' data in ways that might address omissions and errors in highly localised data, something that some public officials and researchers have already articulated as a valuable benefit (Onsrud *et al.* 2005).

In all likelihood, no single approach is wholly sufficient, given the social, political and technological complexity of data sharing, SDIs, and the relationships and interactions of local data producers and users. But the different approaches illustrated through this case study are not mutually exclusive. Weighing their different capacities and limitations suggests the utility of pursuing efforts toward both, seeking stronger involvement of grassroots groups as legitimate stakeholders in the production and use of public data, and seeking ways that SDIs might better support the ability of diverse users to locate, obtain, and modify data to suit their unique needs.

6. Conclusion

Improving the accessibility and usefulness of local government data infrastructures for grassroots users is fraught with challenges, including administration and policies, database and system architectures, semantic and epistemological complexity, and the politicised nature of data in urban governance. This paper has illustrated problems of data access, quality and content that tend to face grassroots groups in

their efforts to use local government spatial data, even in contexts where these data are supposedly publicly available. Further, it illustrates how these problems are rooted in grassroots groups' resource constraints, diverse knowledge systems, and socio-political position as less powerful actors in local government and unrecognised stakeholders in local spatial data development. The efforts of these groups to obtain and adapt local government data for their own use, as well as their propositions for bringing their own deep local knowledge into public data resources, can serve as starting points toward imagining solutions to grassroots data challenges. For those contexts in which SDIs are conceived as strictly situated in the realm of government, this case illustrates the significance of local knowledge, suggesting potential benefits of incorporating grassroots groups as stakeholders in local SDIs. But the feasibility and appropriateness of the alternatives discussed here (and a host of other possible solutions that could be imagined) must be evaluated with systematic attention to the resources, epistemologies, and socio-political positioning of these diverse users.

In part what this discussion of grassroots spatial data needs and constraints illustrates is the necessity of engaging conceptual and methodological frameworks from GIS and Society research and from other areas of GIScience research. Questions such as those examined here require research that integrates work from across a wide spectrum of GIScience research. It might be tempting to draw primarily on social and political conceptualisations developed in PPGIS research to explain the unique opportunities, constraints, and strategies of grassroots GIS and geospatial data users. But closer examination of grassroots groups as stakeholders in local data infrastructures illustrates that the challenges they encounter are also fundamental dilemmas in geospatial data handling, regardless of user community. The access, quality, and content problems experienced by grassroots data users are linked to basic challenges involved in the politics and administration of large shared databases and of data integration and interoperability in the face of data heterogeneity and user diversity.

GIScience has been actively working on these issues for years, through research on data integration and interoperability; and efforts to understand the effectiveness and impacts of various technologies and structures for data sharing, such as geoportals, SDIs, clearinghouses, or data and metadata standards. Many key propositions emerging from this work speak directly to the challenges of spatial data handling and sharing in an environment of stakeholder diversity. Schuurman's flexible standardization technique (2002) for integrating large heterogeneous data sets, for instance, was explicitly designed to facilitate effective data sharing by institutions with scarce resources, precisely the situation of most grassroots groups trying to gain access to geospatial data. The ontology-based GIS of Fonseca *et al.* (2002) incorporates ontologies directly into geospatial data, and specifies them in a hierarchical manner that would enable users to search the ontologies with varying levels of detail, while attempting to capture a wider cognitive range of what people perceive about the physical world. While a great deal more work would be needed, both of these elements could speak to some central data problems at the grassroots, such as variable levels of detail and diverse knowledge systems. For the most part, the exciting potential linkages between such research trajectories in GIScience and persistent challenges identified by GIS and Society researchers have remained relatively underdeveloped. The phenomenon of grassroots groups acting as local data stakeholders illustrates the need to bridge this gap in both directions. While the problems of grassroots data users are fundamental dilemmas in spatial data

handling, they are manifest in unique ways because of the particular resources, epistemologies, and socio-political contexts of these stakeholders.

Given the vast differences in terminology, conceptual frameworks, and approaches to building theory in these different arenas of GIScience research, collaborating across these lines is a challenging proposition. GIScience research on interoperability, SDIs, cognition, and other relevant areas involves terminologies, programming languages, and system architectures that are not part of conceptual and applied repertoire of many GIS and Society researchers, just as the social theory constructs of these researchers are not always a familiar lexicon across GIScience. But continuing our efforts to engage across these differences is imperative. As shared geospatial data resources expand, user diversity continues to rise, and grassroots groups continue to assume an ever-greater role in urban governance, issues of local data integration and accessibility matter tremendously for grassroots groups, for government, and for society.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant No. BCS-0652141. The project has benefited greatly from the involvement of participants from Humboldt Park and West Humboldt Park, and the research assistance of Nandhini Gulasingam, John Baldridge, Man Wang, Jennifer Hampton, Allan Kempson, Jennifer Grant, Grant Garstka, and Danny Shields. I am especially grateful for the detailed and thoughtful input of three reviewers and the editor.

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