GEOSPATIAL DATA ISSUES BASED ON SOCIO POLITICAL CONTEXTS

Dr. Falguni Mukherjee
Assistant Professor
Department of Geography and Geology
Sam Houston State University
P.O. Box 2148
Huntsville, TX 77341
E- mail: fsm002@shsu.edu

ABSTRCT

Research on geospatial data have mainly drawn from two bodies of literature – Organizational implementation of GIS and Critical GIS. The organizational literature give important insights on organizational implications of geospatial data sharing. Scholars who have used the Critical GIS lens provide a thorough understanding of the socio political elements that influence geospatial data creation and usage. Various aspects related to geospatial data have significant connection with GIS usage and have an important bearing on the process of GIS spatial knowledge production. Very few studies till date have focused on the social and political elements that influence geospatial data decisions. Inspired by the few pioneering work on geospatial data issues this article examines the process of geospatial data creation and usage in Dane County, Wisconsin and unearths how this process is intertwined with the socio – political norms of the county and ultimately shapes the county's GIS spatial knowledge production.

INTRODUCTION

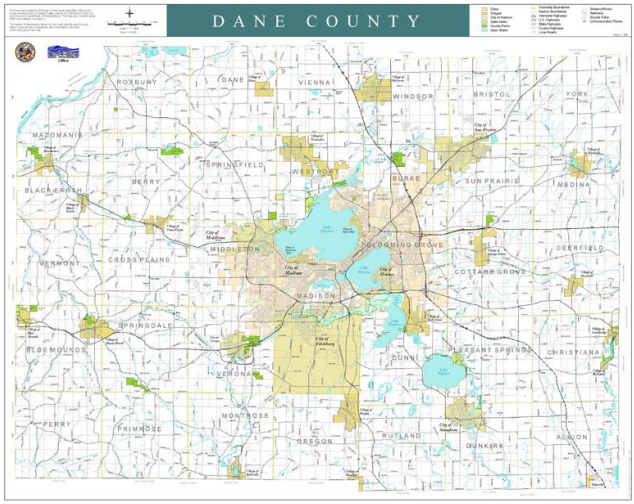
Work on geospatial data have drawn from two important bodies of literature – Organization implementation of GIS and Critical GIS. Seminal work within both these bodies of literature have examined the implications of social and political contexts on geospatial data creation and usage and also its impacts on organizational decisions making. Initial work (Budic 1994, 1998) on such issues has drawn from the organizational implementation literature while latter studies (Harvey 2003; Harvey & Tulloch 2006; Schuurman 2005, 2009) have followed the Critical GIS approach. Critical GIS calls for a socio – political analysis of GIS spatial knowledge production. Under the Critical GIS umbrella scholars have demonstrated how GIS spatial knowledge production is constructed and socially embedded within various internal and external contextual elements (Elwood & Ghose 2004; Elwood 2006; Sieber 2007; Lin and Ghose 2008, 2010; Mukherjee & Ghose 2009; Knigge and Cope 2009). These scholars provide a nuanced view of GIS spatial knowledge production using the notion of social construction. Social construction emphasizes the importance of culture and context in understanding what occurs in society and constructing knowledge based on that understanding. This perspective presents technology as an integral part of society (Harvey & Chrisman 2004). The notion of social construction thus implies that GIS technology, like any other technology is embedded in an intricate web of social relationships and remains surrounded by multiple social contentions (Sheppard 1995; 2005). Constructive engagement with social construction of GIS draws attention to seven themes: the social history of GIS as a technology, the relevance of GIS for community and grassroots perspectives and life worlds, issues of privacy, access to spatial data and ethics, the gendering of GIS, GIS, environmental justices and political ecology, GIS and the human dimensions of global change, alternate kinds of GIS (Sheppard 2005).

Proponents of social construction of GIS have investigated various elements of these seven themes (Kyem 2004; Ghose 2005, 2007; Elwood 2006; Sieber 2007; Lin & Ghose 2008, 2010; Mukherjee & Ghose 2009). However, very few researchers have forayed into the area of social construction of geospatial data creation and dissemination (Harvey 2003; Harvey & Tulloch 2006; Schuurman 2005, 2009), which is a key component of GIS spatial knowledge production. Geospatial data creation is the most time intensive and expensive part of any GIS project. Various aspects related to geospatial data have significant connection with GIS usage viz. data standardization, data currency, data interoperability, data integration. In a multi – user and multi – departmental environment these issues have important implications on the success or failure of a GIS project. In such environment issues related to geospatial data can also impede or enhance organizational data sharing which is vital for organizational management and decision making. There remains a dearth of empirically grounded research that focuses on the social construction of geospatial data and its implications on organizational GIS knowledge production. Inspired by the pioneering work on geospatial data issues this article examines the process of geospatial data creation and usage in Dane County, Wisconsin and unearths how this process is intertwined with socio – political norms, institutional practices and economical mores of the county. It also examines the implications of this social construction of countywide geospatial data on Dane County's spatial knowledge production process. This work is an attempt to contribute to calls for examination of social and political contexts influencing geospatial data issues (Schuurman 2005).

This study is based on research conducted in Dane County, Wisconsin from 2006 thru 2007. Dane County was one of the earlier adopters of GIS in the state of Wisconsin and

over the years has developed a robust countywide GIS system. The county has a long history of collaborating with the local community in initiating GIS applications and is considered a regional leader in the use of GIS. Also, presence of the state capitol, Madison and University of Wisconsin – Madison, a premier land grant research institute has conferred unique opportunities and resources on the county. The county played a key role in the development of the multipurpose land information system concept by researchers at the university. The local political contexts that have influenced GIS usage in Dane county are very unique. Firstly, the presence of a premier university is a big asset that used the county as a test bed to try new and innovative ideas and technologies. Secondly, the formation of a statewide program, Wisconsin Land Information Program in the 1980s provided a boost to countywide GIS usage. The county's GIS activities are attributed to the formation of this Program and have been uniquely shaped by this Program over the years. In accordance to the Program requisites, the county established the Land Information Office (LIO) which has evolved into a well-established local and regional resource for geographic and land information services. This office is also the GIS hub of the county. All countywide GIS related activities are administered and managed by the Land Information Office. The LIO's GIS activities have been influenced by federal grants, Wisconsin Land Information program, research grants and projects at the university as well as state and county executive mandates. In the recent past the local political contexts at Dane County have changed due to various internal and external influences which in turn have impacted countywide GIS usage. Dane county's GIS spatial knowledge production has been reported by few (Ventura et al. 2003; Ventura 2006; Harvey F. & Tulloch D. 2006; Mukherjee & Ghose 2009). For instance, Ventura (2006) discusses the "successful" GIS practices of Dane County

and Mukherjee and Ghose (2009) provide a comprehensive and in-depth examination of GIS activities of the county within the context of the county's political, social, historical, and institutional processes. This study examines the internal and external contextual elements that have shaped the county's geospatial data model and its impacts on the county's contemporary GIS spatial knowledge production.



Map of Dane County

The research methodology used for this study is case study research method. Arguably, GIS construction is a highly situated process wherein the place, context and relationship matters. In such instances, a case-study approach is particularly appropriate. Here I have used single case study approach since it allows detailed and comprehensive analysis. Case studies are the preferred strategy when "how" or "why" questions are being posed, when the investigator has little control over events and when the focus is on an individual, group, organizational, social,

political and related phenomenon within some real-life context (Yin 2003). Qualitative methods of data collection such as intensive semi structured interviews, document analysis and direct observation at field site were employed. Multiple data collection methods were used to generate multiple chains of evidence, verify data collected from various sources and generate multiple perspectives on key issues. In addition to data verification and interpretation, use of multiple methods was useful in filling in gaps that existed in some data sources. Data collection was conducted for two months in spring of 2007 and for four months during summer of 2007. Pilot work had been conducted in summer of 2006 to prepare the ground work for the primary data collection in 2007. Forty in-depth semi structured interviews[1] were conducted with actors from various departments within Dane County who make use of GIS such as the LIO manager, GIS technicians, senior planner, members from the sheriff's office, public safety, emergency management, highway department etc, the city of Madison officials, officials within the State Cartographers office, private agencies involved in GIS projects, spatial and non-spatial data providing agencies, university researchers who are involved with Dane County and officials from the Land Information and Computer Graphics Facility (LICGF) of UW-Madison who are involved in constructing GIS either directly or indirectly. To further gather information documents produced by the LIO office, Dane County, city of Madison, State Cartographer's office, UW-Madison were thoroughly analyzed. Besides these, administrative reports, newspaper clippings, websites of related organizations, journal articles, were also a critical source of data.

CONSTRUCTION OF GEOSPATIAL DATA

[1] These interviews ranged between 45 minutes and two hours and were conducted at respective offices of the agencies.

Studies by GIS researchers have focused on various aspects of geospatial data using different lenses. Such studies have mainly drawn attention to planning agencies and local government organizations since these organizations were the foremost users of GIS. Seminal work on organizational GIS implementation and usage give invaluable insights regarding geospatial data creation and usage (Budic 1994; Campbell and Masser 1991; Campbell 1991; Huxhold 1993). According to these studies, effective GIS knowledge production through implementation, diffusion and usage hinges on data accuracy, data sharing, data standardization, data access and efficient data infrastructure. In a study conducted by Budic (1994), GIS users in a planning agency identified data accuracy, data processing and data access as the most improved aspect of information quality resulting from GIS usage. Studies conducted to explore the possibilities of achieving maximum benefits from GIS usage identify a multi-departmental or corporate approach to GIS as a pivotal component of organizational GIS (Campbell 1991, 1994; Croswell 1991; Budic 1994; Budic & Godschalk 1996; Onsrud & Pinto 1993) and a valuable component that determines the success of a multi departmental GIS is geospatial data. In order to accomplish a multi departmental approach it is imperative for an organization to develop an enterprise-wide view of geospatial data and processes. Huxhold (1993) argues that with a strong emphasis on geospatial data sharing and user involvement in the development process, enterprise-wide approach can provide a structured and standardized approach to the traditional "top down" philosophy of the past. A multi-departmental GIS has the potential to yield greater organizational benefits, by avoiding duplication of efforts for database development and maintenance. Such a strategy has been found to be the most cost effective approach. An enterprise-wide GIS also assures that GIS's

capability to integrate data from different sources and handle information sharing is used (Campbell and Masser 1995; Campbell 1991), allowing an organization to capitalize on GIS technology's full potential. In some organizations, a centralized group performs the planning, implementation, and support of enterprise GIS data and infrastructure as witnessed in Dane county. In others, core data layers and related infrastructure are administered centrally while individual departments maintain the data and infrastructure specifically required to meet their unique requirements. There is no single enterprise GIS model that is right for everyone. The optimal architecture, procedures, and governance processes will ultimately depend on the complexity of the organization. However, implementing a corporate GIS is more complex and realizing the benefits more difficult (Campbell 1991). According to Masser and Campbell (1995), some of the biggest hurdles in following a corporate strategy are differences in the level of awareness and spatial data handling skills and inability to achieve agreements over access to information, leadership, data standards, equipment and training. A number of issues emerge as geospatial data across organizations are integrated. The skills needed to implement a GIS extend beyond technical capabilities to include managerial and data skills. As suggested by Huxhold (1993), collaboration between users, senior management, elected members and computer specialists is essential for successful GIS implementation at a multi-departmental level. It is important to identify the most important data providers and get their support in the integrated GIS database relationship. Another important issue is to make arrangements for additional resources for departments that are responsible for maintaining the data. Generally, departments or units responsible for maintaining data begin to incur additional workloads, expenses and responsibilities and if they perceive inequity in data maintenance

commitments they are inclined to minimize their support (Budic and Pinto 2000). Openness with regard to data access, minimal proprietary interest in data and gains expected from data distribution are the quintessential prerequisites to avoid conflict regarding data ownership. Also a clear indication of the nature of the sharing structure should be done early on. Allowing the GIS and database interaction to evolve over time without set rules and procedures only invite trouble later on in the project.
Another strand of research that gives critical insights on issues related to geospatial data uses the notion of social construction. Work under this research umbrella has explored the multifarious socio – political contexts that influence geospatial data usage (Harvey 2003; Harvey & Tulloch 2006; Schuurman 2002, 2005, 2009). Certain studies have mainly focused on issues of geographic data sharing and geographic information infrastructures for local government organizations (Harvey 2003; Harvey & Tulloch 2006). Harvey (2003) contends that building spatial database infrastructure is an inter-agency act and is thus a matter of trust**.** Harvey and Tulloch have examined the process of data sharing in local governments in the US and have identified four distinct types of local government data sharing arrangements that reflect institutional, political and economic factors (Harvey and Tulloch 2006). Differences in data sharing arrangements reflect flexibility of local government responses to changes in levels of support, political uncertainties and resilience of staff. As demonstrated in their work data sharing involves significant issues of ownership and control, ultimately involving questions of power.
An area related to geospatial data that has received limited attention within the organizational literature as well as Critical GIS literature is semantic interoperability and data standardization. Influential work by Schuurman (2005) shed some much needed light on the social political

contexts that impact these issues. According to Schuurman (2005) much attention has been narrowly focused on the technical hurdles of data standardization and interoperability while ignoring the social and political contexts that shape such processes. Standardized data is vital to ensure that databases are multifaceted and transferable between departments and applications. Discussing the significance of the social and political influences on semantic interoperability Schuurman (2005) explains the contextual implications of simplistic terms such as urban, range or road and how such terms can be interpreted differently in different institutional and socio political contexts. Technical and socio political contexts have a two way relation. Each has an important connection to the other. As Schuurman (2002) emphasizes there is no division between the two. Technical issues related to data standardization and interoperability are ultimately associated with social and political contexts. However, there are limited empirical studies that draw attention to this multifarious relation and its influence on geospatial data issues. This study is an attempt to address this gap by examining the socio political contexts that influenced Dane County's geospatial data model creation and usage and the GIS knowledge production challenges it has ultimately posed for the county departments.

LOCAL SOCIO POLITICAL CONTEXTS

The most critical socio – political context that catapulted Dane County's GIS usage was the creation of a statewide program – Wisconsin Land Information Program (WLIP) in the 1990s (Mukherjee & Ghose 2009). The program established a funding mechanism for the county's GIS activities giving it independence from the state's general fund. The funding mechanism was created such that

surcharge collected for any real estate transactions in the County would fund the program. The recording fees at the register of deeds for any real estate transaction is $7.00, out of which $5.00 stays with the County where the fee was generated and $2.00 goes to the State. The County then uses its portion for various modernization efforts including GIS activities. The Program guidelines established the following three qualifying criteria for the funding: establish a Land Information Office (LIO), name a Land Information Officer who works for the state as a point of contact and finally develop a land records modernization plan. Other than the qualifying criterias the Program guidelines are very complaisant and have imparted complete independence to the counties regarding the structure and administration of their LIO office. Keeping with the Program guidelines, Dane County Land Information Office (LIO) was established by the Dane County Board of Supervisors (Resolution 295, 1989-1990). The county adopted a "management by committee" approach, where administration of the LIO activities is supervised by an oversight committee known as the LIO committee. Since its inception LIO's activities have been funded by the mechanism established by the statewide Program. Dane County LIO office is the core GIS department of the county that manages and facilitates all internal and external countywide GIS related activities. This office not only supports the GIS infrastructure of the County but is also the custodian of all spatial data created by the County.

This local political context i.e. the Wisconsin Land Information Program has shaped Dane County's GIS knowledge production in varied ways. Firstly the funding mechanism established by the Program has compelled the county's GIS activities to be overly dependent on the local economy. The real estate market in Dane County has seen a major slump in recent years leading to huge decline in real estate transaction fees that are collected by the Register of

Deeds affecting LIO funds. Thus, a slump in the housing sales has caused a slump in the LIO funds. As a result the LIO office has faced huge funding cutbacks thereby affecting the GIS activities the office can undertake or support.

Secondly, the flexibility conferred by the Program guidelines has led to the LIO's GIS knowledge production being shaped by influential political members within the county. Historically, the authority concerning key decisions of the LIO office was placed in the hands of the LIO committee members and the County Executive. The LIO office thus, gets its directive from them regarding the LIO staff, budget allocation, governance issues, policies and project priorities. Agendas set by the actors in the LIO committee are particularly important in shaping LIO's GIS provision to other departments in Dane County. These agendas are in turn influenced by the priorities of the committee members. As mentioned by a county staff, key resources of the LIO office have been allocated to other departments to fulfill mandates of key political actors. This has had a detrimental affect on LIO's organizational structure and their capacity for GIS knowledge production. For instance, in recent years the LIO office has faced several restructuring due to funding cutbacks and internal political influences. Today the office functions with mere two GIS analysts as compared to five staff members when the office was established. As a result, the LIO office is compelled to provide to an increased countywide GIS demand with less manpower which has severely hampered their GIS outreach and support capacity.

SOCIO POLITICAL CONTEXTS AND COUNTY GEOSPATIAL DATA

Design of geospatial data is the key to any GIS endeavor. How a spatial data model is designed has far reaching

repercussions on GIS projects. In a multi departmental and multi user environment such as the one in Dane County it is imperative that the geospatial data is comprehensive enough to cater to a wide range of users and departments. The biggest hurdle identified by GIS users to successful implementation of GIS projects in public agencies was the lack of standardization in data structure and format that inhibited the transfer and exchange of geospatial data (Croswell 1991), as witnessed in Dane County. Today a new breed of GIS users has emerged in the county such as emergency management, sheriff's office, 911 and these new users face several impediments related to geospatial data which in turns hinders their GIS knowledge production capabilities. Dane County has a very rich geospatial data model albeit geared towards land use and planning. Decisions regarding the geospatial data model design were taken by key members of the LIO committee when GIS use was first initiated in the county. Due to the land use and planning oriented priorities of the LIO committee members, a lot of effort was channeled towards creating parcel mapping data and tax data rather than road centerlines data that is of greater use to departments like emergency management and public safety who represent the new GIS user group. As a result these departments lack comprehensive and good quality data. For instance, the county lacks good quality roads centerline data. Due to lack of understanding and agreement regarding conventions and data standards between these departments and the LIO office, the roads centerline data lacks consistency and currency. Design of the attributes of the data is not in accordance to the requirements of the departments that need the centerline data on a daily basis such as public safety, sheriff's office and 911. As mentioned by Richard McVicar (personal communication, summer 2007) from the public safety department, the roads centerline data is sufficiently good for parcels and tax data but not for

emergency services. Another issue that these departments face is that of data currency. An example is the Sheriff's office. The sheriff's office is required by the State to create a map of all crashes for a calendar year. When officers investigate a crash they record the location in a record management system used by the sheriff's office. The technical staff then uses that information to create crash maps using ArcView. The method adopted by the staff to create the map is very cumbersome attributed to unavailability of appropriate geospatial data. An ideal method to map the crash sites would be to geocode the addresses in ArcView that would automate the entire process and save staff time. However, in order to do so the office needs an updated roads centerline data to serve as reference data for the geocoding process. The county lacks good roads centerline data that can be relied on. This data is not updated regularly and it also lacks consistency in naming conventions. The biggest hurdle for them is data currency. Importance of data currency has been emphasized by scholars for efficient GIS knowledge production (Croswell 1991, Budic 1998). In a study conducted by Croswell (1991) that identifies hurdles for public organizations in implementing GIS, lack of organization wide procedures for updating GIS database was identified as a major impediment. As new infrastructure is built it does not get updated in the county's database in a timely manner. Updating such databases is the LIO's responsibility. However, due to staff restructuring the office is short staffed. Besides, project priorities of the LIO office do not align with those of the new GIS user group. Hence, a new infrastructure such as a road, a house number or a street is not included into the countywide geospatial database as soon as they are built and departments such as the Sheriff's Office and the department of Public Safety Communications Administration are compelled to work

with data that is not current. A mentioned by the operations manager:

> "It is a multi level process. There are cases when a new road is created and it even gets built and somehow the loop was not completed and we did not hear about it. There have been times when we get a 911 call and sure enough we get there and there is a road and building and everything, just we didn't know about it. Even today the maps the dispatchers are looking at are not up to date".

Another quote below by a staff member of the sheriff's office also demonstrates the frustration among the new GIS users about unavailability of geospatial data that meets their needs:

> "So where are we going to get this accurate centerline file and what mechanism are we going to keep in place to keep it updated when a new subdivision is added? That's the milestone we are dealing with right now. It's just getting that rock solid accurate centerline file that we can rely on".

Thus, the new GIS users face considerable challenges to GIS spatial knowledge production, posed by two pronged issues. One of the issues is a lean staffed LIO office. And the other is the design of the spatial data model of the county that caters more to the requirements of departments representing the LIO committee members and excludes the new GIS user groups that have recently emerged in the county.

Dane County LIO office was established almost twenty one years ago when GIS usage in the county was limited to land use and planning. Except for a few departments such as land conservation, planning and zoning most of the other county departments lack GIS expertise on staff. As a result departments that have recently started using GIS are completely dependent upon the LIO office for their geospatial requirements. Their capability for GIS

knowledge production is shaped by the LIO's outreach and support capabilities. Due to lack of support including geospatial data needs, database requirements or GIS technical support from the LIO office these new GIS users have no option but to depend on vendor product or abandon their GIS project. One such example is the department of Public Safety Communications Administration. There is a clear need for a sophisticated mapping and GIS program in this department (Mukherjee & Ghose 2009). However, due to lack of understanding and support from the LIO office the department is compelled to depend on a vendor specific product that fails to meet all their geospatial requirements. As mentioned by the operations manager in response to the department's choice of a non – ESRI product:

> "It's what our vendor sells. My understanding is that there are a lot of ways to buy other products and interface them and connect them to our CAD system (dispatch software) but we decided to purchase whatever product our CAD vendor sold. In my limited understanding the product that is in front of our communicators is not ESRI product. It was mainly us going to our vendor and asking them what can you do for mapping. One thing that is not clear to me is what would it mean for us to be ESRI. I hear we want to be ESRI but I don't know what that means".

This also poses other challenges related to geospatial data such as data interoperability, data integration, data standardization and data currency. For a multi – departmental and multi – user environment, such as Dane County interoperability is the key to reduction in cost and time to data management and promoting shared organizational structures (Schuurman, 2005). Interoperability is a broad discipline and semantic standardization is one of its components (ibid). When geospatial data are acquired from a variety of sources, data standardization is very difficult to achieve as witnessed in certain departments. Lack of data standardization has the potential to cost an organization excessive staff time and

resources as witnessed in the department of Public Safety Communications Administration. The Public Safety Communications Administration department uses a mapping program provided by an external vendor to locate incidents in order to send dispatchers to a scene of an emergency. This program is very vendor specific and works only with the vendor's dispatch software. The program is very limited in the number of layers that can be used like contours and ortho photos. It has very limited GIS capabilities and cannot be integrated with any ESRI product. In addition, the database that is used by the program follows a convention for street names and addresses that differs from the convention that has been used for county data by the LIO office. For instance the format used for spelling and naming the streets is very different from that of the county. The street names have space that is not present in the county data. For instance everyone agrees the road name is McKenna but one convention names it as Mc Kenna and the other names it as McKenna, generating errors when integrating the data. The vendor's mapping program also has limitations in terms of field sizes and special characters. Sometimes the road name is accurate but street suffix cannot be added because the mapping system does not have enough spaces to include it. As a result parcel data and tax data of the county does not easily integrate with the vendor's mapping program that is being used the Public Safety Communications Administration department.

Another issue related to data standardization arises from departments using data from external sources due to lack of good quality data that serves their requirements. Different geospatial data vendors use different street naming protocols. The main external sources of data are the United States Postal Service (USPS) and AT&T – Telephone Company. The telephone company uses one convention for data creation, the post office has a different convention and

the department's mapping program follows a completely different convention. Thus there is no standardized system for naming streets and addresses. This is a critical issue because spatial attributes used for query and display depend on how a certain attribute is defined (Schuurman 2002; 2005), further impacting spatial knowledge production. One of the biggest issues arises with street naming. AT&T uses the suffix La for "lane" whereas the post office (along with the county) uses the suffix Ln. Also the post office recognizes all types of street and suffixes, whereas AT&T recognizes only 10 – 20 street suffixes. If AT&T does not recognize a particular street type they put "St" at the end of the road name. Thus there are countless streets that are displayed with the suffix "St" at the end when in reality the road name has a different suffix and have to be manually edited by a staff member so that the road names match with the names that appear on the dispatchers' map. Thus, lack of data standardization creates a high overhead cost for the department of Public Safety Communications Administration in terms of staff time.

CONCLUSION

Creation and usage of geospatial data revolves around social and political contexts as demonstrated in this study on Dane County, Wisconsin. Majority studies on geospatial data focus on technical details. Very few studies till date have delved into the social, political and institutional elements that influence the creation and usage of geospatial data (Harvey, 2003; Harvey & Tulloch, 2006; Schuurman, 2002, 2005, 2009). Geospatial data are social constructed. The local political context of Dane County shaped the creation of countywide geospatial data when GIS was first introduced in the county and subsequently the political contexts also shaped geospatial data usage over the years. GIS knowledge production has thrived in the county and

recently a new group of GIS users has emerged. However, the design of the geospatial data model has had a detrimental affect on their GIS use. Countywide geospatial data usage are shaped by two important factors. First, is the support and outreach capacity of the LIO office which is the main GIS hub of the county. However, the support and outreach capacity of the LIO office is also shaped by the local political and institutional contexts which in turn have shaped the construction f county geospatial data. The second factor is the political atmosphere of the county. GIS knowledge production is influenced by agendas and priorities of key political actors. These local political contexts have posed various data related issues for GIS users such as issues related to data interoperability, data currency, data standards. Thus, as witnessed in Dane County geospatial data and issues related to geospatial data are influenced by factors beyond technical elements. Nonetheless, more comprehensive studies are required to shed light on the social, political and institutional contexts that shape geospatial data creation and usage.

REFERENCES

Budic, Z. and Pinto, J, 2000, Information sharing in an inter-organizational GIS environment. Environment and Planning B: Planning and Design, 27(3), 455-474

Budic, Z., 1998, The impact of GIS technology. Environment and Planning B, 25(5), 681-692.

Budic, Z. and Godschalk, D. R, 1996, Human Factors in Adoption of Geographic Information Systems (GIS): A Local Government Case Study. Public Administration Review, 56(6), 554-67.

Budic, Z, 1994, Effectiveness of Geographic Information Systems in Local Planning. APA Journal, 60(2), 244-263.
Campbell, H. and I Masser, 1995, GIS and Organizations: How Effective Are GIS in Practice? (London: Taylor and Francis).
Campbell, H., 1994, How effective are GIS in practice? A case study of British local government. Geographical Information Systems, 8(3), 309-325.
Campbell, H., 1991, Organizational Issues in Managing Geographic Information. In I. Masser and M. Blakemore (Eds.), Handling Geographic Information. (London: Longman), 259-282.
Croswell, P., 1991, Obstacles to GIS Implementation and Guidelines to Increase the Opportunities for Success. Journal of the Urban and Regional Information Systems Association, 3(1), 43-56.
Elwood, S., 2006, Beyond cooptation or resistance: Urban spatial politics, community organizations, and GIS-based spatial narratives. Annals of the Association of American Geographers, 96(2), 323-341.
Elwood, S. and Ghose, R., 2004, PPGIS in Community Development Planning: Framing the Organization Context, Cartographica. 38 (3&4), 19-33.
Ghose, R., 2007, Politics of Scale and Networks of Association in Public Participation GIS. Environment and Planning A, 39, 1961-1980.
Ghose, R., 2005, The Complexities of Citizen Participation through Collaborative Governance. Space and Polity, 9(1), 61-75
Harvey, F. and Tulloch, D., 2006, Local Government Data Sharing: Evaluating the Foundations of Spatial Data Infrastructures. International Journal of Geographical Information Science, 20(7), 743-768.
Harvey, F. and Chrisman, N., 2004, The Imbrication of Geography and Technology: The Social

Construction of Geographic Information Systems. In S. Brunn, S. Cutter, and J.W. Harrington (Eds.), Technoearth: A Social History of Geography and Technology. (Kluwer Academic Publishers: Boston).

Harvey, F., 2003, Developing Geographic Information Infrastructures for Local Government: The Role of Trust. Canadian Geographer, 47(1), 28-37.

Huxhold, W., 1993, The Application of Research and Development from the Information Systems Field to GIS Implementation in Local Government: Some Theories on Successful Adoption and Use of GIS Technology. In Masser and H. Onsrud (Eds.), Diffusion and Use of Geographic Information Technologies. (Dordrecht/Boston/London: Kluwer Academic Publishers). 61-76.

Knigge, L. and M. Cope, 2009, Grounded Visualization and Scale: A Recursive Analysis of Community Spaces". In Cope M. & Elwood S., (Eds.), Qualitative GIS: A Mixed Methods Approach, (Thousand Oaks, CA: Sage Publications), 95-114.

Kyem, P., 2004, Of Intractable Conflicts and Participatory GIS Applications: The Search for Consensus Amidst Competing Claims and Institutional Demands. Annals of the Association of American Geographers, 94(1), 37–57.

Lin, W. and R. Ghose, 2010, Social Construction of GIS in China's Changing Urban Governance: The Case of Shenzhen. Cartographica, 45 (2), 89 - 102.

Lin, W. and R. Ghose, 2008, Complexities in Sustainable Provision of GIS for Urban Grassroots Organizations. Cartographica, 43(1), 31-44.

Mukherjee, F. and R. Ghose, 2009, Complexities in GIS Construction and Spatial Knowledge Production in Dane County, Wisconsin. Cartography and Geographic Information Science, 36(4), 299-314.

Onsrud, H. and J. Pinto, 1993, Evaluating Correlates of GIS Adoption Success and the Decision Process of GIS Acquisition. Journal of the Urban and Regional Information Systems Association, 5(1), 8-39.

Schuurman, N., 2009, Critical GIScience in Canada in the New Millennium. The Canadian Geographer, 53(2), 139-144.

Schuurman, N., 2005, Social Perspectives on Semantic Interoperability: Constraints on Geographical Knowledge from a Data Perspective, Cartographica, 40(4), 47-61.

Schuurman, N., 2002, Flexible Standardization: Making Interoperability Accessible to Agencies with Limited Resources. Cartography and Geographic Information Science, 29(4), 343-353.

Sheppard, E., 2005, Knowledge Production through Critical GIS: Genealogy and Prospects. Cartographica, 40(4), 5-21.

Sheppard, E., 1995, GIS and Society: Towards a Research Agenda. Cartography and Geographic Information Systems, 22(1), 5-16.

Sieber R., 2007, Spatial Data Access by the Grassroots. Cartography and Geographic Information Science, 34(1), 47 – 62.

Ventura, S., 2006, Crossing the Divide: Penetration of Spatial Information Technologies in Middle America. GIS Development, 28-33.

Ventura, S., Niemann, B., Sutphin, T. and Chenoweth, R., 2003, GIS-Enhanced Land Use Planning in Dane County, Wisconsin. Paper submitted for the NCGIA Specialist Meeting on "Empowerment, Marginalization, and Public Participation GIS".

Yin, R., 2003, Case Study Research: Design and Methods. (Thousand Oaks/London/New Delhi: Sage Publications), Third edition.