Extending Geographic Information Systems to Meet Neighborhood Planning Needs: The Case of Three Chicago Communities

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Abstract: *While community-based organizations (CBOs) increasingly seek to utilize geographic information systems (GISs) for neighborhood planning and development, many have serious misconceptions about what GIS can and cannot do and what is needed to make effective use of it. This article describes the problems and opportunities in utilizing GIS as a tool for enhancing participatory planning in three neighborhoods in Chicago. It illustrates the process of creating a useful community GIS database and ways to augment GIS with other tools to foster public participation. Through 3 years of extensive experience in implementing a community GIS, a planning team at the University of Illinois at Chicago found that GIS has significant limitations that could be addressed by integrating other high-tech and traditional tools. Following Shiffer's work, the team incorporated innovative multimedia and three-dimensional modeling and, inspired by Hopkins' work, the team augmented GIS with electronic sketchboards. The Internet was also utilized to extend the reach of the community GIS. This combination of tools empowered residents to visualize, evaluate, and participate in revitalizing their neighborhoods. We hope that the experiences described in this paper will assist others who want to utilize GIS in community planning.*

Introduction

This paper addresses an issue that is often overlooked by geographic information system (GIS) practitioners: the planning needs of the local community, and extensions to GIS that can help meet those needs. The paper describes how a planning team from the University of Illinois at Chicago (UIC) joined with leaders in the Chicago communities of Pilsen (Lower West Side), North Lawndale, and South Lawndale (Little Village) to integrate technology with community-based planning. In Pilsen, utilizing GIS has expanded into multiple phases, and in North Lawndale, the team has begun building a GIS property monitoring system and using the Internet Map Server (IMS) to deliver it. However, in South Lawndale, GIS has not been employed because it was an inappropriate tool for the kind of projects proposed by the community. Instead, we employed easy-to-use three-dimensional design software to quickly test the conceptual design of residential and commercial developments. Overall, the team found that GIS greatly assisted residents to comprehend spatial relationships at a community scale; however, it was less useful when we zeroed in on smaller areas and individual sites. It was necessary to augment GIS with eye-level photographic images, 3-D representations, and sketch planning.

Our research builds on works by several scholars on community GIS, including Elwood and Leitner (1998), Craig (1998), Sheppard (1995), and Weiner (1998). It particularly builds on Shiffer's work (1999) on augmenting GIS with multimedia in planning information support systems (see, e.g., http://yerkes.mit.edu/ncpc96/home.html and http://gis.mit.edu/projects/). The projects described in this paper are an attempt to find the appropriate mix of technology for the communities currently involved in a grassroots planning process. The team focused its efforts on refining the mix of tools that is most effective in conducting community-based planning. Describing the integration of traditional and computerized tools may be helpful to other researchers because, with the rush to embrace computers and GIS, it is easy to forget the effectiveness of traditional tools. We argue that traditional activities and tools, such as sketching with pen and paper, are very powerful and are irreplaceable in the early stages of planning.

This article seeks to accomplish two goals. The first is to illustrate the difficulties involved in creating a community GIS by describing the process of collecting local level data and the process of incorporating a database of photographic images into the GIS. The second goal is to show how the UIC team enhanced the utility of the GIS by incorporating several other public participation methods. This paper has four sections. The first section presents the background of the partnership between UIC and the above mentioned communities. The second section details the process of data collection, the compilation and creation of GIS layers, and describes the integration of images into the GIS based on various urban design models. The third section discusses five ways of augmenting the GIS: electronic sketchboards, multimedia, 3-D modeling software, hands-on participation, and the Internet. The fourth section identifies five key limitations of a community GIS and describes our responses to these issues.

Background of Projects

The Urban Commitment of the University of Illinois at Chicago

In 1993, the UIC established the Great Cities Institute (http://www.uic.edu/cuppa/gci/about/index.htm) to respond to urban problems facing American cities. "Great Cities" refers to the university's commitment to use its teaching, research, and service programs to improve the quality of life in metropolitan Chicago. Under Great Cities, UIC has worked with Chicago communities on approximately 220 projects and programs.

One of the newest urban outreach initiatives under Great Cities is the Great Cities Urban Data Visualization program (GCUDV), which was established in 1998. GCUDV is committed to using state-of-the-art visualization technology to foster neighborhood planning (http://www.uic.edu/cuppa/udv/GCUV.html). The program addresses social and ecological issues as well as urban image visualization ones. The program is staffed by a multidisciplinary team that includes faculty, students, and recent graduates from UIC's Electronic Visualization Laboratory and from several other disciplines.

The projects described in this paper drew on resources from other UIC research units as well. The City Design Center (http://www.uic.edu/aa/cdc), established in 1995, pulls researchers from two major colleges-Architecture and the Arts, and Urban Planning and Public Affairs (CUPPA)-to focus on community design. Finally, the Center for Urban Economic Development supplied data for the projects (http://data.cued.uic.edu/cued).

Background on the Communities and the Planning Process

Pilsen, the first of the three communities we work with, has long served as a port of entry for many of Chicago's immigrants. By the end of the 19th century, rapid industrialization and urbanization had transformed the largely Bohemian (Czech and German) working-class neighborhood into a national center of labor activism. This activity drew Poles, Croatians, Lithuanians, Italians, and other immigrants to the community. After a few decades, these residents moved on, giving way to newer immigrants of Mexican descent. In 1990, 88% of the area population was Hispanic, making this the second highest concentration of Mexicans of all community areas in the city. Interestingly, each of the successive immigrant groups has, in turn, left its unique imprint on the architecture of the community, creating a cultural mosaic in the built form of Pilsen.

Despite being a welcoming home for new immigrants, Pilsen presently struggles to retain residents; many people start out in the community but eventually move on to other neighborhoods or the suburbs as they assimilate into the American culture and become financially secure. The number of housing units in the community has declined and little new residential construction has taken place since 1930. In 1980, 27% of the housing units were overcrowded, having more than one person per room (CFBC 1990). Over the years, several strong community organizations have formed to help Pilsen's disenfranchised residents address issues such as housing and economic development.

North Lawndale, the second community we are working with, is located northwest of the university, four miles from downtown and near the United Center. This community, like Pilsen, has experienced successive waves of immigrants, beginning with Bohemians and Polish and followed by a wave of Russian Jews. However, the population has decreased by approximately 30,000 people per decade between 1960 and 1980. The total population in 1990 was 47,000, a decline of 23% since the 1980's total of 61,000. Ninety-six percent of its 1990's population was African Americans (CFBC 1990).

The number of housing units in North Lawndale continues to decline, causing a housing shortage. The community has experienced a net loss of almost half of its housing units since 1960. North Lawndale has an abundance of redbrick and graystone homes, mostly built in the 1910s and 1920s and, although the community has suffered from urban blight, the housing stock has proved to be surprisingly solid for renovation. Recently, the area has begun to see some revival, as one development corporation has turned the old Sears catalog complex into homes at Homan Square, which brings infrastructure and housing improvements to 55 acres. New businesses and families are moving into North Lawndale and the economy is starting to turn around. However, the community still has many vacant lots and abandoned buildings.

South Lawndale, the third community we are working with, is considered an extension to Pilsen where 80% of its 1990 population is Hispanic. The area is home to 18% of all Mexicans in Chicago, which is the highest concentration of this ethnic group in the city. In 1989, the median income ($23,000) was below the city median, and the percentage of families living in poverty (22%) was above the city average. The percentage of people having educational experience beyond high school and working in white-collar jobs were the lowest in the city. Residents of South Lawndale are more likely to be found in manufacturing or service occupations. The main business thoroughfare, 26th Street, displays signs in Spanish advertising their businesses or services offered (CFBC 1990).

Housing continues to be a major problem in South Lawndale. Very few units have been added since 1920 and more than half of the current units were built before 1940s; fewer than 10% have been built in the last 20-30 years. In 1990, more than one-third of the housing units were overcrowded. The median value of single-family, owner-occupied homes was $48,552, which is well below the city average. Between 1920 and 1960, industrial areas developed to a point where they and the large railroad yards virtually surrounded the residential area of the community. Considerable industrial development took place along the western

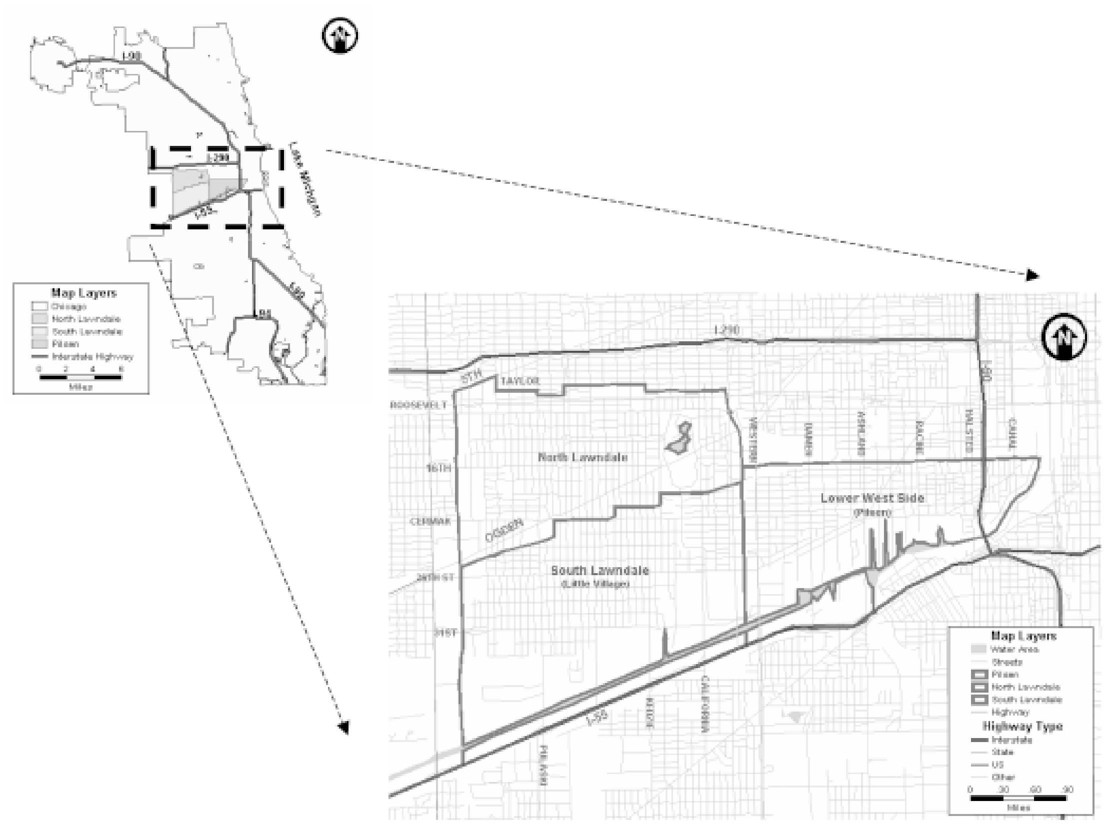

Figure 1. Geographic locations of the examined communities in Chicago. Images were produced using the HUD's Community 2020 GIS software program.

boundary on previously undeveloped land (CFBC 1990). Figure 1 shows the geographic locations of the examined communities.

Beginning in 1997 leaders from these communities approached the City Design Center with an interest in developing a participatory, collaborative approach to the planning and design of their community. In Pilsen, we partnered with the Eighteenth Street Development Corporation; in North Lawndale, we worked with the Lawndale Christian Development Corporation; and in South Lawndale, we worked with the Hispanic Housing Development Corporation. These community organizations felt that they needed the new technical capabilities of GIS and related computer systems to monitor change and plan effectively.

These organizations were eager to harness the enthusiasm and creative energies of residents necessary to take serious actions and improve the neighborhood. They felt that the meaningful involvement of all stakeholders-including their neighbor, UIC-would strengthen the sense of community and that a collaborative effort would help present a "unified front" when funding opportunities arose. A planning and design team was formed that included community residents, representatives of the three involved organizations, and faculty members from the Urban Planning and Public Affairs and the Architecture and Art colleges of UIC.

The primary goal of our projects in these communities is to help create a vision that will guide future development. A secondary goal for UIC is to create a mutually respectful partnership between the university and neighborhood residents. The University team believed that developing community leaders and empowering citizens to take responsibility for problem solving and decision-making could promote an atmosphere of mutual commitment to redevelopment in the community. The team wanted to create a series of workshops that would engage residents in the planning and design of their community. In Pilsen and South Lawndale, overall, the projects had a strong design orientation; in North Lawndale, the focus is less on site design and more on strategic planning for redevelopment. The first step in North Lawndale was to build for the community a parcel information system accessible via the Internet (see http://131.193.154.228/).

The foundational tool of the Pilsen projects was a community-based GIS (a separate one is being created by the UIC team for North Lawndale). It consists of local data, parcel level maps, and photographic images of the neighborhoods. During the workshops, the data from the GIS were projected onto a large screen. As the team progressed through the workshops, several enhancements were made in response to issues and concerns that surfaced. First, to supplement the GIS, the team employed an environmental design artist who could listen to the participants' ideas and incorporate them into graphics, diagrams, and design drawings on an electronic sketchboard. The team then added a

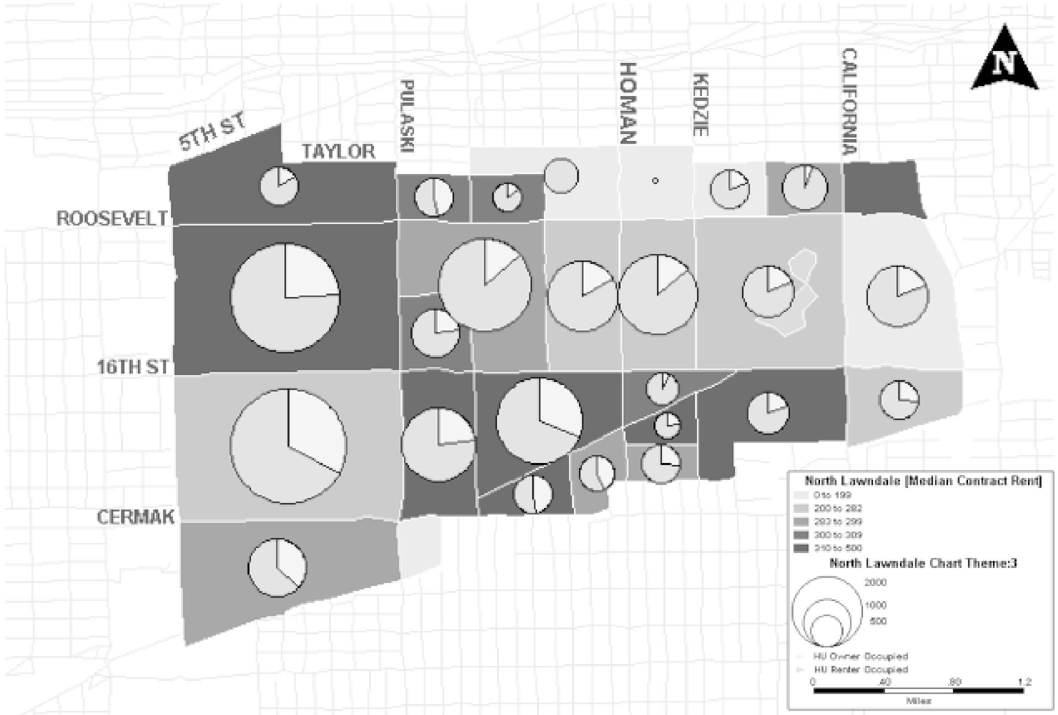

Figure 2. Typical GIS map based on census tracts, North Lawndale. It looks beautiful and authoritative but it means little to local residents. The Image is produced by using the HUD's Community 2020 GIS software program.

more hands-on element, having participants write and color on maps printed from the GIS. In South Lawndale, the team along with participants used 3-D software to better represent several proposed development projects.

It is important to note that these projects are costly; for example, the total costs for the Pilsen project reached almost a half million dollars. GCUDV provided four technical research assistants for four semesters at a cost of $120,000. In addition, GCUDV supplied the technical hardware (two digital cameras, three computers, two laptop computers, two projectors, and two electronic sketchboards), the software (ArcInfo and ArcView), and the data (GIS data from the City of Chicago's Department of Planning and Development), which brought the cost up to $200,000. The City Design Center spent an additional $80,000 on the setup of the workshop and for the salaries of the adjunct professor and two research assistants who led the workshop preparation for 1 full year. The development of the community GIS was an enormous project, but it was an important base and solid framework for many future projects in UIC at large. In the next section, we detail some of the challenges experienced by the UIC team and the solutions found in constructing a GIS database for these neighborhoods.

Creating GIS Databases

Preliminary Steps

While many scholars and community planners have advocated for the use of GIS in community planning, few have described what is needed to build an appropriate community GIS database. In the community-based organizations that we have been working with, few individuals understood that the data collection process is necessary to even begin using the GIS. A clear description of the data collection process and what is needed to build an appropriate database for community development is important to communities interested in adopting GIS. In this section, some of the efforts to collect relevant local data and find data sources are described, and a few examples that illustrate constructing layers from raw data are provided. The team also describes how photographic images were incorporated into the GIS database, offering several urban design models for organizing images.

As the team began compiling data for the GIS, it found that most of the available GIS data was not at a resolution that is useful for neighborhood planning. The team searched for data in municipalities, counties, agencies, and regional planning commissions such as the Northern Illinois Planning Commission, but none of these offices had GIS data at the parcel level. In general, Illinois is not a GIS data-rich state. The team then contacted commercial vendors, but their products were costly and they had very little data for lower-income neighborhoods. Most of their data was business-oriented and involved locating retail stores, fast-food franchises, gas/convenience stores, and entertainment facilities. Other agencies such as the U.S. Geological Survey and the Environmental Protection Agency provide an abundant amount of GIS data but it is at much smaller scales such as 1:100,000 and 1:24,000, which are not particularly useful for neighborhood projects.

The team obtained paper maps at the parcel level from the city's planning department and then digitized the parcel boundaries into ArcInfo GIS. We obtained vital legal information, such as owners' names, deed book and page number, transfer dates, mailing addresses, and property addresses, from the Center for Urban Economic Development at UIC that was originally purchased from the Tax Assessor's Office. The unique parcel identification number was used in the graphic environment as a link to the tabular data. Within the GIS, the assessor's numbering system had to be slightly revised to accommodate the multiple functions of the GIS.

For basic maps showing the broad demographics of the community, we used the Department of Housing and Urban Development's (HUD) GIS software program: Community 2020 (http://www.hud.gov/cpd/2020soft.html). Community 2020 is a custom version of Maptitude GIS software that comes with a large amount of HUD data along with 1990 census data and a TIGER file street map. We used Community 2020 to create demographic maps showing census data, to pin map a list of addresses, to show the locations of HUD projects in the neighborhood, and to obtain general information about neighboring communities. For some types of information, we utilized data from Community 2020 to create map layers in ArcView, since ArcView was more useful for analysis.

As we began using the GIS with the data described above (from official sources), the UIC team soon discovered that the maps, which generally included land use and census tract data, were limited in their ability to portray the qualitative aspects of the neighborhood environment. In working with the Pilsen community, we decided that it would be important to gather qualitative data through a field survey. We interviewed individuals from community groups to discover what kind of qualitative data they thought they needed. The groups said that they would like to map such things as neighborhood architecture, lively commercial corridors, places of local cultural or community importance, public murals and other public art, stores selling ethnic foods and other imported goods, and blocks of particularly well-kept houses.

The team carried out a block-by-block survey to gather information on central properties, properties with code violations, boarded-up properties, vacant lots, and sanitation problems. However, while the team felt that it is important to pursue the remaining qualitative data, we have found it difficult to gather because of the labor and time commitment that it entails. The team plans on utilizing student projects in the future to gather the remaining data.

One critical problem that we faced in utilizing local data was that most GIS data are structured geographically by census tracts. Since the data are structured in this way, it follows that the analyses are usually presented by census tracts as well. However, we found that census tracts are not meaningful to local residents. Census tracts are poor spatial units because residents could not identify with them or relate them to their daily experience in the neighborhood (Figure 2). In the future, we will need to modify the GIS unit of analysis to fit the novice spatial experience.

Constructing GIS Layers

As with the Pilsen GIS, the community GIS currently being created for North Lawndale is based on the ArcInfo and ArcView GISs, and is operable on a Windows-based desktop personal computer, with the aim of eventually providing the program via the Internet. This GIS contains many layers of mapped and tabular information to support the work of community organizations and to increase community involvement in planning. For example, layers developed to date for North Lawndale include: a digitized parcel map, vacant land, land uses, aerial photographs, historic landmarks, institutions, private and public schools, major industries and employers, buildings that are currently in housing court, buildings that are targeted for demolition, and buildings that have tax or other types of liens against them.

One important lesson that we learned from creating the GIS for North Lawndale was that it was most efficient for one group of students to work on a single GIS theme from data gathering to digitizing maps, creating tables, associating tables with maps, and geocoding. The Coordinator would then organize the files in the GIS in one project file. This method is useful because each theme requires a different process to create, as explained in the following examples.

One theme that was created for the North Lawndale community GIS identified of all public and private schools. Data for the public schools were easily collected from the Chicago Public Schools Web site. However, data gathering for private and Catholic schools was a challenge. The site American School Directory http://www.asd.com provided the information on all schools K-12 in the United States. Furthermore, the site allowed performing address searches for schools by state, county, and city. Once the lists were compiled and saved in the .DBF format, they were geo-coded and mapped in ArcView (Figure 3).

Another theme that was created for North Lawndale was the buildings that are currently in housing court, buildings that are targeted for demolition, and buildings that have tax or other types of liens against them.

After visiting the Chicago City Hall, the students determined that no department was able to provide the subject data in digital format and even data in hard-copy format was difficult to obtain. Information pertaining to tax liens was especially difficult to obtain for the North Lawndale neighborhood since all information regarding tax liens is accessible only if a real estate Permanent Index Number is available.

The team secured a hard-copy report, generated by the City of Chicago Building Department, listing buildings targeted for demolition in the community area. It contained 336 individual properties. A listing of all properties in housing court was also secured, although these were a subset of the demolition list. After transcribing the information, it was geo-coded and overlaid upon the North Lawndale shapefile. Other data that we plan to secure are the age of particular structures (i.e., historic significance), the length of vacancy for each structure, and photographs of each structure for use in redevelopment schemes.

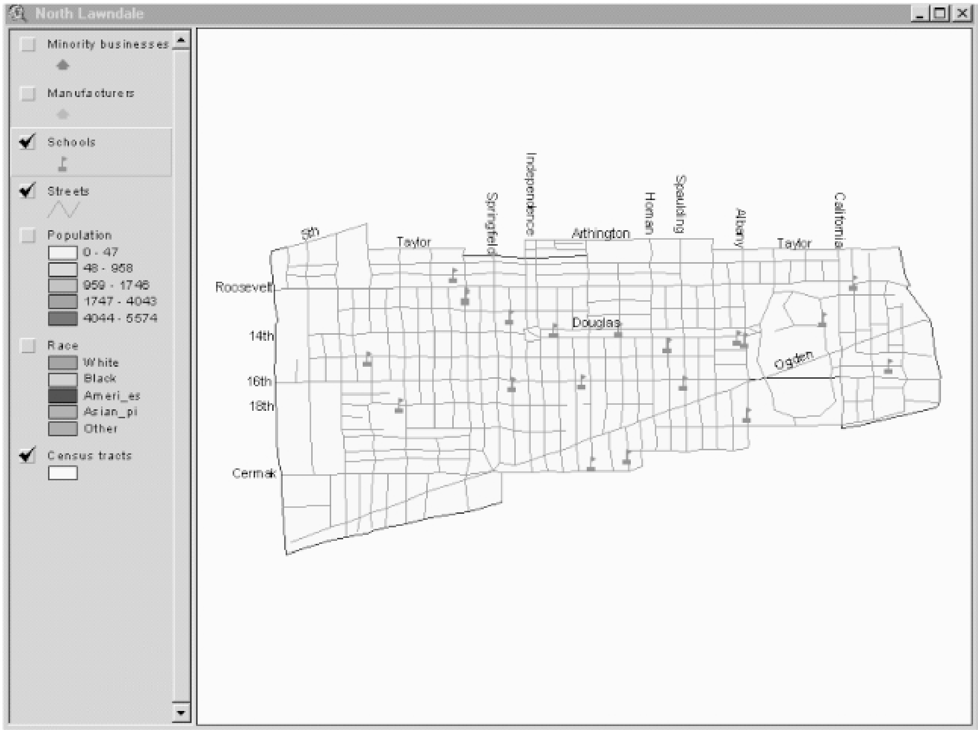

Figure 3. An example of a GIS layer constructed by UIC students. The layer helped residents to visualize the locations of schools in their community, North Lawndale.

Another theme that the students created was major industries and employers. The data were developed from two separate sources. The first data source-a listing of manufacturers with greater than 10 employees-was obtained from the Illinois Manufacturing Database. It provided formatted information on a company's size, the number of employees, location, sales, type of product by standard industrial classification (SIC) code, product description, name of owner, and number of years in existence. It is focused strictly on manufacturers and is updated yearly through mail surveys. The second database came from the Chicago Minority Development Council and is composed of all minority businesses across the Chicago area that have gone through the minority certification process. It is by far the most comprehensive database but may not contain all of the minority businesses located in the city. Unlike the manufacturing data, information had to be reformatted into an Excel database from a printed catalog. These two databases were obtained from UIC's Center for Urban Economic Development, which had been working on a concurrent GIS project for the Civic Committee of Chicago.

The students then transformed all databases into a .DBF format and the tables were added to ArcView. They geo-coded using the address field included in the database. Some of the address formats had to be modified individually to match that of the TIGER map addresses. The result was two layers. The first layer was the North Lawndale manufacturing businesses. There were about 20 manufacturing units identified in North Lawndale. This theme was further broken down into four subsections by SIC classification. This layer indicated that metal works and metal servicing industries dominated the neighborhood. The second layer was the North Lawndale minority-owned businesses. There were only three minority-owned businesses recognized in this mostly African-American neighborhood (Figure 4).

The above examples briefly illustrate the different type of research involved in the process of locating information sources, gathering data, and creating a map layer for a community GIS. The housing information has proven to be the most difficult to obtain. Although the City of Chicago does track the information, they do not make it readily available to the public. Furthermore, updating housing information is a challenge since buildings move in and out of housing court while others are divided weekly.

Collecting and Organizing Images in GIS

A unique aspect of the community GIS that we have worked on has been the inclusion of a photographic image database within GIS. The purpose of integrating photographic images, taken mainly at eye-level, was to assist planners and participants with visualizing the physical context of their community. Community planning projects happen in a physical context and researchers felt that it was important to visualize this context. The conventional GIS provided the underlying spatial data, including locational and associated attribute data. Photographic images helped participants recognize locations and associate their knowledge and experiences of those locations. These images were "hotlinked" to their precise geographic locations on maps.

In efforts to visualize the physical context and the present situation of the neighborhoods, we have moved through several different stages as we have experimented with multiple urban

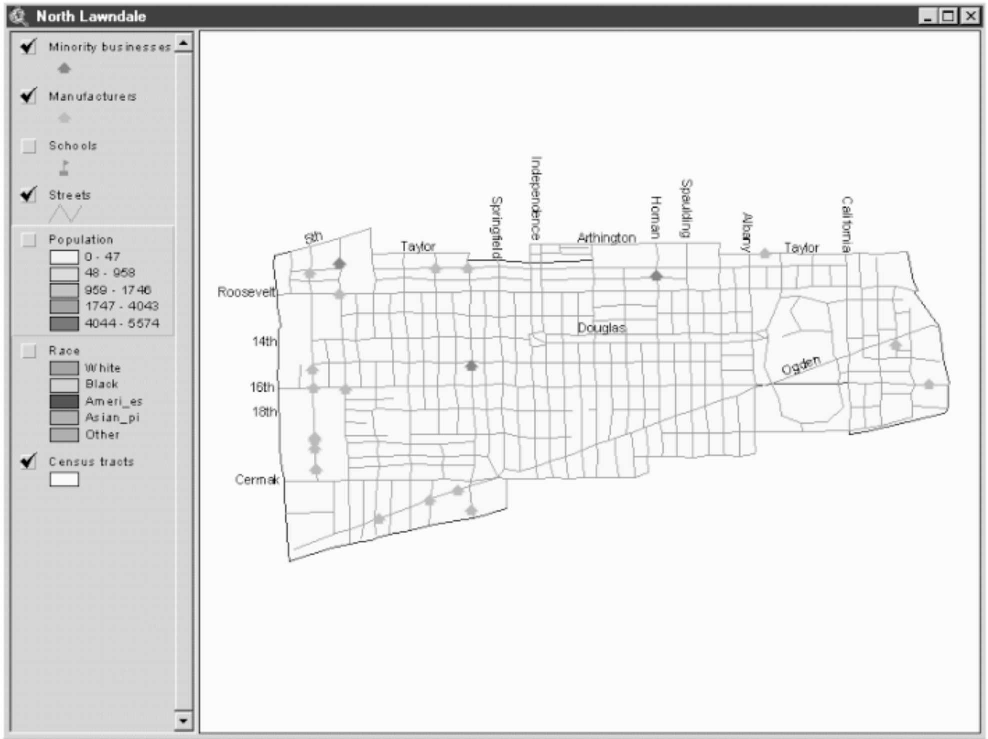

Figure 4. Another example of GIS layers constructed by UIC students, the Manufactures and Minority business themes. These maps informed North Lawndale residents that there are only three minority owned businesses in their community.

design models. For instance, working with images was a technical problem in the beginning, but it later became clear that it was more of a conceptual problem. The challenge was: What urban design model should we use in selecting photographic images? What images should we choose to truly reflect the existing conditions, urban form, and appearance of a community? What should these images focus on and how should they be organized? So far we have tried out several models, including traditional landscape architecture and urban design models, Kevin Lynch's five "imageable" elements of the city (nodes, paths, districts, edges, and landmarks) (1960) and Jack Nasar's Likability/Dislikability model (1998). Later, we experimented with Al-Kodmany's (2000) model of creating thematic image maps.

In the beginning stage, the team took photographs following traditional landscape architecture and urban design models (Cullen 1961). A digital camera was used to document the present conditions of the neighborhood. For example, the UIC team photographed the long-distance implications of the neighborhood from vantage points such as tall buildings. Conversely, on-neighborhood shots recorded spatial links from the inside looking out into the surrounding space: shuttered, filtered, sneak, and panoramic views. The team also shot all access routes and visual links, including sneak glimpses and views from the immediate neighborhood periphery looking in. On-neighborhood photographs also documented the mass and detail of the impinging forms: materials, openings, textures, colors, and the like. The digital photos were then collected into a database and each was hotlinked to its geographic location. By "pointing and clicking" on maps, participants were able to interactively view images in relation to their precise geographic locations in the neighborhood. For example, the user could click on an intersection, and a window would open displaying the actual view looking in a single or in multiple directions. The photographs described above were also coordinated with a key plan showing the direction and position of each shot. As with the historic photos, the purpose of this was to aid orientation during future discussions about design (see http://www.ncgia.ucsb.edu/varenius/ppgis/papers/al-kodmany.html). Despite the extensiveness of this database, we found that the method was somewhat burdensome, was too architecturally oriented, and it did not suffice for neighborhood planning activities. In examining the literature, we followed two prominent urban design models that we used in creating new GIS image databases: Lynch's concept of Imageability and Nasar's concept of Likability/Dislikability.

Lynch organizes and describes the built environment by breaking it down into five "imageable" elements: nodes, paths, districts, edges, and landmarks. The planning and design team applied this model to the community, took digital pictures of these significant elements, and then hotlinked them to GIS maps. This model was useful in visualizing the major components of the overall community (Figure 5).

We used Nasar's Likability/Dislikabilty model to document residents' own evaluation of the visual appearance of their communities. The premise of this concept is that the most important evaluation of a city's built form is the opinion of those who live there and use it on a daily basis. A team, consisting mainly of students, went to the sites with local residents and visually and orally recorded the residents' spatial experience. Students would

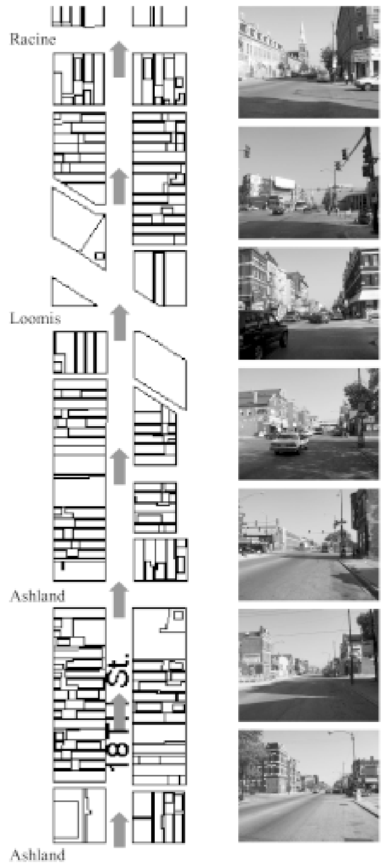

Figure 5. Organizing images in the GIS based on Lynch's urban design model of five elements (node, path, edge district, and landmark). The graphic illustrates a path: 18th street is a major commercial corridor in Pilsen. This brief slide show helped residents to recall the physical context and visual characteristic of the examined street.

ask residents to point out areas of their community that they visually liked and disliked, and would then give a disposable camera to the residents to take shots of these areas. In the computer laboratory, students typed in the comments and associated them with the pictures and then hotlinked them to maps in ArcView GIS. While Lynch's model was useful for visualizing the overall appearance of the community, Nasar's model was useful for visualizing the evaluative feelings of residents about specific areas in their community. Also, incorporating comments enriched the image database and made the photos more meaningful.

The implementation of Lynch's model could be considered a "top-down" approach where the planning and design team "experts" decided on the pictures to be taken. Pictures reflected the team's view of the community. In contrast, our implementation of Nasar's model could be considered a "bottom-up" approach, as actual residents took the pictures. Pictures reflected their evaluative feelings about their neighborhood. Since we have not yet utilized the residents' images in a workshop setting, we do not know how community residents will react. It could create some controversial discussions since the comments about particular locations are not necessarily opinions that all community members would agree upon. However, the planning team found these images and comments to be very informative about the areas that are liked and disliked and about the perceived strengths and weaknesses of the community.

Most recently, we have been testing Al-Kodmany's model of creating thematic image maps. In this model, images are collected according to themes that reflect the different aspects of a neighborhood such as social, cultural and economic. This model was appealing and fitting to GIS since it parallels thematic mapping in geography where each layer focuses on a single issue. In trying out this model, we have developed one image theme that reflects the socio-cultural activities of the neighborhood. We asked residents to record by camera key activities; the images were then geo-referenced to maps (Figure 6). Each of the above models needs to be rigorously evaluated in terms of their effectiveness in neighborhood planning and design.

However, one important contribution of GIS in organizing images, regardless of the conceptual/theoretical model, is that within GIS we are able to geo-reference images (i.e., link images to their specific geographic locations). This function is crucial because it simulates human cognition and memory in that the human mind continuously geo-references images. That is, when our eyes view something, the brain immediately associates the image with its geographic location (Muehrcke and Muehrcke 1998). The image could be a book, a tree, a neighborhood, a city, etc. We recall a book by picturing it to be on the bookshelf or on a table. Similarly, we picture a tree to be in our backyard and we picture a neighborhood to be within a city and a city within a country and so forth. Vividness of recalled images and precision in identifying the geographic location varies, usually becoming weaker as the scale grows larger. Humans need to locate images in concrete space and the GIS, through the "hotlink" function, meets this need. Furthermore, GIS compensates for human weakness in terms of recalling images vividly and linking images to their geographic locations precisely.

Augmenting and Extending the GIS

In our 3 years of extensive experience in implementing a community GIS in a variety of workshop settings, we have identified various ways to augment existing capabilities of the GIS (such as adding multimedia features and using an electronic sketchboard) as well as additional tools to be used alongside the GIS (such as 3-D modeling software and participant drawing on maps). These features have allowed creating "customized planning support systems" that meet the needs of specific communities. In this section we also describe some of our initial research into utilizing the Internet to extend the reach of the community GIS.

Electronic Sketchboards

In the beginning stages of using GIS in workshop settings, we were fascinated by a new product: IBID Whiteboard Model 400, by Microtouch (http://www.microtouch.com/ibid/index.shtml). It is 3 x 4 feet and is placed on an easel. In community workshops, both the University team and the community residents

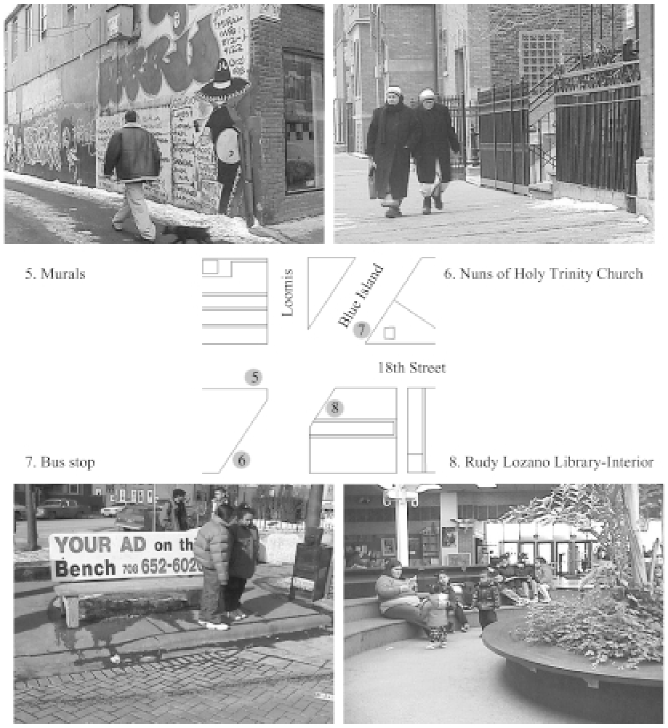

Figure 6. Organizing images in the GIS based on Al-Kodmany's model of thematic image mapping. The above theme attempts to capture key aspects of the socio-cultural life of Pilsen.

sketched on the whiteboard to covey their ideas. Since we wanted everyone to see the images, we linked this board to a multimedia projector so that the emerging sketches were projected onto a large screen. We positioned the equipment so that the projections of sketches and the projections of the GIS screens were side by side in order to connect the GIS discussion and artists' sketches in a simultaneous way. The first screen showed images of existing neighborhood sites from the GIS image library and functioned as the "before" scenario. The second large screen showed sketches projected from the Whiteboard and was the "after" scenario. The side-by-side positioning of the screens helped the audience compare before and after scenarios (Figure 7). We also supplemented the electronic presentation with hard-copy drawings of the sketches drawn at the previous session that had been generated off-site on an HP Design Jet 750 Plotter. These were hung around the walls of the room.

The usefulness of the electronic Whiteboard in conjunction with GIS is illustrated in the following example. One issue that arose was the lack of sidewalks in Pilsen. Some residents said new sidewalks were definitely needed; others said sidewalks were not a priority. A lengthy and heated debate ensued. The UIC team used the GIS to display streets in Pilsen with and without functional sidewalks. The data indicated that approximately half of the streets did not have functional sidewalks and these appeared on the map highlighted in bright yellow. Interestingly, the cluster of yellow matched the location of pedestrian/automobile accidents that appeared on a separate GIS layer.

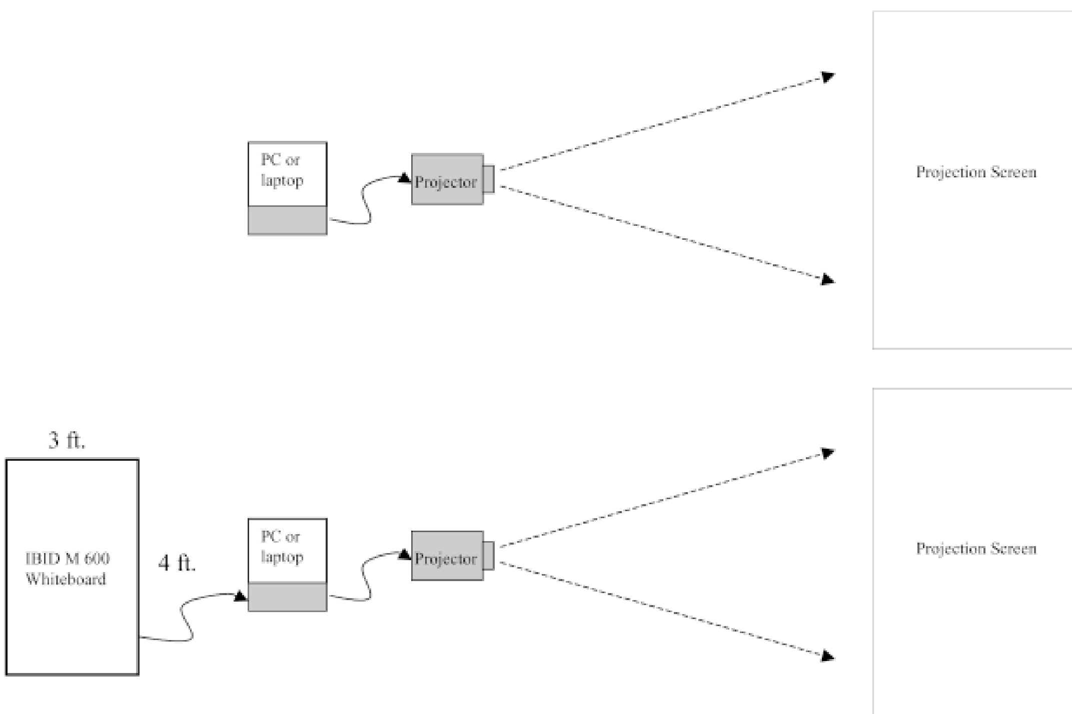

Figure 7. The set up for sketch planning on the Whiteboard. Sketches are projected on large screen (bottom). GIS maps are projected on a large screen (top).

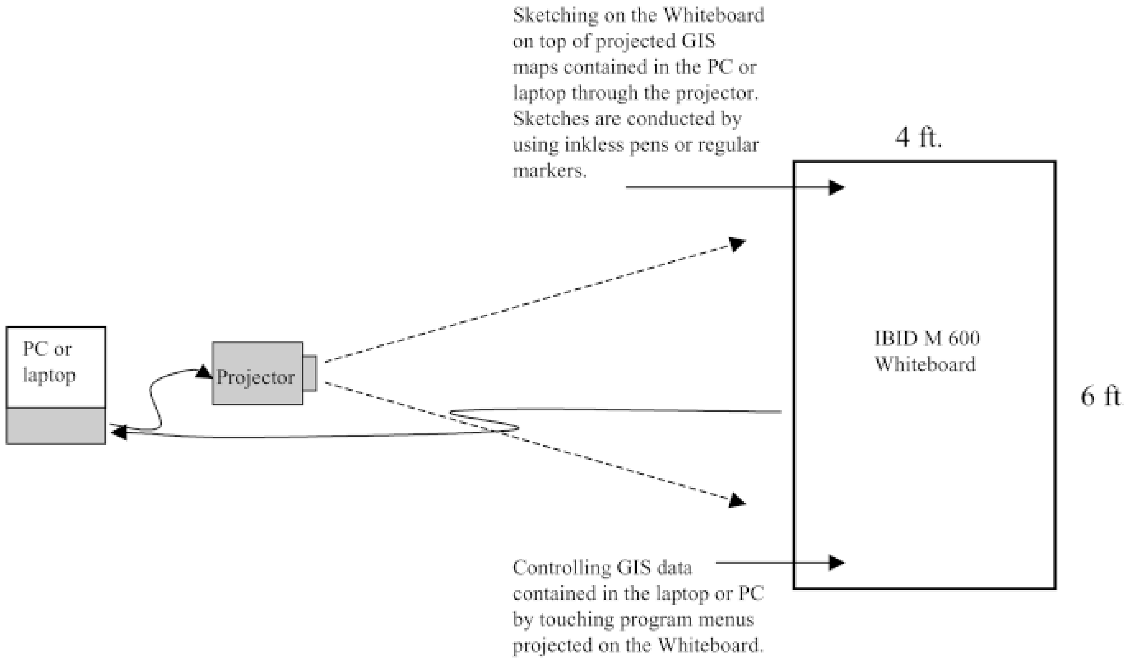

Figure 8. The setup for sketching on projected GIS maps on the Whiteboard.

Once consensus was reached that sidewalks were needed, the participants moved on to streetscape design. When the artist added tall trees, some community participants objected, saying that tall trees were not an option since there are hollow vaults under Pilsen's streets. Due to an elevation problem, the original sewer system had been built aboveground, and streets were built on top of the sewer lines in a vaulted structure. The community participants suggested plants for the design instead of trees. The artist drew beautiful sidewalk plant beds with heavy vegetation and greenery. Some participants objected to the heaviness of the vegetation due to visibility and safety concerns. The artist adjusted the scale and intensity of the vegetation in the sidewalk plant beds. In this instance, community residents' knowledge of the area's history and safety issues led to effective urban design solutions. The Web page (http://www.evl.uic.edu/sopark/new/RA/skeches.htm) shows artists' sketches. In a later stage, we animated the sketches to better represent the design evolution, sequence, and process (see http://www.evl.uic.edu/sopark/new/RA/GIF/pic.GIF).

Recently, a new version of the IBID Whiteboard became available, Model 600, by the same company in a bigger size (4 x 6 feet) and with a new feature called "screen projection" (http://www.foxgraph.com/). Computer images are projected on the board and by touching the menus (projected on the board), one can control the end computer-the touching function replaces that of a mouse (Figure 8).

As a result, one can sketch over projected GIS maps on the board as well as control the GIS database from the board. These capabilities may revolutionize charrette and sketch planning since they allow developing conceptual plans against GIS layers and data. The Whiteboard empowers traditional sketch planning that involves conceptualizing the groupings and connections of various individual elements in organization. For example, a bubble diagram can be overlaid on GIS layers to freely delineate geographic elements and show spatial relationships. Connecting arrows and lines and shading in overlapping areas are quickly sketched to define the interactions and relationships, whether hierarchical or parallel. These diagrams and sketches are useful in thinking through a problem, particularly in preliminary schematic sketches (Dandekar 1988). Figures 9 and 10 show sketching performed against multiple GIS layers of the North Lawndale community. As in the previous version, the Whiteboard output can be saved in graphic formats such as TIFF, GIF, or HTML for direct publishing on the Web.

Most recently, we have been inspired by another electronic board, mentioned by Hopkins et al (1999) called a SMARTBoard (manufactured by SMART Technologies, Calgary, Canada, http://www.smarttech.com/). We intend to use this board in subsequent participatory planning sessions. The Whiteboard surface can record the equivalent of Whiteboard markers as digital files to be stored, combined with other images, and printed. Hopkins used a version of SMARTBoard that supports the rear projection of images. The surface can be directly marked on with a felt-tipped marker, and both the marks and projected images can be manipulated digitally. The markers can also be used like a mouse to control a graphical user interface that is projected onto the board. While a basic GIS station is not accessible to the novice in a workshop setting, the sketchboard is accessible, as anyone can draw on it. Thus, in addition to facilitating sketch planning and conducting site analysis, we envision that the electronic sketchboard will empower participatory planning and design.

Figure 9. Sketching on projected multiple GIS layers. Douglas Park, North Lawn dale.

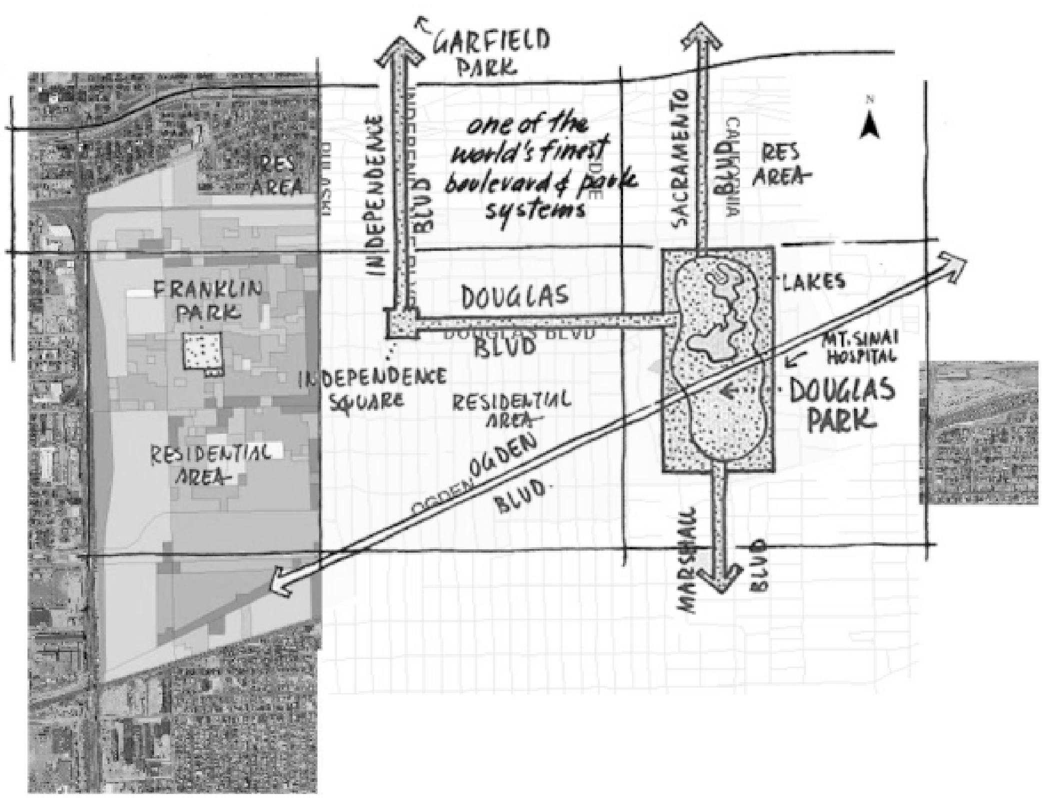

Figure 10. Sketching on projected multiple GIS layer maps of North Lawndale.

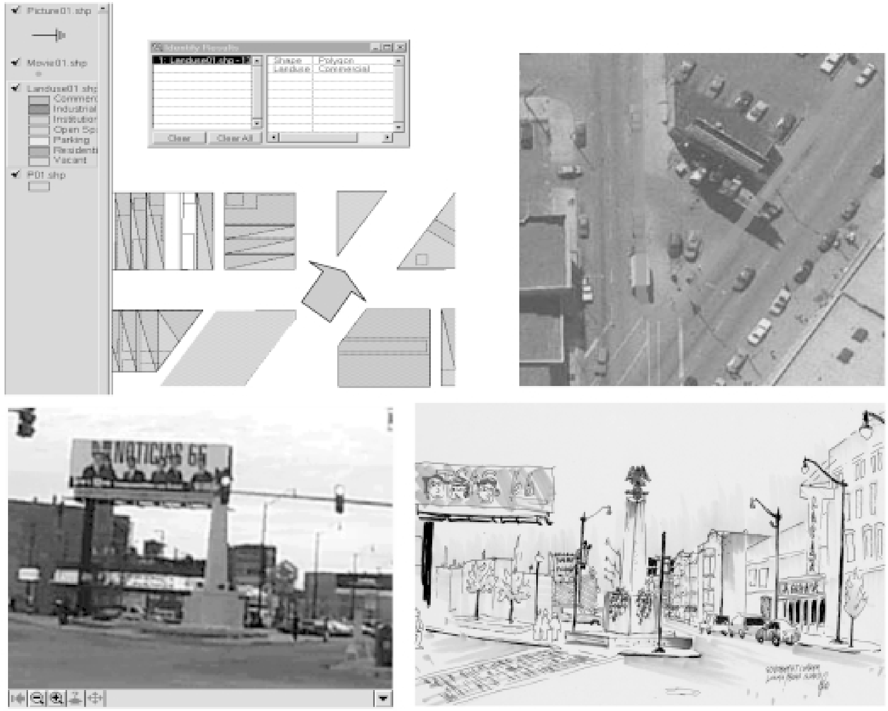

Figure 11. Documenting Pilsen's community design discussion through multimedia GIS. a) landuse map, b) aerial photograph retouched with PhotoShop software, c) 360 degree panoramic nodal movie with zooming capabilities, d) freehand sketches.

Customization and Multimedia GIS

In addition to the development of sketch planning methods, we have been integrating other emerging technologies within GIS. Along the lines of Shiffer's work, we have incorporated multimedia such as aerial photographs, maps, animation, movies, and sound into the GIS (Figure 11).

One powerful visualization tool is the nodal movie. For visualizing major nodes along 18th Street, the major commercial corridor in Pilsen, the team took a series of digital pictures of these locations with a wide-angle lens and a tripod and created panoramic movies. The panoramic movie files were constructed with Apple's QuickTime VR authoring studio. A total of 12 images per node were taken with a difference of 30 degrees. To encompass the whole area (360 degrees), the images were imported into the computer, retouched with Adobe Photoshop, and sewn together with QuickTime. By adding Avenue scripts, we were able to incorporate these nodal movies into ArcView GIS. These scripts enable ArcView to execute QuickTime Movie Player and load its movie file. Without the scripts, the hotlink function of ArcView cannot load a nodal movie or QuickTime movie. In order to play a nodal movie in ArcView, it was necessary to add proper Avenue scripts and QuickTime Movie Player.

Another way in which the images of nodes were displayed was the "four-directional view" technique. Digital images of a node were taken across from each corner. These images were then imported into a computer, retouched, and assembled along with the street layout using Adobe Photoshop. Similar techniques were used to illustrate edges, landmarks, and districts.

For visualizing a path, we animated hotlinked images of a particular path to create virtual movies along a street. They functioned as a brief "slide show" within the GIS. In one window we have photographic images of the street loading in sequence, and in another window we have a map with moving arrows indicating the location of taken shots. To view these and the above images refer to (http://www.evl.uic.edu/sopark/new/RA/). By using Java and dynamic HTML, the site mimics some of the GIS functions. It is meant to provide the viewer with an interactive experience similar to what was achieved in the workshops.

An additional effective way to augment ArcView GIS is linking maps to related Web sites by using Avenue scripts available from the Environmental Systems Research Institute (ESRI) ArcScripts site (http://gis.esri.com/arcscripts/scripts.cfm). The downloaded file executes the Web browser program (Netscape 3.0 or higher) and opens pre-defined Web sites when a user clicks linked features on the maps. This can supplement ArcView maps with relevant information in Web sites that we created for these communities. For example, the site http://www.uic.edu/depts/ahaa/imagebase/ created by the City Design Center has valuable information about North Lawndale, including Landmarks Division Survey Sites, Topographic Maps, Fire Insurance Maps, 1978 Aerial Photographs, 1996 Alex S. MacLean Aerial Photographs, and Brubaker Photographs. A direct link to the Web from ArcView takes tremendous advantage of the HTML document capabilities. Since the hotlink function of ArcView has limited capability for image presentation, this technique can be applied for demonstrating related images in a flexible way. Users should specify URLs on the attribute tables of the maps and have an active connection to the Internet for the Web links.

Finally, we have been working on customizing ArcView GIS to incorporate a partial turn on/off layer feature. Again, with Avenue scripts, we are attempting to create a sliding bar that allows turning on only one part of the active layer. As the bar slides, a corresponding portion of the active layer is turned on. This feature will substantially enhance overlay analysis as it enables focusing on just one portion of the layer that intersects with other layers underneath.

GIS and 3-D Modeling

In community planning workshops, it is desirable to quickly create future scenarios in a 3-D format. In South Lawndale projects, we did not find the ArcView 3-D Analyst to be helpful at conceptual design because it could not quickly generate 3-D images of what the proposed development would look like. It had geometric limitations and difficulty in representing more than simple boxes (e.g., it could not simulate pitched roofs or domes), and the program could not handle multiple Z values (Bernhardsen 1999). We then resorted to a 3-D software program called Trispectives, which enabled us to quickly create conceptual 3-D models. Trispectives (or IronCAD, the newer version) is a user-friendly software program that enables the construction of 3-D images by using a library of basic shapes and environmental design elements. It is also easy to adjust these elements in the 2-D and 3-D environments. The program employs features such as drag and drop, resize, a pop-up and drop-down menu, wizards, and has import and export capabilities. One drawback, however, is that the produced models are not sufficiently realistic. The following are two examples (a housing development and a commercial development in South Lawndale) that demonstrate the use of the 3-D software.

One project involved evaluating a housing development proposal called "Hermosa Gardens." The Hispanic Housing Development Corporation was to act as the developer of the project, which included 100 units of family housing. We took a site plan that had been created by an architectural firm and used it to create an animated 3-D model in Trispectives. Through the use of the animated 3-D fly-through, several serious design issues were discovered. As we flew through the model, we noticed that automobiles would not be able to go around the block within the community because the architect's design of the streets had two pedestrian crosswalks that blocked the road at two points of the development. This prohibited the easy flow of traffic. Cars would have to go outside of the development to get to the other side of the block. This can be easily overlooked when looking at the architect's site plan because the pedestrian crosswalks actually look attractive and appealing from a top-view perspective. However, one cruise around the block in the animated tour showed that this was a serious design flaw.

Another problem that participants discovered by using the virtual fly-through model was that the houses were positioned in an impractical fashion. Again, from a site plan perspective, the houses appeared to be arranged properly and in an orderly fashion, but when we toured through the prospective development using the animated model, participants had the feeling of walking or driving through an alley. As we flew through the streets, we saw garages rather than the front yards of houses. In order to create a sense of community, participants suggested that the houses should face inwardly, toward the park (rather than outwardly away from their neighbors), with smaller setbacks to the sidewalk that faces the street. Participants decided that garages should be eliminated from the plan altogether to create additional open space and to reduce the cost of each house. This would bring the pricing more in line with the neighborhood housing market, where the median family income is $32,539 and the average home value is $97,383. Instead of parking in private garages, residents suggested that cars park in the parking spaces provided across the street from each house. See http://www.evl.uic.edu/anu/upp502/movie.html to interactively view the fly-through, the helicopter models, and other 3-D models created for the proposed development (Figures 12 and 13).

In another recent project, a higher degree of involvement was achieved. After training a few active community members in

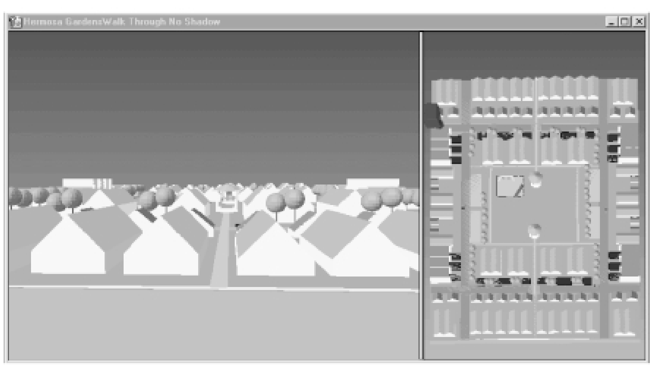

Figure 12. Using Trispectives to create conceptual design of residential development in South Lawndale (Little Village). Conceptual design is performed in 2-D and 3-D environments simultaneously.

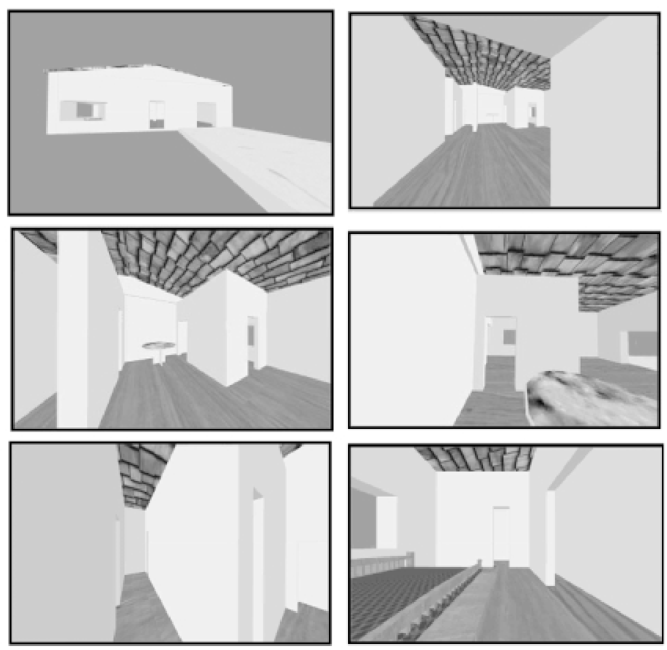

Figure 13. A virtual tour of the interior of a housing unit for the residential development in South Lawndale (Little Village), created by using Trispectives program software.

the use of the 3-D software, the UIC team and residents collaboratively created a 3-D digital model. Community residents received a total of 8 hours of training on the use of the software (four sessions of two hours each). In this project, called "Plaza Mercado," participants created a model for a mixed-use development for a deteriorated area of the community. The proposal for the site included 104 single-family houses, 65 townhouses, 10 two-flats, two elderly-housing buildings, a public school, a community center, a retail shopping center, open space (parks, greenways, plazas, and fountains), and 1270 parking spaces. They inserted ready models from the software program's library, including schools, elderly-housing buildings, and town houses. These models can be navigated in real time so that the user can view the object from all angles before deciding to include it in the master plan. After the 3-D model was completed, the participants added animated views (walk-throughs and fly-throughs) of selected paths in the development to show various elements, particularly the retail center. Animations and motion pictures were illustrative as well as engaging, necessary ingredients for public participation. It was helpful to visualize the masses, volumes, compositions, and layouts. However, as mentioned earlier, this kind of program suffers from a lack of showing details and realism. Since this model has a high level of abstraction, it cannot be used in the next stages of design development that deal with finer design details (Figure 14).

Involving Participants: Hands-on Traditional Techniques

Despite the powerful features of GIS, electronic sketchboards, and digital 3-D modeling, some community participants commented that the high-tech set up hampered the social function of these meetings. To address this and to further foster participation, we resorted to the use of traditional tools: pens and large printouts of GIS maps. We conducted several hands-on exercises such as "coloring the map" using large paper maps. This technique was inspired by the work of McClure (1997) who argued that this technique, and others like it, help citizens to visualize and communicate what they want their community to look like, to create alternative solutions to a particular design problem, and to identify desirable and undesirable community qualities. The "coloring the map" technique was used to further learn about the residents' likes and dislikes. Participants were broken into small groups and were given a map and felt-tipped markers. Residents recorded their opinions and preferences by marking in green those things that they felt were good, features that should be protected or built on, and marking in red things that they saw as problems or liabilities. They also used maps to indicate neighborhood boundaries and landmarks, the location of landmarks, paths, activity centers, and the like. They were also encouraged to write miscellaneous comments directly on the maps. This gave them an opportunity to read these maps at their own pace and write in their comments. These maps become resources for suggesting unique changes to the community (see also Jones 1990).

GIS and the Internet

The employed traditional and computerized tools were accessible only to individuals who attended the meetings. Often, local residents do not attend these meetings due to a lack of time, schedule conflicts, and lack of motivation. A partial solution to this problem may be found on the Internet. The Internet opens up exciting possibilities for empowering more people to become involved in community-level planning. Kingston (1998) viewed the Internet as a critical opportunity for extending and complementing GIS for community development and planning. In this

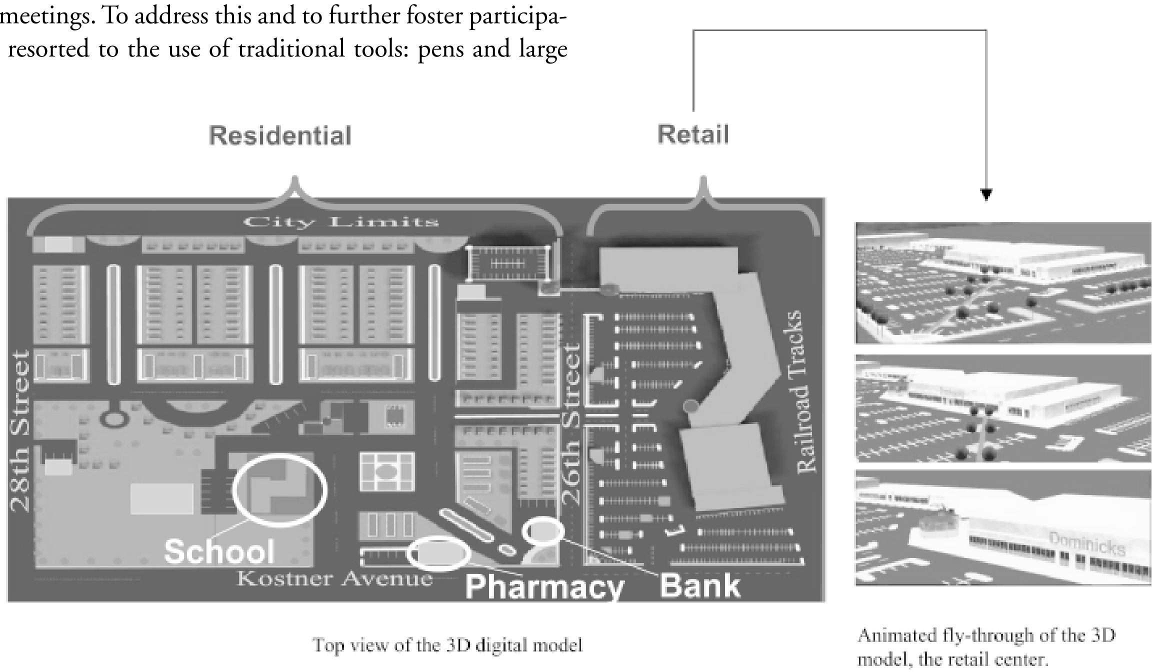

Figure 14. Using Trispectives software to create conceptual design of Plaza Mercado, a proposed mix-use development in South Lawndale (Little Village).

way, GIS information and analysis can be accessible to a larger population. There are three ways in which we are beginning to use the Internet to extend GIS capabilities in community planning: an Internet Map Server, a Web site for graphically displaying community information, and Web surveys.

One form with which we have experimented is using the Internet Map Server (IMS) for ArcView GIS. The IMS is a relatively new product by ESRI to empower users to tap into a remote GIS database and is interactive, as it allows users to perform basic GIS functions without the need to have necessary GIS software or hardware on the users' computer. For example, users can overlay layers, click on a parcel, and get information about it in tabular format including ownership, value, taxes, and dimensions. In addition, via IMS, users can perform basic functions such as zooming in and out. Currently, the City Design Center at UIC is using IMS in community work with North Lawndale (see http://131.193.154.228/ and http://e036.cuppa.uic.edu/ims/north-lawndale/index.html). The aim of this project is to design and implement an easy-to-use Internet-based GIS providing community organizations with basic information about properties, building conditions, and land use that is central to their work. Currently available for test purposes are the parcel map, the street network, property assessments, historically significant buildings, aerial views, and generalized land use.

A second way that we have been using the Internet and the World Wide Web in particular, is displaying the outcomes of the workshops in an engaging manner (same place/different time participation). In this way, residents can view results of discussions and recommendations in a visually rich and easy-to-understand format at a time of their choice. Our Web sites are increasingly becoming a place for residents to learn about their community. Community-based organizations are very supportive of this endeavor. This can be useful for sharing meetings' results because many cannot attend these meetings (see http://www.evl.uic.edu/sopark/new/RA/skeches.htm, and http://www.evl.uic.edu/anu/upp502/movie.html).

A third way in which we are beginning to use the Internet is to conduct surveys on the Web. We have done two projects where we have used an Internet map tool to survey residents on the "likability" of their community (areas of their community that they like and dislike) and then incorporated the results into a GIS database (Al-Kodmany 2000) (see http://g015.cuppa.uic.edu/gridFeedbak/final/index.html). Others are beginning to use the Web in this manner as well (see, e.g., http://www.hillsborough-nj.org/survey/).

Discussion: Limitations of GIS in a Community Planning Process

Many scholars argue that GISs are becoming increasingly suitable for community planning (Myers et al. 1995, O'Looney 1997, Bosworth and Donovan 1998, Craig and Elwood 1998, Elwood and Leitner 1998, Obermeyer 1998; see also http://www.ncgia.ucsb.edu/varenius/ppgis/papers/index.html and http://www.upa.pdx.edu/IMS/psuhome/psuhome.html). Research shows that the use of GIS technology at the neighborhood level has been increasing at an enormous rate since 1995. This is a result of lower costs of GIS hardware and software, making it possible for more citizens and citizen groups to use or own a GIS. Additionally, more local governments are providing some level of public use of GIS equipment, or the co-development of GIS products, applications and displays.

In spite of these positive indicators, this paper seeks to inform community based organizations that want to adopt GIS of its limitations. Based on our experiences with three communities, we describe five major limitations and our attempts to respond or "fill the gaps."

It is Difficult to Find Useful GIS Data for Community Planning

For most community GIS projects, finding relevant local data is a major issue (see Michael Barndt, http://www.ncgia.ucsb.edu/varenius/ppgis/papers/index.html 1998). For the typical community, there is no source for a comprehensive data set, this puts strict limitations on analysis and planning, since GIS software is useless without the necessary data. We found that residents' questions and concerns were often beyond the available data and mapping capabilities of GIS. In order to respond effectively to residents' concerns, a tremendous amount of mapping should take place which, in many cases, is not affordable.

In both the Pilsen and North Lawndale communities of Chicago, participating community organizations have a goal to build "comprehensive" GIS databases of their communities independently. This will require too much additional information on environmental issues, infrastructure and utilities, water and sewer facilities, crime incidents, planning and zoning activities, and some social locations (such as community gathering places, and locations of public art) that address the "quality of life" issue. In the future, additional field surveying is needed, with the purpose of gathering information that is not readily available. For instance, additional interviews need to be conducted with community organization leaders and residents in order to discuss their understandings of new GIS applications and relationships between maps and data. Following GIS projects in Milwaukee neighborhoods (Myers et al. 1995), we envision addressing other issues, such as determining feature codes, symbiology, attribute definitions, and local codes, laws, and standards, in order to facilitate the much-needed coordination of efforts between the various "players" in the communities.

The structure of the data must be re-evaluated. The fact that considerable GIS data are structured geographically by census tracts presents a problem when interacting with a novice audience. Census tracts do not mean very much to local residents because most people do not mentally organize their community in terms of these arbitrary boundaries. The spatial unit of a census tract must be translated into more meaningful and intuitive geographic sections that fit with residents' daily experiences in the neighborhood.

Another area for future work is the need to analyze the kinds of data that are included in the database. For instance, the UIC team realized that residents' mapping wish list focused on the negatives of the community and that the positive aspects and assets should also be mapped. The Neighborhood Mapping Project in Philadelphia, Pennsylvania (O'Looney 1997) is a good example where planners mapped the location of residents who have skills, talents, interests, and hobbies, and who are willing to assist their neighbors. Strength-focused assessments represent an improvement over traditional community assessment processes and, in the hands of creative community organizers, they can be much more powerful. Community asset maps can be used to match families who have particular skills and knowledge with families who need such knowledge and skills, and families who have goods or services can provide them to neighbors who need these services.

Finally, in addition to the challenges of constructing the GIS database, there are many practical issues to be considered, such as handling the gigantic size of the database, data ownership, storage, maintenance, and updating. Any mapping at the parcel level is a continuous and arduous process. Updating the GIS involves updating the geometry (graphics) as well as the tabular data. Parcel level maps, in particular, are never finished and require constant updating to keep pace with cadastral transactions. While a city government such as in Chicago collects this information, they are not yet making it accessible to the public. The content and the size of the database will have a significant impact on the design of the overall system and should be thoroughly examined in the user needs analysis process. Improper database design can have a negative impact on the planning and design process.

GIS is Limited for Doing Conceptual Planning

Our findings agree with Hopkins et al., who concluded that "current computing systems that support planning do not support sketch planning" (1999, p 1). The problem with using computers at this stage is the ill-structured nature of planning problems and processes. "Ill-structured processes are the primary bases from which planning support systems can and should be designed. Ill-structured implies sufficient structure to benefit from experience of similar situations, but insufficient structure to resolve by a process that is completely defined in advance" (Hopkins et al. 1999, p 1). Computers including GIS require a well-defined process that is usually lacking at the beginning of a community planning and design endeavor.

In the conceptual stages of planning where rapid descriptions of ideas are required, sketching is the only way to proceed. Sketches allow constant modification and elaboration and they allow participants to conceptualize complex scenarios. Ideas can be recorded for future consideration, as well as recorded as a means to communicate with other individuals and with computers. Presently computers do not support sketch planning purposes and activities. Trying to rely solely on computers at this stage may limit the process of exploration, problem-identification, and solution finding, particularly in planning where problems are ill structured.

The strength of computers, including GIS, continues to lie in amassing and organizing vast inventories of information and outputting spectacular presentations and detailed production drawings. However, computer interaction "goes to zero" at the concept stage because available software is not yet able to emulate the tactile flexibility that enables a designer to search for form with a pencil on a sheet of tracing paper. It is best to get at least some working concepts on paper. This return to "hand-and-eye" methods demonstrates that the use of the computer is not always appropriate. It also calls for the need to develop more "intuitive" software that simulates the way in which designers use traditional media. Thus, new computer tools must be more flexible and versatile to effectively assist in conceptual planning and design. We view the electronic sketchboard, as demonstrated in this paper, as a step in this direction.

The importance of traditional tools (i.e., pen and tracing paper) for generating planning and design ideas is reflected by the recent experience of landscape architects at the The American Society of Landscape Architects (ASLA) Annual Convention in Cleveland, Ohio. In a 1996 article in Landscape Architecture, William Thompson explained how in a 3-day design charrette, five teams of computer-savvy landscape architects demonstrated computer sophistication and the persistence of traditional design media simultaneously. All teams used both traditional and computerized media to create a vision for a 5-acre industrial site that is currently being used for dumping. Thompson commented, "If inventory and analysis demonstrated the superiority of computer applications in certain areas, design development demonstrated precisely the opposite. During the search for design alternatives every single team turned its back on the computer and reverted to pencil and tracing paper" (1996, p 41). Furthermore, scholars such as King et al. (1989) assert that freehand sketching is a prime method for communicating with lay participants. They argue that on-the-spot sketching is an architectural technique with several purposes: it provides participants with an entry into the design process, it promotes dialogue, and it provides accurate design data afterward.

GIS Lacks the Capability to Quickly Generate 3-D Representations of Proposed Scenarios

In our project, as is the case in typical neighborhood planning, it was crucial to illustrate the existing context and multiple variations of proposed developments to participants in a 3-D format. To meet this need, we utilized 3-D modeling software, which worked well in a workshop setting for giving the participants a quick idea about a proposed development and for identifying spatial and site design issues that are not discerned or communicated by 2-D maps. It added important capabilities to the designing process, and the selected software program was fairly easy to use. In Trispectives (IronCAD), unlike 3-D GIS, the user does not have to draw each line and specify each point with associated data to move to the next level of extruding 3-D models. Instead, the user starts immediately in 3-D and explores designs in this environment. This is helpful to quickly test conceptual designs in 3-D space. The tool allows residents to better conceptualize proposed developments. A drawback, however, is that the program lacks realistic rendering capabilities. The 3-D models generated by the program have a high level of abstraction, which is useful for visualizing the massing, although not the details.

GIS is Difficult for Non-experts to Use

Present "user-friendly" GIS programs are actually not so friendly, as they require substantial skills and expertise to operate. GIS programs, on their own, failed to engage the novice in the planning process. This is a critical issue in a process where public participation is a primary goal. Even when ArcView training was offered prior to workshops, the novice could not use it. ArcView commands are designed for a person who has already developed good geographic thinking and analysis capabilities. To correctly perform a function, the user must already possess knowledge about geography and a fair amount of training on ArcView. It is not as simple as just "pushing a button." The Graphic User Interface could be redesigned to become more intuitive. For example, the required multiple steps could be replaced with "short cut" buttons. Additional intuitive ways to navigate and interact with the data and maps are needed.

A related concern is that a high-tech setup can create a division between the computer literate and illiterate due to multiple reasons. First, people who are less familiar with computers may feel intimidated and view those who know how to operate machines as "being in control" of the discussion. Second, appropriate design and layout and accommodations for electronic equipment (e.g., projection considerations, wires, and Internet connection) evoke a formal, technical atmosphere. In contrast, the only tools needed for a low-tech setup are tables and chairs. There is more freedom in re-arranging these simple elements and no concerns about locations for wires, projectors, computers, and other equipment. The simple table and chairs arrangement may foster more casual interaction among participants. For example, during discussion, if someone wants to move from one location to another in order to point to something on the map, there is concern about about stepping on a wire or blocking the projection. Based on the above observations, we decided to hold the latest meeting in a restaurant, the Nuevo Leon, located in the heart of Pilsen. We brought in maps, pictures, and other materials and discussed issues. Participants enjoyed the discussion as well as the food. Such a causal atmosphere proved to be more relaxing and conducive for public participation. Also, this activity drew the attention of restaurant's customers and staff and played as a self-advertisement, motivating more people to participate in future projects.

Residents Cannot Make Use of the Data Outside the Workshop Setting

Even when GIS software becomes very intuitive, there will be a question of accessing the data. Since most people in the community cannot attend meetings and do not own GIS hardware or software, they are unable to interact with the data outside of the structured workshop setting. One way in which we are trying to overcome accessibility issue is by using the IMS, as described above. The IMS allows community members to access data at any time from computers that do not have GIS programs installed . One drawback of this technology at the present time is that it is quite slow, particularly if you are working through a modem. It takes time to call layers through phone lines. Another drawback is privacy, since any person would have access to the information present in the GIS database.

Conclusion

Based on practical experiences in three Chicago communities, Pilsen, North Lawndale, and South Lawndale, this article describes key challenges in effectively utilizing GIS in community development. We focused on the problem of locating relevant local data and the limitations of GIS software as a planning tool, particularly in terms of sketch planning and 3-D representation. We described some approaches for using GIS to meet the needs of the community and for combining it with traditional tools and advanced technology in a university-community collaborative planning process. The basic tool of a community GIS, with its sophisticated mapping and visual display capabilities, assisted participants in visualizing spatial data, distributions, clusters, and patterns of variables. However, it had some significant limitations that led us to incorporate several complimentary techniques. Our adaptations of GIS are related to two categories of issues: the GIS data, and the functionality of GIS as a planning tool.

GIS Data Issues

A local GIS may lack key information for reasons such as the data do not exist or are prohibitively expensive, the community-based organizations' desired data list is large, available raw data is only available in an incompatible format, and electronic storage space for the data is insufficient. A second problem is that the data available with traditional GIS does not contribute to the participants' ability to visualize geographic locations. We found that incorporating a multimedia image database into the GIS enhanced its spatial analysis capabilities and enabled planners and participants to understand the physical context of the community. The multimedia photographic images (aerial photographs, maps, movies, and photos) assisted participants with recognizing locations and associating their knowledge and experience of those locations. This ability of planning participants to geo-reference images within GIS (i.e., link images to their specific geographic locations) is crucial because it simulates the activity of human cognition and memory, which requires constant geo-referencing of images in the brain.

GIS as a Planning Tool

We determined that there were points in the design process when the GIS was indispensable, such as viewing spatial distributions (homes with tax delinquencies, areas with new housing development, rent levels, etc.) and, for example, viewing the overlaps between car-pedestrian accident sites and streets with and without sidewalks. However, GIS was not helpful for quickly testing ideas and scenarios in 2-D and 3-D as required in the conceptual design stage of planning. In the community design workshops, we found that GIS was not appropriate for sketch planning and, more generally, that computers are not usable as design tools given the current technology. We found that the best solution to the problem of the inability of GIS to allow quick sketching of ideas is to complement GIS with use of an electronic sketchboard. The sketchboard allows drawing and quickly sketching thoughts and ideas on GIS maps. Participants could use the sketchboard as well as planners, and everyone could view the emerging designs on the projection screen.

We also found GIS to be too unfamiliar and difficult for novices who were hesitant to freely interact with a computer system. After evaluating the initial series of workshops and concluding that a more hands-on participation was needed, we incorporated exercises in later workshops where residents could draw on the electronic sketchboard and on paper maps. The "color the map" technique allowed community residents to physically participate and have personal involvement in the evolving designs.

The problem with the limited ability of GIS to represent designs in three dimensions was addressed by the addition of 3-D modeling software. This tool enhanced public participation in the workshops by helping community members to analyze existing and proposed development scenarios. In a recent project, community leaders were trained in the use of a simple 3-D modeling software program and empowered to create their own digital model for the development of a deteriorated site in the community.

Participatory design is a complex undertaking intended to encourage the best design solutions possible for any given situation. It requires creativity, flexibility, and experimentation to discover a process that structures but does not inhibit the participants' creativity and input. These case studies presented several ways in which GIS could be used to meet the needs of the community, as well as ways to combine GIS with traditional tools and advanced technology. By experimenting with the convergence of people and technologies, we were able to find an appropriate mix of activities and technologies to fit the resources and needs of these communities. While there are a growing number of case studies and articles relating to GIS in community planning, the need to share experiences and build on the work of others persists. The demand for GIS in the grassroots is growing as the technology becomes more user-friendly and becomes more widely recognized by the general public. We hope that the experiences described in this paper will assist others who want to pursue similar endeavors.

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Dr. Kheir Al-Kodmany has been an Assistant Professor at the University of Illinois at Chicago since 1995, where he teaches urban design, physical planning, geographic information systems and urban data visualizations. Previously, Al-Kodmany worked for the company of Skidmore, Owings & Merrill in Chicago where he designed projects in the U.S., Europe, and the Middle East. Al-Kodmany's recent research focuses on reshaping planning and design through powerful computerized visualization including Geographic Information Systems, 3D modeling, Hypermedia and Virtual Reality. Al-Kodmany advances foundational urban design theories and integrates multiple traditional and computerized visualization tools to inform urban planning decision making processes and to enhance public participation. The author may be contacted at: University of Illinois-Chicago College of Urban Planning and Public Offices, 412 South Peoria St., CUPPA Hall, Chicago, IL 60607; 312-413-3884; khein@uic.edu

Acknowledgments

I would like to thank Whitney Dahlman-Oeth (a writer and planning consultant) for her help in preparing the manuscript. The author also wishes to thank the following students who helped in this project: Gina Caruso, Kelly Clarke, Vince White-Petteruti, Russell Pietrowiak, Dejan Milenkovic, Mike Schwarz, Tracy Lainer, Carlos Hernandez, Aisha Shirzi, Sakina Saulath, and Snigdha Srivastava. Furthermore, I would like to thank Derek Lee, Kim Schaffer, Javid Ali, and Tania Kadakia for useful comments. Finally, I would like to thank Albert Schorsch (CUPPA's Associate Dean and Director of GCUDV), Dong-Han Kim, Anupreet Kalra, and Soyan park (Research Assistants), and Diane Farley (the City Design Center coordinator) for their tremendous help.

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