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Using visualization techniques for enhancing public participation in planning and design: process, implementation, and evaluation

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Abstract

This paper describes three different visualization tools employed during a participatory planning process in Chicago's Pilsen neighborhood. These tools were used during different phases of the planning process to encourage maximum public input and participation. In the initial neighborhood design workshops, a Geographic Information System (GIS) was used in tandem with an artist. The GIS provided the planning team with interactive visualization of the neighborhood through maps and images. The artist provided an avenue for residents to actively participate in the design creation by quickly capturing ideas and discussions into sketches. In later workshops, a third tool, computer photo-manipulation, was introduced. This technique allowed participants to view photorealistic examples of proposed design prototypes that were seamlessly placed into photographic images of the neighborhood. Each of these tools was highly effective in promoting resident participation in the planning and design process. We found that the three visualization tools were appropriate for different phases of the planning process. Freehand sketching and the GIS were most effective for problem *identification* and brainstorming, while photo-manipulation using computer imaging was most useful for exploring solutions to *previously-defined* design issues.

Keywords: GIS; Artist; Photo-manipulation

1. Introduction

The benefits of broad-based community involvement in planning and design are widely documented; they include enhancing the capacity of citizens to cultivate a stronger sense of commitment, increasing user satisfaction, creating realistic expectations of outcomes, and building trust (e.g. Altschuler, 1970; McClure, 1997; Sanoff, 1978, 1991; Smith, 1993; Towers, 1995). Charles Moore argues that community participation has an enlivening effect on design and that energies of individuals and the community as a whole strengthen design. Others state that community architecture has the promise of 'good design' because it meets the requirements of users, fulfills their lifestyles, and carries the essence of their desires and expectations (Wates, 1985). Furthermore, the Regional/Urban Design Assistant Team (R/UDAT) in the US and the Royal Institute of British Architects

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(RIBA) in the UK believe that public participation in planning and design allows planners and designers access to community expertise and local knowledge, which invariably produces better plans and designs.

In *Co-Design: A Process of Design Participation* (1989) Stanley King and his co-authors (King et al., 1989) suggest that visualization is the key to effective public participation because it is the only common language to which all participants—technical and non-technical—can relate. Visualization provides a focus for a community's discussion of design ideas; it guides community members through the design process, it raises their design awareness and facilitates better communication. Several planners have developed and described effective participation techniques using hands-on methods (Sanoff, 1990, 1991; Nelessen, 1994; McClure, 1997). However, the latest advances in computer technology provide a unique opportunity to use digital visualization techniques to change and enhance the way the public interacts with design.

This paper seeks to build on the work of other scholars who have explored the use of traditional and computer visualization techniques in participatory planning. In 1998, planners and designers at the University of Illinois at Chicago joined forces with residents and other stakeholders in Chicago's Pilsen neighborhood to implement a participatory planning process. Three methods of visualization were used in a series of design workshops—a Geographic Information System (GIS), an artist using an electronic sketchboard, and computer photo-manipulation. In early workshops, the GIS and the artist were used together, while in the later workshops the computer imaging technique was used alone. These visualization tools greatly enhanced the planning process by allowing participants to directly participate in the design of their neighborhood. This paper will review each visualization technique in detail and describe how each tool was used to elicit public participation and input. It will also evaluate the strengths and limitations of the three tools in the planning process.

2. Using visualization techniques in a community planning process: background of the Pilsen community

Pilsen is a largely Mexican-American and Mexican immigrant community of nearly 50 000 people which is located immediately adjacent to the University of Illinois at Chicago (UIC). The shared history of UIC and its neighbors includes not only the displacement of homes and businesses to accommodate the University's need for expansion, but also large, well-publicized, and eventually discontinued community service programs. These issues have created a nearly universal distrust of the University in Pilsen. In recent years, however, UIC faculty and staff have been working to rebuild trust with their neighbors through cooperative community planning and design.

Leaders in the Pilsen community expressed an interest in a participatory, collaborative approach to the planning and design of their neighborhood. A particular focus was 18th Street, the neighborhood's main commercial district. Leaders were very interested in promoting commercial tourism along this business corridor, while at the same time addressing problems such as urban blight and decay, vacancies and crime. Eighteenth Street Development Corporation's (ESDC) leaders requested UICs assistance to develop strategies to revitalize the commercial district in Pilsen on 18th street. A $500 000 Empowerment Zone grant was awarded to ESDC to finance infrastructure and facade improvements designed to promote tourism, promote neighborhood stability and vitality, and to purchase and rehabilitate of an existing neighborhood commercial building. Community leaders were anxious to harness the creative energies of residents as a way to foster the enthusiasm required to take serious actions and improve the neighborhood. Leaders felt that the meaningful involvement of all stakeholders—including the technical experts at the University of Illinois—would strengthen the sense of community and that a cooperative effort would help present a 'unified front' when other funding opportunities arose. A planning team was formed that included 25 community residents (including representatives of the 18th Street Development Commission), and, from the University, two architects, two planners, and one artist.

The University team's objectives included creating a mutually respectful partnership with neighborhood residents, preserving neighborhood history, providing a broader understanding of urban issues, and exploring effective visual communication methods. Building trust was the highest priority in the planning process. One of the first lessons that the University team would

learn was that effective visualization was a key to engaging residents.

3. The failure of traditional planning tools to engage community residents

In his book *Participatory Desing*, Henry Sanoff (Sanoff, 1990) writes that currently employed methods of user participation actually disenfranchise the user because the methods of communication have not changed to accommodate a non-design oriented population. This was true in the case of UIC and the Pilsen community. After a short period of involvement, University design professionals realized that the presentation and visualization techniques at their disposal were not promoting meaningful public participation.

At the first working session, dozens of slide images of the neighborhood were presented to display current site conditions. Slides were set and presented in a fixed sequence. As the discussion moved from the project introduction to the design development stage, no interaction between the present conditions of the neighborhood and the potential developed future images was available. In addition, because a slide projector lacks navigation capabilities, the images were not readily available during the design discussion. When participants requested a specific image, it was impractical to search for it in the slide tray. Similarly, when the artist and the planners asked for specific images to help them remember contextual details of the site, the images were inaccessible. The process lacked a means of visualizing what was being proposed within the context of what currently existed. Long-time community residents became overwhelmed trying to remember small details of specific sites, rather than applying their community knowledge and expertise to develop overall strategies and solutions. Planners, architects and the artist also grew frustrated with the limitations of the design process (Al-Kodmany, 1998).

Lynn McDowell (McDowell, 1987, p. 20) argues that "the public needs a language that can give its creativity a focus and help individuals turn their intuition and knowledge into a workable idea." It was clear that the technical experts needed to develop an interactive visual 'language' that would enable all members of the planning team to fully participate in the process. The UIC team began searching for a visualization environment that could effectively link proposed design alternatives with their physical context. A visual connection between the context and proposed design had to be established so that citizens could participate to the fullest extent possible.

4. The Geographic Information System

The first tool to be developed was an interactive GIS image database. With ArcInfo software, University planners developed a database that consisted of maps and tabular data mainly at the parcel level for the Pilsen neighborhood. The GIS database contained information about Pilsen including: demographic (race, age, income), transportation (traffic volumes, traffic patterns, bus routes, sidewalks); housing and property information (type, condition, property values and zoning); economic (existing business and employment), historic (designated historic districts and landmarks) and crime statistics. Historic maps included the Robinson Fire Insurance Map, and 1978 aerial photographs. A 1996 aerial photograph, landuse map, and base map were added and scanned as raster images. About two dozen layers were generated. In the ArcView environment, images showing the current neighborhood characteristics were hot-linked, respectively, to the base map. Additional images showing the existing conditions of the 18th Street Corridor were also hot-linked to the parcel map of the street. Finally, few historic images, available through UICs collection, were hot-linked to the fire insurance map. The total number of images in the database was about 2000.

5. The artist

The GIS provided critical contextual information, such as maps, demographics, and images. However, this technology needed to be supplemented with human drawing capability that could quickly transform ideas into realistic drawings. The UIC artist was trained to draw urban scenes including streets, parks, plazas and retail areas, as well as landscape and detail elements such as shrubs, street signs, benches and chairs. She also depicted human activities in her

sketches, to bring a human scale to the drawings. With a few lines, this artist could capture the salient features of an image. The original photographic image was always available, but the artist reconstructed the scene according to the participants' wishes and concerns, capturing the group's multiple perceptions. While the artist provided a more human element to the process, this technique also relied on computer technology. She used an electronic sketchboard—an easily erasable drawing board, or white board, from which sketches could be saved as electronic files in a graphic format, such as a TIFF or JPEG, and then transferred to a zip drive.

The artist annotated the sketches with written notes and arrows to call out information. She also developed the habit of recording people's non-visual comments (e.g. sounds, smells, feelings, meanings) and suggestions in the margins of the drawings. In addition to recording non-visual concerns, notes helped to record fine details, such as the texture of surfaces, that the artist did not have the time to dwell on. Also, the artist drew larger sketches of particular items (blow-ups) in order to show more detail. She showed the relation of the large sketch to the original sketch by drawing a connecting line between the two. Collectively, these sketches communicated the audience's concerns and visions in a clear and simple fashion. The notes complemented the visual image and provided a more complete description of the ideal environment that people were imagining. The annotated sketches were saved and later printed out and displayed in the community. The pictures were electronically stamped with the date and time, so those who could not attend the meetings could look at the sketches and comments and reconstruct the flow of the conversations.

6. Implementation of first two visualization tools (GIS/Artist)

These two tools were used in the first phase of the design process. Workshops were planned for four consecutive Saturdays, from 9 a.m. to 5 p.m. at a church in the Pilsen neighborhood. Equipment for the planning workshops included a computer, the electronic sketchboard, two projectors, and two large screens. The two screens were set up side by side with the artists' sketches projected onto one screen and the GIS images projected onto the other. The positioning of the screens allowed for cross referencing for both the artist and the participants. The GIS screen showed images of the existing condition of different areas of the community, or the 'before' scenario. The artist's sketches showed potential design solutions, or the 'after' scenario. The parallel positioning helped keep the artist and the residents in check with reality, ensuring that the emerging drawings were practical, applicable and relevant. Together, the artist and the GIS image database reinforced each other in creating a common visual language. The method allowed residents and other key stakeholders to be actively involved in the development of the design plans, rather than simply reviewing a final plan.

Sanoff (Sanoff, 1990, 1991) writes that many environmental problems requiring technical guidance can best be solved through the active participation of those affected by the design decision. In the case of the Pilsen planning process, the GIS and the artist working in tandem had the effect of 'leveling the playing field' between university planners and designers and the community. Residents truly became co-planners and co-designers in the process. A few examples illustrate how the visualization tools of the GIS and the artist were able to build consensus and to draw out local knowledge, which was critical to the planning process. The planners relied on the residents to learn the community's cultural values, history, and context.

One issue that arose was the lack of sidewalks in Pilsen. Some residents expressed a strong desire for sidewalks; 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, highlighting them in bright yellow. Interestingly, the cluster of yellow matched the location of pedestrian/automobile accidents that appeared on a separate GIS layer. As mentioned earlier, electronic layers contained maps and information about the site, particularly 18th street.

To further examine the issue, the UIC team browsed images of streets. One picture showed school children entering and exiting their school and walking on the street alongside cars. Another picture showed how some sidewalks were too small in the busy retail areas.

These sidewalks were jammed with people, and pedestrians were encroaching on the right-of-way. Other pictures illustrated the deteriorated condition of the existing sidewalks, and as a result, pedestrians did not use those sidewalks. Instead, they used the right-of-way. The images showed that the elderly and disabled had a difficult time getting around the neighborhood; one picture actually showed a blind person attempting to walk along the cars.

As a result of the maps and images, business owners became more supportive of sidewalks as they learned that they would facilitate better access to their businesses. Parents became more supportive as they learned that sidewalks would protect their children from traffic accidents. The community became more sensitive to the needs of their disabled population. These processes led to the collective agreement on the necessity for sidewalks as a top priority. The method helped identify important issues and build consensus. In this example, the visualization tools helped residents reach an informed decision about an important safety issue.

A second example illustrates how residents interacted with the artist to improve community design decisions. In sketching a major thoroughfare, 18th Street, the artist added tall trees. One resident objected, saying that it is impossible to plant trees because of the hollow vaults under Pilsen's streets. Due to an early elevation problem, the original sewer system was built above ground, and streets were built on top of the sewer lines in a vaulted structure. The community participants suggested shrubs and small plants along the streets instead of tall trees. In this instance, community residents' knowledge of the area's history and safety issues led to effective urban design solutions and the artist helped to draw out this knowledge. Planners and designers who did not live in the neighborhood would not have necessarily known about these issues and could have made uninformed decisions.

The above examples illustrate the effectiveness of the visualization environment in drawing out local community knowledge. The interactive maps and images enabled participants to immediately understand and visualize community data and then come to a consensus. The sketching activity allowed participants to see that the artist listened to their comments and immediately incorporated them into the design. Consequently, participation in the design process was enhanced.

7. Computer photo-manipulation: the third visualization tool

After the four Saturday workshops, a second round of 'advanced' workshops was held to further explore the issues that had been raised in the previous sessions. The artist's sketches of participants' ideas were used as a starting point for doing computer-aided photo-manipulation. The goal was to assist residents in evaluating design changes by realistically depicting what design elements would look like when placed into the physical neighborhood context.

To prepare for the advanced workshops, the UIC team identified physical design elements that had been discussed in the workshops, such as façade designs, streetlights, trash cans, benches, landscaping, etc. They collected digital photographic images of these objects and imported the files into computer imaging programs, organizing them into a digital library. Using a variety of software packages, primarily PhotoShop 4.0, the design team then modified the images to more closely represent the type of design elements that had been suggested by the community residents. Then, the images were added as layers to original photographic images of neighborhood sites. These layers could be turned on or off to show what these design elements would look like in the context of the neighborhood.

For example, at the beginning of one workshop, a blank-looking street with some litter in the gutters appeared as the original neighborhood scene. One of the artist's rough sketches was then projected that showed some ideas the residents had generated in earlier sessions—brightly colored awnings, park benches, and shrubs. Then, with several clicks, a series of benches appeared in the street photograph, then some landscaping, then new store awnings. To the residents, it appeared that the street furniture objects were suddenly and seamlessly inserted into the photograph. While these elements had been depicted in the sketch, the manipulated photo offered an entirely different, more realistic image to the residents.

When one person did not like the type of vegetation that appeared, that layer was turned off and a different type of landscaping that was in a separate layer was

turned on to appear in the same place. Different styles of benches could be tried out as well. In effect, the layers acted as clear acetate sheets. By turning on and off each layer, it was possible to demonstrate the visual impact of each individual element on the overall scene. This enabled the planning team to visualize streetscape changes and make informed comments about the proposals. The realism of the images prompted a great deal of enthusiasm and lively discussion about the individual designs.

8. Additional uses of photo-manipulation

Photo-manipulation was also used to bring attention to subtle design issues such as façade treatment. A new concept in urban design and landscape literature emphasizes how façade treatment can create a more attractive and friendly pedestrian environment. To illustrate this idea and to engage the residents with this concept, the team used photo-manipulation to demonstrate the visual impact of incorporating ground-floor retail into a blank parking ramp. The team selected photographic images of parking ramps and commercial storefronts and used cut and paste functions to combine them. To make the combination more realistic, they used the drawing tools of the software program to blur lines and colors so that the result appeared to be one original image. Some of the storefronts that the team selected were from local stores that had Mexican art in the façade design. The resulting images helped to demonstrate how using space creatively, such as using the parking ramp as a retail store, could reinforce cultural identity in the streetscape of the neighborhood.

Photo-manipulation was then used to illustrate the impact of a new zoning code that is being considered in Chicago. The code would require 'big box' retailers to use higher quality materials on their facades than most companies ordinarily use. During the workshop, the team projected an image in which a typical big box WalMart store had been overlaid onto an original photograph of a neighborhood site. Then they displayed another manipulated photo of a WalMart in the identical location but with a facade treated with more attractive materials. To complete this photo, the team had cut and pasted elements that represented the Mexican–American cultural heritage of Pilsen and integrated them into the 'improved' WalMart façade to show how easily facades could improve the community's appearance. This gave residents insight into the purpose of such an ordinance and helped them to visualize the effect of alternative building materials.

These examples illustrate the resident engagement that occurred when participants could realistically view design changes in their own neighborhood context. Because the images were so photo-realistic, the community members understood and appreciated the concepts and were able to voice informed opinions. The team agreed that the same level of participation would not have been achieved with more traditional planning tools such as static photos (slides), hand-outs and group discussion.

9. Evaluation of the three visualization tools[1]

9.1. GIS

The GIS image database tremendously assisted all members of the planning team in visualizing past and present conditions of the neighborhood. It contained a vast amount of community data that was presented in a very interactive format. The GIS engaged community members in developing alternative design solutions and it also helped in visualizing current urban development examples in the city. The constant reference to the image database—including maps, existing buildings and lots—made the discussion contextual and more realistic for everyone involved. An additional feature of the GIS was the ability to perform spatial analysis, which is essential for identifying neighborhood problems.

However, a few drawbacks to this method must also be mentioned. Using the GIS in the church required transporting a large amount of equipment to and from UIC, and technical glitches were a frequent part of the process. The computer was often slow in processing information such as loading images and overlaying

[1] Examples of images illustrating the three visualization tools used during the design workshops are available on the World Wide Web at http://www.evl.uic.edu/sopark/new/RA/#sub1. This web site provides live and interactive views of images resulting from the workshops. It simulates images development and interaction between the university team and community residents.

thematic layers. These delays often prolonged the planning process and interrupted the steady flow of ideas. Also, the costs of developing the GIS system were substantial. Building the GIS database was a tremendous undertaking and University planners and designers exceeded the budget for this project due to the labor-intensive activities required in gathering and assembling the images, maps and historical data. However, the benefits of this system for the University and the neighborhood far outweighed the cost. The visual context provided by the GIS image database was critical to the success of the project.

9.2. *The artists' freehand sketching*

Employing an artist to do freehand sketching of participants' ideas was extremely useful in the early stages of the project. These early drawings captured residents' perceptions of the images and data they were seeing projected from the GIS and their reactions to particular sites, social issues and designs. Combining the artist with the GIS provided a very interactive human element to the process. The artist could immediately respond to participants' ideas and quickly give shape to ideas that only seconds earlier had simply been fuzzy thoughts. By the end of the workshops, the sketches reflected the actual conversation between the artist, the planners and designers and the community residents.

In addition, sketching enabled residents to play an active role in the design process. In many cases, participants would become so involved in the discussion that they would walk up to the electronic sketchboard and draw their own ideas. The artist was then able to take their ideas and build upon them. The community members resonated with this method, in part, because it represented a way of working that was not wholly linear but which involved going back and re-examining given questions. For many people, thinking through ideas is not a linear process—a fact that may be emphasized in a participatory setting.

The final product of the sketching process was a visual community conversation. As the artist said, "These sketches are becoming a story board that shows the evolution of the community vision. I find the relationship between drawings and words growing stronger and our story boards are becoming more sophisticated." An unexpected benefit of the sketching process was that it was possible to physically reconstruct the design process, in sequence, so that the team could backtrack to find a bad decision or an unexpected alternative. The sketches became guideposts to trace the development of ideas throughout the workshops and they also provided a trail to guide others who were not present.

The sketches were by nature experimental. Their purpose was to communicate and record the participants' concerns, rather than to create attractive artwork. They were exercises that provided an abstract outline for later, more concrete architectural ends, and the scribbled notes, in particular, were of intrinsic value for work that would follow. The UIC team felt that the sketches documented the process of inquiry, examining questions raised by the planning team in a way that provided a basis for future, more definitive work. Thus, the team found that freehand sketching on the electronic whiteboard was key to promoting participation in the early stages of the design process, but it was too abstract and imprecise for generating final design solutions.

9.3. *Photo-manipulation using computer imaging*

The use of computer imaging technology in the community design workshops proved to be a successful technique for enhancing the group decision-making process. A relatively recent application to be used for planning purposes, computer-aided photo-manipulation offers an innovative way for planners to communicate visual relationships and patterns. The team found that by providing highly realistic images of potential design alternatives embedded into the actual neighborhood context, participants could more easily make communal decisions. Since photographs are a very close representation of reality, little interpretation was needed to convey the design message to the public. Also, by stacking image layers, where each layer provides a piece of information for the same geographic location, it is possible to analyze relationships and identify potential problems in an area by examining the overlaps.

Our experience suggests that photo-manipulation is most helpful in cases where the design issues have already been defined, since the image library must be prepared ahead of time. In the advanced workshops in the Pilsen project, the participants had already brain-

stormed and identified problems when the photo-manipulation technique was introduced. The photographic images facilitated more precise design decisions. Instead of showing various pictures of different styles of benches, the team could show exactly what the benches would look like when actually located along a particular street. The participants could evaluate how well they blended with the existing streetscape. This kind of realism, which included vivid colors, seemed to stimulate excitement and commentary. It proved to be a very helpful tool in explaining new designs and eliciting responses.

Some of the special features of imaging technology include high storage capacity of images, the versatility of the layering system, powerful selection tools, and sophisticated techniques for composing and decomposing images. One can place images into multiple layers, channels, and paths, which allows one to separate elements while retaining visual integration. Layers can be merged, flattened, flipped, copied, clipped and linked together. Also, computer imaging provides a practically unlimited number of ways to alter images, including using millions of colors, cutting and pasting selected elements of images, controlling light and contrast, drawing, using masks, and repositioning elements on a layer without disturbing any other layers in the image.

However, a number of limitations of computer imaging must be mentioned. First, performing the computer photo-manipulation required considerable preparation before the workshop took place. This is in contrast to the freehand sketching technique where the artist was able to sketch emerging ideas with no prior preparation. For each idea or concept illustrated through computer imaging, the team had to collect numerous images of specific objects and create ‘libraries’. (Commercial ‘image libraries’ were also acquired but there was a compatibility problem in the file format which precluded using them, at least at this time.) A related issue is that computer imaging is limited to the options that exist in the digital library at the time of presentation. For example, when a resident asked to visualize a specific type of vegetation that was not present in the library; it was impossible to show it. Another problem with computer imaging, which we hope that newer technology will overcome, is perspective fit. When introducing objects into an image it is often a difficult and tedious task to keep the new object consistent with the viewpoint and vanishing points of the original image. Finally, performing some tasks during the workshop was time consuming. For example, when a resident asked, “what would it look like to remove overhead wires from this streetscape?” it took the team considerable time to carefully ‘select’ the wires from the picture and then remove them. In spite of these limitations, however, the UIC design team found that computer photo imaging was exceptional at creating realistic scenarios which greatly assisted the audience in voicing their design preferences.

10. Conclusion

This paper described three visualization techniques employed at different phases of a participatory planning process. We found that the GIS used in the first set of workshops provided the participants with a rich source of data and contextual information. It supplied a wealth of maps and visual data that helped orient the participants, identify problems and facilitate consensus. The artist helped to unveil critical issues, constraints and opportunities. The drawings, together with the artists’ notes, provided a storyboard of the community’s conversation. While the sketches were abstract and inherently less realistic and precise than photographs or computer images, they served an important purpose. These two tools were most helpful in the first stages of the planning and design process.

In the advanced sessions, photo-manipulation was the most appropriate tool. The photographs that were presented were more realistic, precise representations of the ideas people had expressed in previous workshops. In a way, these part-real, part-created images provided a way of reflecting back to the participants what they had asked for through the abstract drawings of the artist. The appropriate context for using computer-aided photo-manipulation in participatory community planning is at the final decision-making stage.

While computer technology provides a new way for planners to interact with communities, it must be admitted that computer glitches were to some extent an ever-present problem, from recurring error messages, to having to reboot the computer, to lost files. However, we found that with all three of these techniques, visualization through digital technology

provided a common language for all participants. The tools helped empower residents to plan and design for the future of their community. As one of the residents exclaimed, "as we saw ideas begin to take shape before our eyes we could feel the excitement rise. The pulse begins to beat a bit faster!" The designs that were created by the planners and designers reflected the community's wishes and input and respected their cultural heritage. We believe that the use of these computer-based visualization techniques could be an important contribution to the evolution of participatory planning and design, progressing toward the art of designing with people.

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