Towards a scenario-based approach to participatory design

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ABSTRACT: Scenario-based community design enables designers and community members to work together to address uncertainty in future community growth and develop a range of alternative design solutions to envision and plan for possible future conditions. This essay traces the history of scenario-based design practice and attempts to understand its application to community design from a socio-technical perspective, which sees community design as both spatial inquiry and communicative action. The essay discusses the three fundamental components that enable the implementation of scenario-based design. These three components can be best understood from the three common perspectives of design: 1) evaluation: design as an iterative feedback loop; 2) visualization: design as spatial thinking; 3) collaboration: design as a participatory process. This essay then discusses two projects and demonstrates the key steps to implement these scenario analysis methods, including visioning, compiling data, and conducting community design workshops.

KEYWORDS: scenario planning, participatory design, citizen participation, community design, geographic information system

1.0. INTRODUCTION

Physical places matter. Mollenkopf and his colleagues, in their book *Place Matters* argue that where we live makes a big difference in the quality of our lives, and how the places in which we live function has a big impact on the quality of our society. People's view of a place is dominated by its physical features: its roads, houses, business buildings, green spaces, railroad tracks, bridges, vacant land, etc. (Mollenkopf et al., 2001). Architects and design professionals have long been tasked to (re)shape the physical qualities of a place. They are often asked by their clients (or the public) to help envision the futures of a place (or a community) as some sort of master plans. Their missions, however, cannot be fulfilled without a clear understanding of a place's unique characteristics. This requires architects and professionals in other associated design fields to take a bottom-up approach to reach out to the people in the place. They ought to understand the collective wills of the people in (re)shaping their place and to hear the collective stories and memories about the place from the people. Any change to the physical settings of a place requires collective vision. Architects and design professionals must work to see that collective vision together with the public.

Throughout his career, Samuel Mockbee had stressed the importance of a deeper democratic inclusion in the practice of architecture, which, from his view, requires not only individual participation from practitioners, but also requires active civic engagement from one's community. Many methods for conducting community engagement have been developed and introduced in architecture and its allied fields such as community planning and urban design. Scenario planning is one of such methods allowing architects and urban designers to interact with community members in a design project. It enables community members to envision a range of alternative future conditions for their community by creating a series of design scenarios. By evaluating the strengths and weaknesses of these different scenarios against a set of measures, a preferred design scenario may emerge to become the selected solution.

Scenario planning typically relies on mapping software, such as Geographic Information System (GIS), to manage and process data and provide contextual information about a community. It then utilizes a unique user interface to enable painting on the map generated by the software to develop and test ideas for possible improvements in the community. This type of community-based practices has its root in the field of participatory design, which is a response to the demand to have voices heard and ideas taken from those

who are involved in the design process. It sees community members as citizen designers who play an active role in shaping the formulation of both the design process and its results.

This essay discusses two community design projects conducted between 2014 and 2017 for two small neighborhoods, one in Georgia and the other in North Carolina. These projects employed scenario analysis to connect regional planning frameworks to local community design processes. This essay revisits scenario planning's theoretical background, which has three fundamental components tying closely to the three common conceptions of design: 1) evaluation: design as an iterative feedback loop of concept generation, performance evaluation, and design refinement; 2) visualization: design as spatial thinking relying on seeing in our mind's eye what the intended outcome could be; 3) collaboration: design as a participatory process requiring an inclusive, communicative, and interdisciplinary approach to information sharing and public deliberation. The essay then details the empirical framework for these projects including key steps taken to implement the scenario planning exercises, including visioning, compiling data, conducting community workshops, and drafting of community design plans.

2.0. TECHNICAL PERSPECTIVE: COMMUNITY DESIGN AS SPATIAL PLANNING

Spatial planning shapes the physical settings of a place where people live. It integrates a variety of techniques to influence the distribution of people, resources, and activities in spaces of various scales. Community design is inherently a spatially oriented profession. As spatial planning, it gives geographical expression to the economic, social, cultural, and environmental policies of society. It is both a scientific discipline and an administrative technique that is developed as a comprehensive approach towards a balanced land development and physical organization of space according to a wide-ranging strategy supported by rigorous technical knowledge and investigations. Community designers are routinely confronted with a myriad of ad hoc decisions requiring accurate spatial data. Their tasks rely on a set of procedures that enable them to convert a diverse amount of spatial data into the type of information needed to support decision-making. Community design provides structured processes in which decision-making and problem-solving occur (Kliskey, 1995). Within these structured processes, information becomes a key ingredient to successful decision-making. Community design therefore is considered to be an information processing activity. All relevant information must be stored, managed, made available, and presented in a suitable and organized form for use at different stages in community design (Scholten et al., 1990).

3.0. SOCIO-POLITICAL PERSPECTIVE: COMMUNITY DESIGN AS COMMUNICATIVE PLANNING

Counter to its rational and technical aspect, community design is regarded as not only the activity of spatial analysis performed by isolated individuals but also as an ongoing process of social design, interactive dialogue and debate in which designers, public officials, and the general public seek to decide together how to best manage the collective concerns of society (Healey 1992, 1997). Moving away from its analytical nature requiring data and information processing, community design has increasingly become a process of structured negotiation and deliberation that requires broader participation from those who involved in its processes. It needs soft data to reveal the social values and cultural meanings embedded in different sectors of society, which are usually based on personal views from differences in culture, religion, education, politics, or age. Communicative planning has been called upon in planning and design domains where there are a range of competing stakeholders and where the distribution of decision-making power is highly dispersed across different sectors of society. Community design that incorporates communicative approaches allows for uncertainty and conflict in its processes. It encourages outreach and engagement, and attempts to foster socio-political will among the stakeholders by promoting structured dialogue.

4.0. FACING UNCERTAINTY IN COMMUNITY DESIGN WITH SCENARIO PLANNING

Architects and planners, tasked to help envision the future, have recognized the need to prepare for future community needs and challenges through structured planning and design activities with a hope that the future can somehow be created following planned investments and fall within reasonable expectations. However, a community's future remains uncertain. The number of factors that influence whether development occurs and to what extent it takes place is enormous. Moreover, past trends are not necessarily the direction communities wish to head. Consequently, scenario planning has grown in use recently, particularly that which is referred to as visioning (Bartholomew 2005). Over the course of the past two decades, planners, designers, and citizens increasingly articulated priorities and values to help shape the futures of their communities. Through scenario planning, the question of what the future might bring can be narrowed down to a more manageable set of possibilities.

5.0. SCENARIO PLANNING IN COMMUNITY DESIGN

According to Porter, a scenario is “an internally consistent view of what the future might turn out to be; not a forecast, but one possible future outcome” (Porter, 1985, p. 446). Essentially, scenarios are stories about the future (Ogilvy, 2002). They cannot predict the future precisely. Instead, each should present a vision of the future plausible in light of known information (Ringland, 2002). Following Bartholomew (2007) and Smith (2007), most scholars trace the origin of scenario planning to the RAND Corporation (Kahn, 1962) and its application to business to the Royal Dutch Shell (Wack, 1985). In its earliest stages, scenario planning was used as a way to consider multiple facets of a problem simultaneously; considered as a tool to help decision makers with limited backgrounds and resources address the uncertain future. It has been used in disciplines from business to conflict resolution to military (Andrews, 1992; van der Heijden, 1996). The scenario planning practices emerged in the 1990s essentially grafted the military and business approaches onto to the more customary planning structures of the continuing, cooperative, and comprehensive (3C) process required by the Federal Aid Highway Act of 1962 and the environmental impact reporting requirements of the National Environmental Policy Act (NEPA) (Bartholomew, 2005). The typical scenario planning process compares one or more alternative future community design scenarios to a trend scenario. In the trend scenario, urban development and infrastructure investment patterns of the recent past are assumed to continue to the planning horizon 20 to 50 years in the future and the impacts of this on the study area are assessed. This is followed by the formulation of one or more alternative futures that differ from the trend with respect to community design and growth (Lee, 2016). Essentially, scenario planning assumes that if planners and designers consider multiple futures, they are more likely to make better decisions.

6.0. GIS-ENABLED SCENARIO PLANNING TOOLS

The advancement in digital visualization and analytical capabilities of geospatial technologies has supported scenario planning substantially over the past two decades (Ewing, 2007). Many agencies and private firms were involved in this growth; among them, Peter Calthorpe and John Fregonese was particularly instrumental in popularizing the tools and their associated applications (Goodspeed, 2013). The adoption of GIS by professionals and the emergence of a dominant GIS software package in the 1990s enabled the development of this new class of computer tools, which relied on GIS for data management, visualization, and other functions. Especially, the ArcGIS software suite produced by ESRI has become a monopoly provider of GIS software, enabling them to effectively define file formats and analytical workflows. The analytical and mapping functions offered by GIS-enabled scenario analysis tools estimate and illustrate likely effects and potential costs of various community growth and development patterns portrayed by multiple scenarios. This expansion of software development included the creation of a new class of scenario planning tools in the 1990s such as CommunityViz, INDEX, I-PLACE3S, What-if, and Envision Tomorrow. These tools present a variety of technical and functional approaches that are necessary to support community designers in their daily tasks (Lee, 2017).

7.0. SOCIO-TECHNICAL PERSPECTIVE

These GIS-enabled scenario planning tools are designed to make full use of modern geospatial technologies to support a design process that is characterized by communicative and participatory actions. In general, this type of scenario planning practices and techniques shares the following characteristics: 1) a focus on spatial development patterns typically in the form of physical design; 2) extensive use of spatial data, geographic analysis, and visualization; 3) the involvement of multiple stakeholders through public participation activities. This type of community design is fundamentally a way of thinking and implementing the design of community spaces. Any discussion about it therefore has to be based on the ways in which community design is conceptualized. In this regard, scenario-based community design, as a method of design, has three major components that tie closely to the three common conceptions of design.

Component 1: Evaluation: Design as an iterative feedback loop of concept generation, performance evaluation, and design refinement

Scenario-based design tightly couples the creation of design ideas with performance evaluation and impact assessment informed by geographic analysis (Flaxman, 2009). It is expected to produce databased design options and in turn lead to informed decisions (Dangermond & Artz, 2012). Scenario-based design enables designers to sketch alternative design scenarios and quickly get feedback on performance and suitability by comparing design proposals to geospatial data behind GIS.

Component 2: Visualization: Design as spatial thinking relying on seeing in our mind's eye what the intended outcome could be

Design at the geographic scale implies an effort to create something that is functionally efficient and environmentally sound. It requires an ability to generate a macro-level, or bird’s-eye, view of the designed thing embedded within landscape in the mind’s eye of a designer. This type of broad-scale

image reveals both the process and the product in a conscious way before it eventually becomes realized. Scenario-based design, using the cartographic and graphical capabilities built into GIS, allows designers to visualize spatial relationships within and to map potential impacts of their design (Ervin, 2016).

Component 3: Collaboration: Design as a participatory process requiring an inclusive, communicative, and interdisciplinary approach to information sharing and deliberation

Scenario-based design emphasizes collaboration and relies on a joined effort that draws upon inputs from different fields, including landscape architecture, environmental science, engineering, urban planning, and community development (Slotterback et al., 2016). In order to increase public engagement and collaborative learning, it offers different tools for individuals to communicate, share data, and design collectively.

Scenario-based community design takes on a unique approach that seeks to integrate social and technical dimensions of design. This socio-technical perspective is essential to examine this particular genre of design. It emphasizes the importance of investigating technology and social contexts together in order to both develop methodology and improve problem-driven technology. Therefore, this essay sees this class of GIS-enable scenario planning tools not as a freestanding technology in a laboratory setting, but as they are applied in real-world projects with specific socio-political settings.

8.0. CASE STUDIES

This section presents two scenario planning projects. Each case starts with a brief description of the case contexts, including its geographic area, physical conditions, and a project overview. This background information is followed by detailed descriptions of two key aspects of the project: 1) the development of technical components supporting the scenario-based design process; 2) the design and implementation of public outreach activities enabling communication and collaboration among key participants in the project.

8.1. Case 1: Davidson, North Carolina

The town

Town of Davidson is a vibrant community located 20 miles north of Charlotte. It has a lively main street with local shops, a post office, library, farmer's market, and pedestrian friendly atmosphere. Located just north of the main downtown of Davidson, the North Gateway area covers 134 acres and spans both Mecklenburg County and Iredell County. It is mostly a green field site, bordered on the west by Lake Norman and Ingersoll Rand, and Highway 115 to the east. With the surrounding residential neighborhoods and an industrial park, the site is situated to be an extension of Downtown Davidson creating a new destination for residents to live, work and play in the area. It has a mixture of multifamily, townhomes, single family lots, industrial and civic spaces, blended with lake shore overlay buffers, vast tree canopy, and open grass fields.

The project

This project, funded by a Faculty Research Grant, launched a Scenario Planning Assistance Team, aimed to function as a research platform for collaborative projects to advance the practice of scenario planning. The team partnered with Town of Davidson to conduct a community design project. This project utilized GIS and scenario planning methods to articulate community growth alternatives that inform the adaption of land use policies aimed to create sustainable built environment.

Figure 1: A scenario planning workshop was successfully held at Town Hall in April 2015. Each table had about eight participants with one moderator who used ET+ to track participants' actions and record all mapping and scenario-building activities. Source: (Lee, 2015)

The technical framework: software tools and processes

This project used Envision Tomorrow Plus (ET+) to create and test land use scenarios at the site scale. ET+ is an enhanced scenario planning software plug-in for the ArcGIS platform. The components of ET+ include Microsoft Excel and an extension to ArcGIS, a popular GIS software package by ESRI.

The actual scenario planning process consisted of following four steps:

1. Create Prototype Buildings: Develop a range of prototype buildings at the parcel level that are financially feasible based on local conditions in Davidson.
2. Create Development Types: Create a series of development types by combining a mix of prototype buildings with streets, open spaces, public amenities and other urban attributes.
3. Build Scenarios: Conduct a workshop with a mapping exercise to allow participants to create scenarios. ET+ was used alongside the mapping exercise to digitize these workshop scenarios on the fly into computer.
4. Evaluate the Scenarios: Evaluate the scenarios using ET+ template maps, charts, and graphics.

A total of 27 prototype buildings were identified and included in ET+. 9 different development types then were developed by combining a mix of these 27 prototype buildings with various public infrastructure and amenities to create a range of different places that are suitable for the context in Davidson.

The socio-political framework: workshops

Another important component of the project is the establishment of a citizen engagement program. Two rounds of public events at the site were conducted. At the first, a scenario planning workshop was successfully held at Town Hall in April 2015 with 27 participants. Four alternative growth scenarios were created by the participants (Fig. 1). Three complete scenarios were further digitized and analyzed using ET+. Each complete scenario had similarities and differences that allow them to pose different choices for how Town of Davidson might develop in the future. In addition to these community growth scenarios that were created in the workshop, a baseline scenario was later prepared by a joined effort between Davidson planning office and the Team. This baseline scenario was mainly based on current planning ordinances and was meant to be used as a reference for policy comparisons (Fig. 2). Four weeks after the first workshop, an open house event was held at Town Hall to present the four scenarios to the community based upon the results from the workshop. Through in-person discussions with participants at the meeting, residents stated preferences and offered further suggestions for the refinement of the community design concepts.

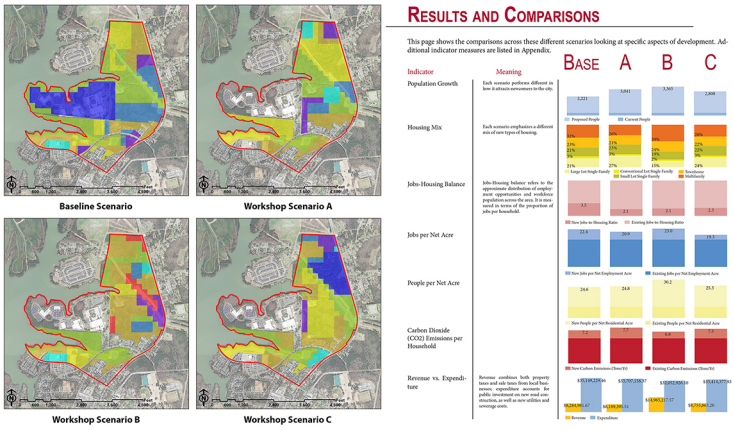

Figure 2: Three complete scenarios were further digitized and analyzed using ET+. A baseline scenario was also prepared for comparison purposes. Source: (Lee, 2015)

The outcomes

This scenario planning project was mainly conducted as a pilot study to demonstrate our research and project managing capacity. Despite its experimental nature, this pilot project thoroughly followed steps for a typical scenario planning process to calibrate all analytical components based on local development conditions and market trends to ensure that the GIS model reflects closely what is on the ground in Town of Davidson. In addition, with enthusiasm, rich awareness of local issues, and constructive dialogues during the workshop, participants together created four different community growth scenarios. A survey was conducted at the end of the workshop. 21 of 27 workshop participants completed the survey form. The results generally revealed participants' positive experience with this type of planning exercise involving the use of information technology.

8.2. Case 2: Buttermilk Bottom, Atlanta, Georgia

The site

Buttermilk Bottom was originally an African-American neighborhood in the City of Atlanta, Georgia. It is currently centered on the area where the Atlanta Civic Center now stands in the Old Fourth Ward side of the SoNo area in Atlanta, just south of Midtown. The area was once considered a slum area with unpaved streets and no electricity. Some suggest that the name may also refer to the sour stench of stagnant water, which tended to pool in low-lying areas with poor surface drainage and inadequate basic infrastructure.

The project

The main idea for this academic project for a graduate-level urban design studio, conducted in spring 2017, was to learn from the historic City of Savannah in Georgia about how we might use those lessons to redo what was badly done three decades ago in this site in Buttermilk Bottom. The students studied the original African American neighborhood, learned about the badly imagined plans and urban renewal developments that followed, and then explored ways to apply lessons from Savannah. The site was complex with a lot of topography, stormwater issues, real estate markets that are currently pushing for higher densities. The class assignment was to re-design the Buttermilk Bottom site according to the design principles observed in the plan for Savannah Georgia's Historic District and their quantifiable traits. Many GIS applications were incorporated in this urban design project, including 2D mapping, remote sensing, scenario planning, 3D procedural modeling, and cloud-based tools.

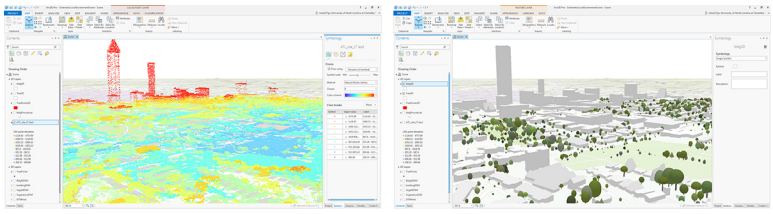

Figure 3: The class used ArcGIS to reclassify LiDAR remote sensing data (left) and extract 3D features from the LiDAR (right) for the study site in City of Atlanta. Source: (Lee, 2017)

The technical framework: software tools and processes

The class was divided into three teams with each developing a design scenario for the site based on one of the three principles of sustainable development respectively: 1) environmental preservation; 2) economic development; 3) social equality. The three teams, initially only representing one narrow view, then went through a negotiation process to modify their design scenarios in order to incorporate all three aspects of the sustainability ideals. Envision Tomorrow, an ArcGIS plug-in for conducting scenario planning, was used throughout these processes to assist in design, scenario development, and discussions. In addition to the use of scenario planning tools similar to the Davidson case, this case utilized more advanced imagery processing techniques and virtual reality for 3D visualization.

Figure 4: ESRI CityEngine allowed the class to create a large-scale model with details to render future urban design solutions. Source: (Lee, 2017)

The class created city-scale 3D models to further visualize and analyze these different community design scenarios. These 3D models were created by extracting features from LiDAR data, an optical remote-sensing technique that uses laser light to densely sample the surface of the earth. This step built a simple 3D representation of the existing urban structure for the site and its surrounding area (Fig. 3). ESRI CityEngine was then used to build a series of 3D models according to the scenarios proposed by the class. These 3D models were built with details including architectural structures and textures, landscape features, roadway signs and pavements, transportation features, vehicles and human figures. The students imported

GIS scenario maps into CityEngine, which then generated 3D scenes of these design scenarios using the procedural rules available in the program (Fig. 4). Overall, the class was able to use these 3D models to examine the physical qualities of the areas, such as overall land use distributions by color-coding building footprints; potential ways of urban transformations by urban design; streetscape configurations with fully rendered details. The class also tested the potential of using virtual reality (VR) as a way to explore community design scenarios. Their 3D CityEngine models were imported into Unity, a game development platform, and converted into virtual reality scenes. Unity allows additional lighting effects and environment rendering options to enhance the appearance of the models. It also enables virtual reality settings that allow a user to experience these community designs in an immersive way through a VR-enabled headset, such as Oculus Rift. The user can use a typical game controller, such as Xbox controller, to walk around 3D scenes generated by the CityEngine models (Fig. 5).

Figure 5: Virtual reality scenes, converted from CityEngine models, allowed reviewers to experience students' urban design solutions in an immersive way. Source: (Lee, 2017)

Participatory processes

While public input was not integrated into the overall experience of this project, the class built upon an interdisciplinary knowledge base with students coming from different design programs, encouraged collaboration among students themselves and between faculty members and local activists with deep local knowledge about the site. The combination of virtual and in-person collaborations with community activists provided students with insights into the participatory access that this scenario-based design practice can afford designers. In this sense, the studio utilized local community activists as surrogate public participants in order to provide both expert opinion as well as overall qualitative feedback.

9.0. DISCUSSIONS AND FINAL THOUGHTS

One of the many characteristics shared by these two projects is that both incorporated GIS-based methods into their community design processes for 1) collecting and analyzing data; 2) promoting and sustaining public participation; 3) developing and evaluating alternative design choices for the future of their communities. As demonstrated in this essay, GIS-enabled scenario planning seeks to increase the technical effectiveness of spatial analysis in community design as well as to offer transparent channels for communications and open platforms for participation. This socio-technical perspective is important to understand the significance of this particular type of community design, which seeks to integrate social practices of participatory design with information technologies. It is again through this particular viewpoint that four key observations about the interplays between the two aspects are drawn as the follow:

Technology enables scientific inquiry and increases understandings of the complexity in design processes

The ability of these geospatial technologies to conduct analyses and to illustrate the results of such analyses substantially increased designers' ability to engage and educate the public about the scientific aspect of various key factors involved in the design process.

Technology allows collaborative design and enables exploration on design alternatives

Scenario planning tools allow users to generate and compare various community design scenarios that represent different design alternatives.

Technology helps identify community values and promotes social learning

The awareness created through public engagement efforts about the potential benefits of alternative growth strategies help build durable, inclusive consensus within the community over time.

Technology helps shape community coalitions and build organizational capacity

The success of this type of scenario-based practices is highly dependent on the delicate organizational sensibility of the early leadership of a local community. The initial involvement of key players prior to the beginning of the process is a formula for reducing resistance in the long run. This process of building coalitions can also be assisted by some of the technical procedures in the scenario planning process.

In summary, scenario-based community design helps transform ad hoc community development into better design by clearly revealing the true impact of incremental changes in the built environment of a place over time with the use of simple diagrams and clear charts generated by innovative GIS-enabled digital tools. Furthermore, through public participation, collaboration, creativity, and careful consideration of the long-term impact of design choices, communities can design better, more livable futures. The two projects described in the essay show that, with proper tools and methods and an open mind to listen, architects and designers can learn about the collective wills and vision from the people in a community and together reshape the built environment of the community as the foundation for future prosperity.

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