Visioning and Visualization

People, Pixels, and Plans

Michael Kwartler and Gianni Longo

Visioning and Visualization


OKI
Metropolitan Sewer District
OfficeMax

Visioning and Visualization

People, Pixels, and Plans

Michael Kwartler and Gianni Longo

LINCOLN INSTITUTE
OF LAND POLICY
CAMBRIDGE, MASSACHUSETTS

Library of Congress Cataloging-in-Publication Data

Kwartler, Michael.
Visioning and visualization : people, pixels, and plans / by Michael Kwartler and Gianni Longo.
p. cm.
Includes bibliographical references and index.
ISBN 978-1-55844-180-4
1. Land use—Planning—Computer simulation. 2. Land use—Planning—Citizen participation. 3. Land use—United States—Planning—Case studies. 4. Information visualization.
I. Longo, Gianni, 1947- II. Lincoln Institute of Land Policy. III. Title.
HD108.6.K95 2008
333.730285--dc22
2008008178

Designed by Peter M. Blaiwas, Vern Associates, Inc.

Composed in Frutiger. Printed and bound by Capital Offset Company in Concord, New Hampshire.
The paper is Galerie Art silk, a recycled sheet.

MANUFACTURED IN UNITED STATES OF AMERICA

Front cover: An eye-level view of Broadway in the 3D physical model used for visualizing a zoning alternative. The scale is revealed by the person's hand inserting an object into the model. (Environmental Simulation Center, 1993)

Back cover: Two screen shots from an interactive real-time 3D model used during the design phase of the Greenwich Street South Urban Design Plan. The top image shows existing conditions—the Brooklyn-Battery Tunnel entrance and a parking structure spanning the approach. The bottom image shows the proposed alternative, which decks over the tunnel entrance, replaces the garage with a park and new residential towers, and restores the historic street system, which was interrupted by the tunnel entrance. The ability to move freely in the virtual environment proved invaluable in understanding complex design issues and spatial relationships. (Environmental Simulation Center, 2004)

Title page: During one of several workshops held throughout the Ohio, Kentucky, and Indiana region surrounding the city of Cincinnati, participants developed growth scenarios that were subsequently calibrated and digitized to identify areas of consensus. (ACP–Visioning & Planning)

Contents

Figures

Boxes

Acknowledgments

We thank the Lincoln Institute of Land Policy for its generous funding of this book, which has its roots in the many Lincoln Institute–sponsored Visioning and Visualization workshops that we have conducted across the country. Special thanks go to Armando Carbonell, who conceived both the need for the workshops and the idea for this book. Thanks also to Lisa Cloutier who has been instrumental in making the Visioning and Visualization courses as successful as they have been. We deeply appreciate Lincoln Institute's Ann LeRoyer and Brian Hotchkiss of Vern Associates for their gracious support, gentle prodding, and insightful editing as we produced this manuscript. And finally the book's designer, Peter Blaiwas of Vern Associates, has crafted a volume that is able to clearly and elegantly communicate our ideas to the reader.

The architects, planners, and landscape architects at the Environmental Simulation Center (ESC) have all contributed to the development and application of the visual simulation tools described in the manuscript. In particular, we thank Paul Patnode for his tireless dedication and genius for translating innovative concepts into reality as represented in the graphics that illuminate the manuscript. Paul and the ESC staff, including Alihan Polat, Kiyoshi Yamazaki, and Prasanta Bhattarai, have created, refined, and assembled the book's graphics.

Several members of the staff at ACP–Visioning & Planning have provided tremendous support in refining the visioning process and in helping with this manuscript. Jamie Greene, ACP's principal, has provided encouragement and advice from the start. Suzanne Nienaber has contributed to the writing and editing of this text, helping to weave together its many parts. Jennifer Lindbom has polished ACP's public process guidelines and trained untold numbers of facilitators in cities throughout the country. Greta Stough and Daria Siegel have provided logistical support to the manuscript's final production.

—Michael Kwartler, Environmental Simulation Center

—Gianni Longo, ACP–Visioning & Planning

Introduction

The purpose of *Visioning and Visualization* is to assist urban professionals, public sector leaders, and the public to navigate two complex and evolving fields: public involvement and digital visualization as applied to planning. To that end, this book is based on the authors' experiences in developing sophisticated public involvement processes and applying information technology to planning and design.

Two remarkable phenomena have affected the practice of planning over the past two decades: the rise of public involvement as an integral component of urban decision making and the technological innovations that enable the visualization and simulation of physical reality. Together the two phenomena anticipate the future, turning the planning process into a journey of discovery for professionals and laypeople alike.

The book is not a "how to" publication. It does not focus on the procedural steps of public process techniques or on specific technical features of digital visualization tools. Rather, the book suggests ways that digital visualization tools can be integrated in a public process to offer participants clear choices and help them make informed planning decisions. Evidence from communities throughout the country shows that public involvement supported by visualization leads to better plans and more livable communities.

The book is organized in six chapters:

- *Chapter 1,* "The Context," presents a historic overview of the public involvement and digital visualization fields. It traces the trajectory of public involvement in planning from confrontational and adversarial tactics to the present emphasis on cooperation and inclusion. It expands on the evolution of representation techniques from perspective drawings to computer-aided visual simulations.
- *Chapter 2*, "Benefits, Principles, and Lessons Learned," outlines principles to guide the integration of public process and visualization tools in a democratic decision-making process. It also explores lessons learned in the application of digital visualization tools to planning activities.
- *Chapter 3,* "Public Involvement Techniques in Planning," illustrates visions, charrettes, and other techniques that invite the use of visualization tools.
- *Chapter 4,* "Visual Simulation Tools," introduces specific tools and their uses in planning, including representing existing conditions, visualizing alternatives, and monitoring impacts.
- *Chapter 5,* "Implementation," describes formal and informal ways the implementation of a plan can benefit from feedback opportunities created by visualization tools.
- *Chapter 6,* "Case Studies," presents four case studies spanning from the regional to the neighborhood scale where public involvement and visualization tools were used to help the public make informed decisions.


FUTURE
THE GREENS
RIVERWALK ESTATES
24 DUs/Acre Uniform End
24 DUs/Acre Uniform Corner Left
24 DUs/Acre Varied Middle
24 DUs/Acre Varied Corner Right
Religious
ing and Visualiz
hitecture and
Legend
500 Year Flood Zone

1. The Context

FROM CONFRONTATION TO COOPERATION

The direct involvement of the public in contributing to making decisions that affect our cities and regions is not a new phenomenon. It finds its roots in the earliest form of democracy of the Greek city-states and was a strong component of the civic foundation of this nation. Over time, however, direct involvement of citizens in the affairs of a city has declined. By 1961, as Jane Jacobs (figure 1.1) succinctly wrote in *The Death and Life of Great American Cities,* there were "only two ultimate public powers in shaping and running American cities: votes and control of the money" (Jacobs 1993, 171).

In this environment the public was by and large cut off from directly participating and having a say in shaping cities. Opportunities for providing input were typically limited to very formal public hearings, intimidating affairs held in formal chambers, where "helplessness, and its partner, futility, became almost palpable" (Jacobs 1993, 529).

Figure 1.1 – Jane Jacobs (Image courtesy of Frank Lennon / *Toronto Star*)

Proxy chips representing 3D building blocks are used to build a development scenario and evaluate its performance in a real-time 3D model. Visioning and Visualization Workshop cosponsored by the Lincoln Institute of Land Policy and the College of Architecture and Environmental Design at California Polytechnic State University at San Luis Obispo. (ACP–Visioning & Planning)

Although marginalized at the public hearing, the public was not silent. Jane Jacobs describes the "abounding vitality, earnestness and sense with which so many of the citizens [participating in public hearings] rise to the occasion. Very plain people including the poor, including the discriminated against, including the uneducated, reveal themselves momentarily as people with grains of greatness in them, and I do not speak sardonically" (Jacobs 1993, 529). The vitality and earnestness of the public were about to transform the formal civility of the public hearing into confrontation.

In the aftermath of World War II, the federal government engaged in massive investments in housing, transportation, and social programs. Yet those programs often necessitated large-scale relocation and the breakdown of viable neighborhoods. These were conditions that forced a bottom-up direct involvement of citizens and neighborhood groups.

A major target for civic opposition was the massive federal urban highway program. As a direct result of that program, in the early 1960s cities began to clear wide swaths of land, mostly in inner cities and poor neighborhoods. Cities were hacking their way, in Robert Moses's words, "with a meat ax" (Heckscher 1977, 119). Neighborhood residents in New York, Phoenix, and Baltimore, among many other cities, rebelled against heavy-handed programs, stopped construction of proposed highways altogether, or demanded and obtained more suitable alternatives.

Confrontational tactics against urban renewal projects worked equally well in efforts to preserve unique features of a community and followed a similar script. The City of Seattle proposed a 220-acre urban renewal project that would raze Pike Place Market and areas surrounding it. Citizens organized as Friends of the Market and gathered 50,000 signatures on a petition to declare the market a historic district. In spite of opposition from the city, the business community, and the local newspapers, when the petition was put to a vote, citizens voted overwhelmingly to protect the market.

At about the same time in the 1960s, neighborhoods began to organize to address compelling issues of social and environmental justice. Community organizing was not a new phenomenon. In the 1930s, Saul Alinsky had organized the Back of the Yards, an industrial and residential neighborhood located on the southwest side of Chicago, which was profiled in Upton Sinclair's 1906 book *The Jungle* (Sinclair 2004). Alinsky's work in the Back of the Yards neighborhood became a model and an inspiration. Assisted by the training and organizing work of the Industrial Area Foundation (founded by Alinsky) and other capacity-building groups, countless community organizations sprang up throughout the country. Alinsky's activism fueled the reemergence of the public as a key participant in the decision-making process.

The 1970s saw the emergence of business as a third power base in the urban decision-making arena. Business, of course, had always played an important role in civic affairs. Great examples of such involvement are the forward-looking 1906 Plan for Chicago sponsored by the Commercial Club (a business organization) and the activities of the Allegheny Conference in Pittsburgh after World War II.

In the 1970s businesses began to invest substantial resources in addressing specific problems and challenges. The Greater Baltimore Committee, for example, led the redevelopment of Baltimore's Inner Harbor, which became an exemplar of successful inner-city revitalization. Seattle METRO, having spectacularly succeeded in cleaning the waters of Lake Washington, focused on an ambitious program of park, transportation, and other quality of life initiatives called Forward Thrust. These initiatives were the result of the vision and leadership of inspired individuals. It is a tribute to these leaders' focus and intensity that their top-down approach succeeded as well as it did.

A CENTER-OUT APPROACH TO DECISION MAKING

By the early 1980s the question in the minds of many was how to bring together government, business, and the public in ways that would not be confrontational and that would lead to cooperation and, more importantly, to support during implementation. In other words, how to build Senator Bill Bradley's "three-legged stool," which included government and the private sector as two of the legs and civil society as the third (*New York Times* 1995).

The establishment of the government, business, and civic triad as an effective way to do business in cities and, increasingly, regionally has not displaced confrontation entirely. In fact, such displacement would not be desirable, as debate on issues continues and changes over time. Confrontation today, in the form of NIMBYism (the not in my back yard type of activism), remains very much a part of the shaping of cities and regions. However, an open and inclusive public involvement approach to address issues will reduce the chances that opposition flares up, since projects and initiatives are amply debated in the community, within established criteria, and principles are developed that the community agrees to uphold.

The experiences of some of the most progressive cities showed that the answer to the "three-legged stool" question was to seek a new model of urban decision making based neither on a bottom-up nor a top-down approach. In hindsight it seems entirely logical that the model to emerge would be one that brings the broadest range of interests to the table—in other words, an all-inclusive, center-out approach.

Vision 2000 in Chattanooga, Tennessee, was one of the first planning processes to aim for such an approach. At a time when most efforts were still top-down or bottom-up, Vision 2000 recognized the need to expand the circle of inclusiveness. In 1984, just a few months after its start, the program had ensured the direct involvement of business and government leaders, foundations, educational institutions, the clergy, arts and other special interest groups, and citizens. They agreed to participate in the actual process of developing a shared agenda and pledged to stay involved through developing a vision and implementation. "We wanted people who were both hopeful and helpful," said Mai Bell Hurley, the chair of Chattanooga Venture (the organization set up to be the recipient of Vision 2000).

The coming together of all these forces propelled the community on a trajectory of implementation successes that it still follows today, 23 years later (box 1.1). Chattanooga has become a sought-after destination for delegations from cities throughout the country that are eager to understand and imitate its success. In its May 1998 issue, the magazine *Governing* stated that "visioning fever" is "a very contagious bug that has been sweeping civic America in the late 1990s," due in part to the success of Vision 2000 (Walters 1998).

Inclusive models of public involvement proliferated through the 1990s as a result of numerous factors. One of them was Community Partnership Strategy, a key priority of the U.S. Department of Housing and Urban Development during the Clinton administration, which required inclusive participation as a precondition to funding. Another resulted from the rise of metropolitan regions. As cities grew beyond their jurisdictional boundaries, regions became de facto cities, the places where people lived, worked, shopped, and recreated. Regions, however, are complex multijurisdictional realities. In regions, inclusive and comprehensive public involvement programs became the preferred, and often the only, way to develop shared regional agendas with enough public support to be implemented.

Box 1.1 **The Chattanooga Story**

In the early 1980s, Chattanooga, Tennessee, suffered from a number of problems that had been building for a long time. In 1969, the Environmental Protection Agency declared that Chattanooga had the worst air quality of any urban area in the United States. Unemployment was at a historic high. The transformation from a manufacturing base to a service economy was lagging due to the lack of an adequately prepared workforce. Race relations were stressed and erupted in violence in 1981.

Trying to respond to these problems and driven by a desire to develop a clear agenda for the future of the community, a number of civic leaders came together and sought to take action outside the political arena. These individuals became the first ring (core) of participants in the center-out approach. During a visit to Indianapolis in spring 1983, these community leaders became acquainted with the Greater Indianapolis Progress Committee (GIPC). Upon returning, they began to meet weekly in an open-salon manner in a vacant storefront. More residents joined in, forming the second ring of participants. These meetings were passionate, heady, engaging, risk taking, and rigorous. By everyone's admission, nothing like it had ever occurred in Chattanooga. These informal meetings led to several critical decisions:

- An organization—loosely modeled after GIPC, and later called Chattanooga Venture—would be formed.
- Chattanooga Venture would develop a citywide agenda through a public involvement process (Vision 2000).
- The process would be inclusive and transparent and would start with a blank slate with no predetermined issue.
- The discussion would be organized under general headings such as people, place, play, jobs, government, and "future alternatives," a catch-all heading for any idea that did not fit the other categories.
- The circle of participants would be enlarged to include business, government, foundations, special interest groups, citizens, and anyone willing to contribute time and ideas to the process. (This became a cast of thousands as the participation rings enlarged.)
- The governance structure of Chattanooga Venture would reflect the makeup of the community and the circle of participants.
- Participants would pledge to become involved in implementing Vision 2000's agenda.

Because there were no precedents and the outcomes were unknown, these decisions had a high-risk aura at the time, but have since become the paradigm for this type of public involvement process.

Chattanooga Venture, with funding from the Lyndhurst Foundation (a local foundation that played a leading role in implementation), conducted Vision 2000 in a period of eight months, from fall 1983 to spring 1984. Implementation started in earnest thereafter. Vision 2000's success was extraordinary. It became the catalyst for the coming together of the public, private, and civic sectors in implementing forty shared goals and objectives to cover areas such as downtown revitalization, the riverfront, human relations, education, affordable housing, jobs, and the city's form of government. In the first ten years, it prompted 223 projects and initiatives that created thousands of permanent and temporary construction jobs, and stimulated more than $1 billion in investments (figure 1.2).

Vision 2000 drastically changed the way business was conducted in Chattanooga because it demonstrated, without qualifications, that transparency in decision making is an asset that will speed rather than slow implementation (a concern often expressed at the time). It showed that taking risks and being open to new ideas would pay dividends in the form of innovation, which was a key in Chattanooga's success in dealing with seemingly intractable issues such as affordable housing, which was addressed through the highly imitated Chattanooga Neighborhood Enterprise organization. Vision 2000 demonstrated vividly that rekindling citizenship and encouraging participation, not just with ideas but also with direct involvement in implementation, can be a rewarding, creative, and fun activity. Not incidentally, three citizens—a planning professional and two business leaders—have since run for office and have been repeatedly elected as councilpersons and mayor, further integrating their leadership in Vision 2000 with their work in government.

Figure 1.2 – The Tennessee Aquarium in Chattanooga has been the catalyst for the riverfront development and has become the symbol of the city's renaissance. It is the focal point of the Riverbend Festival, the city's largest community event. (Image courtesy RiverCity Company)

SEEING TO UNDERSTAND THE WORLD

Visual simulation is a form of representation in which things that do not exist, but are contemplated, are represented or simulated allowing the user virtually to peer into the future. Until the advent of the motion picture, visual simulations were two-dimensional (2D) images (e.g., an architect's renderings of yet-to-be-built buildings). Current technology allows us to create three-dimensional (3D) virtual reality environments in which the user is an active participant, determining where she is going and what she is looking at in the 3D virtual model. These types of virtual environments are also referred to as immersive environments or real-time environments because the user controls the experience of actually moving around in the 3D model.

Visual simulation in a 3D virtual reality environment has a long pedigree in the history of visual representation. The change in representation of places from the medieval quasi-axonometric view (figure 1.3) to the Renaissance system of linear perspective (figure 1.4) was not only a shift in representation, but a profound philosophical change in how people perceived themselves in the world. In Lorenzetti's frescos, the representation of the world is not based on the location of the painter—it is as if from God's view, if you will. This view is supplanted by the Renaissance homocentric view of the world in which the

Figure 1.3 – Ambrogio Lorenzetti, *Effects of Good Government on City Life* (detail), 1338–1340, illustrates the medieval quasi-axonometric view. (Photo Credit: Erich Lessing / Art Resource, NY)

Figure 1.4 – Luciano Laurana, *Ideal City,* 15th century, illustrates linear perspective developed by Florentine architect Brunelleschi. (Photo Credit: Scala / Art Resource, NY)

Figure 1.5 – Albrecht Dürer, *Draughtsman Drawing a Recumbent Woman,* 1525, illustrates the perceiver's point of view. Woodcut illustration from *The Teaching of Measurements.* (Photo Credit: Foto Marburg / Art Resource, NY)

painter, the perceiver, becomes the critical element in representation; hence, the term point of view (figure 1.5).

The representational convention of reality in linear perspective is about the "accurate" placement of objects as perceived by a single viewer from a single location at a single moment in time. If the viewer moved, the perceived placement of objects would change as well. The representations were static, since only one point of view could be represented at a time. Advances using the camera obscura added a new element of naturalism to the representation of places—such as those seen in city views painted by Canaletto in Italy and England and by Vermeer in Holland (figure 1.6). Later artists attempted to bring representation closer to the human physiology of seeing by using the optical lens as a proxy for the human eye.

In the nineteenth and twentieth centuries the advancement of the camera and the science of human physiology and perception led to dramatic changes in representation. With the advent of photography, painting no longer needed to be tied to recording events or making "naturalistic representations," but was freed to explore how we see and perceive the world around us. The innovations of Manet and Cézanne through those of David Hockney are profound examples of the shift from realism to the physiology and psychology of human perception. Nonetheless, the images remained static representations, at best implying motion, time, and change (figure 1.7). Film and animation provided the means to capture those aspects, but this was still from the point of view of the lens in an edited, predetermined form in which the viewer passively responds to a controlled flow of visual information.

The innovative use of film to understand how people use space greatly benefited planning and urban design. William H. Whyte, in his film on the Seagram's Building Plaza in New York City, used time-lapse photography to record where,

Figure 1.6 – Camera obscura: a new naturalism. Jan Vermeer van Delft, *View of Delft* (detail), 1660.

Figure 1.7 – In *Place Furstenberg, Paris, August 7, 8, 9, 1985,* David Hockney records his "looking" in separate photographs, consciously imitating the way in which the eye scans an environment. The separate photographs are then assembled into a photomontage. Photographic collage; 43 ½" x 61 3/8"; © David Hockney, 1985.

how, and at what time of day people used plaza space. The time-lapse film not only revealed that the plaza was well used and inviting, but also provided insights into the nature of and reasons for activity.

Animation provided the means to directly create virtual environments that, nonetheless, still relied on linear perspective and its conventionalized form of representation. It is the precursor to digital visual simulation.

DEVELOPMENTS IN COMPUTER-AIDED DECISION MAKING

Over the past 30 years, computer-assisted planning and urban design have come of age. Beginning in the 1960s, information sciences focused on data and electronic data processing. Later, with information management (management information systems, or MIS) of the 1970s, decision support systems (DSS) in the 1980s, and in the 1990s more comprehensive planning and design decision support systems (PDDSS), information sciences have increasingly been integrated into planning and urban design practice and public decision making.

The growing menu of tools should not blur this critical question: How does one use and integrate these tools in the participatory planning process to improve the public's understanding of the issues and their choices for the future? When used in conjunction with geographic information systems (GIS), impact analysis, and forecasting tools, visual simulation has emerged as one of the most powerful tools to engage citizens and lay decision makers.

The Origins of Geographic Information Systems (GIS)

The development of GIS and the integration of analytical reasoning into GIS have been deeply influenced by the work in the 1960s–1970s of Carl Steinitz at the Harvard University Graduate School of Design and Ian McHarg at the University of Pennsylvania. McHarg's 1969 book, *Design with Nature,* describes a manual geographic information system—GIS before GIS. The subject of the book is ecology, the interplay between natural and man-made systems. For example, by creating separate maps of discrete information on acetate, and overlaying the geo-referenced sheets in logical sequence, McHarg was able to determine what land was not developable by first setting metrics and then sequentially layering data acetates depicting wetlands, slopes, agricultural land, important animal habitats, etc. (McHarg 1969). The resulting map illustrated the places where development would be appropriate.

To get to the output, the user needed to:

- formulate a question or query;
- assemble the data needed to respond to the question;
- determine the variables and formulate criteria to be used to screen the data;
- establish the sequence of analysis most critical to the least critical variables (This is important, as it allows the user to understand the deductive process at each stage in the analysis.); and
- select the appropriate display format or formats.

If done in GIS, McHarg's analysis would result in a series of maps showing the process of deduction, illuminating the relationship among data layers and tabular and graphic information not only about each data layer, but about the results (e.g., how much land is in agricultural use? in critical habitats? on slopes? or less than 2 percent forested? and, in the end, how much land is developable?). The last operation would involve querying the results using GIS's capability to quantify both existing data and the new information created in response to a query.

Digital Visual Simulation and 3D Geographic Information Systems

Digital visual simulation emerged in the 1990s from six different user groups:

1. Digital photomontage from the graphics industry (e.g., the application Photoshop) (figure 1.8)
2. 3D modeling, rendering, and animation from computer-aided drafting (CAD) for architects (e.g., the application 3D Studio) (figure 1.9)
3. 3D graphics from the computer gaming industry (figure 1.10)
4. Animation and digital special effects from the entertainment industry (figure 1.11)
5. Real-time interactive virtual reality 3D environments from the defense industry (figure 1.12)
6. GIS from geography and environmental planning and management (figure 1.13)

Figure 1.8 – A digital photomontage showing before and after conditions of a proposed urban renewal project. The "after" photomontage (below) is created by the artist by adding elements using Adobe Photoshop or other digital image-editing tools. (Images courtesy of Urban Advantage)

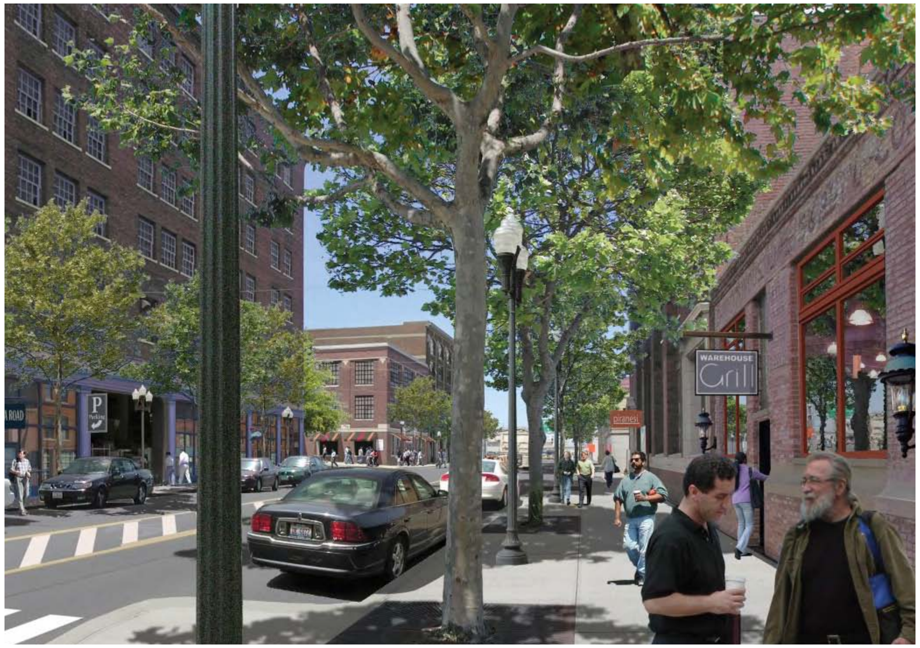


Figure 1.9 – A rendered CAD image for the Theater for a New Audience in Brooklyn, New York. All the elements in the scene are modeled with geometry and rendered using materials, textures, lighting effects (including shadows, reflectance, transparency, etc.), and atmospheric effects (sky and haze) to achieve realism. (Image courtesy of H[3] Hardy Collaboration Architecture LLC, New York, NY)

While they emerged more or less in the same time frame, each technique was developed to serve a specific purpose driven by the needs of its user group, and for all intents and purposes they were not interchangeable. Their origins notwithstanding, a convergence of visual simulation techniques is now evolving. An early example is the development of 3D GIS that merged CAD 3D representation of a place with attribute data about the place and the objects in it in a format that allowed the user to pose questions (queries) to the database and have the results visualized in three dimensions as well as traditional charts and tables (e.g., Environmental Simulation Center's 3D GIS; figure 1.14). More recently, GIS has been linked to real-time interactive 3D environments by adapting virtual reality real-time formats for its 3D visual simulations. Convergence is also seen in the development PDDSS, where information can be queried and displayed in a multidimensional environment.

Visual simulation tools, particularly those that represent the world in an interactive 3D virtual environment, support the planning of places. Of the six

Figure 1.10 – A screen shot from an educational computer video game targeting students 13–19 years old, challenging them to be critical and reflective about real-world conflicts. (Global Conflicts: Palestine 2007; © Serious Games Interactive)

Figure 1.11 – A frame from the computer-generated animated movie *Elephants Dream,* the first movie made entirely with open source graphics software. (© 2006, Blender Foundation / Netherlands Media Art Institute)

Figure 1.12 – A screen shot from a real-time virtual reality simulation for military flight training. (Image courtesy of Presagis)

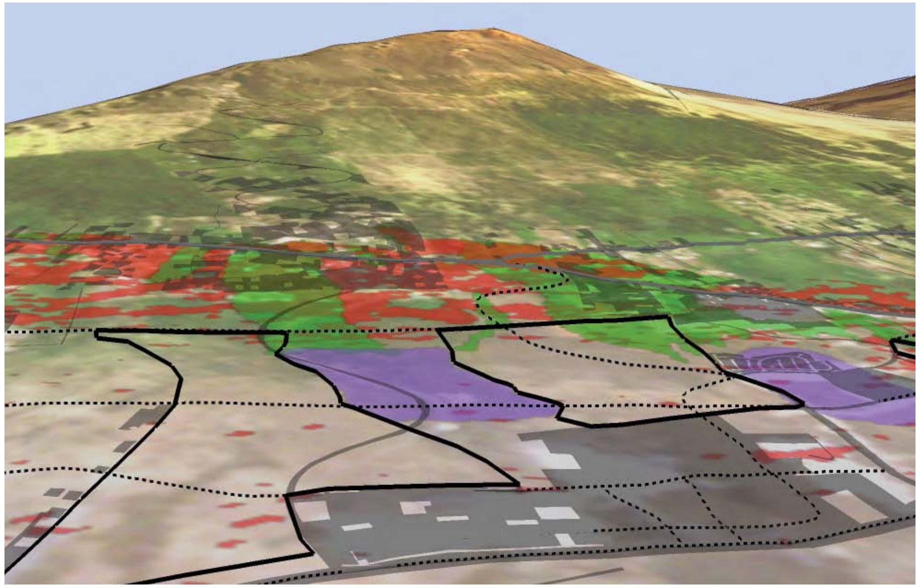
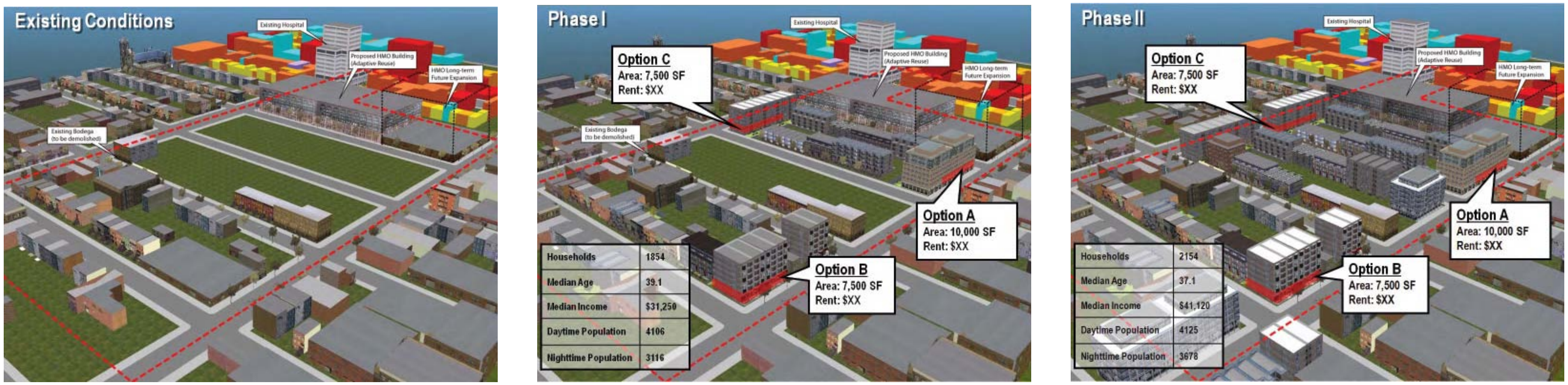


Figure 1.13 – In this example from Kona, Hawaii, steep slopes (red), agricultural lands of significance (green), endangered species habitat (purple), and proximity to existing development (gray) were some of the factors used to delineate areas appropriate for urban expansion (outlined in black). (Environmental Simulation Center, 2006)



Figures 1.14 – 3D GIS represents a transition from a purely visual display by integrating the 3D model with a queryable database. In this example a store owner in a hypothetical redevelopment area (left) queries the 3D GIS to determine potential relocation sites that will become available at the end of Phase I (middle) as well as the proposed market demographics at the end of Phases I and II (middle and right). (Human Development Overlay District (HDOD): Environmental Simulation Center / Ford Foundation, 2007)

types of tools, GIS is the most familiar to planners. In the world of GIS, analytical graphics and 2D maps were the preferred modes of representation until recently. Connections to other data and databases varied considerably among the other modes. For example, digital photomontages and film or computer-generated animation are purely visual data, while the others have varying capacities to attribute other data and information to the 3D models and environments. GIS has historically had the strongest connection between data and 3D visual simulation because of its origins in geography and as an analytical land and environmental planning tool. What these tools share is their reliance on the representational conventions of mapping, orthographic projections, and linear perspective.

Of the six modes of digital visual simulation, only real-time interactive virtual reality allows the user to navigate freely in a virtual 3D environment. A dividend resulting from the end of the Cold War, real-time interactive virtual reality was used (and today is increasingly used) in flight simulation training and war games. Computer games, while similar, restrict the user to a limited set of options in a narrowly delineated 3D environment, albeit an increasingly complex one. Animation, either in the CAD environment or the entertainment industry, can create hyper-realistic environments in a controlled format that includes a narrative, supported by predetermined paths and editing, that literally frames the viewer's experience. Digital photomontage is similar to animation, predetermining the viewer's visual field, albeit in a static photographic image.

Planning and Design Decision Support Systems (PDDSS)

Planning and design decision support systems are the planning tools of choice as most of them have been specifically designed to be integrated into the public decision-making process. They have the capacity to make sense of complex problems and issues for laypeople and professionals without simplifying or "dumbing" them down. At the moment, two sophisticated PDDSS have emerged that are built on a GIS platform: INDEX (figure 1.15) and CommunityViz™, both of which include powerful 2D and 3D design and visualization tools.

While we will focus on PDDSS, it is important to understand that they are a subset of planning decision support systems (PDSS) and share many but not all of the characteristics of PDSS. For example, most PDSS and PDDSS are built on a GIS platform or on some GIS data, and they support scenario planning where scenarios can be created, and variables and constants can be changed (including spatial configurations such as the allocation of land uses). These systems produce results that can be evaluated against user-determined criteria such as performance indicators, benchmarks, and capacities. The defining characteristic of PDDSS is that they are *design* tools.

PDSS models can be categorized as either allocative or sketch models. In allocative models the computer algorithms distribute projected jobs and housing units in the area being planned. In sketch models the user distributes projected jobs and housing units in the area under consideration. Because PDDSS by definition includes design, sketch-based models are the only types of software that let the user design the physical form of a community. Allocative models typically used are:

- METROPILUS (DRAM/EMPAL), which is widely used by regional councils of government (COGs) to allocate employment and households;
- CURBA (California Urban Biodiversity Analysis) models, which factor in ecological considerations;

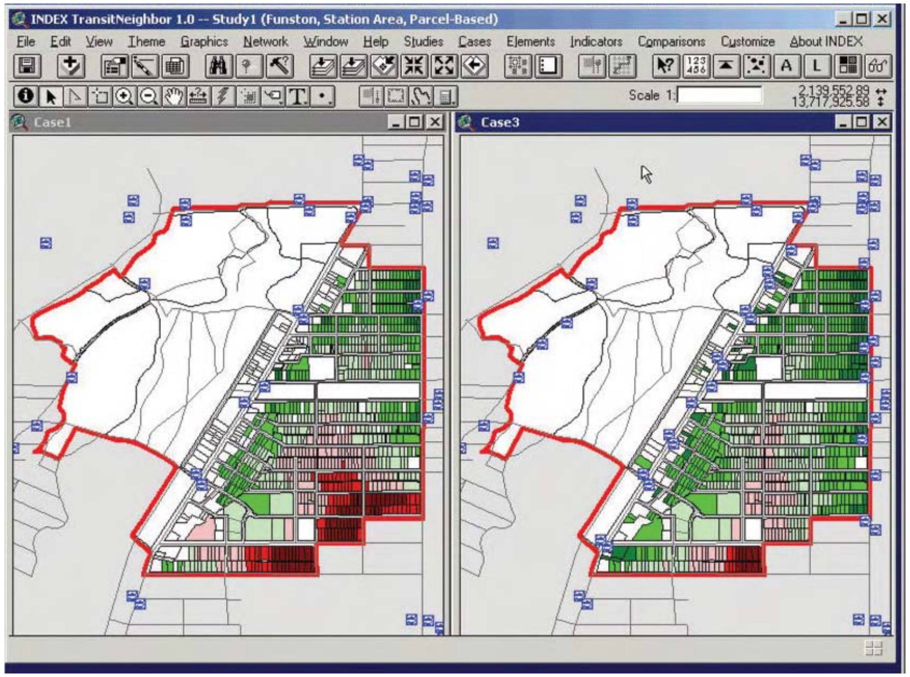


Figure 1.15 – This image illustrates the walkability of two planning scenarios providing different levels of transit service, whereby shades of green indicate parcels with good transit access, and shades of red represent parcels with poor transit access. The scenario on the right adds more transit stops to increase the number of parcels with good transit access. (Image courtesy of Criterion Planners, Inc.)

- UrbanSim, which is used for regional planning, models the relationship between transportation, land use, and the real estate market based on microeconomics; and
- What if?, which allocates land uses based on policies.

Sketch models typically used are:

- CommunityViz™ (designed and developed by the Environmental Simulation Center with Multi-Gen Paradigm, Foresight Consulting, and PricewaterhouseCoopers for the Orton Family Foundation) consists of two components, a scenario constructor and a tool that can be used to design places and visually simulate them in a real-time 3D environment.
- INDEX includes 2D design tools called Paint the Town and Paint the Region. INDEX is similar to CommunityViz's™ scenario constructor allowing for user-determined indicators.
- PLACE^{3}S (Planning for Community Energy, Economic, and Environmental Sustainability) is also a scenario-construction tool with basic 2D mapping capability where plans can be evaluated against indicators that are templates, similar to CommunityViz™ and INDEX.

Three-dimensional planning and urban design tools have a lineage that originated in the early 1980s. The objective of these early tools was to allow stakeholders to experience a streetscape visually by moving through the environment at eye level. These tools emerged from special-effects simulators developed by the film industry and driving/flight simulators. The former involved the construction of physical models at a scale large enough to accommodate an optical probe suspended on a gantry connected to motion-control software that programmed a path through the physical model (figure 1.16).

To make simulation more accessible to laypeople, photographs of existing and proposed buildings were perspective corrected and literally glued to the physical massing model, creating a convincing visual experience (figure 1.17). The path through the model could either be predetermined, as in an animation, or forged manually by the user, who directs the movement of the optical probe through the physical model. The user would experience movement through the physical model on a monitor as it is simultaneously recorded on videotape, from which it

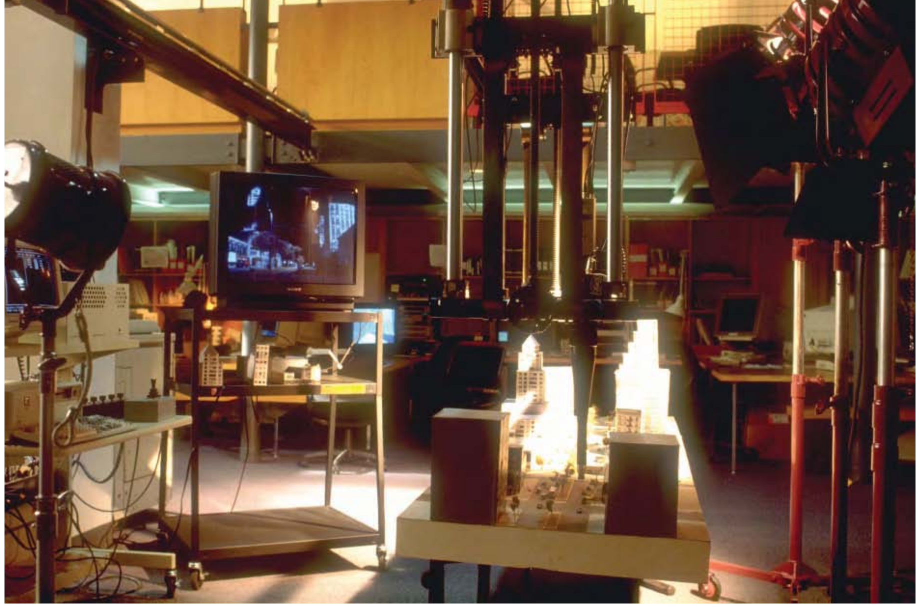


Figure 1.16 – Visualizing zoning alternatives for Broadway on Manhattan's Upper West Side: Prior to the development of real-time photorealistic 3D digital models, a gantry-mounted miniature camera controlled by computer moves through and records a video on a path in a physical scale model. Photographs of existing and proposed buildings are corrected for parallax and mounted on the physical massing models to create a photo-real effect. (Environmental Simulation Center, 1993)

Figure 1.17 – An eye-level view of Broadway in the 3D physical model used for visualizing a zoning alternative. The scale of the model is revealed by the person's hand inserting an object into the model. (Environmental Simulation Center, 1993)

could be shown, independent of the gantry, on a videocassette recorder. Alternatives could be inserted into the 3D model at preselected points in the walk-through or recorded separately along the same path and compared by splitting the screen into multiple windows and viewing the alternatives simultaneously and in synchronization with each other.

Concurrently, immersive interactive digital environments were being developed for the driving/flight simulation industry. Similar to visual simulation, which employed physical models and moving optical probes, these environments also required a high degree of visual realism to make them effective teaching and learning tools. Rather than paste photographs on a physical model, this software pasted photographs of buildings and landscape on virtual 3D massing models of buildings and topography.

The visual effect was similar to that of physical simulators, with two distinct differences. First, it was immersive, allowing the user to navigate freely and easily and respond in real time without prepathing, providing the possibility of unlimited freedom of movement and exploration. The second difference was the ability to attribute information to elements in the landscape. These two characteristics were critical to the concept of designing and planning in an information-rich environment.

Until recently, neither the physical nor the digital visual simulations were portable; both required the stakeholders to travel to the production location. In addition, they were expensive to use in the context of planning and design, in terms of initial cost, and the time and effort needed to construct the 3D models in either digital or physical format.

The advent of increasingly powerful personal computers equipped with sophisticated graphics software and hardware dramatically reduced the initial cost and complexity of 3D real-time visual simulations. More recently, powerful laptops and lightweight projectors have made it possible to take the simulations to the stakeholders rather than requiring that they come to the lab (figure 1.18). Portability has substantively changed the ability to integrate real-time 3D visual simulation more fully with public participation, opening up new possibilities for collaborative decision making.

PDDSS take advantage of 2D and 3D visualization and analysis technologies to combine them in a powerful decision-support environment. Two-dimensional mapping and analytical software GIS are linked with 3D interactive simulation

Figure 1.18 – 3D simulations that once required large, expensive gantry-mounted cameras and/or computers can now be realized on inexpensive portable laptops with projectors, allowing planners to bring interactive 3D to workshop participants. (Houston Near Northside Economic Revitalization Plan). (Environmental Simulation Center, 2001)

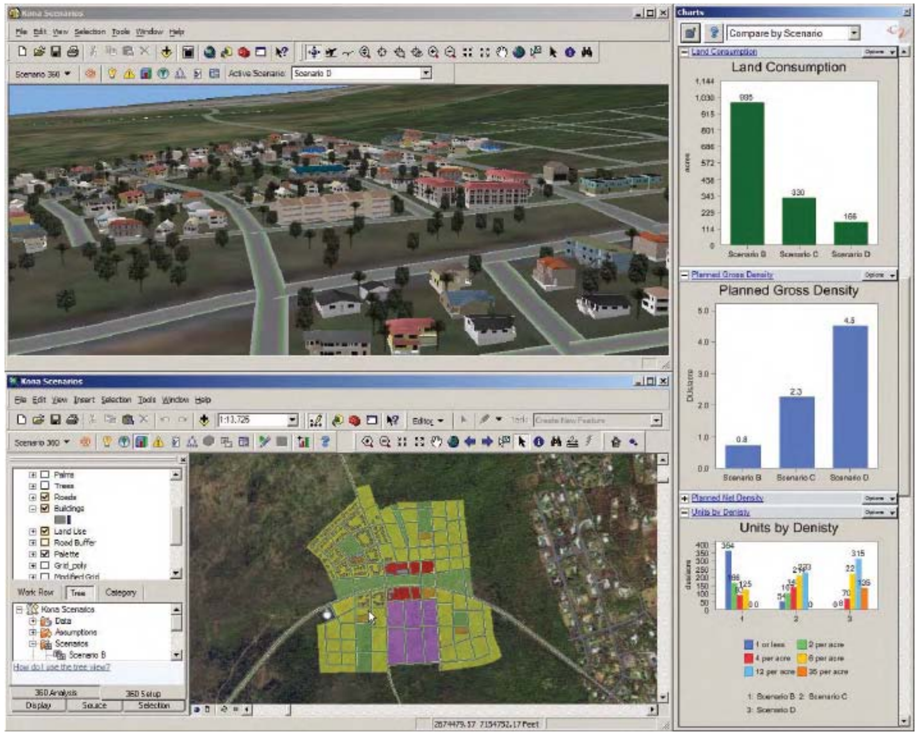


Figure 1.19 – In conjunction with the Kona Community Development Plan "How Do We Grow?" workshop, CommunityViz™ was used to support stakeholder exploration of alternative development scenarios in both a 2D GIS map and a 3D real-time model, making changes and evaluating impacts on the fly. (Environmental Simulation Center, 2006)

software, to allow users to think, design, analyze, and experience place in both 2D and 3D for a more holistic approach to planning. In addition, the fourth dimension of time can be designed into the representation for public participation and decision-making processes. This allows the user to forecast the impacts of public and private decisions and develop scenarios in both 2D and virtual reality 3D (such as in CommunityViz™ and ESRI's ArcScene). It is now possible to analyze the scenarios' results on the fly, and refine the alternative scenarios in a nonlinear, nonhierarchical fashion in both 2D and 3D. In CommunityViz™, the three-dimensional representation of alternatives in an information-rich interactive virtual reality environment transcends the use of visualization as merely illustration (figure 1.19).

SUMMARY

The simultaneous coming of age of the two fields that make up the narrative of this book—public involvement and digital visualization—and the increased flexibility and sophistication of available tools are profoundly changing the way decisions about planning issues are made. First, the process of decision making is becoming increasingly transparent, with the public becoming involved early in the process. Second, the ability to visualize alternatives and understand their impact has made public choices increasingly better informed. Finally, the use of computers and GIS-linked 3D imagery has dramatically shortened the time needed for feedback. While at one time it took several meetings to enable the public to make decisions, today feedback occurs instantaneously, enabling the same group of people to test alternatives and make informed decisions within a single meeting.

The technology is continuing to change. For example, Google Earth™ has begun to make the use of real-time visual simulation both more affordable and accessible to the public. Provided free over the Internet, users of the 3D Google Earth™ can now construct and add their own 3D models of buildings to a growing shared library that can then be used in a planning process and disseminated via the Internet. The construction of 3D environments has been simplified through the use of Google Earth's™ authoring tools (Google SketchUp™), and the cost of creating 3D environments has been drastically reduced.