

Planning

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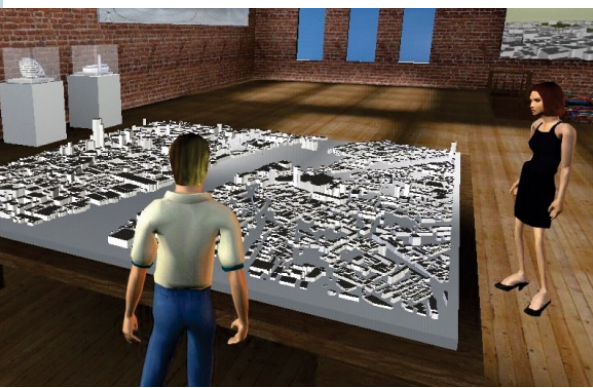
Systems

for Cities

and Regions

Edited by

Richard K. Brail



Planning Support Systems for Cities and Regions

Edited by **Richard K. Brail**

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Acknowledgments

In September 2007, the Lincoln Institute of Land Policy sponsored a conference in Cambridge, Massachusetts, at which the papers in this volume were first presented. The authors, discussants, and attendees were drawn from the United States and abroad, and were connected through research and practice to the use of information technology in urban and regional planning and policy formulation. Four discussants were invited to the conference to review and comment on the papers: Richard S. Bolan, University of Minnesota; Joseph Ferreira, Massachusetts Institute of Technology; Lewis D. Hopkins, University of Illinois; and Lyna Wiggins, Rutgers University. Their insights fed into spirited discussion among conference participants and were well received. John Landis, University of Pennsylvania, was also a welcome addition to the program. A particular note of appreciation is due to Richard Klosterman for assistance in developing the theme and structure of the fall conference.

Lincoln Institute was an excellent host. We deeply appreciate the support of Gregory K. Ingram, its president, and the Institute's board of directors. Armando Carbonell, senior fellow and chair of the Department of Planning and Urban Form, provided strong guidance throughout the conference planning period. Lisa Cloutier was a tremendous help with organization and arrangements. Brooke Digges of ResourcePlus did an excellent job handling conference logistics. Book production was similarly well supported. Ann LeRoyer, senior editor and director of publications, has provided superb guidance as well as access to Brian Hotchkiss and Peter Blaiwas of Vern Associates, an excellent editor and book designer, respectively.

A final thank you is due to all who supported and participated in this effort. I hope this book will highlight the potential of planning support systems in assisting the growth and development of cities and regions.

— Richard K. Brail

Foreword

Planning Support Systems for Cities and Regions invites the reader to join in a virtual dialogue with its authors—educators, theorists, model builders, and planners—about technology and the social context in which technology is employed. It is also the trace of a face-to-face dialogue that took place at Lincoln House in Cambridge in September 2007, when we convened the authors and several invited planning experts to discuss earlier drafts of these chapters on the state of the art in planning support systems. (This term dates only to 1989 and is attributed to Britton Harris, if not first coined by him.)

This dialogue, or perhaps dialectic, revolves around the almost unlimited potential of computer-based tools to enhance the effectiveness of planning and the serious challenges in applying these tools within real-world planning environments. The Lincoln Institute of Land Policy has focused on tools for planners in a number of its recent books, including Kwartler and Longo's *Visioning and Visualization: People, Pixels, and Plans* (2008), Campoli and MacLean's *Visualizing Density* (2007), and Hopkins and Zapata's *Engaging the Future: Forecasts, Scenarios, Plans, and Projects* (2007).

All three of these books and the current volume have in common, albeit to varying degrees, an interest in the spatial and visual side of planning. However, it is useful to differentiate the two visualization/design books from this volume and *Engaging the Future*, which are less about “showing” the tools and more about promoting a critical understanding of their strengths and limitations. The intended audience, therefore, is both the user—and potential user—of these tools, and those who seek to continue to improve them.

Richard Brail, the editor of this comprehensive and ambitious volume, has been notably successful in bringing together the wisest of the field's thinkers, the most inventive of the toolmakers, the most experienced of those working at the interface with real clients, and the most battle-seasoned practicing planners (and many of these individuals occupy more than one of these niches). Together they present a broad view of the field, in-depth developmental histories of the most important models and tools as told by their creators, and a provocative, in-the-trenches critique of the state of the art. In part, it is a book about “matching the user to the instrument”; and, if not yet the *Consumer Reports* some have called for, it is a helpful guide for those new to the field.

But I think this book is also much more than that. It is an invitation to think about how planning support systems can help in shaping the uncertain future that planners must visualize and communicate to an increasingly participative public. These tools have emerged during an age where the expectations of communities to be able to “take control” of their futures have increased, where fragmentation of interests is more the rule than is confluence, and where complexity is seen to trump rationality.

Planning support systems aspire to enable the expert and the citizen to meet on an equal footing in a new communicative planning process. The structure of the book moves from the broadest conceptual level, through regional and local applications including project planning and regulatory review, to the perspective of the practitioner. I sense, in following this transect from the heights of the academy to the front lines of practice, a gradient of increasing pessimism and lowered expectations, ending with a call for ease of use and simplicity in the face of a task that is irreducibly complex and unpredictable.

Planning will never be easy; it needs and deserves the best support systems that modelers and system developers can deliver. This volume not only reports that they are “working on it,” but also gives us a glimpse at future tools suited to a planning process that has become, as Brail says, “more visual, more public, more accessible, and more collaborative.”

— Armando Carbonell
Chairman
Department of Planning and Urban Form

Introduction

Richard K. Brail

PLANNING SUPPORT SYSTEMS (PSS) THAT INTEGRATE SPATIAL MAPPING, analysis, and visualization have evolved substantially over the past decade. Significant resources have been devoted to making these computer-based systems operational and meaningful in public decision making. In September 2007 the Lincoln Institute of Land Policy held a conference focusing on planning support systems that highlighted the current state of the art and pointed to future developments. Leading scholars at the intellectual and operational centers of current work in the area contributed the eleven chapters included in this volume.

The term *planning support systems* has been defined both broadly, to encompass a range of technology-based solutions useful to planners, and more narrowly as GIS-based models that project urban futures and/or estimate impacts. In the broadest sense, PSS encompasses analysis, design, participatory planning, communication, and visualization.

The Lincoln Institute conference focused on mature planning support systems that have been implemented in a number of applications, and have received broad recognition. Yet, they vary in their theoretical frameworks, data inputs, and types of output. The one common theme to the PSS models in this book is that they are all operational and have been implemented in real-world applications. The systems were selected for this reason as well as for representing different design approaches. These models are not speculative and unproven, but rather show that a powerful concept such as PSS can be translated into operational frameworks useful in planning and public policy.

The book is divided into four sections. In the first section, “A Broader Perspective,” Michael Batty’s and Harry Timmermans’s essays provide an overview of planning and decision support systems. Batty introduces the concept of a planning support system and highlights the movement of urban planning over the past decades from a top-down, “professionals know best” attitude to a participatory

approach involving a broad spectrum of citizens, interest groups, and public officials. Today planners and public officials interact with multiple communities and increasingly do so with digital technology. Batty develops the concept of a planner's toolbox of digital tools and applications that focus on the visualization of models and processes.

Batty states, "communication through visualization is rapidly becoming one of the main foci in PSS as the computer revolution moves ever more swiftly to graphic and related media in contrast to its origins in numerical data processing" (Batty, chapter 1, page 5). He demonstrates the power of visualization with a set of interesting examples, including a land use model, a "virtual" London, and Google-based implementations. These remarkable examples illustrate the power of graphics-based tools and their place in a planning support system.

Harry Timmermans looks broadly at spatial decision support with particular focus on land use and transportation models (LUTMs) and offers an excellent review of their evolution. While these models comprise only one class of planning support system, there are lessons to be learned from their implementation because their broad dissemination has had a mixed history. Some have been used widely, while others are little more than academic exercises. Based on the experiences of LUTMs, Timmermans suggests that developing a model does not mean that it necessarily will be used. Even more, emerging planning support systems often are "toy" enterprises, developed as stand-alone projects presented at academic conferences. In "on the street" legitimacy, there is a substantial gap between operational PSS used in live situations and research designs that show promise but have never been tested in the real world. For Timmermans, cities and regions are complex and require substantial resource commitments and complex modeling solutions.

The second section of the book, "The Regional Scale," contains three chapters about operational PSS that work at broader geographic scales. These three systems are generally focused on groups of cities, counties, or other regional-scale entities such as river basins or watersheds. These models reflect different methodological approaches to projecting into the future. The first chapter, by Keith Clarke, describes SLEUTH, a cellular automaton model that uses the grid cell as the unit of analysis. SLEUTH is widely used, having been applied to more than 100 cities and regions. Key to its development is the availability of the model code on the Internet and the host of researchers and students who have worked with and improved the model design. Clarke outlines the history of SLEUTH, discusses unresolved issues, and shows how this complex and computationally intensive model is evolving into a PSS with visualization, scenario construction, and alternatives analysis.

The second chapter in this section, by Brian Deal and Varkki Pallathucheril, presents the Land-use Evolution and impact Assessment Model (LEAM), which integrates a grid-based cellular automata (CA) approach with regional socioeconomic models—a "hybrid CA" framework. LEAM balances the results of model runs against stakeholder and professional review and comment. Developed at the University of Illinois at Urbana-Champaign, the model has been used in Chicago and St. Louis. The St. Louis case, where LEAM is loosely coupled to a regional

transportation model, is described in detail. This connection permits the simulation of the classic interaction between development and the transportation infrastructure impacts. The authors emphasize the connectivity between models and citizens, where scenarios are put in the public arena for discussion and consensus building.

In the final chapter of this section, Richard Klosterman offers a view of planning that underlies the development of the What if?TM planning support system. Klosterman reviews the evolution of planning theory and practice from top-down design and analysis to collective reasoning. Successful PSS should consider a set of design principles that recognize the difficulty of prediction, the inadequacy of available data, and the need to keep model implementations understandable.

Klosterman reinforces Deal and Pallathucheril's comments about involving the community in developing the model and exploring the policy alternatives. What if? responds to these design principles since the model "is an explicitly policy-oriented model that suggests *what* might happen in the future *if* clearly specified public policies are adopted" (Klosterman, chapter 5, page 90). This model employs vector-based developable land units (DLUs) and builds future scenarios based on user-defined policies and rankings. What if? has been used broadly, with installations in the United States, Australia, China, Italy, Korea, Malaysia, Spain, and the United Kingdom.

The third section, "Moving from Region to City," contains four chapters that examine how planning support systems transition from the regional scale down to neighborhoods and into the planning office. The chapter on UrbanSim, authored by Paul Waddell, Xuan Liu, and Liming Wang, describes a complex and powerful model used in a variety of city sizes and locales, including Brussels, Honolulu, Rome, Salt Lake City, San Francisco, Seattle, Tel Aviv, and Zurich. UrbanSim simulates interactions through agents representing persons and jobs, and contains an urban land market at the parcel, zone, and grid-cell levels. Unlike many other simulation efforts, UrbanSim models real estate interactions and prices, and integrates directly with urban transportation models. The development of UrbanSim has been fostered by broad and extensive funding support and recognition of the strength of the conceptual framework and the need for such a model system. This PSS is also widely known for open source licensing.

Eliot Allen authored the next chapter, focusing on the INDEX PSS, which was designed as a straightforward scenario generator and scoring tool. INDEX contains a set of indicators that can be used to evaluate alternative land use designs in terms of their environmental and sustainable impacts. These indicators are embedded in the PSS and described in detail in a dictionary. The focus of INDEX is on the assessment of current projects and plans, rather than long-range activities. Its intent is to improve the numerous planning decisions made daily by the thousands of agencies in the United States that deal with land use and transportation issues. The INDEX consulting group has also used "smart boards" as an interactive design device for citizen planning. This innovative tool, Paint the Region, permits broad citizen participation in planning issues. INDEX has been used widely—in 690 locations across 36 states as well as internationally.

The section's third chapter is by George Janes and Michael Kwartler of the Environmental Simulation Center (ESC). The center directed the research effort that developed CommunityViz[®], a highly ambitious effort supported by the Orton Family Foundation. The original CommunityViz was a bold attempt to integrate cutting-edge technology and theoretical concepts into a unified framework. The initial design included a scenario builder connected to both a two-dimensional GIS and a three-dimensional visualization environment. Users could work across 2D maps and 3D scenes, seeing the results of planning and development decisions in both media, and actually flying through a computer-generated landscape.

Coupled to this integrated 2D and 3D framework was an agent-based urban microsimulation model, the Policy Simulator[™], which is no longer supported as part of the original CommunityViz. The Policy Simulator represented an innovative attempt at simulating a city at the level of the individual activities of households and firms. Today CommunityViz consists of Scenario 360[™], the 2D PSS that offers indicator-based evaluation, and SiteBuilder 3D[™], the three-dimensional interactive viewing module. Scenario 360 provides an excellent tool for building indicators with the Formula Wizard, and has been used in a variety of localities.

The last chapter in this section focuses on the use of the PSS as an administrative tool in the planning office. Anthony Yeh details how PSS is being used in Hong Kong and China for development control, in particular for processing project applications. The primary objective of these PSS implementations is to rationalize the planning and administrative decisions made about applications for new development projects. The chapter provides a detailed window into the use of two interesting conceptual and methodological approaches, Computer-Supported Collaborative Work Flow (CSCWF) and case-based reasoning (CBR). This PSS implementation uses GIS, database management, and visualization tools as well as knowledge-based frameworks, complementing the other systems presented in the book.

The final section, "Planning Support Systems in Practice," focuses on using PSS in planning and public policy applications from two different perspectives. Stan Geertman, a professor in the Netherlands, has researched and written about planning support systems, while Terry Moore is a practicing planner in the United States. Both offer critical assessments of the application potential of PSS in practice and recommendations of how to move PSS further into the mainstream.

Geertman sees PSS as an information technology tool that requires user acceptance to be successful, requiring a solid understanding of planning decisions and decision makers. Context is important; the nature of the problem, the predilections of the staff, and the level of available resources all matter. He calls for a research agenda that supports the continuing development of PSS, noting that we have a long way to go. Critical in this future work is the matching of the user to the PSS instrument used.

Moore reinforces the need for user acceptance and argues that planning support systems should be more flexible, easier to use, and focused on producing needed and useful outputs for planners and the community. He also presents the dilemma of

complexity versus simplicity. As Moore states: “A dilemma for planners is that the decision makers make irreconcilable demands of PSS. On the one hand, they know metropolitan areas are complex, and that everything affects everything else. They want a model that deals with that complexity and especially with the myriad policy choices that they want investigated” (Moore, chapter 11, page 252).

But planners and policy makers also “want transparency. They claim not to want a black box, implying that they want to understand all the relationships and be able to adjust on the fly” (Moore, chapter 11, page 253). Moore offers insights on how to deal with this issue by focusing on the PSS design process.

What can we learn from these authors? Planning support systems already exist to help professionals and citizens better understand the consequences of their decisions and better “see” the future. This book presents a range of operational systems that do a variety of tasks, and these modeling frameworks have been used widely. SLEUTH has been run in more than 100 regions; UrbanSim is used both in the United States and internationally; and INDEX has been applied in about 700 places in the United States, as well as internationally. PSS can do projections to the future, can estimate impacts of development options, visualize urban environments, and help manage the office. Yet, there are still many gaps between what PSS offers and what is needed by cities and regions. There is the continuing frustration that PSS has not entered the planning and policy arena more broadly.

There is the gap between the ideal PSS, an analytic tool useful in communicative planning, and the reality that many planning organizations do not use these systems. This lack of use is attributed to a wide range of causes including tool and user mismatch, lack of resources, and inadequate knowledge. We face the obvious question: How do we find the resources and commitment to develop PSS so that these decision support tools can be better connected to planning and public policy?

In the United States the urban transportation planning community benefited from a large influx of federal dollars that assisted in developing a coherent and robust analytic framework, which has survived and evolved over half a century. Sufficient resources would be welcome, but even without the significant influx of new finances, PSS tools can evolve. As the reader will see in these chapters, there are success stories as well as recommendations about how to move PSS forward.

PSS are a small piece of the larger movements occurring in planning and policy development. The planning process today is more visual, more public, more accessible, and more collaborative than in previous decades. Technology—in the form of models, visual simulations, and the Internet—is feeding the broadened access of citizens to their environment and to the decisions that affect the community. Google Earth and Microsoft’s® Virtual Earth™ are two examples of widely available mapping tools as three-dimensional “flying” is becoming commonplace.

Cities and regions are on the digital map. At the same time, the world faces the issues of climate and environmental change and energy depletion. Within this dynamically changing landscape sits urban and regional planning. Planning support systems will evolve; they will have to in order to remain relevant. This book provides ample evidence that this evolution is taking place.