Planning Support Systems for Spatial Planning Through Social Learning

by

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Abstract

This dissertation examines new professional practices in urban planning that utilize new
types of spatial planning support systems (PSS) based on geographic information systems
(GIS) software. Through a mixed-methods research design, the dissertation investigates the role
of these new technologies in planning workshops, processes, and as metropolitan
infrastructures. In particular, PSS are viewed as supporting social learning in spatial planning
processes. The study includes cases in Boston, Kansas City, and Austin.

The findings indicate high levels of social learning, broadly confirming the collaborative
planning theory literature. Participants at planning workshops that incorporated embodied
computing interaction designs reported higher levels of two forms of learning drawn from Argyris
and Schön’s theory of organizational learning: single and double loop learning. Single loop
learning is measured as reported learning. Double loop learning, characterized by deliberation
about goals and values, is measured with a novel summative scale. These workshops utilized
PSS to contribute indicators to the discussion through the use of paper maps for input and
human operators for output. A regression analysis reveals that the PSS contributed to learning
by encouraging imagination, engagement, and alignment. Participants’ perceived identities as
planners, personality characteristics, and frequency of meeting attendance were also related to
the learning outcomes. However, less learning was observed at workshops with many detailed
maps and limited time for discussion, and exercises lacking PSS feedback. The development of
PSS infrastructure is investigated by conducting a qualitative analysis of focus groups of
professional planners, and a case where a PSS was planned but not implemented.

The dissertation draws on the research literatures on learning, PSS and urban computer
models, and planning theory. The research design is influenced by a sociotechnical perspective
and design research paradigms from several fields. The dissertation argues social learning is
required to achieve many normative goals in planning, such as institutional change and urban
sustainability. The relationship between planning processes and outcomes, and implications of
information technology trends for PSS and spatial planning are discussed.

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# Table of Contents

| Illustrations | ........................................................................................................................................ | 7 |
| Tables | ........................................................................................................................................ | 9 |
| Acknowledgements | .................................................................................................................................... | 10 |
| Abbreviations | ....................................................................................................................................... | 11 |

## Chapter

1 **Introduction** .................................................................................................................................................. 12
   1.1 Overview ............................................................................................................................................. 12
   1.2 The Methods and Tools of Metropolitan Strategic Spatial Planning ................................................. 14
   1.3 Research Questions ................................................................................................................................. 19
   1.4 Design Research Paradigms .................................................................................................................... 21
   1.5 Research Significance ............................................................................................................................... 26
   1.6 Dissertation Structure ............................................................................................................................... 26

2 **Planning Through Social Learning: A Pragmatic View** .................................................................................. 28
   2.1 Introduction .......................................................................................................................................... 28
   2.2 Types of Theory in Planning .................................................................................................................... 30
   2.3 Framing Theory: Spatial Planning ............................................................................................................ 30
      2.3.1 Historical Overview ............................................................................................................................ 30
      2.3.2 Alternative Futures and Scenario Planning ........................................................................................ 33
      2.3.3 Collaborative Planning Theory .......................................................................................................... 36
   2.4 Social Theory: Pragmatism ......................................................................................................................... 37
      2.4.1 Pragmatic Spatial Planning ................................................................................................................. 37
      2.4.2 Pragmatism in Planning Theory ......................................................................................................... 38
   2.5 Exogenous Theories: Social Learning ........................................................................................................ 39
      2.5.1 Argument for a Social Learning Perspective ....................................................................................... 39
      2.5.2 Social Learning Theories (Micro and Meso) ..................................................................................... 40
      2.5.3 Social Learning Theories (Macro) ....................................................................................................... 45
   2.6 Exogenous Theories: Frames and Institutions ......................................................................................... 47
      2.6.1 Linking Planning and Social Learning ............................................................................................... 47
      2.6.2 The Concept of Frames ...................................................................................................................... 47
      2.6.3 Frame Reflection as a Mechanism for Professional Innovation ........................................................ 49
      2.6.4 Institutional Theory ............................................................................................................................. 50
   2.7 Multilevel Social Learning Framework ..................................................................................................... 54
   2.8 Conclusion .............................................................................................................................................. 56

3 **Spatial PSS in Context** ..................................................................................................................................... 58
   3.1 Overview .............................................................................................................................................. 58
   3.2 Two Approaches to Computation in Spatial Planning .............................................................................. 58
      3.2.1 Urban System Model Builders ........................................................................................................ 60
      3.2.2 PSS Builders .................................................................................................................................... 62
      3.2.3 The Approaches Compared ............................................................................................................... 63
      3.2.4 Representations in Planning Models .................................................................................................. 66
      3.2.5 Indicators .......................................................................................................................................... 67
      3.2.6 Spatial Data Infrastructures .............................................................................................................. 69
   3.3 Spatial PSS ............................................................................................................................................. 70
      3.3.1 Technical Architecture ..................................................................................................................... 70
      3.3.2 Envision Tomorrow ............................................................................................................................ 73
3.3.3 CommunityViz ..............................................................74
3.3.4 Other Spatial PSS ..........................................................75
3.4 Previous Research ...........................................................76
3.4.1 Human Computer Interaction .........................................77
3.4.2 GIS Tool Evaluations .....................................................78
3.4.3 Participatory Modeling .....................................................80
3.5 Conclusion .................................................................82

4 Hypotheses, Cases, and Research Methodology ........................................84
4.1 Overview ........................................................................84
4.2 Research Questions and Hypotheses ..........................................84
4.3 Research Design .............................................................88
4.4 Case Selection ..............................................................90
4.4.1 Case Selection Criteria ..................................................90
4.4.2 Case Selection Procedure ...............................................93
4.5 Overview of Cases ........................................................93
4.5.1 Case Terminology and Structure ......................................94
4.5.2 Sustainable Communities Program Funding ......................95
4.5.3 Cartographic Representations as a Visual Language of Spatial Planning ..............96
4.5.4 Boston ......................................................................96
4.5.5 Austin ..................................................................105
4.5.6 Kansas City ...............................................................118
4.5.7 Boston (BRA) ..............................................................122
4.5.8 Planning Process Analysis .............................................124
4.6 Case Research Methodology .............................................126
4.6.1 Field Survey Instrument ...............................................126
4.6.2 Workshop Data Collection Protocol .................................132
4.6.3 Case Data Collection Protocol .......................................134
4.6.4 Additional Data Sources .............................................134
4.7 Conclusion ..................................................................135

5 Results .............................................................................136
5.1 Overview ......................................................................136

Workshop (Micro)
5.2 Hypothesis 1.1 Interaction Design .......................................136
5.2.1 Introduction ................................................................133
5.2.2 Austin Sustainable Places Project ..................................137
5.2.3 Boston North Suburban Priority Mapping Project ............141
5.2.4 Boston Marshfield Buildout and Alternative Futures Project .................144
5.2.5 Kansas City Sustainable Places Project ........................146
5.2.6 Boston (BRA) Fairmount-Indigo Planning Initiative ..........147
5.2.7 Workshop Design Comparison .....................................148
5.2.8 Learning Outcomes .....................................................150

Process (Meso)
5.3 Hypothesis 1.2 Wenger’s Model and Reported Learning ..............152
5.4 Hypothesis 1.3 Participant Personality ..................................155

Infrastructural (Macro)
5.5 Hypothesis 2.1 and 2.2 Wenger’s Model and the Double Loop Index ..........156
5.6 Hypothesis 2.3 Relationship Between Learning Types ..................159
5.7 Hypothesis 2.4 View Diversity and Learning ..........................160
5.8 Introduction ..................................................................161
Illustrations

Figure
1.1 Illustrative photo of spatial planning workshop organized by SACOG. .................................................. 15
2.1 Wenger’s Three Infrastructures of Learning .................................................................................................. 42
2.2 Illustrative diagram of Argyris and Schōn’s theory of single and double loop learning. ...... 44
3.1 Overview of Cases, Projects, and Workshops ................................................................................................. 72
4.1 Overview of Cases, Projects, and Workshops ................................................................................................. 94
4.2 MetroFuture Growth and Preservation Areas ................................................................................................. 99
4.3 MAPC Region and its Subregions .................................................................................................................. 99
4.4 Illustrative Photos of North Suburban Subregion .......................................................................................... 101
4.5 North Suburban Planning Council Local Priorities Map ............................................................................ 102
4.6 Illustrative Photos of Marshfield ................................................................................................................ 103
4.7 Marshfield Zoning Map .................................................................................................................................. 104
4.8 Austin Sustainable Places Project timeline presented at Lockhart Planning Charrette...... 106
4.9 Centers Concept from CAMPO 2035 Long-Range Transportation Plan .............................................. 107
4.10 Hutto Demonstration Site Map .................................................................................................................. 109
4.11 Illustrative Photos of Hutto, Texas .............................................................................................................. 110
4.12 Elgin Demonstration Site Map .................................................................................................................. 111
4.13 Illustrative Photos of Elgin, Texas ................................................................................................................ 112
4.14 Illustrative Photos of Dripping Springs, Texas.......................................................................................... 114
4.15 Dripping Springs Demonstration Site Map ............................................................................................... 115
4.16 Illustrative Photos of Lockhart, Texas.......................................................................................................... 116
4.17 Lockhart Demonstration Site Boundary ..................................................................................................... 117
4.18 Transportation Outlook 2040 Activity Centers and Planned Transit Corridors ...................................... 120
4.19 Kansas City Creating Sustainable Places Project Focus Corridors ...................................................... 121
4.20 Policy Plan Framework from Kansas City, Kansas City-Wide Master Plan ........................................ 122
4.21 Illustrative Photo of Upham’s Corner ......................................................................................................... 123
4.22 Fairmount-Indigo Planning Initiative Study Area ...................................................................................... 124
4.23 Case Project Workshops .......................................................................................................................... 126
5.1 Austin Workshop Exercise Interaction Design. ............................................................................................. 138
5.2 Illustrative slides from Austin workshop introductory presentations. ...................................................... 140
5.3 Photos of Austin Sustainable Places Project workshop exercises. ......................................................... 140
5.4 Images from 3D Animation Shown at Austin Workshops. ...................................................................... 141
5.5 Images from North Shore Priority Mapping Project Regional Priorities Screening..........142
5.6 Illustrative images from North Suburban Priority Mapping Project Public forum. ..........143
5.7 North Suburban Priority Mapping Project Public Forum Exercise Interaction Design ....143
5.8 Marshfield Planning Board Presentation Interaction Design ......................................144
5.9 Marshfield Planning Board Presentation .................................................................145
5.10 Kansas City State Avenue Corridor Community Meeting Interaction Design ........146
5.11 Kansas City State Avenue Corridor Community Meeting .......................................147
5.12 Upham’s Corner Visioning Forum Exercise Interaction Design ..............................148
5.13 Photos from Upham’s Corner Community Forum ..................................................149
5.14 Reported learning and double loop index, by workshop. .........................................159
5.15 Scatterplots illustrating relationship between workshop view diversity and reported learning, and the double loop index. ...............................................................160
Tables

Table                                                                                      Page
4.1 Survey Instrument *Double Loop Index* ........................................................................126
4.2 Survey Personality Questions ......................................................................................128
4.3 Survey View Questions .................................................................................................129
4.4 Other Survey Workshop Questions ................................................................................129
4.5 Survey Planning Support System Questions .................................................................130
4.6 Survey Demographic Questions ....................................................................................131
4.7 Workshop Data Collection Summary ............................................................................132
5.1 Workshop Overview .......................................................................................................148
5.2 Summary of Keypad Questions .....................................................................................149
5.3 *Reported learning* and *double loop index* by workshop ...........................................150
5.4 Reported learning by workshop interaction design type ................................................151
5.5 Correlation matrix for variables included in Model C ..................................................152
5.6 Regression analysis of *reported learning* at Austin workshops ....................................153
5.7 *Sensation seeking* and *goal orientation* personality traits of workshop attendees ....154
5.8 Correlation between participation, identification, and reification variables and *reported
    learning* and *double loop index* ...................................................................................155
5.9 Regression analysis of *double loop index* at Austin workshops ....................................157
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### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AICP</td>
<td>American Institute of Certified Planners</td>
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<tr>
<td>BRA</td>
<td>Boston Redevelopment Authority</td>
</tr>
<tr>
<td>CAMPO</td>
<td>Capital Area Metropolitan Planning Organization (Austin)</td>
</tr>
<tr>
<td>CAPCOG</td>
<td>Capital Area Council of Governments (Austin)</td>
</tr>
<tr>
<td>CMAP</td>
<td>Chicago Metropolitan Agency for Planning</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gasses</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System(s)</td>
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<tr>
<td>HUD</td>
<td>U.S. Department of Housing and Urban Development</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>MAPC</td>
<td>Metropolitan Area Planning Boston (Boston)</td>
</tr>
<tr>
<td>MARC</td>
<td>Mid-America Regional Council (Kansas City)</td>
</tr>
<tr>
<td>MPO</td>
<td>Metropolitan Planning Organization</td>
</tr>
<tr>
<td>NSPC</td>
<td>North Suburban Planning Council (Boston)</td>
</tr>
<tr>
<td>PSS</td>
<td>Planning Support System(s)</td>
</tr>
<tr>
<td>SACOG</td>
<td>Sacramento Area Council of Governments</td>
</tr>
<tr>
<td>SOA</td>
<td>Service Oriented Architecture</td>
</tr>
<tr>
<td>STS</td>
<td>Science, Technology and Society</td>
</tr>
<tr>
<td>TOD</td>
<td>Transit-oriented Development</td>
</tr>
<tr>
<td>VMT</td>
<td>Vehicle Miles Traveled</td>
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Chapter 1

Introduction

1.1 Overview

Land use planning stands at a crossroads. Urban change is increasingly taking place at the scale of metropolitan regions, requiring new planning methods that engage multiple stakeholders. Public concern about balancing economic, environmental, and social goals to achieve sustainability has focused attention on planning for urban change, even as uncertainty about the future has grown. Finally, the ongoing revolution in information technology (IT) has put more information and more analysis tools in the hands of professional planners than ever before. New tools hold the potential to make available rich new sources of knowledge, and support the types of dialog theorists argue are required for effective collective action.

This dissertation examines one result of these forces: the emergence of a new set of professional practices that utilize new types of spatial planning support systems (PSS) based on geographic information systems (GIS) software. Through a mixed-methods research design, the dissertation investigates the role of these new technologies in planning workshops, processes, and as metropolitan infrastructures. In particular, the spatial PSS are viewed as tools for social learning in the planning processes, supporting different types of social learning at different scales.

Although the new technologies are the focus of the research, investigating them requires considering the broader planning practice in which they are embedded. To do this, the study draws on two types of theory identified by Allmendinger (2002) in his planning theory typology. The first is a framing theory, or a world-view that “shapes attention and bias towards issues and, crucially, other kinds of theories” (Allmendinger 2002). The framing theory used in this study is Albrecht’s strategic spatial planning, which provides a theoretical description of both the process and outcomes of planning (2004). Specifically, strategic spatial planning argues planning processes integrate four types of rationality: value, strategic, communicative, and instrumental.
This framing theory argues there are four outcomes to the planning process: a long-term vision for a place, long-term and short-term actions, contact with stakeholders, and a public process with citizens.

The second type of theory used in this study is *exogenous theory*. As discussed in Chapter 2, the field of social learning provides specific, empirically grounded behavioral theories that are used to construct testable hypotheses. These include Wenger’s social theory of learning (1998), Argyris and Schön’s theory of organizational learning (1996), and Roger’s theory of the diffusion of innovations (2003). These theories do not provide a comprehensive description of strategic spatial planning, but do describe some of the most important dynamics in the planning process. In particular, this dissertation’s research questions and hypotheses focus on three areas: how participants change their views and factual knowledge in light of new information and tools, how tools can facilitate open group deliberation, and how useful new tools are developed and spread between cities.

The framing theory was used to select planning projects to use as cases, and the exogenous theories guided the empirical data collection and analysis. The dissertation draws on evidence from two *primary cases* set in the U.S. metropolitan regions of Austin, Texas and Boston, Massachusetts. Two projects, in Kansas City, Kansas, and Boston are treated as *secondary cases*, which provide additional perspectives on the research questions. The cases all share some similar characteristics: metropolitan contexts, a focus on spatial development patterns and land use, the involvement of multiple types of stakeholders, and public participation through public workshops. The cases differ in some ways: their institutional and regional contexts, the types of PSS they use and how they are implemented, and the specific topical focus of each planning project.

Finally, this study adopts a research approach that seeks to integrate social and technical dimensions. This *sociotechnical* perspective draws on the emerging design research literature in fields like information systems, management, and education, as well as the perspective of researchers in the interdisciplinary field of science, technology and society (STS) (Bijker and Law 1992; Hackett 2008; Edwards 2003). These research traditions emphasize the importance of investigating technology and social contexts together in order to both build theory and improve problem-driven technology. Therefore, the research design involves studying innovative technology not as freestanding tools in a laboratory setting, but as they are applied in specific projects. In addition, using real planning projects maximizes the realism of the context,
although at the expense of measurement precision and generalizability (McGrath 1981). The cases and research methodology is described further in Chapter 4.

The remainder of the introduction is as follows. First is a description of the new tools and methods of the new regional strategic spatial planning being practiced in metropolitan regions across the U.S. Encompassing planning techniques and digital tools, it is argued that these new spatial planning projects are producing social learning, partly through the use of new spatial PSS. Second, the three primary research questions that organize the study are introduced: how these tools support social learning at the workshop, process, and regional levels. This section introduces the theoretical perspectives considered at each level. Third, I describe the structure of the dissertation.

1.2 The Methods and Tools of Metropolitan Strategic Spatial Planning

The past decade has seen surprising changes in regional planning in the U.S., part of a broader resurgence of regional planning that Wheeler (2002) has dubbed “the new regionalism”. Despite fragmented decisionmaking and apparently contradictory interests in metropolitan regions, professionals across the country have designed planning processes that have created regional plans with surprisingly broad-based support. In politically conservative Salt Land City, community leaders led a process that resulted in a commitment to significantly change the pattern of development in the metropolitan region. The results of this process are already visible in the metropolitan landscape as new high-density development downtown, and a new light rail system (Scheer 2012; Briggs 2008; Montgomery 2011; Matheson 2011).

Sacramento, California is another example where new approaches to metropolitan strategic spatial planning have emerged. In 1999, the Sacramento Area Council of Governments (SACOG) produced a Metropolitan Transportation Plan as part of its role as a federally-designated metropolitan planning organization (MPO). The plan was completed by “combining the individual transportation plans of its member cities” (McKeever 2011). The proposed land use pattern was based on existing plans, codes, and trends. A lack of detailed data limited the plan’s underlying analysis, and stakeholder participation was limited to a small number of town hall meetings and presentations. While unanimously accepted by the agency’s board, the plan’s lackluster analysis and goals sparked a lawsuit and set in motion a series of events which led to a quite different metropolitan planning process culminating in a plan just five years later (McKeever 2011).
Involving leaders who promoted greater consideration of land use and consideration of more aggressive alternative growth patterns. The resulting plan, the Sacramento Region Blueprint, called for aggressively shifting development patterns in the region. The process—and the resulting plan—has become institutionalized as a planning model for all California metropolitan regions through the state law SB 375 (Montgomery 2011; Barbour and Deakin 2012). In Metropolitan Boston, where local town meetings and municipal autonomy are deeply rooted traditions, regional leaders agreed to the MetroFuture Plan in 2008, which called for “bold yet achievable” regional goals (Metropolitan Area Planning Council 2008; Barron et al. 2004; Rosan 2007).

In all of these cases, digital technologies including GIS and PSS played central roles in the planning process. Lewis and Knaap observed in a review of six metropolitan planning exercises that “the critical role of GIS cannot be overstated. … the ability of GIS to conduct analyses at the metropolitan scale and to illustrate the results of such analyses substantially increased the planners’ ability to engage the public” (Knaap and Lewis 2011: 204). As an example, in Sacramento, planners organized participatory workshops where stakeholders could design growth scenarios and compare alternatives by running real-time analysis on laptops using the I-PLACE$^3$S software (Figure 1.1).

Fig. 1.1 Illustrative photo of spatial planning workshop organized by SACOG. Laptop shown is running I-PLACE$^3$S PSS. Photo by SACOG.
In the words of SACOG Executive Director Mike McKeever, “I have a strong bias for pushing as much of this into the hands of the citizens at workshops ... it produces more ownership and increases likelihood of implementation” (McKeever 2012). Planners in Boston created a regional-scale digital model that supported exercises where participants were asked to explore trade-offs between housing density and land conservation (Walker and Daniels 2011: 72-74). The Envision Tomorrow software has been used for projects in Portland, Oregon and by the Southern California Association of Governments (Fregonese Associates 2013).

The increasing popularity of these tools poses a puzzle: why now? Since the initial expansion of GIS to regional planning agencies in the late 1980s, planners predicted their application in the planning process. After describing decades of interest in computers in planning, Klosterman observed that “in spite of this continued optimism, it is clear that the oft-foretold revolution in computer-aided planning has yet to occur” (Klosterman 1997). In the same article, he proposed the term “planning support systems” to describe a new class of tools. These tools were designed to support a planning process characterized by communication and collective design. Although finding some success, Klosterman’s own tool to implement his ideas has found only modest adoption in regional planning (see Klosterman 1999; 2001). Brail argued the full implementation of planning support tools will require some of the same factors that explain widespread adoption of transportation models at the metropolitan scale, which he found lacking for land use planning: a common methodology, extensive government financial support, and user acceptance (Brail 2006).

The recent metropolitan planning projects that use spatial planning support tools differ from many previous projects in several ways. First, the tools are not implemented by independent consultants, but increasingly developed and institutionalized within regional governmental organizations. Second, many of the projects feature PSS used in interactive workshops with stakeholders and the general public. Finally, through repeated use and iterative development, regions are adapting them to local conditions and priorities, developing planning cultures that integrate IT artifacts.

There are also technical reasons why PSS emerged at this period as well. Increasing availability of data, computing power, and maturing software has made it possible to use PSS in real time. In most projects, the software is run on relatively high-powered, low-cost laptop computers that have come on the market in the last decade. High-speed networking and the World Wide Web facilitate data sharing, and in some cases the tools are deployed as online applications.
Practitioners and tool builders argue in general terms that using the spatial PSS in public workshops helps facilitate discussion and improve the planning process. A recent guide to CommunityViz, a software package which can be used to develop spatial PSS, argues “GIS software has brought about a new generation of planning,” observing it can be used not only for improved technical analysis but also to support “the human and political aspects of planning” (Walker and Daniels 2011: xvii). However, alternative views are possible to explain the widespread adoption of PSS. The technology could be coercive, pushing participants towards preferred outcomes through digital visualization and intimidating technical sophistication. Second, it could be simply associated with new planning practices but not the cause of meaningful effects on the process, participants, or the resulting plans.

Recent metropolitan strategic spatial planning projects reflect ideas from planning theory that emphasize the importance of engaging diverse stakeholders to produce a commitment around a common plan. This “communicative turn” in planning theory rejected the rational planning paradigm, where planners seek out information and options to achieve specific goals defined with minimal involvement of those who are affected (Healey 1996). Influenced by theorists such as Jürgen Habermas and by empirical studies, such as Foresters’ (1999) and Hoch’s (1994) studies of practicing planners, planning theorists have argued planning should be viewed as a deliberative process where stakeholders create mutual agreement about problems. In one formulation by Judith Innes and David Booher, collaborative planning with certain characteristics: diversity and interdependence of interests, authentic dialog (or DIAD), will produce outcomes like shared identities, meanings, and innovation (Innes and Booher 2010). Collaborative planning theory proposes to anchor planning in agreement created through discussion for each project, not in objective criteria applied to every case. As a consequence, experts are redefined as participants in a dialog, contributing knowledge but not definitive answers. Unlike theories which assume known and largely static preferences and interests (such as Arrow 1951), communicative planning concedes these may be flexible. The success of negotiation methods based on communicative theory, such as the consensus building approach, seems to empirically validate its basic argument (Susskind and Cruikshank 1987). However the usefulness of theories and their implied planning approaches depends on the specific planning context. Sager has proposed a theoretical approach describing how some situations may be best described with social choice theory, but others may require a communicative perspective. Instead of mutually contradictory, he argues they can be usefully combined (Sager 2002, 1997). Chapter 2 contains a discussion of communicative planning theory in greater detail.
Although communicative theory has been used to analyze and propose new forms of planning practice, it alone does not predict a large role for PSS. Collaborative planning focuses on inclusive deliberation. Computer tools are often associated with an earlier model of technocratic planning, where complex “black box” models containing hidden assumptions were used to produce predictions that could not be questioned (Lee 1973, 1994). More broadly, this focus on deliberation and increasing application of social science theory has resulted in a broad shift away from an interest in physical artifacts as relevant for planning theory. At one extreme, purely deliberative theory neglects discussing the urban environment itself, but also excluded is theoretical consideration of the maps, models, and documents used in planning. Drawing on the STS scholar Latour, Beauregard argues artifacts shape debate because the city is a source of experience for planning participants, and representations like models and images structure deliberation (Beauregard 2012; Latour 1993, 2005). Anthropologist Lisa Peattie, writing in her famous account of the Argentinian project to develop Ciudad Guyana, described how representations served as instruments of power (Peattie 1987). A preliminary exploration by Mandelbaum thoughtfully discussed the relationship between “tools” and the way each defines problems, but this thread has not been taking up by subsequent studies (Mandelbaum 1996).

Inspired by this work and developments in research paradigms from other fields described below, this study seeks to directly address the question of how, and in what ways, technical artifacts are being used in and shape the planning process.

To answer these questions, we turn to the theoretical perspective provided by strategic spatial planning. Following Albrect (2004), it involves multiple forms of rationality, including communicative rationality, but also value, instrumental, and strategic. While this theoretical perspective makes up for the weaknesses of planning theory focusing exclusively on communicative rationality, it introduces additional methodological problems: how can “types of rationality” be observed, let alone categorized? Some researchers have attempted to conduct fine-grain analysis of discourse to detect evidence of the elements of Habermas’ theorized communicative rationality (Steenbergen et al. 2003). However, a broadened perspective of “rationality” means the plain sense of any statement cannot be easily categorized, as the same words can be used in different ways depending on the type of discussion and relationship between the speaker and listener. To avoid these problems, the more specific concept of learning is used to guide the empirical investigation. The learning literature describes multiple types of learning, and this study measures two: one associated with instrumental and strategic
rationality (*reported learning*), and one associated with communicative and value rationality (*double loop index*).

Although this strategic spatial planning definition was developed in the European spatial planning literature, it can useful describe professional planning practices in the U.S. often described as “scenario planning.” In these cases, maps or GIS tools are used to create multiple spatially explicit “scenarios.” According to scenario planning methods, these scenarios combine an analysis of possible future trends, as well as sets of long- and short-term actions. The definition used here refers to public sector scenario planning with spatial characteristics, as well as other activities that may not fit existing scenario planning models. However it also provides more theoretical description than most scenario planning models of the type and purpose of public deliberation unique to public-sector planning.

These techniques combine methods arising in corporate strategic planning with a spatially explicit approach. As Chapter 2 will argue in more detail, these practices incorporate technical artifacts as the medium for the creation, evaluation, and communication of spatial strategies. Bartholomew found less than six land use and transportation scenario planning projects completed each year in the U.S. in the 1990s, jumping to 17 in 2003 (the last year included in the study). Among 80 total projects, 33 used GIS models or GIS-based scenario construction tools, and 34 used other types of computer models (Bartholomew 2007).

In the context of a spatial planning process, this suggests a complex set of learning processes both among and between participants and planners. Therefore this dissertation analyzes the new PSS as learning tools, designed to support some of the learning processes above.

**1.3 Research Questions**

When spatial PSS are implemented in specific projects, they can be analyzed as sociotechnical systems for social learning. Edwards argues sociotechnical infrastructures can be analyzed at multiple scales, and that each scale may result in different theories and perspective on the system (2003). This dissertation is divided into three levels of analysis that roughly follows Edwards’ *micro*, *meso*, and *macro* scales. This perspective is related to the broader design literature, described in the research design section below.

At the *micro* scale, learning can be viewed as short-term changes to participants’ knowledge or views after exposure to a planning support tool in a workshop or other setting. Several previous studies, discussed in Chapter 3, have adopted this perspective and focused on short-term shifts to preferences and knowledge after participants are exposed to PSS using an
experimental methodology. Given the newness of this area, one review of nine participatory integrated assessment projects across the European Union that relied on computer models to evaluate climate change, land use, and water resources issues concluded that “no validated guidelines are available on how to design and combine … computer models with other tools to effectively and efficiently support the social learning of stakeholders” (de Kraker, Kroeze, and Kirschner 2011). Researchers have adopted a wide range of definitions for social learning outcomes including factual knowledge, skills, relationships, and changes in attitudes (Muro and Jeffrey 2008).

The key independent variable at this scale is the interaction design, or how participants interact with the PSS. This includes the design and types of interfaces, as well as the presence of system operators. Although taking place in a social context, the forms of learning are measured at the individual level. The dependent variables at the micro scale is reported learning.

Q1: How do spatial PSS contribute to individual learning in participatory workshops, in light of evolving technology and infrastructure?

The meso scale considers PSS and social learning during a planning process extending beyond a single meeting. The definition of social learning is drawn from the organizational learning literature. Argyris and Schön (1996) argued organizational learning took two forms. Single-loop learning takes place when the focus is on improved techniques of efficiency, and goals, values, and strategies are taken for granted. Double-loop learning involves “questioning the role of the framing and learning systems which underlie actual goals and strategies” (Usher and Bryant 1989: 87 quoted in Smith 2001). In the terms of the multiple forms of rationality in planning adopted here, single-loop learning processes are dominated by instrumental and strategic rationality, and double-loop learning involves communicative and value rationality. This form of learning is operationalized as dialog with certain characteristics, such as the open discussion of values and use of evidence. The independent variable at this scale is the sociotechnical process design. The design of the sociotechnical process is operationalized with constructs from Wenger (1998). This theoretical model argues artifacts like models can play a role in learning if participants both participate in its development, and feel they can question its contents. In his words, “the communicative ability of artifacts depends on how the work of negotiating meaning is distributed between reification and participation” (Wenger 1998: 64).
Q2: What characteristics of the sociotechnical PSS design facilitate single loop and double loop learning?

The *macro* scale refers to the evolution of spatial planning systems over many projects taking place over years, and even decades. At this scale, spatial PSS are viewed as a form of infrastructure. Healey argued spatial planning required a social infrastructure she dubbed “institutional capital” which encompassed three dimensions: knowledge resources, relational resources, and capacity for mobilization (Healey 1998). In the context of spatial planning, the knowledge resources for includes developing a spatial data infrastructure, the development of data sources and indicators that shed light on regionally relevant issues, and the capacity to design and implement planning support tools. Two theories in particular provide accounts of how PSS are developed: Rogers diffusion of innovations (Rogers 2003), and through professional frame reflection (Schön and Rein 1994; Schön 1983).

Q3: How do metropolitan regions develop a sociotechnical infrastructure for social learning in spatial planning?

1.4 Design Research Paradigms

This dissertation utilizes a design research approach, a research paradigm that integrates behavioral theories with the study of artifacts. Commonly used in archeology, the term *artifact* refers to any human-made object, and can refer not only to physical objects but also digital data and software, meeting agendas, or a design for the overall planning process. Although artifacts may be designed for use as *tools*, artifacts become tools when they are used for a specific purpose, and frequently toolmakers are surprised by how their creations are put to use. Therefore the term artifact is used instead of tool, to emphasize the effect of any specific artifact must be empirically determined and is not inherent in the object. This section briefly introduces some theorists that influenced the research paradigm of this dissertation. The origins are placed with philosophical pragmatism, especially John Dewey, who argued for viewing science and technology as unified, and argued for greater attention to methods of analysis and debate attuned to the needs of a democracy. Later theorists, including Herbert Simon, Horst Rittel, and Donald Schön discussed the role of design in professional education as well as developing theories about design reasoning in the public sphere. Finally, these ideas have been developed into formalized research traditions in the fields of education, information systems, and management.
While the broader links between philosophical pragmatism and the research described here are included in Chapter 2, pragmatic philosophy provides an intriguing, if underdeveloped, perspective on technology. Dewey observed that the increase in the “physical tools of communication” alone did not develop communities, the could potentially play a useful role in a democracy as “communication can alone create a great community” (Dewey 1985 [1927]: 142). His classic the Public and Its Problems concluded two things were needed to improve democracy: “continuous inquiry” of the empirical facts would be needed for democracy, and second, the “improvement of the methods and conditions of debate, discussion, and persuasion” (Dewey 1985 [1927]). Dewey also rejected a division between science and technology, viewing them as part of the same intellectual project, rejecting curriculum reforms to separate technical training from liberal education (Hickman 2003). In his view, ongoing scrutiny and experimentation were the only means to hold technology accountable to the democratic public.

In the 1960s, a group of theorists revitalized an interest in design in the context of professional education. Herbert Simon argued in the Sciences of the Artificial that the professions were concerned with design, what he called the “artificial sciences,” but argued this focus had been weakened with an emphasis on natural science. He argued “the professional schools can reassume their professional responsibilities just to the degree they discover and teach a science of design, a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process” (Simon 1996). His perspective was influenced by an interest in analytical techniques and a specific focus on engineering, however his perspective had shifted somewhat by the time the third edition of the book was published in 1996 to reflect a more nuanced position:

> We have usually thought of city planning as a means whereby the planner’s creative activity could build a system that would satisfy the needs of a populace. Perhaps we should think of city planning as a valuable creative activity in which many members of a community can have the opportunity of participating – if we have wits to organize the process that way. (Simon 1996)

Another author who shared Simon’s interest in design in professional education was Donald Schön, who examined the nature of professional knowledge in the Reflective Practitioner. Schön critiqued Simon’s early version for focusing only on “well-formed problems already extracted form situations of practice” (Schön 1983). In contrast to Simon’s early focus on analytical methods, Schön rejected an exclusive focus on technical rationality, arguing professionals often possessed a “knowledge-in-practice” they could not easily describe. This
knowledge could be captured by professionals with the right attitudes and organizational contexts through a process of reflection.¹

A theorist who grappled with the issue of design reasoning in the public sphere is Horst Rittel, a key figure in the Design Methods Movement at the University of California, Berkeley’s College of Environmental Design from 1962 to 1972. After considering and rejecting analytical approaches to problem-solving, Rittel, together with urban planner Melvin Webber, developed a theory of “wicked” problems, described in Chapter 2. While this formulation is sometimes used to argue against public action, Rittel himself remained optimistic, arguing these problems could be addressed through deliberation and argumentation. He began to develop the concept for a never-realized “Issues Based Information Systems,” conceived as a method of improving dialog and facilitate design by tracking the information and arguments used in a design process (Rittel and Dubberly 2007; Rittel and Webber 1973; Protzen and Harris 2010).

Both Simon and Rittel have inspired an emerging research paradigm developed by researchers in the field of information systems. Importantly, these researchers do not reserve design methods for only well-formed problems, as Schön feared, and one influential article uses the concept of “wicked problems” as a starting point for research (Hevner et al. 2004). The central insight is that design research contained two forms of inquiry. Natural science was empirically grounded theory building, discovery, and justification, and could include social science or mathematical theories (March and Smith 1995). Secondly, design science, is research which aims to develop of artifacts that solve human purposes. They were linked by kernel theory, the natural science or behavioral science theories for explaining and predicting, and design theories, prescriptive theories that describe in an abstract way how artifacts work to solve a particular problem in a particular concept (Jones and Gregor 2007; Walls, Widermeyer, and El Sawy 2004). Although the methods can be deployed for well-formed problems, recent research has applied this approach to “messier” contexts.

In design science research both the artifact and the experimental setting are intentionally complex (and thus confounded) in order to develop methods and artifacts that are useful in practice. Due to the confounded nature of the observations gained in the evaluation phase of a [design science research in information systems] effort it is difficult if not impossible to disconfirm a theory.

¹ Schön’s other work elaborates on these themes. While they will be cited as references in this dissertation, as an overview they are: on professional knowledge see Theory in Practice (Argyris and Schon 1974), organizational settings see Organizational Learning I (Argyris and Schön 1978) and Organizational Learning II (Argyris and Schön 1996), and for the use of a particular type or reflection in public policy, Frame Reflection (Schön and Rein 1994).
However as noted by other researchers, the relation of a designed artifact to theory is extension and refinement of the theory rather than disconfirmation. (Kuechler and Vaishnavi 2008)

The development of technical artifacts or “tools” that embody both applied theoretical knowledge to solve problems can be researched and taught. In this paradigm, technical innovations can take the form of constructs (vocabulary), models (abstractions and representations), methods (algorithms), and instantiations (complete prototypes or systems) (March and Smith 1995). These, in turn, can be developed and evaluated in academic research. Like in natural and social science research, creativity and inspiration play a role in theory development. However, like in other sciences, the results of ingenuity are subject to systematic evaluation and study.

The design science paradigm has been used for research projects related to executive information systems (Walls, Widmeyer, and El Sawy 1992), emergent knowledge processes (Markus, Majchrzak, and Gasser 2002), and with an action research approach to develop a competence management technology (Sein et al. 2011). Some researchers argue design science can add additional detail to social science theories. For example, by using progressively less rich communication channels (in person, video chat, text chat) one study examined social facilitation theory (Niehaves, forthcoming).

Design research approaches, often with explicit links to this literature from the field of information systems, have also developed in the education and management science literature. Education has long focused on the design of not only learning tools, but also exercises, processes, and experiences, and has a recent focus on design research (Anderson and Shattuck 2012; Cobb et al. 2003). Similarly, Van Aken has argued for its application to business research (van Aken 2004) to develop what she calls “field-tested and grounded technological rules” to achieve business goals in a firm.

Finally, this research builds from a diverse collection of scholars interested in studying technical tools like GIS and computer models as they are used in social contexts. As examples, drawing on Giddens’ (1984) structuration theory and their own empirical experimental studies of GIS use, Jankowski and Nyerges have developed a theoretical framework for group GIS use they call Enhanced Adaptive Structuration Theory (2001). Similarly, while often lacking a strong link to social theories, the participatory modeling literature has many useful methodological insights such as Van den Belt’s (2004) careful evaluation instruments or Jones’ useful “Protocol of Canberra” framework (2009) that stresses a research design attuned for policy modeling.
projects to both espoused theory and theory-in-use. Research in these fields is only beginning to draw explicitly on the “design science” paradigm described above, although one notable example is Çağdaş and Stubkjaer’s (2011) application of this approach to a review of research on cadastral systems.

It is notable that while these ideas were developed with explicit links to the field of urban planning (such as Rittel and Webber’s article), they have not been hitherto widely adopted by urban planning research. The unique trajectory of the planning field partly explains a suspicion towards technical artifacts. In fact, as described further in Chapter 3, technical analysis and modeling in the mid-twentieth century were often linked to top-down planning efforts which actively disregarded the knowledge and views of those affected by planning (Peattie 1987; Lee 1973). The planning field in the 1970s experienced a crisis of legitimacy as the techniques of planning were politically challenged and their intellectual underpinnings re-evalauted (Rein 1969; Anderson 1967; Jacobs 1961). The result was what Klemek has called the “collapse” of the “urban renewal order” and a fundamental intellectual and political re-alignment of the field (Klemek 2011). As described in Chapter 2, the eventual theoretical response to these concerns was a shift to a “communicative” perspective, which seemingly provided firmer theoretical ground and a means for diagnosing and addressing manipulation (Fischer and Forester 1993; Healey 1996; Innes 1996). With its focus on the involvement and conditions of debate, this perspective had little to say about the design and use of technical artifacts and expertise, other than arguing they should be under the control of a diverse and legitimate stakeholder group.

While not ignoring these ethical and theoretical concerns, this dissertation takes the position that the design research paradigm provides a useful approach to develop a greater understand how and in what ways the artifacts are “working” in a social context. In fact, this knowledge is crucial for a more nuanced understanding of influence and power in the planning process. While communicative theory may not address artifacts beyond the structure of the process and deliberation, they increasingly pervade practice (Beauregard 2012). For practical and theoretical reasons, the field needs a richer understanding of these tools that the design research paradigm can begin to provide. The legitimacy of planning which involves tools and methods largely in control of professionals is revised in Chapter 6, in light of the debate theoretical debate about public participation.
1.5 Research Significance

This dissertation topic is ripe for examination for three primary reasons: because of ongoing technology development, to scrutinize widespread professional techniques, and to answer theoretical questions about the nature of the planning process.

First, the development of geospatial technologies has resulted in greater access to and use of both desktop, web-based, and mobile geospatial tools. An expanding number of professionals have skills in desktop GIS and free alternatives such as QGIS and Google Earth. In web mapping, growing sophistication in available technology is allowing live, server-based geoprocessing using distributed computing technology. Finally, accessible through smartphones and tablet computers, mobile applications support navigation, data collection, and other functions in the field. In combination with these technical developments, the growing maturity of spatial data infrastructures and expansion of web-based data sharing technologies enable the use of these tools for topics and places previously facing data limitations. Finally, open source geospatial software has begun to rival commercial products for some purposes. These trends mean the professional community is poised for a drastic reduction in the financial and technical barriers to wider use of geospatial applications. Together with the rapid expansion in data availability, the limiting factor for professional practice will be models of professional practice.

Second, as observed in the opening section, spatial planning projects utilizing GIS-based tools and models are in widespread practice. Publications on these practices have targeted professional audiences, and do not feature either links with theory, or rigorous research testing the various "best practices" advocated by many planners and tool builders.

Finally, interest in social learning theory has expanded as the understanding and of social change has grown as the central interest of planning scholarship (Kim 2011). The "communicative turn" has deepened the understanding of this particular dimension of planning process, but lacks links to more detailed theories that can provide specific, testable hypotheses (Healey 1996). In addition, previous research emphasizes that design matters, but much of the work has not been to rigorously test design attributes or link "technical" research with social theory.

1.6 Dissertation Structure

The dissertation is organized as follows. Chapter 2 discusses theories used to describe planning, social learning, and account for professional and institutional change, culminating with a multilevel social learning framework. Chapter 3 discusses the specific PSS which are the
focus of this dissertation, situating them within the broader landscape of computation applied to spatial planning. This chapter discusses previous research on these topics, which influenced the design of this study. Chapter 4 introduces the specific hypotheses, cases, and research methodology used. Chapter 5 presents the results, and Chapter 6 contains a discussion of the results, as well as discussions of participation theory and ethics, the tie to urban sustainability, the impact of broader technology trends on planning. The chapter closes with recommendations and prospects for U.S. metropolitan spatial planning.
Chapter 2

Spatial Planning Through Social Learning: A Pragmatic View

2.1 Introduction

If “all observation is theory-laden,” the selection and specification of theory is crucial for all empirical studies (Sayer 2010: 83). This dissertation draws on several interrelated but distinct types of theory that describe the nature of spatial planning and describe the specific social processes that underpin planning activities. The argument proceeds as follows. First, Allmendinger’s (2002) post-positivist typology of planning theory is used to describe types of theories in planning and their relationships. Using his typology, Albrecht’s (2004) strategic spatial planning is identified as a primary framing theory for this dissertation, influencing the relevant social science philosophy (critical realism), social theory (pragmatism), and exogenous theories (social learning, framing, and institutional theories). Second, Albrecht’s theory is used to provide a brief overview of alternative theories of spatial planning. Third, theories and previous research of social learning in planning and policymaking are discussed that inform the research approach of this dissertation. This section also describes pragmatism as a social theory for planning. Fourth, theories of planning and social learning are linked through a discussion of the use of frames and sociological institutionalism. Finally, these ingredients are brought together in the form of a multilevel social learning framework, which identifies specific theories, variables, and alternative theories at each level of analysis.

2.2 Types of Theory in Planning

Theorists in several fields have described multiple types of “theory.” For example, theorists in economics make the description between “positive” (what is) and “normative” (what ought to be) theory (Robbins 1981). Gregor observed there might be several types of theory in information systems, each varying along dimensions such as scope, means of representation,
and causal and prescriptive components (Gregor 2006). In planning, Allmendinger argues that all theory is to some degree normative, and proposes a useful typology of theories for planning (Allmendinger 2002). It is a *post-positivist* typology since it rejects a chronological (or teleological) model of theory development, as well as observing that theory must be analyzed in specific times and places. The elements of this typology are:

- **Framing theory** is a paradigm or ordering worldview, for the purposes of this study Albrecht’s strategic spatial planning (2004), described in additional detail in the following section.

- **Social scientific philosophical understanding** is the assumptions about the nature of reality, including degree of agency of individuals. For this study the perspective used is *critical realism*, which holds that observation is theory-laden, not theory-neutral or theory-determined, and that practical adequacy can provide a means for evaluating theories (Sayer 2010: 84).

- **Social theory** is a set of assumptions about society, such as whether it should be thought of from more structural, top-down more interpretative, bottom-up ways. Following theorists such as Hoch (1994; 2007), Briggs (2008), and Stein and Harper (2003) this dissertation draws on American pragmatism, especially Dewey (1985 [1927]). Dewey’s theory of pragmatism argues for a vision of society as an open-ended experiment by democratic publics to resolve mutual problems, despite the centrifugal forces of modern society.

Allmendinger’s typology also includes *exogenous theory*, for the purposes of this study two types are included. This type of theory differs from *social theory* in their level of abstraction, as exogenous theories “do not provide a holistic of general theoretical understanding of society” (Allmendinger 2002). These include social learning theories from the psychology, learning, and organizational change literatures, containing specific constructs that lend themselves to testable hypotheses. Secondly, theories concerning the use of frames and institutions are used to bridge the realms of planning theory and social learning. While both encompass widespread social phenomenon, neither constitute of theory of society. These therefore provide descriptive theories of social structure, but within the social theory of pragmatism.
2.3 Framing Theory: Spatial Planning

Klosterman argued that planning was needed in a market economy to respond to several common problems: public goods, externalities, prisoner’s dilemma conditions, and distributional questions (Klosterman 1985). Addressing these issues requires processes to make social choice outside of markets. These economic categories are related to what Rittel and Webber called *wicked problems*, which can only be addressed (but not solved) since they cannot be definitively defined, are about values, and describe unique situations, among other characteristics (Rittel and Webber 1973). Spatial planning can therefore be thought of as a specific type of wicked problem, which includes well-known market failures. Following Albrecht (2004), strategic spatial planning is “a public-sector-led sociospatial process through which a vision, actions, and means for implementation are produced that shape and frame what a place is and may become.” According to Albrecht, the process involves multiple forms of rationality:

- **Value rationality** is the design of desired alternative futures or outcomes.
- **Communicative rationality** is the result of a deliberative exchange between different parties where new understanding and consensus is created.
- **Instrumental rationality** is determining the best way to solve specific problems given the desired future, and for the purposes of this study also “factual” or “single-loop” learning.
- **Strategic rationality** is an explicit strategy for dealing with power relationships.

Furthermore, Albrecht argues the process has four “tracks” related to these types of rationality: the first is for the vision, the second for the development of short-term and long-term actions, third for the involvement of key actors, and the fourth an ongoing process with the broader public. Vision refers to the specific “way of describing the sort of place we want to live in, or think we should live in” that “creates’ a vision for a future environment,” produced by applying value rationality to a specific context (Albrechts 2004: 750). This framework also encompasses ideas drawn from strategic planning, which as described below, emerged in the U.S. in the 1980s as a planning paradigm that responded to the critique of and declining legitimacy of the “comprehensive” or “general” planning traditions.

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2 These refer to core concepts in economics. *Public goods*, such as a clean environment, are non-rival and non-excludable and therefore not readily allocated by a market, and often the concern of government; *externalities* are spill-over effects not taken into account by the market; *prisoner’s dilemma* conditions are where individual self-interest results in sub-optimal outcomes for all; and *distributional question* refers to how resources should be distributed, which markets do not determine. For further discussions of these issues in planning see, for example, Heikkila (2000) or Warner (2011).
2.3.1 Historical Overview

The history of spatial planning can be read as successive professional models emphasizing different types of rationality. Early spatial plans emphasized value rationality, translating one view of the public good into a specific plan (such as Burnham’s *Plan of Chicago*). While a logical professional model for a profession which emerged from private engineering and architecture (Krueckeberg 1983), architect-planners like Burnham or Olmstead could be criticized as social engineers or imposing class-specific values on society (Rosenzweig and Blackmar 1992). While visionary planning resulted in new parks systems and civic buildings, more fine-grain changes ran into challenges given the limited legal powers of municipal government. Specific details of Burnham’s plan, such as street widening, could only be implemented through dozens of individual ballot initiatives (Schlereth 1981). While not the focus here, the response was the institutionalization of planning functions within city governments, and the simultaneous development of municipal legal powers like zoning (Frug, Ford, and Barron 2010; Dyble 2010; Levine 2006).

The profession had shifted to an emphasis on instrumental rationality by midcentury. Under this model, elected officials provided goals (and by implication, the values) and expert planners found optimal solutions to achieve the desired outcomes. The planning process was exemplified by the general or comprehensive planning models proposed in Kent and Chapin, where values and goals are provided by elected officials, and planning involves forecasting and expert design (Chapin, Kaiser, and Godschalk 1995; Chapin and Kaiser 1979; Chapin 1957; Kent 1964).

Scholars such as Lindblom, Meyerson and Banfield, and Altschuler criticized the ideal of comprehensive planning as theoretically or practically impossible. Lindblom (1959) argued that planning tool place within a sharply restricted set of resources and options. A more realistic portrayal of the planning process was a model he proposed of “muddling through.” Meanwhile, Mererson and Banfield (1964) argued that planning, with its aspirations for rational decision-making did not exist, and instead actual decision-making in a public housing authority was dominated by political dynamics. Finally, Altschuler (1965) question the ability of planning to identify a set of common goals to guide planning activities, or muster the political support to attempt to achieve them.

In response to these criticisms, some advocated for planning models that did not require defining the public interest. Inspired by the adversarial legal system, Davidoff proposed an advocacy planning model, where each community would retain planners to create separate
plans, however he did not specifying who would pay for the planners or who would serve as judge (Davidoff 1965). However, advocacy planners found that identifying disadvantaged communities was just as challenging as defining the public good (Peattie 1968). Others eschewed the substantive dimensions entirely, focusing on constructing negotiation methods that brought the relevant stakeholders to the table in order to forge a mutually acceptable resolution (Susskind and Cruikshank 1987, 2006; Susskind, McKearnan, and Thomas-Larmer 1999). Such resource-intensive negotiations were useful for large-scale decisions, but less easily adopted to more routine forms of planning.

Meanwhile, professional planners who retained a belief in the public good searched for an alternative to cumbersome comprehensive planning. In the U.S., professional planners began adopting practices from corporate strategic planning (Kaufman and Jacobs 1987; Sorkin et al. 1984; Bryson and Einsweiler 1988; Kemp 1993). In contrast to comprehensive planning, strategic planning is based on a narrow focus on specific strengths, weaknesses, opportunities, and threats facing a specific place, and linking general goals with detailed objectives, strategies, and implementation plans. While not addressing the theoretical critiques of comprehensive planning, the narrowed scope of these plans meant that in theory, greater resources could be focused on a few key “strategic” issues. Although they varied in their approaches, a number of localities conducted strategic planning exercises, including Detroit (Detroit Strategic Planning Project 1987), Oakland, California (Sharing the Vision Inc. 1992), Oak Ridge, Tennessee (King and Johnson 1988), and Hennepin County, Minnesota (Eckhert et al. 1988).

Strategic planning codified and legitimized an approach to planning that was narrower in scope and more attuned to practical considerations than earlier models. However, like the earlier planning traditions, even strategic planning can be criticized. Earlier planning models were too limited to the physical, but strategic planning as it was practiced did not contain a strong spatial dimension. In addition, neither adequately addressed uncertainty about the future, and neither specified in theoretical or practical terms the role of participation, increasingly viewed as crucial for implementation. These critiques have led to two primary results, a shift to professional techniques focusing on “alternative futures” combined with participation, and greater theoretical emphasis on communicative rationality by theorists.
2.3.3 Alternative Futures and Scenario Planning

In the wake of mounting evidence of the inability of planners to predict the future, some practitioners turned to the idea of alternative futures, influenced by the eclectic field of future studies (Bell 1996; Masini 2006) and earlier urban utopian thinkers (Fishman 1977; Howard and Osborn 1965 [1898]; Hall 1988). For advocates of this view, thinking about the future was the intellectual key to spatial planning, and therefore imagining possible futures was useful even if it was impossible to determine which outcome may actually occur (e.g., Isserman 1985). One widespread professional practice that implemented this general idea was scenario planning, which like strategic planning, originally arose as a management technique for large businesses.

Scenario planning is a methodology developed in the private sector for corporate planning, and prominent early models included the Shell oil company and other large industrial firms (Huss 1988; Schoemaker 1991, 1995). It was developed as a methodology suitable for analyzing topics with high complexity and uncertainty, and therefore began to expand as a method for public sector planning in the late 1980s (Khakee 1991). In scenario planning, practitioners attempt to identify current trends, and develop alternative future scenarios incorporating exogenous forces and voluntary choices through qualitative and/or quantitative methods. In recent years, it has become a popular method for strategic spatial planning. Despite its popularity, a major weakness for scenario planning in the public sector is the challenge of reconciling it with the broad distribution of power in a democracy. Bartholomew identified “participation” as an area where the projects he reviewed was particularly weak in his recent systematic review of scenario planning projects (Bartholomew 2007). How to integrate scenario planning into participatory contexts has been the subject of recent research, such as chapters on multicultural planning and other outreach strategies in Hopkins and Zapata (2007) and research on large-scale online participation (Raford 2011).

Scenario planning is a process artifact, or what van Aken would call a “management theory” for solving a planning problem, not a descriptive or explanatory theory that explain the underlying social processes that explain why “it works” (van Aken 2004). The primary motivation for private sector scenario planning has been improved firm performance (e.g., Phelps, Chan, and Kapsalis 2001). Although the cases take place in scenario planning contexts, the proposed research is not limited to a specific methodology. Some research on scenario planning applied to urban planning contexts has focused on the instrumental rationality used, such as the future densities and vehicle miles traveled of the resulting scenarios (Bartholomew and Ewing 2008). Others focus on modifying the technique by which scenarios are created, for example by
pursuing “robust” plans with multiple scenarios (Chakraborty et al. 2011) or proposing new models such as “anticipatory governance” (Quay 2010). This dissertation adopts a different perspective, instead focusing on one underlying mechanism in scenario planning processes, namely social learning. In the terminology of the “design science” paradigm from the field of information systems, this study links research on the “design theory” (scenario planning) to research on to “kernel” theories (social learning) (Jones and Gregor 2007; Walls, Widermeyer, and El Sawy 2004; Peffers et al. 2007). At least two scholars have pursued similar investigations. As part of a larger theoretical description of scenario planning, Chermack has proposed constructivist learning as an intermediate variable in scenario planning (Chermack and Van Der Merwe 2003), and Zegras and Rayle (2012) explore whether scenario planning shifted participants’ views and perceptions, although the study is framed using communicative theory (described below) and limited by a small sample size. For longer term scales, the dissertation follows scholars from STS who argue for the social and technical must be considered together when analyzing the development of infrastructures (for introduction see chapter 11 in Bijker and Law 1992).

As professionals sought practical techniques to organize their activities, and the ideas of alternative futures and scenario planning, combined with an evolving mix of participatory techniques, seemed to “work” to create plans (Faga 2006; Creighton 2005). A group of planning researchers and theorists sought to probe the nature of planning practice. In contrast to earlier theorists concerned with defining ideal models, these researchers worked in the interpretative tradition, building theory from the actual activities of practicing planners. The results of this inquiry led in several fruitful directions. Baum launched a research program investigating the psychological dimensions of professional practice, arguing, for example, planners continue to espouse the rational paradigm, even if they don’t practice it, because it provides “psychological safety” (Baum 1996, 1983). Hoch generated rich insights from empirical research of planning from the perspective of pragmatic and democratic theory (Hoch 1994). However the largest body of work in this traditional developed into what is called collaborative planning theory.

2.3.2 Collaborative Planning Theory

This section will briefly introduce the conceptual underpinnings of this research, before describing how it has been applied in planning and the resulting theoretical debate. These researchers draw on the theoretical insights of Jürgen Habermas, particularly his two-volume Theory of Communicative Action (1984, 1987). This work serves as a theoretical sequel to his
earlier work on the public sphere, which examined the relationship between the rise of the middle classes in Europe. This work drew connections between the emergence of habits of critical discourse which emerged in the arts, and the eventual development of a political public sphere that functioned as a check on absolute state power (Habermas 1991 [1962]).

Inspired by philosophers like Wittgenstein, who looked to the structure and use of language as the basis for broader social philosophy, the Theory of Communicative Action argued that rationality was located in argumentative language, not, for example, in the abstract logical systems of analytic philosophy (Habermas 1984). For Habermas, the logical starting point for theory was the lifeworld, the set of assumptions and lived experience of everyday life. Modern life has resulted in the development of abstract ideologies and institutions, which he calls system, that have the tendency to invade and dominate the lifeworld. For Habermas, this invasion results in a dangerous crisis of legitimacy, as well as the domination of individuals by outside forces; “colonization” by the system is often the mechanism of manipulation and oppression. Therefore, the only hope of societies to hold these systems in check is argumentative discourse beginning in the lifeworld, which is the ultimate source of social meaning and legitimacy. The conditions for this discourse have come to be called the “ideal speech situation,” although Habermas himself has avoided the term. The theory seeks to describe the ideal conditions for deliberation: where everyone is allowed to speak, pose questions, and express their attitudes and opinions, without threat of violence or external coercion. While this theory is vulnerable to a number of criticisms, it provides a useful description of why totalitarianism and authoritarian socialism both usually produce oppressive societies, and why there exists a persistent link between political democracy and lively public debate.

This theory is useful for planning theory since it provides a rich diagnosis for the purpose of the extensive deliberation and discussion in planning, as well as provide a normative theory of deliberation which can be used for critical research (Forester 1989). For Innes, it provided a rich theoretical account for the collective construction of meaning she discovered in her research on the origins and use of social indicators and other information in planning (Innes 2002; Innes and Booher 1999; Innes 1996; Innes 1975). This work has culminated in what Innes and Booher have called the “DIAD” model, which summarized their theory of “what collaborative policy making can accomplish and under what conditions” (Innes and Booher 2010). Other theorists have opted for alternative approaches. Healey has advocated for a collaborative planning with a more nuanced perspective on how institutions can be arranged to achieve
normative goals, drawing on theories from geography and Giddens' theory of structuration (Healey 1997). Others raise philosophical and practical critiques, observing that planning participants have unequal knowledge and resources, and that planning takes place within a top-down institutional framework (Tewdwr-Jones and Allmendinger 1998), a perspective taken up by Huxley (2000) who argued planning's relationship with the state made adopting Habermas' ideas problematic. Observing that planning does often entail collective choices between discrete options, Sager has proposed a model which combines communicative rationality with insights from social choice theory, which explicitly addresses how decisions are made among individuals with differing interests (Sager 2002, 2001, 1999, 1997).

Others have levied more fundamental theoretical critiques on communicative rationality. Some advocate approaches to planning theory that omits communicative rationality entirely. For example, Hopkins' definition of spatial planning emphasizes the internal logic of plans and their recommendations, not how they are created, de-emphasizing the importance of the deliberative processes between participants and stakeholders (Hopkins 2001; Kaza 2006). Others advocate adopting alternative normative theories, such as Rawls' concept of justice or neomarxist perspectives which judge planning based on material outcomes, not the process by which they are obtained (Fainstein 2010).

Some, skeptical of normative theories, have opted for research paradigms from the social sciences which avoid strong normative commitments, instead viewing planning as merely an extension of conventional adversarial and interest-based politics (Layzer 2006, 2002), or as a venue for universal sociological dramas to play out (e.g., Steelman and Carmin 1998). Others argued for alternative paradigms, such as Flyvbjerg's insistence on using Foucault to understand how rationality is (in his view) subordinated to power (Flyvbjerg and Richardson 2002; Flyvbjerg 1998, 1998), or Yiftachel's interest in planning as an instrument of social and ethnic domination, informed by a close view of the role of urbanization in the conflict between Israel and Palestine (Yiftachel 2001, 2006).

This dissertation takes a nuanced perspective on these debates. First, as a normative theory, communicative rationality is useful to describe the conditions of discussion, and characterize a form of rationality arising in policy deliberation. As such, communicative rationality is a component to the strategic spatial planning framing theory. However, an exclusive focus on communicative rationality as an organizing paradigm for all of planning, as Innes has argued, makes several important omissions, such as alternative forms of knowledge and rationality at play, the role of institutions, an account for artifacts, and even a concern with
substantive outcomes of planning. Furthermore, rationalities cannot be easily observed or measured. As such, communicative rationality is an inadequate descriptive theory. Therefore, the descriptive theories chosen provide more concrete guidance for empirical research potentially linking more abstract theories with a more nuanced view of their underlying processes.

2.4 Social Theory: Pragmatism

However, the ecumenical use of theory raises the possibility of theoretical eclecticism. Put differently, what is the theoretical bedrock that justifies these theoretical choices, and provides a common ontological and epistemological perspective for the research? The answer of this question is philosophical pragmatism, the subject of the following sections, which provides the social theory justifying both the research approach and the broader perspective on spatial planning.

2.4.1 Pragmatic Spatial Planning

Albrecht argues that strategic spatial planning integrates four forms of rationality to result in an analysis of existing trends, long-term vision, plan for short- and long-term actions, and budget and implementation strategy, as well as a partial or full consensus between the key actors. However the need for such a process and product can only be justified if the outcome is distinct from outcomes in the absence of planning. Put differently, on what basis should this activity influence public collective action?

First, planning could be viewed as necessary to fulfill Klosterman's “economic arguments”: to help resolve questions about public goods, externalities, prisoner’s dilemma conditions, and distribution of resources. Resolving these requires defining values, and the collective design of solutions, and a mechanism for social choice. Second, urban development results in local bundles of positive and negative externalities that can be shaped only through collective action. The preferences or economic interests of participants in relation on these externalities are often ambiguous and contradictory. For example, municipalities may seek to maximize revenues through “fiscal zoning” that encourages commercial development, yet commercial development may decrease desirability and property values. A consensus on individual – or collective – preferences on many separate dimensions does not remove the need for a process to reconcile competing preferences and allow for social choice and collective action.
However, as Klosterman observes, these economic arguments, while necessary to justify planning in a market economy, are not sufficient, because they can be resolved in any number of ways, such as through direct decisions by elected officials or by market-based solutions. As a consequence, he subsequently describes pluralist and traditional arguments that rely on a concept of the public good (Klosterman 1985). However, the argument advanced here is distinct from these and is based on the philosophy of pragmatism. Pragmatism links the concept of “wicked problems” to a broader theory of society, providing the social theory described by Allmendinger’s typology. This section will briefly describe pragmatism, which is presented as a theoretical backdrop for both the framing theory (strategic spatial planning, previously described) and exogenous theories (social learning and theories of framing and institutions, described below).

2.4.2 Pragmatism in Planning Theory

American pragmatism arose in the late 19th century, coincident with a rapid expansion of scientific knowledge and new technology. Charles Sanders Peirce pioneered pragmatism as an epistemological philosophy that rejected a naïve realism, and argued that “clear” beliefs must remain focused on the practical consequences that could be empirically investigated through the scientific method (Burch 2010). Peirce’s friend and contemporary William James held a view of pragmatism that expanded beyond epistemological questions, arguing it constituted a broader philosophical and metaphysical perspective (James 1975 [1907]). Verma has argued that James philosophy provides a useful model of “pragmatic rationality” as a replacement for the rational paradigm (Verma 1996).

From these early roots, Dewey developed pragmatism into a full-fledged theory of democracy and government built on the twin ideas of the democratic public and political problems. In two influential books published in the early 1920s, Walter Lippmann argued that democracy was not a workable model for modern government and the “public” did not exist, and was instead composed of a mass of citizens, vulnerable to manipulation (1922, 1927). In its place, he advocated a technocratic government where experts would guide government action. Written in response to this perspective, Dewey’s The Public and its Problems (1985 [1927]) conceded that democracy in modern society faced many challenges. In particular, technological change had “expanded and fragmented” the public, resulting in a hollow politics. Instead of adopting Lippmann’s pessimistic view of a mass of manipulable citizens, Dewey drew on a more expansive view of a democratic society reminiscent of that of De Tocqueville (2004 [1835]).
Dewey argued inevitable “common effects” of collective life continually spur the creation of multiple publics, each with different “problems.” The result would be an ongoing debate about the nature of government. Since it exists to manage problems, government is “by its very nature … something to be scrutinized, investigated, searched for” (1927: 31). Dewey conceded that modern society produced a fragmented community, which could, as Lippmann argued, remain “shadowy and formless, seeking spasmodically for itself” (1927: 142). However, the solution to this problem was not technocracy, but a renewed focus on the “methods and conditions of debate, discussion and persuasion” (1927: 208), and Dewey called for a focus on education, continuous scientific inquiry into problems, and local community development.

This theory provides several useful features. First, it links the concept of problems developed by the design theorist Rittel with a broader theory of society since in many respects the two authors describe similar concepts. Importantly, it avoids the pessimistic conclusion that because problems are wicked, they are irresolvable and therefore are futile to consider. In contrast, Dewey viewed problems as a creative force that drove the political process, spurred the development of institutions, and ultimately provided the motivation for applied social research. Second, as Stein and Harper (2003) have argued, pragmatism provides a theoretical perspective that allows for the trust that is necessary to both create and reform institutions, unlike alternative theorists like Foucault. Forester has drawn on pragmatism to analyze the micro politics of professional practice, who has combined it with critical theory to propose a “critical pragmatism” (Forester 1989, 2013). Hoch argued for pragmatism as the basis to planning theory, and proposed a synthesis with Habermas’ communicative rationality (Hoch 1984; Hoch 2007). From the topic of social theory, next in the typology are two groups of exogenous theory: social learning, and theories of frames and institutions that form a conceptual link back to spatial planning.

2.5 Exogenous Theories: Social Learning

2.5.1 Argument for a Social Learning Perspective

Social learning is a useful theoretical approach for analyzing the use of planning support tools in strategic spatial planning for several reasons. First, it provides theories providing needed richness and detail for measuring communicative rationality. Scholarship on “communicative” planning, which posits social learning outcomes, has generally focused on large-scale processes (Innes and Booher 2010; Innes 1995). Other descriptions of planning
focus on social learning at a societal level over long time scales (Friedmann 1987). One study attempted to measure communicative learning by observing shifts in reported views of participants over time (Deyle and Slotterback 2009), however a social learning theory could provide additional richness, measuring not only shifts in views but inquiring into whether this was caused by deliberation or manipulation, and examining the role of artifacts and the meeting space and structure. Studies have found that complex, multi-day participatory processes result in significant learning (Webler, Kastenholz, and Renn 1995; Schusler, Decker, and Pfeffer 2003), but fewer have evaluated shorter term interactions (Zegras and Rayle 2012). Second, researchers studying participatory computer modeling have argued learning theories provide a useful framework to see whether participants are learning from the tools, or whether they facilitate group learning (de Kraker, Kroeze, and Kirschner 2011). The subsequent chapter will report additional research on this topic. Finally, learning has been viewed as an important outcome to participation in general in several fields. For example, in the field of natural resources management, a recent review of this literature found diverse definitions of social learning and “only limited empirical research” and few examples where the social learning theory shaped the participatory process instead of being used for evaluation (Muro and Jeffrey 2008).

The word social is used here in two senses. First, even what could be conceptualized as individual learning in planning largely takes place in social settings: in workshops and meetings with others. Turning to “social” theories provides an adequate perspective to the unique emotional and psychological dimensions to these group interactions. Second, learning is social in that it often takes place through interaction with others, and involves learning from others. This type of learning is particularly important for value and communicative rationality, when collective action requires, if not a consensus, incompletely theorized agreements ironed out through deliberation (Sunstein 1994).

### 2.5.2 Social Learning Theories (Micro and Meso)

The history of social learning theory is linked to the diverse contexts researchers have used to develop theory through revelatory cases. Early learning theorists focused on individual information processing and retention, and behavior changes as the evidence of learning. Bandura argued that people learn from observation, and that socially-derived mental states (such as pride, satisfaction, and a sense of accomplishment) are an important component of learning, and behavior was produced by cognitive, behavioral, and environmental factors
In a related development, theorists studying children argued for a “constructivist” view, where learning is the construction of a mental model through interaction with the world (Piaget 1978). Wenger and Lave, with an interest in adult learning, argue for understanding learning as taking place as situated, occurring under conditions of legitimate peripheral participation, such as when apprentices learn through increasing involvement in a trade (Lave and Wenger 1991).

Rogoff, building on the works of Vygotsky and Piaget, developed a theory of cognitive development that highlights the potential for cultural variation (Rogoff 1990). Like Wenger and Lave, Rogoff emphasizes the importance of social contexts in the development of new skills and capabilities, stressing the link between cognitive skills and specific tasks. However, what differentiates her concept of guided participation from Wenger and Lave’s legitimate peripheral participation is a greater attention to cultural variation. It suggests that individual skill in participating in deliberation, and factual learning outcomes, will depend on the extent to which the workshop or process conforms to culturally specific practices. Although Rogoff focuses on children, she argues that adults experience lifelong development. A similar argument has been proposed by democratic theorists such as Pateman and Mill, who argue political participation is the “schoolhouse of democracy” (Pateman 1970; Mill 2008 [1861]). Rogoff’s theory argues that the effects of participation will be effected by cultural variation in the goals of development and forms of guided participation, suggesting workshop and modeling structures may result in divergent outcomes for different participants.

Another theorist who has explored learning theories is Jackson, who points out many of the traditional distinctions in learning style, such as “kinesthetic” “auditory” or “visual” learners have not stood up to rigorous testing (O’Connor and Jackson 2008). His typology bridges more biologically based characteristics of personality with those that are socially constructed (Jackson 2008). In particular, sensation seeking arises from biophysical structure of the brain and explains natural variation in adventurousness (Zuckerman 1979). However Jackson argues this trait is not necessarily positive or negative as it is expressed through goal orientation (Locke and Latham 1990). Those with high sensations and high goal orientation will pursue constructive paths, those with low goal orientation may find outlets in dysfunctional or destructive behaviors (Jackson 2011). These two characteristics explain the intrinsic motivation for learning, and capacity to engage in goal-directed educational activities.

Contrasting with the individual-level methods from psychology used by Jackson, Wenger developed a theory of learning encompassing the broader learning environment, not only
intrinsic or learned personality traits. Using ethnographic techniques at an insurance company’s claims processing office, Wenger further developed his earlier work to explain the patterns of behavior he found surrounding a professional community of practice (Wenger 1998). This theory addresses the role of designed artifacts in the workplace – printed manuals, paper forms, and computer systems. These communities must foster his constructs of engagement, imagination, and alignment, but their design involves trade-offs. For example, the practice must be both reified in concrete practices but open to participation, both designed and emergent. This suggests design choices, such as the way technical models are presented, will affect groups learning, for example “access to information without negotiability serves to intensify alienating effects of non-participation” (Wenger 1998: 226).

Fig. 2.1 Wenger’s Three Infrastructures of Learning. Source Wenger (1998:237).

In a theoretical perspective elaborated over an influential series of works on professional and organizational learning, Argyris and Schön constructed a theoretical model which links individual-level behaviors with their resulting organizational cultures (Argyris and Schon 1974; Argyris and Schön 1978, 1996; Schön 1983). Since it proposes measurable variables linked with a culture of organizational learning, their theory is used to define a scale used to measure meso-scale social learning in the planning process.

Argyris and Schön argue organizational cultures (or “behavioral worlds”) are the collective creation of individuals following different behavioral patterns. They describe two general options for individual organizational behavior, and argue they produce two distinct
organizational cultures. Individual behavior dominated by defensiveness they call Model I. When organizations have individuals following this behavioral pattern, the result is a series of behaviors and reactions that produces a distinctive closed organizational culture:

When the several parties to an interaction behave according to Model I, there are predictable consequences. The behavioral world—the world of experienced interpersonal interaction tends to be win/lose. The participants in it act defensively and are perceived as doing so. Attributions to others tend to be tested privately, not publicly, for public testing carries a perceived risk of vulnerability. Hence attributions tend to become self-sealing: the individual cannot get the data that would disconfirm them. And individuals tend to employ strategies of mystery and mastery, seeking to master the situation while keeping their own thoughts and feelings mysterious. (Schön 1983: 227)

Model I results in organizations with limited capacity for learning and change (which they call Model O-I). The second general category they call Model II. Not merely the opposite of Model I, this set of behaviors is associated with an alternative set of “governing variables”: valid information, free and informed choice, internal commitment to choice, and evidence seeking behavior. In organizational contexts, Model II involves sharing power and control over the collective task and work environment.

This in turn results in a reduction of defensiveness in individuals and groups, producing a culture where assumptions are questioned and individuals pursue “public tests of their underlying hypotheses” (Argyris and Schön 1996: 117-119). They argue the resulting organizational culture produced by Model II will exhibit double loop learning, where underlying assumptions of existing systems are explicitly questioned and discussed (Figure 2.1).

In these works, Argyris and Schön elaborate on Model I in much more detail, as they view it as a much more common organizational culture than Model II/O-II. While highly influential, these ideas have not been widely applied in planning contexts. In the Reflective Practitioner, a meeting between a planner, architecture, and developer where each attempts to dominate the situation and conceal their true position is described as an example of Model I behavior and a demonstration of the “limits to reflection-in-action” (Schön 1983: Ch. 7, 204-235).

In recent doctoral research, Holden proposed a theoretical framework for social learning spanning organizational learning, communicative action, and pragmatism. From the theory, she proposes social learning research that focuses on communities as the unit of analysis, and studying tacit knowledge and how knowledge diffuses in a community. She implemented this approach in a case study of a sustainability community group in Seattle (Holden 2008). For the purpose of this research, Model II is viewed as a plausible, if unproven, theoretical description of
the relationship between observable individual behaviors and collective social learning. Therefore double loop learning is operationalized through a scale constructed from five questions designed to measure the four “governing variables” described above (see section 4.6.1).

![Diagram of single and double loop learning](image)

**Fig. 2.2 Illustrative diagram of Argyris and Schön’s theory of single and double loop learning. Adapted from Batista (2008).**

A close reading of this theory suggests a distinct approach from much of the previous research. First, by focusing on the relationship between individuals and social groups, it suggests the effects of experiences will depend on participants’ social and professional identities, and how the exercises encourage them to learn by solving problems. Most studies do not specify the background or changes of individuals or sub-groups, aggregating all participants together and assuming uniform effects. Second, the research invites close attention to the design of participatory experiences. Existing theories predict significant learning will occur from extensive deliberation. Relatively unexplored is the suitability of various designed exercises and tools for various audiences, the nature and type of learning that results, and trade-offs between design features and learning outcomes within constrained contexts. In addition, although communicative dialog is important, often the stated and mutually accepted goal of a decision support tool is to introduce new indicators or factual inputs to the process to “enrich” the
discussion or avoid “false learning” resulting from a blurring of personal perceptions with observable phenomena.\textsuperscript{3} In the spatial planning, this type of straightforward learning may be relevant as it shapes political views, guide voting, and as components of “frames” used to interpret subsequent experiences.

Therefore, social learning theory is viewed as a useful perspective to study the design and effectiveness of participatory processes and PSS. In this dissertation, specific theories have been chosen for their appropriateness for variables and scales at interest for the research questions. Chapter 4 describes how the variables from these social learning theories inform the selection of the research cases, and how they have been operationalized.

\textbf{2.5.3 Social Learning Theories (Macro)}

Argyris and Schön describe an organizational learning system as “made up of the structures that channel organizational inquiry and the behavioral world of the organization, draped over these structures, that facilitates or inhibits organizational inquiry.” The organizational structures include channels of communication, information systems (“including their media and technologies”), the spatial environment of the organization, procedures and routines, and systems of incentives. From the perspective of this study, spatial PSS and the processes by which they are developed and used constitute a crucial organizational structure for learning.

Although these structures are interdependent with the organization’s “behavioral world,” or culture, Argyris and Schön argue a critical type of organizational learning is “the second-order learning through which the members of an organization may discover and modify the learning system that conditions prevailing patterns of organizational inquiry,” what they call, after Bateson, \textit{deuterolearning} (Argyris and Schön 1996: 28-29; Visser 2003; Bateson 1972). Therefore this section considers the creation, adoption, and development of these tools. How do planning organizations, and broader regional networks described in these cases, engage in \textit{deuterolearning}?

One popular account for the spread of new technologies is the diffusion of innovations theory (Rogers 2003; Wejnert 2002). According to this theory, an innovation is an “idea, practice or object that is perceived as new by an individual or other unit of adoption.” Innovations spread among units in a social system through the sharing of information through communication channels over time. Important variables to explain the rate of adoption are several perceived

\textsuperscript{3} This reflects a “realist” worldview that stresses both the existence of an objective reality (acres of land, units developed, energy use, etc) and also the existence and validity of subjective perspectives.
characteristics of innovations: relative advantage, compatibility, complexity, trialability, and observability. The theory had been adopted to topics as diverse as the adoption of new pesticides and corn varieties by farmers, public health practices like boiling drinking water, or the adoption of consumer technologies like the VCR or cellular phones. Earlier versions viewed the innovation as relatively fixed, although Rogers concedes some innovations are “more flexible in nature, and they are re-invented by many adopters who implement them in a wide variety of different ways.” He argues this shows that an innovation diffuses more rapidly (Rogers 2003). This theory was applied to the diffusion of GIS technology in planning by Innes and Simpson, but they argued GIS should be viewed as a socially constructed technology. Therefore, more significant impact would require organizational reforms.

For planners to use GIS to improve planning significantly they must fundamentally change the way they think and work. Effective implementation may require changes in the institutional arrangements and responsibilities of planning agencies. For example, a GIS gives planners the capability to forecast different growth scenarios that would result from alternative regulatory policies (Landis 1992). This capability permits planners to play a more active role in the development of regulatory policy, suggesting that they should often work with chief executives as well as with planning commissions and that planners may have a more important role at the state level than they have had in the past. Alternatively the potential for GIS to provide readable, analytical maps quickly and cheaply gives planners the opportunity to implement innovative strategies for interactive citizen involvement in ongoing policy discussion. (Innes and Simpson 1993)

Therefore, Innes and Simpson argue the adoption of GIS in planning is not simply a matter of adopting an existing innovation. Instead, it requires initiating institutional reforms. The next section describes two related concepts that together provide a theoretical link between learning and spatial planning practices. Frames provide an explanation for why professional practices, and the institutions in which they are located, are so durable to change. Next, a rich body of theory on institutions is described that goes beyond the concept of frames, providing both a nuanced account of how the ubiquitous institutions in modern society arise and are changed. Finally, this section describes how these theories are beginning to be applied to an understanding of urban planning institutions. While outside the empirical focus of this research, the conclusion reprises the issue of how planning institutions might transform their practices in light of new technology trends, building on theorists like Zuboff (1988) and Fountain (2001).
2.6 Exogenous Theory: Frames and Institutions

2.6.1 Linking Planning and Social Learning

Thus far, spatial planning and social learning have been presented as related but largely distinct bodies of theory. This section discusses their inter-relation in light of two broad developments in the social sciences. First, scholars in public policy have increasingly realized policy conflict can be as much explained by different views of the world as by clashing material interests (Stone 1997). Emerging from this literature is the powerful yet flexible concept of frames, to characterize the several types of mental models people use to understand the world. However frames exist not only in the arena of policy debate, but also in daily life, where they are created by and help define social institutions. Scholars from several fields have increasingly focused on the question of how or institutions come to be created in society. Some theorists focus only on “formal” organizations like government, the legal system, and corporations, while others are also interested in widespread professions and practices that make up formal institutions and pervade society. Institutions are seen as both crucial for self-government, since they maintain order and provide public goods, and are also important to explain economic development. Therefore, through a focus on institutions the concept of frames is brought from the discursive realm into the everyday creation and development of institutions, which in turn powerfully influence social life. Spatial planning will be defined as constructed from a diverse institutional frame that contains not only “technical” dimensions, such as written plans and legally binding zoning codes, but also cognitive, socio-political, and discursive dimensions. Ultimately, spatial planning is presented as paradoxically itself an institution, but one uniquely interested in social and spatial transformation. This dissertation is a discussion of one way knowledge resources are applied within this dynamic institutional context, uniquely characterized by a normative orientation towards learning and change.

2.6.2 The Concept of Frames

Frames are “culturally determined frameworks, perspectives, systems of meaning, paradigms or positions from which the actor or a group of actors order social reality and make sense of his or her actions” (Ernste 2012). They have been used in public policy to explain policy controversies as disagreements about ideas and meanings, not merely as contests for resources (Stone 1997; Fischer 2003; Fischer and Forester 1993; Fischer and Gottweis 2012). While sharing a similar view of frames, Schön and Rein argued they could be transformed
through self-conscious reflection, and that this “frame reflection” is central to design rationality for crafting new policies (Schön and Rein 1994). They propose several types of frames. **Rhetorical frames** are used in policy debate, but **action frames** inform policy practice. **Policy frames** can come at several levels: *individual, institutional, and metacultural*. While useful to sketch out their diverse and multi-scalar nature, the fluidity of the planning process means a frame analysis must be sensitive to the shifting sources and uses of frames. In particular, action frames and policy frames may be intermingled, as discussions about current practices are the raw materials for a discussion about future spatial development.

Given the often-fuzzy boundaries in the planning process, and the close relationship between the administrative and visionary characteristics of planning, it seems likely that frames will move across clear categorical boundaries. In Albrecht’s definition, spatial planning is “a public-sector-led sociospatial process through which a vision, actions, and means for implementation are produced that shape and frame what a place is and may become.” In his terms, a frame is a particular way of understanding a place’s present and future, and according to the definition produced by a social process encompassing perhaps both an abstract vision and concrete actions. Without specifying one framing theory for planning, Ernste proposes frames as a useful approach to study spatial planning cultures in general, as they (1) encompass the broad systems of meaning at play, (2) allow for multi-level analysis, and (3) fit with an “action theoretical approach” that focuses on individuals, not abstract institutions or structures, as the proper unit of analysis (Ernste 2012). These ideas are related to the broader social science literature on institutions described below.

The concept of framing can be critiqued on several levels, several of which are addressed by Schön and Rein. Since a focus on “frames” rejects the existence of a unique, objective worldview, it raises the problem of avoiding the “relativist trap,” and identifying credible criteria for choosing from among competing frames. In addition, discourse across frames introduces a challenge of how two parties can communicate across the gap. Schön and Rein suggest inter-frame communication can be resolved by Kuhn’s idea of “reciprocal translation” or Habermas’ ideal speech situation. Perhaps for this reason, Habermas’ idea of communicative rationality has been a cornerstone of postpositivist planning theory. However, by remaining in the realm of how the world is construed, Schön and Rein do not entertain the epistemological question, namely whether some frames describe reality more accurately than others. In

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4 For a description of action theory in geography, see Werlen (1993).
subsequent work, Sayer has developed a theory addressing this issue. His theory of “critical realism” proposes inter-paradigm communication is possible and proposes practical adequacy as a replacement for the lost objective viewpoint (Sayer 2010). His viewpoint is summarized in the complete quotation that opened this chapter:

The world can only be understood in terms of available conceptual resources, but the latter do not determine the structure of the world itself. And despite our entrapment within our conceptual systems, it is still possible to differentiate between more and less practically-adequate beliefs about the material world. Observation is not theory-neutral nor theory-determined, but theory-laden. Truth is neither absolute nor purely conventional and relative, but a matter of practical adequacy. Differences in meaning need not render inter-theory or inter-paradigm communication and criticism impossible. Knowledge changes neither wholly continuously and cumulatively nor by comprehensive replacements of one monolithic paradigm by another. Theory does not order given observations or data but negotiates their conceptualization, even as observations. (Sayer 2010: 83-84)

The concept of practical adequacy is presented as knowledge that “generate expectations about the world and about the results of our actions which are actually realized” (Sayer 2010: 69) 69 While Sayer does not describe them, there are strong links between this idea and the pragmatic epistemology of Pease and James described above. Practical adequacy is viewed as superior to evaluating knowledge based only on its usefulness, which Sayer calls instrumentalism. This view is usually concerned with predictions and risks “getting the right answers for the wrong reasons” (Sayer 2010: 70).

Therefore, introducing the concept of frames does not lead inevitably to epistemological relativism. Frames make claims about what is and reflect choices about how particular situations should be viewed. Therefore, the problem of multiple frames is not only epistemological, but also one of values, perspective, and worldview. Just as in the parable of the blind men and the elephant, there may be multiple empirically valid ways to view one phenomenon, that share an object but differ in their perspective and focus.

2.6.3 Frame Reflection as Mechanism for Professional Innovation

Schön and Rein proposed the concept of “frame reflection” as an organizing principle for professional education, building on Schön’s earlier work on the role of reflection in the education of professionals (Schön 1983; Schön and Rein 1994). However, they are not unaware of the limitations of reflection, observing that:

Frame reflection may occur but not give rise to reframing. Reframing may occur without the benefit of frame reflection, but it may actually generate a need for such reflection. Although frame
reflection may at times contribute to a kind of reframing that resolves policy controversy, it is neither necessary nor sufficient for that purpose. (Schön and Rein 1994: 40)

These works describe several ways reflection can be used to lead to reframing. First, they observe design rationality inherently contains a flexibility and interest in generating and testing various frames that are possible in any situation. Therefore, educational models that stress design, such as the architecture studio, provide a model for professional education that produces practitioners more attuned to the important role of their own perspectives and the views of their clients (Schön and Rein 1994: 188-209). In practice, reflective practitioners will be interested in engaging in a conversation with clients, in order to understand their perceptions, values, and perspectives. The result is an attitude of viewing professional practice as an ongoing experience in research (Schön 1983: 295-300). Schön and Rein only suggest some of the concrete steps that could be taken to encourage or create professional reflection. The values and behaviors of reflective practice are linked to the organizational culture of the organizations where the professional work, linking this concept to the previous account of organizational learning. However, as the subsequent discussion will demonstrate, institutions are resistant to change and can seem to transcend the will of individual members. More conventionally, professional education like conferences, retreats, sabbaticals, and fellowships may create the physical and mental distance from day-to-day life required for reflection and therefore innovation.

2.6.4 Institutional Theory

Considering institutions raises the important connection between this research and broader trends in the social sciences. Revising perspectives from earlier researchers, scholars in the fields of economics, political science, and sociology have revised an interest in institutions as important conceptual categories to explain human behavior therefore macroscopic outcomes, such as economic development or political decisions. Thelen describes several varieties: rational choice institutionalists who see institutions as the result of economically rational agents, sociological institutionalism view “formal” or “technical” elements of institutions as embedded in broader cultural frameworks of meaning, and historical institutionalism stresses the importance of specific contexts (Thelen 1999). These schools in turn draw from an earlier set of scholarly influences, sometimes called “old institutionalism” (Stinchcombe 1997), that include figures like political economists John R. Commons and Thorstein Veblen. One theorist from this older
tradition is the political scientist Edward Banfield, whose work concerned the role of institutions in facilitating both capitalist economic development and also broader governance foreshadowed later research identifying culturally-shaped institutions as key elements to capitalist economies. In his classic profile of a town in the south of Italy, Banfield argued the community’s failure to develop institutions because of a culture of “amoral familism” caused both economic underdevelopment and an inability of the town to develop political capacity required for collective action (Banfield and Banfield 1958). The revival of institutional theory culminated with several influential works, including a widely cited collection edited by Powell and DiMaggio (1991), and Scott’s (2008) effort to formulate a “encompassing framework” of institutional theory in organizational sociology.

Given the importance of institutions and organizations in planning, it is no surprised that these ideas have attracted planning theorists. A special issue of Planning Theory focused on “institutional transformations” reflects some of this diversity. Reflecting on the contributions to the issue, Healey argues Sanyal (2005) followed a traditional institutionalist account, Alexander focused on economics’ transaction cost theory (2005), and Albrechts (2005) and Hillier (2005) are situated as sociological institutionalists (Healey 2005). Notably these theorists have different visions for the origins of change, with Sanyal focusing on learning, and Alexander arguing that institutions are often designed by powerful, “significant” actors. Separately, Moulaert speculated on the use of institutional theory for planning, but cautioning about the usefulness of one variety, the new institutional economics (Moulaert 2005). A recent edited volume reflected this diversity of perspectives, as well as containing studies applying institutional theories to housing cooperatives, public-private alliances, and Lebanese real estate development (Verma 2007).

While economic perspectives may be useful where the subject of inquiry are transactions within relatively stable markets, an emerging literature has drawn on the broader perspective of sociological institutionalism as potentially useful for understanding processes of social change. This tradition views institutions not merely as formal rules and structures, but also conventions, customs, and scripts (Koelble 1995). Highlighting their importance for understanding institutions in order to account for “unimaginable” change, Kim (2011) advocated a cognitive view that seeks to go beyond debates about the relative impact of agency or context and look for the origins of institutions in empirically documented cognitive processes. Her own empirical study of Vietnamese real estate entrepreneurs argued the market emerged through a process of social learning and ultimately institution-building (Kim 2008). Kim observes that this view casts doubt on economic development techniques focused exclusively on selected formal institutions, such
as property registration and courts systems, and not the more nuanced and widespread socially construction institutions required for economic markets to function.

One proponent of this more fluid, cognitive perspective is North, who argued that considering the perspectives of agents may be adequate for stable, competitive market situations, but is not applicable in situations of change and uncertainty (Mantzavinos, North, and Shariq 2004). The ultimate conclusion to this line of reasoning is an anti-universalist perspective on social order. In the realm of the economy, North argues “it is important to understand that even if we did have it right for one economy, it would not automatically be right for another; and even if we have it right today, it will not necessarily be right tomorrow” (Mantzavinos, North, and Shariq 2004: 80). This perspective, a sociological and cognitive approach to institutions, therefore does not conflict with the anti-foundationalist stance of philosophical pragmatism described above. Instead, it reinforces the pragmatic orientation towards ongoing empirical investigation in light of an evolving society.

While Kim’s cognitive approach argues for the importance of learning to explain institutional development and change, it is by no means the only explanation. Sociology’s interest in the internal origins of institutional change is contrasted with scholars interested in the importance of external forces, such as economic competition or the shocks created by major social change. An older “ecological” perspective argued one mechanism for institutional change would be competition (Hughes 1936). In particular, Weber argued the capitalist marketplace would create a powerful force for bureaucratic efficiency within corporations (DiMaggio and Powell 1983), and Christenson has argued technical change inevitably leads to firm failure as companies invested in obsolete technologies struggle to adopt (Christensen 1997). However, institutional theorists in economic history are divided about whether efficient institutions will arise naturally, some arguing that highly inefficient institutions can be remarkably durable (Ogilvie 2007). Clemens and Cook review literature that argues in addition to learning, other explanations for institutional change, especially changes to their frames or “schemas” are possible (Clemens and Cook 1999). Institutions may evolve more or less randomly due to inherent mutability. Institutions may contain internal contradictions that produce catalytic conflicts. Or the mere multiplicity of institutions may present multiple options, which are no distinguished by their efficiency.

The unique nature of planning institutions means the learning perspective may be particularly important, however these other processes may be useful accounts of change as well. As a governmental function, planning may be relatively insulated from exogenous shocks
produced by economic volatility experienced by private sector firms. Since the value of planning activities may be difficult or impossible to measure, a more important mechanism for institutional reproduction may be the continual definition and description of schema or frames that explain and justify the planning institution. In the terms of some theorists, more “technical” sectors must succeed or fail on the basis of their outputs (such as products sold in a marketplace), however “institutionalized” sectors lack clear outputs and therefore focus their efforts on compliance with the standards of their sector in order to ensure legitimacy and survival. For example, spatial planning offices which follow “best practices” and employ professionally certified planners may be more likely to obtain awards, grants, and professional accolades, whether or not their activities are objectively valuable. In fact, the sociological perspective would question the existence of an “objective” efficiency criterion, thereby implying the need for a normative theory explaining the logic of professional activity, such as the framing theory presented here. Furthermore, Clemens and Cook observe that learning may be particularly important for organizations in changing environments, certainly another distinguishing characteristic of many planning institutions (Clemens and Cook 1999: 452).

Recent work by Servillo and Van den Broeck (2012) provides a useful formulation of these ideas for spatial planning in particular. Drawing on political and sociological and political institutionalism, they argue the actors involved in spatial planning begin to share the “same cognitive, cultural, political, structural frame.” This institutional frame contains several dimensions. The technical refers to the planning instruments, rules, plans, and formal government institutions, most often viewed as the essential ingredients to spatial planning. For example, Loh and Sami (2013) argue the closing of a planning office should be viewed as the end of the “entire regional planning structure in the area,” a view with omits a broader view of planning. What Servillo and Van den Broeck term the cognitive dimension encompasses implicit and explicit knowledge, monitoring structures, planning schools, etc. This dimension could perhaps be better described through Healey’s concept of the “knowledge resources” of planning (1998). The socio-political dimension describes assumptions about the model of society, role of the state and public domain, etc. And the discursive dimension describes specific rhetorical approaches and their related issues, linked to but distinct from socio-political assumptions. These are similar to what Schön and Rein call metacultural frames, which are “generative metaphors” that are at the root of policy discourse (1994). They can include the metaphor of health and life for cities, (resuscitating, revitalizing), the “right to the city,” and “individual freedom” of markets.
Next, Servillo and Van den Broeck describe the dominant coalition’s institutional frame as *hegemonic*, and the institutional frame of excluded parties as *counter-hegemonic*. Although lacking a microscopic, cognitivist perspective on change, they identify as a source of change the conflict between hegemonic and counter-hegemonic coalitions. The result is a view of planning that helps go “beyond the idea of a planning system as a self-standing technology and as a social unity and consensus-based, highlighting its partial, unstable and temporary condition and the forces that are around it” (Servillo and Van Den Broeck 2012: 53).

While useful in many respects, this framework is limited in that it implies a vision of planning defined by contending interest groups operating in the political sphere. Spatial planning’s broad topical scope and porous boundaries mean these dynamics may play out at multiple scales, not only between organized interests but also within organizations and other forums where the institutional frame is constructed. As an arena both embedded within an institutional frame but continually confronted with contrasting perspectives (whether “counter-hegemonic” or otherwise), the result is a normative vision of planning which is embedded within institutions, while retaining a unique capability for change. Healey captures this well in a thoughtful discussion of planning theory in relation to the concept of transformation:

> The contribution of the planning enterprise to creating the future should be in helping to open up institutional spaces within which transformative energy gets released, in feeding transformative initiatives with knowledge resources, technical capacity and the repertoires of practicing, in highlighting value issues at stake and in shaping emergent possibilities. Neither ‘in front’ of governance practices, nor apart from them, but acting ‘inside’ them, the planning enterprise need not decay into a mere cog in someone else’s machine. Governance processes are not a machine, but complex continually emergent dynamics in which small contributions matter and large-scale projects may easily fail. The ‘new institutionalism’ provides a key resource for understanding these dynamics and recognizing the transformative potential of all kinds of contributions in all kinds of governance arenas. (Healey 2007: 82)

### 2.7 Multilevel Social Learning Framework

Drawing on this chapter’s theories, the study adopts a multilevel framework: interactions are examined at the micro level, processes at the meso, and infrastructure at the macro. At the interactions and process levels, three alternative theoretical lenses can be used to interpret the use of modeling tools in planning processes. These are behavioral theories that focus on the participants’ behavior.

- **Social learning** – PSS, when incorporated into workshops, can contribute to changes to participants’ factual knowledge, skills, views and attitudes, trust, and relationships
(Wenger 1998; Muro and Jeffrey 2008). However, the structure of the process may result in different forms of learning as computer models may inhibit flexibility required for deeper double-loop learning, which focuses on values and assumptions (Argyris and Schön 1978, 1996).

- **Social choice or negotiation** – PSS functions to structure a process of negotiation about trade-offs and alternatives. Participants have pre-existing interests and are motivated to maximize their interests in the specific plan (Klosterman 1987; Dutton and Kraemer 1985). There is little dialog exhibiting communicative or value rationality, or changes to participant views, however the system can facilitate negotiation and agreement by making interests explicit. This perspective shares similarities to those from social choice and economic institutionalism (Sager 2002; Arrow 1951; Moulaert 2005).

- **Structured coercion** – PSS are a method for advocating a preferred point of view by the planners, who are usually also the designers. This corresponds with the two lowest rungs on Arnstein’s “ladder of participation”: manipulation and therapy (Arnstein 1969). This is a result of the social legitimacy associated with computerized analysis and realistic visualizations. Peattie argued the political effects of planners’ representations was to make their discourse less accessible to non-planner participants and thereby impose their pro-corporate views (Peattie 1987). This perspective can be associated with Lippman’s concern with powerful elites “manipulating” lay citizens.

At the **process** and **infrastructure** levels, the theoretical perspective selected is sociotechnical systems, which analyzes systems as containing three ingredients: technical elements, actors, and social elements (such as rules, norms, ethics) (Kroes et al. 2006; De Weck et al. 2011). This perspective explains the common perspective that access to and influence over technical models can translate into political power, such as the observation by Dutton and Kraemer (1985) about fiscal impact models that they “will tend to support and reinforce the interests of those involved in the modeling process over those left out of that process.” Or the observation that spatial data sharing is “neither a purely technical problem nor a purely behavioral one” and therefore researching the topic requires studying both simultaneously (Evans and Ferreira 1995). Research in this area stresses how system characteristics such as reliability and robustness require analyzing both social and technical elements together. Specific theories that reflect this perspective that are used include Rogers diffusion of innovations (2003), and the concept of frames (Schön and Rein 1994). Other
possible theoretical perspectives at the process level are engineering systems (De Weck et al. 2011), soft systems methodology (Checkland 1999; Checkland and Holwell 1998), and actor-network theory (Latour 2005; an example of it applied in planning is Rydin 2013).

At the process or infrastructure levels, two primary alternative theoretical perspectives are considered. An alternative theory at this level is institutional social choice theory developed by Sager. Social choice theory finds that any method for choosing among options is liable to manipulation, and Sager argues this may result in the opportunity for manipulation in the planning process (Sager 1999). This theory does not explain or sociotechnical design choices, and does not explain social learning outcomes that are frequently observed in planning, such as shifts in views, preferences, and cognition. However it serves as a useful reminder of the possibility of strategic manipulation by actors when its assumptions of known preferences and discrete choices are met, as sometimes may be the case.

Also related to levels, Hanna’s research on information and participation in planning in estuary management suggests limits to a focus on formal planning processes (Hanna 2000). First, he argues information collection and dissemination has an important impact on decisions, confirming the choice to focus on this variable. Second, he also finds influence occurring through “hidden” or proxy channels, not the most visible participation activities. If interactions cannot be observed, it threatens the validity of the proposed research.

Several of the primary theories undergirding the research questions were primarily developed to explain patterns within organizations, not processes in the public sphere. These are sociotechnical systems theory (Kroes et al. 2006; De Weck et al. 2011), organizational learning theory (Argyris and Schön 1978), and Wenger’s theory of professional learning (1998). Schön subsequently adapted this theory to discuss professional learning in the book Frame Reflection, but sociotechnical systems theory and Wenger’s theory are relatively new and have not been widely applied to planning. All three describe situations where participants have a shared purpose and context. In the case of Argyris and Schön and Wenger, the boundary is a common employer, for De Weck a common system. Therefore these perspectives may be limited in some ways, particularly where more fundamental differences in interests and background exists between participants.

2.8 Conclusion

Researching planning support tools requires not only a theory of planning, but also specific behavioral theories to understand how new tools might impact the social processes and
interactions that make up the planning process. Planning theory, in turn, requires broader assumptions about the nature of society at large and actions of individuals within it. This study adopts strategic spatial planning as a framing theory of planning, which is linked to both broader theoretical assumptions about the nature of society as well as which social learning theories are useful to analyze the planning process. Through the final social learning framework, this chapter attempts to define a theoretical perspective that can be used to frame an empirical study where specific, measurable variables are linked to broader theoretical perspectives.
Chapter 3

Spatial PSS in Context

3.1 Overview

This chapter introduces the specific type of spatial PSS that are the focus of this dissertation, and places them within the broader landscape of computational tools applied to spatial planning. It also describes relevant previous research on similar PSS. The chapter is organized into three sections. First, two general approaches to integrating digital computation into planning are described: urban systems models, and PSS. Although generally viewed as separate, because both rely on representations and specific ways of framing problems, they share common links with the fields of policy indicators and spatial data infrastructures. Second, in light of this background, the specific PSS featured in this research are described. Their technical approaches reflect practical trade-offs that influence how they are used in planning practice. Third, previous studies on similar planning tools are described. This developing literature illustrates both the diverse disciplinary perspectives and alternative research methodologies that have been used to investigate PSS and influence this study.

3.2 Two Approaches to Computation in Spatial Planning

The chapter begins with a brief description of two general approaches to computer models in spatial planning, roughly following a typology proposed by Shackley (2001) for climate modeling. After studying scientists involved in creating climate models, Shackley described two “epistemic lifestyles” of the computer model creators, defined as “set of intellectual questions and problems, and the accompanying set of practices, that provide a sense of purpose, achievement, and ambition to a scientist's life work.” The “climate model constructors” focused on developing models that “capture the full complexity of the climate system” independent of specific applications, assuming the resulting models can then be used for research or policymaking. The “climate seers” focused on constructing models that can be used for experiments to inform policymaking, especially regarding the effects of greenhouse gas
concentrations. Shackley then argues these two “lifestyles” result in different opinions about which models are state-of-the-art, as well as how they should be created and evaluated. In spatial planning, the divide between those focused on models that capture the complexity of urban systems and pragmatic models useful for the planning process is even more pronounced.

The first, urban system model builders, seek to develop models that reflect the full complexity of urban systems. They assume the resulting models can then be used for a range of purposes, including creating or evaluating spatial plans. Given the cost of developing such models, they are often created by university-based researchers or regional agencies for use at the regional scale, however their creators have the ambition to use them for spatial planning at multiple scales. In contrast, the PSS builders start from the contexts where spatial plans are made, usually planning processes featuring deliberation and collective design. Their approach seeks to create computer models and other technologies that will improve these processes in some way. As in climate modeling, these two orientations lead to different criteria for innovation. For urban systems model builders, state-of-the-art models are those that contain the greatest realism to the modeled system, usually in spatial detail or theoretical richness. Given the complexity of cities, this has led to the tendency for this group to develop models with more and more complexity, even if the central focus remains the transportation and land use patterns that are central to spatial planning. Conversely, planning support model builders value artifacts that improve the planning process, often at the expense of representing the known complexity of cities. Planning support model builders are further challenged by disagreements about the nature of the planning process, including who should be involved, what activities they should do, and how “improvement” should be measured. The result is a diverse research literature and professional practice.⁵

This chapter briefly introduces each of these approaches. Although involving contrasting assumptions about how tools should be developed, they are interrelated in two important ways. First, both rely on representations, inevitably invoking broader questions and assumptions about

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⁵ This dichotomy, derived from the epistemological orientation of their creators and the artifact’s intended use, differs from existing categories for urban models, which are often based in technical or topical distinctions. Klosterman has made a distinction between “simple” and “complex” models, while the emphasis here is not in their complexity, but their internal structure and intended use (Klosterman 2012). Separately, Klosterman and Pettit (2012) separates models by four “techniques,” large-scale urban, rule-based, state-change, cellular automata, and argue all constitute planning support systems. In contrast, Landis (2011) lumps together models with contrasting technical approaches, including SLEUTH and UrbanSim, as “urban growth models” since they share a topical focus on urban growth.
how cities and planning should be framed. Second, the use of representations links these efforts with two broader phenomenon: policy indicators and spatial data infrastructures.

**3.2.1 Urban System Model Builders**

One group of researchers seeks to create urban system models that encompass several urban systems, such as land use change, transportation, and economic patterns. Proponents of these models argue they can result in simulations that reflect the counterintuitive or emergent behavior complex systems (Ascher 1981; Klosterman 2012). As an example, urban economic theory and empirical evidence demonstrates there are strong links between transportation infrastructure and land use patterns, and models that include both can estimate these interactions. Models in this category have adopted a range of technical approaches, including deterministic simulation, empirical estimation, or hybrid approaches (after Flaxman and Li 2009).

However, it should be noted the models described below are structurally extremely diverse, and often reflect contrasting and contested theories and assumptions about how urban systems should be represented. They share a focus on exploring urban systems and understanding complexity first, and developing artifacts that can be integrated into real-world planning contexts second. As described below these loose categories are not mutually exclusive and can be contested, but is presented as a means to organize the diverse urban computation literature.

Early attempts to create urban systems models, such as Forrester’s attempt to model the city using a systems dynamics approach (1969), were critiqued for lacking sufficient spatial detail and adequate theory (Lee 1973). However, improvements in both theory and data availability sparked dozens of improved models in subsequent years, created and used by both researchers and government agencies (Silva and Wu 2012; Wegener 1994). Guhathakurta reflected this more contemporary optimism in the introduction to a collection of case studies of land use and environmental models, observing “we are at the watershed of a new generation of models that are more dynamic, more pragmatic, more interdisciplinary, and more amenable to collaborative decisionmaking” (Guhathakurta 2003: i). Specific examples include a range of technical and theoretical approaches. One group took advantage of advances in urban economic theory, including the development of the monocentric model pioneered by Alonso (1964), and related theories of individual and firm location choices (Anas and Xu 1999). Echnique’s MEPLAN is an economic model that simulates supply and demand for real estate and travel used by governments in the U.K. (Echenique et al. 2012). Integrating simulations of
multiple urban systems, Waddel's UrbanSim has been used for both research and as a policy model by regional agencies. The model includes elements that simulate real estate development, land prices, household and economic location, demographic transitions, mobility, and accessibility (Waddell 2002). UrbanSim is the basis for the land use aspects of a model under development by researchers at the MIT-Singapore Future Urban Mobility project called SimMobility (MIT-Singapore Future Urban Mobility Project 2013). Travel demand forecast models, which have long utilized microsimulation, are increasingly incorporating attention to long-neglected alternative transportation modes and land use details. Early four-step travel demand models used by Metropolitan Planning Organizations (MPO) for transportation planning have been refined to better reflect alternative transportation modes (National Research Council 2007). Building from innovations in discrete choice theory, new activity-based approach to travel modeling promises to provide greater sensitivity to alternative land use patterns (Ben-Akiva and Lerman 1985; Shiftan and Ben-Akiva 2011).

However, models based in economic or choice theory rely on extensive, often difficult-to-obtain data, such as household preference surveys and property sales data (Brail 1990). Furthermore, models based in economic simulation can be inaccurate as a result of the significant imperfections in housing and labor markets, and discrete choice models imperfectly reflect important variables related to regulation and culture. For these reasons, another group has pursued alternative approaches to urban systems models. Clarke’s SLEUTH model applies cellular automata to simulate the spatial pattern of urban land development, and has been applied in Portugal (Silva and Clarke 2005) and the Washington, D.C. region (Jantz, Goetz, and Shelley 2004), among others. A research group at the University of Illinois has developed the LEAM model, which estimates the probability of land use change using grid cells, and has been applied in St. Louis (Sun, Deal, and Pallathucheril 2009). Flaxman’s raster-based ATT-CON model, the successor to environmental modeling techniques pioneered by Steinitz, treats the volume and character of urban growth as exogenous, however can provide fine spatial detail concerning the likely pattern of future development (Flaxman and Li 2009; Steinitz et al. 2005). Finally, Batty has explored the application of complexity theory to cities, seeking to explore the phenomenon of emergent properties emerging from relatively simple systems, through cellular automata, agent-based models, and fractals (Batty 2007).
3.2.2 PSS Builders

Another group, PSS builders, has focused on designing technology from the perspective of people involved in spatial planning processes. This group sought to develop practical tools adapted to the technologies and skills available in professionals and communities.

The adoption of microcomputers by professionals in the 1980s provided the earliest opportunities for computers to be applied in planning. Early examples for PSS using newly available tools included spreadsheet models (Klosterman, Brail, and Bossard 1993), databases management tools (Ferreira 1990), and early multimedia Internet-based tools (Shiffer 1993; Shiffer 1995). As technologies evolved, others explored how digital visualization could be applied to planning, arguing they could improve public understanding and deliberation about proposed changes to urban form (Kwartler and Longo 2008; Al-Kodmany 2002). Another inspiration was research in group support systems, which found that structured interaction in “decision rooms” equipped with computer terminals could improve group outcomes such as brainstorming or deliberation on contentious topics (Fjermestad and Hiltz 1998; Nunamaker Jr et al. 1996; discussed for planning in Guhathakurta 1999).

In response to developments in planning theory that emphasized the importance of communication and creating consensus, Klosterman argued these efforts should be organized under the paradigm of “planning support systems” which would “support a continuous and interactive process of analysis, design and evaluation,” with explicit focus on long-range problems and the arenas of social interaction and debate where collective design occur (Klosterman 1997). The term was also adopted by a leading research group led by Professor Joseph Ferreira, Jr. at the MIT Department of Urban Studies and Planning in 1992, where researchers experimented with applying emerging technologies to planning contexts (e.g., Shiffer 1993). The adoption of GIS technology by professional planners (Innes and Simpson 1993), and the emergence of a dominant GIS software package and data formats in the 1990s, enabled the development of a new class of PSS which could rely on the GIS software for data management, visualization, and other functions. In particular, the ArcGIS software suite produced by the software company ESRI has become a monopoly provider of GIS software, enabling them to also effectively define file formats. This GIS software forms the technical basis for many contemporary PSS.

Technically linked with GIS software, these tools take advantage of planners’ growing GIS data and skills, but present a variety of technical and functional approaches. Klosterman himself developed What If?, a software package that facilitated implementing analysis and
planning conventions from land use planning, namely projecting future land use demands from demographic projections, conducting a land suitability analysis for these uses, and allocating the demand to suitable locations (Klosterman 1999). Another package, CommunityViz, was developed initially by the Orton Family Foundation, but was spun off as a for-profit organization, PlaceWays (Kwartler and Bernard 2001; Placeways LLC 2013). A sophisticated toolkit, CommunityViz can be used to create a wide range of PSS reflecting different planning methods. The visualization and analysis functions supported include development impact analysis, regulation “build out” analysis, 3D visualization, and growth projections (Walker and Daniels 2011). In Portland, Oregon, two firms developed tools to support sketch planning during consulting practice. Criterion Planner’s INDEX computes indicators for small-scale land use planning applications (Allen 2001). Fregonese and Associates’ Envision Tomorrow links GIS with a spreadsheet tool that calculates indicators to describe a given pattern of land uses, and the tool has recently been moved to the University of Utah (University of Utah 2013). European researchers have also developed a range of models tailored to local planning and policy cultures, including tools for multi-criteria analysis, agent based modeling, and other applications (Geertman and Stillwell 2003).

The functionality of many of these tools and practical applications have been described in two edited volumes (Brail 2008; Brail and Klosterman 2001), and documented in several recent professional reports and white papers (Condon, Cavens, and Miller 2009; Hoglund 2011; Grant, Rooney, and Assasie 2010; Holway et al. 2012; California Department of Transportation 2007). The specific PSS used in the research discussed here, CommunityViz and Envision Tomorrow, will be described in greater detail in the subsequent sections.

3.2.3 The Approaches Compared

As attempts to introduce additional information and analytical richness to spatial planning processes, each of the approaches described above has both strengths and weaknesses. The ability of urban systems models to capture the interactions and counterintuitive emergent behavior of complex systems can be limited when inaccuracies are magnified by their many formulae, or if surprising results are systematically “tuned out” by model builders (Ascher 1981). More seriously, urban systems models may have limited usefulness as policy tools since they can be viewed as “black boxes” by their intended audiences (Lee 1973, 1994).
While often conflated, there are at least two ways computer models can be a “black box.” First, the computer code for many, including CommunityViz and LEAM, is not available to the public. Therefore users have no choice but to assume it contains no errors, and must rely on documentation to understand the system’s internal structure. Second, even for open source systems where the complete code is publically available, such as UrbanSim, the complexity and knowledge required to understand the model makes it a de facto black box. One antidote to this problem is the familiarity that comes from repeated use and participatory development by project participants. To a limited extent, through ongoing government funding and support, four-step urban transportation modeling systems have become institutionalized in most major U.S. metropolitan areas, despite (or because of) their well known weaknesses, since stakeholders have become aware of their strengths and weaknesses through ongoing use and model development (Brail 2006). In the environmental policy field, researchers have sought to build understanding among stakeholders of models through participatory model development and use (Van den Belt 2004; Zellner et al. 2012; de Kraker, Kroeze, and Kirschner 2011; Costanza and Ruth 1998). The unique example of Portland, Oregon’s MetroScope provides a case where interactive development between a small number of decision makers and system developers results in an unusual combination of analytical complexity and practical usefulness (Moore 2008; Conder 2000). However, this was likely made possible by the unusual centralization of land use regulatory authority in Portland (Abbott 1997). This dissertation examines the relationship between participant’s participation in, and views of, the PSS used. However the role of participation likely differs for urban systems model, which rely on theoretically-linked framing such as economics and more elaborate mathematical manipulations.

PSS have different strengths and weaknesses. Designed for pragmatic usefulness, PSS can be implemented on modest project budgets and with existing data. However, their inevitable simplifications require fixing more assumptions and reducing or elimination interaction effects between urban systems. The result is potentially misleading results, or limited range of topics and choices that can be considered.

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6 Originally developed as a technique for travel demand forecasting in the 1950s, “four-step” models begin with a population and land use forecast. Transportation patterns are then forecasted by calculating: (1) trip generation, (2) trip distribution, (3) mode choice, and (4) route assignment. This type of model can be used to test the effects of making changes to the transportation network, such as adding highways or transit lines. For more on transportation planning techniques see Meyer (2000), and the state of current practice (National Research Council 2007)
Furthermore, digital visualizations often used by PSS introduce largely unexplored dynamics into the planning process, since previous research has suggested how participants understand them depends heavily on participant knowledge and backgrounds. An empirical study of six visualization mediums (including a 3-D visual model) used in neighborhood planning in Vancouver found they had mixed results along several dimensions of “empowerment”: information, inspiration, ideation, inclusion, integration, and independence. The authors concluded “the collective capacity of the tools seems considerable, but no individual tool stands out as being uniquely empowering” (Senbel and Church 2011). Previous research in cartography, demonstrated that “novice” and “expert” users view maps differently (McGuinness 1994), a finding which may extend to other representation strategies. Software and website usability requires participatory testing with the target audience (Nielsen and Loranger 2006). However, visualization practices often resort to professional conventions and norms. The effects and usefulness of visualizations can also be framed in ethical terms, taking into account the motivations of the creator and the expected interpretations of the audience (Sheppard 2001). Cartography advises avoiding “lying” through deliberate misrepresentation (Monmonier 1996), and similarly the field of information visualization stresses omitting extraneous visual information, and urges designers to avoid “deceptions” (Tufte 1990, 2001, 1997). However, visualization ethics, truthfulness, and clarity must be defined in relation to specific goals and audiences.

These two approaches, urban systems models and PSS, have existed in largely separate worlds, however there is limited evidence they are beginning to converge. Waddell is leading a major effort to develop visualization functionality for the UrbanSim system, to make complex modeling understandable to wider audiences (National Science Foundation 2013). Batty, a longtime leading urban system model creator affiliated with the leading Centre for Advanced Spatial Analysis at University College London, is also actively pursuing an earlier interest in visualization for complex models (Batty, Steadman, and Xie 2006; Batty 2003; Batty 1992). Researchers at MIT are exploring visualization as a means to better communicate the results of novel analysis of travel behavior (Jiang, Ferreira, and González 2012). Meanwhile, PSS are developing growing analytical complexity. Envision Tomorrow has been transferred to a research team at the University of Utah, who are adding a variety of additional analysis modules to the original software under the guidance of leading planning researchers Ewing and Bartholomew (University of Utah 2013). The full implementation of web-based system architectures and improving data availability and computing power promises to further blur distinctions, creating an increasingly varied landscape of PSS and urban models (Calthorpe
Associates 2012). It is easily conceivable that planning support tools will be more tightly linked with urban systems models, or vice-versa, in planning practice in the near future. Separate from this functional and technical convergence, urban systems models and PSS both require the model creators to define the city in terms of abstract representations. This common use of representations means both are linked to the broader debate about how cities, and therefore their problems, should be represented or framed. They are therefore linked to two specific topics: policy indicators and spatial data infrastructures.

3.2.4 Representations in Planning Models

“Software depends inevitably on our ideas about representation and reality” (Dourish 2001: viii). This section describes two important implications of the use of representations, especially true for software created explicitly to represent real cities. First, from the field of artificial intelligence, any specific representation is more than a model of reality, but also necessarily contains assumptions about the nature of reality (ontology), and requires making pragmatic trade-offs in light of the representation’s intended uses. In the realm of urban system models and PSS, this means basic representation choices, such as selecting the units of analysis and spatial aggregation, cannot be made without assumptions about how cities function. Second, representations of reality are necessarily political, and when used in the public sphere constitute frames about reality. Therefore, representations are required for communication, but can also be used to further agendas or be the cause of political conflict, as they constitute different ways of viewing the world. Whether urban systems models and PSS function as technocratic instruments or useful tools for planning depend largely on the relationship between their representations and the frames held by participants in a particular policy context.

In their classic 1993 article, Davis, Shrobe and Szolovits rejected the view that knowledge could be encoded in a computer system solely as a neutral representation of reality, which could then in turn be used for any purpose. Instead, they argued all knowledge representations played five distinct roles: a surrogate for reality, a set of ontological commitments about reality, a fragmentary theory of intelligent reasoning, and as mediums for pragmatically efficient computation and human expression. For example, applying their theory to planning topics, whether land in an urban model is represented as legal parcels or a uniform grid is determined not only by which is the “best” surrogate of reality, but also by the nature of the manipulations planned. Natural processes that unfold across a landscape irrespective of
ownership, such as flooding or wildlife habitats, may be more easily represented using a grid. In contrast, legal transactions and real estate development will generally follow parcel boundaries. The spatial detail and number of attributes recorded for either are in turn determined by pragmatic considerations of data storage and human understandability. In this case, no one approach is “right” or “wrong”, but instead implies a different set of assumptions about which elements of reality should take priority for a specific application.

Furthermore, choices about representations are related to the broader issue of frames in public policy, introduced in the previous chapter. Calling them “structures of belief, perception, and appreciation,” Rein and Schön argued policy controversies as disputes where the parties hold conflicting frames. As a consequence, “conflicting frames determine what counts as a fact and what arguments are taken to be relevant and compelling” (Schön and Rein 1994). They propose several types of frames, and model representations most closely relate to what they call an institutional action frame, the “characteristic points of view, prevailing systems of beliefs, category schemes, images, routines, and style of argument and action.” This is a more general perspective from which specific policy frames are developed for specific policy situations. In addition to relying on these general frames, PSS also include quantitative measurements that reflect specific worldviews, called indicators.

### 3.2.5 Indicators

Indicators are usually defined as quantitative measurements of a concept or phenomenon of interest. Although seemingly aligned with the positivist tradition, as Wong observes, their history reveals a “unique blend of technical and normative rationality that make indicators a ‘Jekyll and Hyde’ character” (Wong 2006). Although quantitative, they are selected with normative values in mind, such as broader social values or objectives. Innes’ careful study of several social indicators led to the finding they emerged from lengthy public deliberation (Innes 1975). It is now widely recognized that all indicators, such as the unemployment rate, are carefully designed to reflect normative values about the phenomenon they describe. This unusual combination of technical measurement and normative values have meant they have been sporadically addressed by researchers, as common research paradigms separate quantitative measurement and normative theory (on normative theory see Thacher 2006; on scientific rigor of indicators see Sawicki 2002). Indicators’ normative stance and aura of

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7 For example, the unemployment rate only counts as unemployed those actively seeking work, rather than attempting to define why various people may choose not to participate in the labor force.
objectivity have meant they have flourished in the policy sector, reflected in efforts like the National Neighborhood Indicators Partnership by activists interested in compiling and using quantitative efforts to change policy (Cowan and Kingsley 2007).  

In the planning realm, several definitions for indicators have been proposed. In later work, Innes and Booher proposed three general types: system performance indicators, policy and program indicators, and rapid feedback indicators (Innes and Booher 2000). Broadly speaking, the indicators considered here can be considered policy and program measures, which Innes and Booher point out do not require the same degree of consensus and system understanding that system performance indicators do.

The indicators used in PSS can fall into several specific categories, as they are generally used for the explicit purpose of comparing alternatives. McKeever proposes a distinction between descriptive and predictive indicators (McKeever 2012). Descriptive indicators simply compute descriptions from the information inputted about specific proposals, presenting, for example, the number of housing units, acres of park land under a given scenario. Predictive indicators purport to project what would happen if the proposal was implemented, such as providing an estimate of vehicle miles traveled (VMT). McKeever argues the latter can be useful without high precision by providing order-of-magnitude comparisons. However, such a simple distinction may not be sufficient. Some seemingly descriptive indicators, such as the number of jobs, are themselves based on a set of assumptions about employment density of future employment. Many of the attributes on land use types in planning support tools anticipate development will take roughly the form of current building practices, although materials, design, and regulations all evolve over time (Ben-Joseph 2005).

Finally, one type of indicator illustrating the ambiguity between description and prediction is extrapolation, or the use of indicators to describe what might happen under a specific policy. Isserman argues a projection is a narrow, technical statement of what might happen under certain assumptions, a pure forecast is a statement of the most likely future conditions, and a normative forecast a statement about an attainable, desirable future (Isserman 1984, 2007). Although commonly viewed as mere projections (or therefore descriptive indicators), extrapolation generally requires judgments about how conflicting or ambiguous regulations will

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8 Stone described the use of numbers as metaphors, symbols, and stories in political life: “The fundamental issue of any policy conflict are always contained in the question of how to count the problem” (Stone 1997: 127).
be implemented, as well as the likely economic and demographic trends. Therefore all indicators are to some degree predictive and inaccurate because they simplify aspects of reality.

3.2.6 Spatial Data Infrastructures

Finally, both urban systems models and PSS rely on existing geospatial data—in particular spatial data infrastructures. Spatial data infrastructures are a coordinated effort to develop standards, datasets, and technical systems to support the development of a widely available set of spatially referenced information about geographic features and processes (Lachman 2002; Harvey and Tulloch 2006; Massachusetts Geographic Information Council Strategic Plan Steering Committee 2007; National Research Council 1993; Carrera and Ferreira Jr 2007). Not merely neutral, factual repositories, data infrastructures can serve multiple purposes, but within important limits defined by how the data are collected and structured. One way of analyzing this issue is by describing spatial data, and GIS technology in general, as boundary objects, which are artifacts created by social groups to serve as a common point of reference between groups, but only reflect a partial agreement. As such, they embody political choices about representation, inclusion, and exclusion:

The arrangement simultaneously includes some groups and excludes others. In this sense, coherency means that the position is acceptable, but does not presume complete agreement. … Boundary objects moderate differences and establish a shared understanding that not only enables (partial) agreement across ontological and epistemological boundaries but also leads to the creation of 'things' with increased validity to a much larger portion of society. For example, these things can be terminals, desks, mapping categories, technical standards, and institutional or social arrangements. (Harvey and Chrisman 1998)

This perspective is inspired by scholars from the field of STS who analyze infrastructures not merely as neutral technical systems and standards, but instead artifacts embedded within broader political and social processes (Star and Ruhleder 1994; Star 1999; Latour 1993; Edwards 2010; Hughes 1998). While it is beyond the scope of this study to fully explore the links between these infrastructures and the planning process, the varied state of these infrastructures provides an important context for the local implementation of any urban system model or PSS. As such, the concept of frame reflection will be introduced to explain the evolution of PSS, and by implication the related institutional and infrastructural arrangements they require.
3.3 Spatial PSS

This section includes a brief description of the two tools used in the cases, Envision Tomorrow and CommunityViz, as well as an overview of the other similar leading tools, with an emphasis on how their technical architectures influence their use in the planning process (Figure 3.1). March and Smith’s typology of information systems will be used to describe their structure: instantiations, methods, models, and constructs.

3.3.1 Technical Architecture

Envision Tomorrow and CommunityViz are no mere “tools,” but diverse modeling systems implemented in various ways in specific projects. With the widespread adoption of GIS technology in the 1990s, some scholars in the “critical GIS” literature questioned whether the technology was encouraging naive positivism at the expense of local ways of knowing (Aitken and Michel 1995). More broadly, because GIS was complex and expensive, its use reflected the perspective and interests of powerful institutions, raising fears GIS was a politically oppressive technology (Pickles and Didunyk 1995). The response was a loose-knit effort of “public participation” or “bottom-up” GIS (PPGIS or BUGGIS), which questioned typical assumptions about the use and contents of GIS systems, although these efforts often faced challenges inherent in conducting community-based research with intricate professional software (Pickles and Didunyk 1995; Corbett and Keller 2005; Elwood 2006; Talen 2000). Writing about debates about the nature of GIS in the 1990s, Schuurman argued that social critics were too quick to treat GIS as a homogenous, single entity. Instead, she observed:

GIS consists of combinations of software and hardware but it is also an expression of multiple discourses. Linked at the machine and code level to computer science, at a representational level with mathematics, GIS inhabits a world of numerical and representational strategies. GIS is not an end product of the enlightenment and scientific rationality. Rather, a myriad of practices sustains the technology; GIS incorporates intuitive, cognitive, visual and textual elements in its use and structure. (Schuurman 2000)

Schuurman argued an emphasis on epistemology, and the purported positivist bias of GIS technology in general, had “drawn attention away from the architecture of the technology where many shortcomings are ultimately located,” urging those concerned with social implications of the technology to engage at the machine level, using the vocabulary of the technology” (Schuurman 2000). Following this advice, this section is an attempt to dissect these
tools’ inner structure, to better understand how they are assembled and deployed in practice, and how their structure create options and limitations for practitioners.

Finally, this section discusses the software architecture of the systems, in the context of discussing several emerging tools (Figure 3.1). A system or software architecture is the “fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution” (ISO/IEC/IEEE 2011). In particular in the case of GIS, these include whether the software runs on a web server or as a desktop application, how data will be stored and manipulated, and what choices are available to the user. On the desktop, all of the systems described below function as ArcGIS extensions, relying on the generic capabilities of ArcGIS for some computation, representation, and data management functions, but also contain their own capabilities and interfaces. In the case of Envision Tomorrow, this includes relying on spreadsheet software to implement computations and indicator visualizations. Since these architectures influence who can interact with the tool, what data are used, and other system characteristics, they subtly influence how they are used. However, the tools are deployed in consistent ways (through in-person workshops). While technical architectures play a role, this dissertation argues that the way the PSS are used in specialized social settings is more crucial to explain social learning in planning processes and other outcomes.

March and Smith provides a useful method for analyzing the contents of information technologies (March and Smith 1995). They propose information technology artifacts can be analyzed at several levels. An instantiation is the specific realization of the artifact in the environment. In the cases of these tools, which require different data and modules, each use is somewhat unique. However, the instantiations might share common methods, such as algorithm or guidelines for use. Every time a specific “app” or “wizard” is used, regardless of the instantiation, a common method is being invoked. At the next level they share models, “a set of propositions or statements expressing relationships among constructs,” such as a data model (March and Smith 1995: 256).

Finally, the most granular ingredient is constructs, here the specific categories of representations. Starting from the bottom and working back up, constructs might include specific development types and a set of standard attributes (number of housing units, jobs, water demand associated with them. At the model level, land uses are composed of development types. Methods that operate on these constructs and models include calculating indicators such
as the total number of housing units, or estimated VMT. Finally, an instantiation refers to a specific application of these concepts in a PSS.

Ambiguity and conflict over the definition and flexibility of constructs, models, and methods in PSS partly explain why they have resisted commercialization and standardization. This is especially true since methods are often linked with broader assumptions about the nature of planning (as primarily a technical or collaborative exercise, for example). As examples, INDEX has a fixed set of indicators and requires customization if a different indicator is desired. CommunityViz indicators can be customized through formulas, although common methods are available through wizards. Envision Tomorrow’s methods are embedded in a spreadsheet, which enables them to be viewed and edited, however this means they cannot rely on methods of spatial analysis not available in a spreadsheet.

Fig. 3.1 Illustrative images of four spatial PSS: top left, Envision Tomorrow; top right, CommunityViz; bottom left, INDEX; bottom right, I-PLACE³S. Image sources: Fregonese Associates, PlaceWays LLC, Criterion Planners, and SACOG.
The two PSS used in the dissertation cases will be briefly described in additional detail below. Designed for interactive use in the planning process, they function as “bookkeeping” tools with relatively simple relationships between representations. This means they are easily explainable, however make many assumptions about future development that may not hold true, and also implicitly reflect simplistic behavioral theories. For example, indicators are calculated assuming future development will be similar to existing development patterns, while regulations, practices, and building technology may all change. In addition, it may be possible to “sketch” a scenario which is highly unlikely if economic factors or transportation network capacity were taken into consideration. As such, they are not generative tools that can propose possible designs, but evaluative tools that can be used to record and describe a potential spatial development pattern.

3.3.2 Envision Tomorrow

Envision Tomorrow is a suite of software designed to support participatory sketch planning workshops. The software has two components, a spreadsheet tool called the “Prototype Builder,” and an ArcMap extension called the “Scenario Builder.” The prototype builder is used to construct a set of prototype buildings. These are described by a set of attributes including an abridged financial analysis describing their estimated financial viability. These prototypes are combined with assumptions about streets, civic buildings, and parks, to define “development types.” Within ArcMap, users use the Scenario Builder extension to “paint” these development types on the project area. The extension provides three connections between the GIS environment and the spreadsheet tool: 1) development types (from Excel), 2) acres of land developed by type (from ArcMap), 3) acres of land vacant (from ArcMap) (Fregonese Associates 2012, 2012). The information about the acres of land developed by each type for each “scenario” is used to calculate indicators in the spreadsheet. This system provides great flexibility in the manipulation and definition of indicators since they can be easily constructed using Excel formulas. However, the primary limitation of this software configuration is that spatial indicators (such as average distance to transit or network analysis calculations like walking distance) must be calculated through existing ArcMap tools from the spatial data layers. In addition, redevelopment must be tracked and calculated separately (such as loss of open space to various land use types). Given this architecture, ArcMap provides a visualization of the land uses “sketched” on the study area, and quantitative indicators are summarized using standard spreadsheet charting functions.
Envision Tomorrow's architecture influences how it is used. Since most of the computation is completed in a spreadsheet, the formulas can be much more readily examined and manipulated than software that embeds formulas within code or a custom interface (such as CommunityViz). However, even spreadsheets can be very complex and contain errors. More importantly, the choice to use a spreadsheet allows the PSS to take advantage of users existing familiarity with spreadsheet tools, instead of requiring them learn new interfaces. The primarily drawback of this approach is the limited potential for indicators which rely on spatial functions available in the GIS, although in practice these can be completed using the existing ArcMap tools and interfaces. Using the concept of “apps,” a research team at the University of Utah is working to develop additional tools that can be integrated into the system described (University of Utah 2013). As a result, it might be that in future years Envision Tomorrow develops additional technical complexity, becoming more similar to the related and older PSS CommunityViz.

3.3.3 CommunityViz

One of the more mature PSS available, CommunityViz is “advanced yet easy-to-use GIS software designed to help people visualize, analyze, and communicate about the future of their communities.” Functioning as an ArcGIS extension, CommunityViz can best be thought of as a flexible modeling environment, which can be tailored to be used for a variety of analysis and planning methodologies. The software is distributed by PlaceWays both as a freestanding tool that can be purchased, as well as one that can be purchased through consulting services. An earlier version of the software included a full-fledged microsimulation model (called the “Policy Simulator”) which could be used to forecast demographic, economic, and land-use trends (Kwartler and Bernard 2001), but this component was removed in 2003, reportedly because of user’s difficulty implementing it (Janes and Kwartler 2008). The software also includes support for Scenario 3D, which allows 3D digital models to be linked to quantitative assumptions used by the analysis functions.

The software contains a wide range of technical functions, which must be configured by the user for a particular analysis project. Projects in CommunityViz begin by setting up a specific analysis. Each analysis requires user-inputted data and assumptions. Each analysis can then be set to hold one or more scenarios, a particular set of indicators that are each applied consistently. Under each scenario, some attributes are re-calculated, and indicators are calculated to compare the scenarios (Placeways LLC 2012). Users view the outputs of the analysis through maps and charts within ArcMap. The “decision tools” include a common
impacts wizard with commonly used indicators, land use designer, suitability wizard, allocator, and build-out wizard (Placeways LLC 2011, 2012; for a case using the build-out wizard see Janes and Kwartler 2008). A recent book described its use for a range of purposes: impact analysis, scenario planning, 3-D modeling, visioning, growth projections, value mapping, site selection, and others. The authors claim the “combination of high-tech tools with more collaboration among community residents, planners, and elected officials is the new generation of planning” (Walker and Daniels 2011).

In terms of its technical architecture, CommunityViz is tightly integrated with ArcMap, and the software is exclusively configured and used from within the ArcMap interface, although it can output summary information and charts. The software’s complexity and heavy reliance on user configuration to specific analysis questions mean it has been most enthusiastically adopted by planning projects and organization which possess significant resources, including existing data, skilled GIS users, and time required for configuration and debugging.

3.3.4 Other Spatial PSS

This section describes several emerging PSS, and Appendix E contains a list of these and other tools, as well as references to learn more about them. INDEX and What If?, like the two above, function as ArcGIS extensions. Decision Commons is a desktop application that does not require ArcGIS. Several web-based tools seek to implement PSS on websites, taking advantage of recent advances in Internet GIS databases and software.

Other desktop software systems provide alternative approaches to spatial planning support. INDEX calculates a fixed set of indicators for a given development scenario. These indicators can be adjusted through a “rating and weighting” system to have various weights and thresholds, including settings providing high scores for minimized, centralized, and maximized indicators. These functions can be used to create a quantitative evaluation of each proposal (Criterion Planners 2010; Allen 2001). Klosterman’s What If? is designed to specifically allocate projected land use demand, and specific case studies include projects in Ohio and Iran (Klosterman 2001; Klosterman 1999; Asgary, Klosterman, and Razani 2007). A group in Seattle, Decision Commons, has been developing a tool that would run separately from ArcMap, as it relies on software from the computer game industry for visualization and spatial analysis (Decision Commons 2013).

Several emerging tools seek to replicate similar functionality through web-based interfaces. The Sacramento’s SACOG developed I-PLACE3S for a previous planning effort.
Similar in functionality to sketch planning tools like Envision Tomorrow, I-PLACE’s S is a web-based application (Montgomery 2011). The consulting firm Calthorpe Associates has developed a web-based spatial PSS called UrbanFootprint. An open-source, web-based scenario creation and modeling tool, it can be used analyze impacts of growth scenarios (Calthorpe Associates 2012). In order to comply with California’s climate change law (SB 375), this tool is being adopted by the California MPOs to support evaluating future growth scenarios. Finally, two groups have developed tools for collaborative marine spatial planning that could be applied to urban spatial planning contexts. These are the University of California Santa Barbara McClintock Lab’s SeaSketch, and EcoTrust’s Madrona.

In theory, software architectures not linked to ArcGIS may increase tool access, but do so at the cost of needing to replicate the extensive spatial analysis and data management functions it provides. Web-based systems could broaden access to data and analytical capacity within a planning process. However, the approach used by SeaSketch combines self-directed exploration with workshop collaborative planning exercises (Evan Thomas Paul 2012). The relationship between new technological capabilities and changes to the planning process will be revisited in the conclusions.

3.4 Previous Research

This dissertation draws on previous research from several fields. This section briefly describes three areas of research, with a focus on how they relate to the specific research design adopted here. The first area of research is drawn from the fields of human-computer interaction, and experiments in new forms of human-computer interaction applied to the fields of urban planning and design. This literature emphasizes the importance of evaluating artifacts within their broader social and physical context of use, particularly where participant learning is the outcome of interest. Second, key findings are summarized from an emerging literature evaluating the use of GIS tools for urban planning applications. Several evaluation questions used in these studies have been adapted for this dissertation’s research design, however they differ in their theoretical approaches and reliance on laboratory experiments. Finally, research on the use of participatory modeling for public policy is briefly discussed. This study follows the advice of scholars in this area who urge for detailed, empirical studies that play close attention to the views and perceptions of participants, while also adopting a specific theoretical orientation, namely a focus on social learning and an embodied computation perspective.
3.4.1 Human Computer Interaction

Dourish has argued the evolution from symbolic programming languages to graphical user interfaces should be understood as a “gradual incorporation of a wider range of human skills and abilities,” meaning the locus of computing increasingly able to take advantage of human linguistic, spatial, and visual skills and abilities. This broad shift “allows computation to be made ever more widely accessible to people without requiring extensive training, and to be more easily integrated into our daily lives by reducing the complexity of those interactions” (Dourish 2001: 14). Computer science researchers have extended this reasoning by exploring tangible computing, where physical objects are provided computational abilities, thereby engaging the well-developed three dimensional spatial reasoning and fine motor control skills of human beings. This is in contrast with a more traditional view from human computer interaction premised on an individual user at an individual workstation (applied to GIS in Medyckyj-Scott and Hearnshaw 1993).

In planning and design, many researchers have argued for the potential benefit of using tangible and three-dimensional interfaces to analyze urban form in the planning and design process. Hypothesizing that tactical, spatial interfaces could “combine the cognitive, motor, and emotional advantages of physical media with the capabilities of computation,” Shamonsky created a prototype called “Illuminating Clay.” This research built on similar earlier experiments by the same research group, which applied tangible computing to the urban design field (Ben-Joseph et al. 2001). Combining laser scanning, computation, and overhead projection, this system could read the texture of a landscape modeled in clay, and project results of a computed analysis (such as analyzing slopes) onto the surface, thereby supporting computer-aided interactive design (Shamonsky 2003). Shamonsky argued that such a system could overcome the high costs of switching between mediums, such as when designers shift between digital, printed, and three-dimensional models for the design process.

But, these techniques have not been widely adopted in practice. The complexity of the technology may be one barrier, producing both cost but also practical difficulties in use. Another might be the minimal relative advantage: the highly creative and iterative design process may not value efficiency, and shifts between representational mediums may create opportunities to view design in new ways. What was seen as inefficiency may have other value. Shamonsky speculated on the applications of these technologies for learning, however they were not explicitly tested.
Wenger’s work, described in the previous chapter, provides a link between the world of social theory and that of embodied computing. His *Communities of Practice* (1998) reports findings derived from ethnographic research in an insurance claims processing office. He argued the employees constituted a community of practice, building on earlier work conceptualizing learning as purpose-driven period of apprenticeship (Lave and Wenger 1991). New members became integrated into a community of practice that featured a rich set of artifacts integral to the practice – such as worksheets, printed reference manuals, and the computer system used to track claims. Generalizing from this research he argued learning requires three infrastructures: imagination, alignment, and engagement. From this perspective, tools and technologies are analyzed from the perspective of how they relate to fundamentally social constructs and outcomes (Wenger 1998).

### 3.4.2 GIS Tool Evaluations

Separate from the literature related to human computer interaction, this study is influenced by an emerging literature with links to several fields that applies rigorous experimental research designs to the use of GIS tools. They generally focus on the micro scale, of a single workshop, and stay in a laboratory context, although Salter (2009) used private citizens involved in a real-world project brought to a campus laboratory. In general, the findings of these studies support this dissertation’s general hypotheses that PSS can support social learning and deliberation, although they are not always designed to address the same questions since they are theorized in diverse ways. This research builds on these approaches with two key differences: it studies the tools exclusively in real-world contexts, and explicitly attempts to measure collective, higher-level deliberation and cognition with explicit links to social theory. Despite involving similar topics, these studies are situated in diverse literatures. Salter and Smith are framed as studies of landscape visualization and human-computer interaction (Salter et al. 2009; Smith et al. 2012), Arciniegas as research on spatial decision support systems (Arciniegas and Janssen 2012), and Jankowski as Nyerges use enhanced adaptive structural theory (Jankowski and Nyerges 2003; Jankowski and Nyerges 2001).

Arciniegas, Janssen and Reitveld (2012) compared small groups completing a multicriteria analysis problem in three ways: on paper, on a single digital map (“qualitative”) and as an interactive digital map “quantitative.” The study uses students who were asked to work individually, or in groups of three. At the conclusion of the exercise, the researchers sought to evaluate the materials used along three dimensions: *usefulness*, *clarity*, and *impact*. The study
found that digital maps had higher intensity of use and negotiation. Paper maps had higher time using the tool and performance conflict. The digital maps had highest perceived effectiveness. To the extent that negotiation is a required component of communicative rationality, it seems to suggest positive results for this study. However, the external validity of these findings may be limited: the groups were very small, the experimental task was more analytical than typical in U.S. spatial planning contexts, and the study subjects (graduate students) may differ from conventional planning participants in important ways.

Salter (2009) used an experimental design to evaluate the impact of 3D visualizations from quantitative indicators for a draft plan by real-world stakeholders. Although the group is small (14), they evaluated several dimensions both before and after the workshop: the level of knowledge, level of support, whether the plan will result in sustainability. The participants rated the indicators and non-visual data rated as very helpful, however a weakness of the study is the limited participant time for discussion (after over an hour of a facilitator introduction, the discussions in the two experiments were 21 and 36 minutes). Furthermore, the focus on the study was understanding an existing proposal, not deliberating about the design of alternative proposals.

Smith (2012) conducted an evaluation of forest management scenarios using an interactive web-based interface. The findings highlighted the individual variation of use of the interface, and preferences for visual and nonvisual information. In addition, the findings confirmed users followed a three-phase use of the tool: exploration, comparison, and validation. However, the tool did not allow for interaction and discussion among participants, so the findings are limited to individual behavior.

Jankowski and Nyerges (2011) conducted a small group site selection problem with 100 students divided into 20 groups of five. The tool used was custom group decision support software with ArcMap-based GIS interface. The study sought to assess convening, process, and outcome indicators. This research group has developed a theory for investigating GIS “applied in the context of participatory problem solving and decision-making” through several publications (Jankowski and Nyerges 2003; Jankowski and Nyerges 2001). Calling their theory *enhanced adaptive structuration theory*, they introduce eight constructs: socio-institutional influence, group participant influence, participatory GIS influence, appropriation, group process, emergent influence, task outcomes, and social outcomes. Each construct is sub-divided into several aspects, resulting in 25 elements. While a useful framework for sociotechnical research, it encompasses a domain much more broad than the one investigated here. This study also used small discussion groups and an artificial “decision” exercise. These frameworks also differ
in their conception of the pubic. Jankowski and Nyerges focus exclusively on workshop participants, assuming it is the site of the “decision” that is being investigated. This is distinct from planning, where penultimate “decisions” come after a long process of discussion and design, involving both learning and a myriad of small design choices.

3.4.3 Participatory Modeling

Many types of computer models have been viewed as potentially useful for group learning outcomes in other policy domains. Costanza proposed “dynamic modeling” for environmental systems (Costanza and Ruth 1998). Other examples include agent-based modeling of deforestation and fuel prices (Smajgl 2010), and systems dynamics models of industrial systems and ecosystems (Costanza and Ruth 1998; Van den Belt 2004; Zellner et al. 2012).

An interdisciplinary literature review of collaborative modeling studies concluded the projects faced four trade-offs (Renger, Kolfschoten, and Vreede 2008). Smaller groups are more efficient and more quickly generate shared understanding, but larger groups involving stakeholders and experts results in greater “buy-in” and model accuracy. Greater participation in model construction results in greater acceptance, but experts are required for quality. Starting earlier can speed-up the project, but acceptance may require waiting until a group is convened. Finally, when multiple models are developed in parallel, they can be difficult to integrate the models and ensure shared understanding of the entire system. While defining some useful dimensions for collaborative modeling, this review also implies that methods for collaborative modeling will vary according to the specific project and goals. As such, this dissertation is an effort to explore how the trade-offs required for modeling have been implemented for PSS, and suggest which directions for future development may be fruitful.

A variety of recent studies have sought to implement more detailed research designs on participatory modeling projects. Jones (2009) proposed a research protocol for investigating participatory modeling projects they call the Protocol of Canberra. This framework includes two components: a designers’ questionnaire and a participant evaluation guide. The designers questionnaire reviews the context of the project, including the “espoused theory” for the modeling approach or method. The researchers also record the design of the project and the sequence of methods used, as well as their intended outcomes. A parallel participation evaluation guide investigates the assumptions, views, and responses to the same methods. The
three case studies focused on three specific outcomes: creating and maintain a space for exchange of knowledge and viewpoints, shared knowledge, and promoting collective practices.

This framework shares several strong similarities with the dissertation research design. The participatory modeling tools and methods are studied holistically, as applied in practice, and as sociotechnical methods that are expected to have broad intended and unintended effects. Second, the importance of close feedback from the participants themselves is highlighted as critical to gauging the success or failure of the project. However this study diverges from this protocol in several ways. Developed in the participatory modeling literature, there is no strong orientation for a particular theoretical perspective: the models discussed could have many valid objectives. As discussed in Chapter 2, the focus here is on the social learning required for spatial planning, so their conceptualization of “knowledge exchange” is too narrow for this study. In fact, an exercise that hinders or slows knowledge exchange might result in better learning outcomes as they are defined here, as both factual learning and double loop deliberation. Significantly, this methodology does not define precisely enough measurements for any effects of modeling projects.

Van Den Belt applied systems dynamics models to the policy realm, proposing a “mediated modeling” paradigm for environmental policymaking (Van den Belt 2004). This study implemented a survey design to measure a variety of attitudes and opinions of the modeling process. Similarly, a study of groundwater that utilized a systems dynamics model and real-world stakeholders implemented detailed data collection protocols (including video) to study the resulting interactions (Zellner et al. 2012). Both of these studies have generally assumed the value of the model would be the complex or counter-intuitive patterns emerging from the models, and the key learning they sought to obtain was stakeholders gaining a deeper understanding of the environmental or natural system, not necessarily shifts in problem framing or supporting more open-ended deliberation.

The groundwater study found that understanding evidence of their views did not itself result in changes, “while stakeholders showed evidence that they were able to use modeling to explore an recognize complex interaction effects, they were not willing or in some cases were unable to interpret those effects in a cognitively coherent or morally relevant fashion” (Zellner et al. 2012). This finding suggests what might be lacking was not system knowledge but deliberation about how the facts should be understood and related to values in public policy. The study achieved changes to knowledge but did not see behavioral (or attitudinal) change.
The researchers also found the group relied on moderators to operate the tool, not wanting to engage directly with the computer interface:

We expected that if model estimates did not fit stakeholder expectations that they would ask about the rules embedded in the models and want to peer inside the “black box.” This did not happen, however. Stakeholders expressed discomfort using computers, let alone manipulating the code, and relied heavily on the moderators to guide them and make changes to the models. There was resistance until the very last meeting when testing the injection policy offered some practical promise of offsetting depletion. (Zellner et al. 2012)

In this study, the small number of participants urged the researchers to show the results to municipal officials to build political support for the plan, which the authors construe as similar to an instrumental view of learning. However, it could also confirm the importance of double loop deliberation important for the emergence of communicative, strategic, or other forms of rationality described by Albrecht. From this perspective, the solution to the “problems” of encouraging the participants to interpret the results in terms of values and linking the results with policy is to remove the exercise from the academic laboratory, involve a wider set of stakeholders, and allow for broader deliberation and learning.

3.5 Conclusion

Practitioners and researchers have proposed many approaches for the role of computation in planning. This chapter has argued two useful categories are urban systems models, which focus on system complexity, and PSS, designed first for practical usefulness. While there is some evidence these groups are converging, due to the inevitably limited resources of planning and pragmatic limitations, it seems likely they will persist as distinct complementary efforts. Both share a common reliance on frames of reality and representation, thereby making them inherently political.

Since PSS contain representations and indicators, this chapter describes relevant findings in the literature connects conceptualizations of their social effects to social learning theory. Theorists from critical cartography argue the technical architecture of GIS artifacts must be analyzed in order to understand their shortcomings and use. Therefore, planning support tools are discussed in light of March and Smith’s framework for the components of information technologies (1995). The two tools used in the dissertation cases are described in additional detail, as well as alternative tools whose alternative architectures make it possible to transform the planning process. The subject of the evolution of the planning process in light of the
evolution and development of tools is revised in the conclusion. Finally, a set of studies evaluating similar GIS-based tools and participatory modeling in policy were reviewed, with a particular interest in describing useful findings, research methods, and distinguishing them from the research reported here.

Integrating IT into planning has been discussed for decades. The diffusion of GIS was viewed as a positive development, but too often the analytical potential of the software remained untapped as GIS was used exclusively as a representational medium. The new planning support tools discussed here appear to be an exciting new development for planning, in that they hold the potential to support the planning process by facilitating deliberation and providing participants useful information. Their diffusion is likely due to a host of forces: long-term technology trends, a focus in political culture on measurable outcomes and impacts, and even changes to skills and attitudes due to generational change among professionals.

The next two chapters, constituting the heart of the dissertation, seek to investigate the use of these tools in some detail. It is argued that one factor that explains the success of PSS is the specific measurable effects on the social planning contexts where they are deployed. Their use in context is analyzed at three levels: workshops (micro), processes (meso), and metropolitan regions (macro). Adopting social learning theories at these scales, the research seeks empirical evidence that describes both how the tools are used and what effects they have on planning. The goal of the research is to not only document an emerging trend in the practice of planning through a close examination of several cases, but also generate findings that might direct the evolution of technologies and practices for a democratic, information-rich planning communities will need to tackle 21st Century problems.
Chapter 4

Hypotheses, Cases and Research Methodology

4.1 Overview

This chapter describes the research hypotheses for each research question, introduces the cases, and describes the methods used to test these hypotheses. The chapter sections are: (1) hypotheses, (2) research design, (3) case selection, (3) case structure and contexts, (4) case research methodology, and (5) conclusions.

4.2 Research Questions and Hypotheses

The study’s three research questions are organized at the interaction (mico), process (meso), and infrastructure (macro) levels. As presented at the close of Chapter 2, this dissertation utilizes a multilevel social learning framework. At the interactions and process levels, three alternative theoretical lenses can be used to interpret the use of modeling tools in planning processes: social learning, social choice or negotiation, and structured coercion.

The social learning perspective was chosen for the first and second research questions. While this choice influences the construction of the hypotheses and measurement instruments, it does not mean the alternative perspectives cannot be detected. Specifically, the social choice perspective implies for little changes to participant views, and little reported learning, and little double-loop discussion. Similarly, structured coercion would result in comments in the open-ended survey question and observed frustration at the workshops. One way it might not be detectable is if participants develop a false consciousness, one of the results of the mechanisms of power described by McCullum (2004). In this study, the views of disadvantaged participants of a two and a half-day policy conference collected in focus groups shifted towards the topics preferred by the more advantaged participants during the event, only to revert to the previous concerns after the event ended. However the findings of this study should be qualified in two ways. First, it concerned a much shorter process, and longer processes may provide more opportunities for subaltern publics to resist elite coercion (Fraser 1997). The study also found
some evidence of this influence during the short event, suggesting these dynamics would be observable, if present.

The first research question concerns social learning that will be defined as self-reported learning at the interaction (micro) level.

**Q1: How do spatial PSS contribute to social learning in participatory workshops, in light of evolving technology and infrastructure?**

The hypotheses concern how the interaction design, or how the participants interact with the PSS and each other, influence the dependent variables *reported learning*. The following theories were used to construct these hypotheses. As discussed, Wenger’s theory of social learning (1998) provides a model of learning architectures which has not been empirically tested in planning. Embodied computation was discussed in the previous chapter, and novice participants refer to those who report not attending frequent planning meetings. They are assumed to have less familiarity with PSS, and the related vocabulary and topical knowledge of land use planning. As such, for normative and practical reasons they are an important sub-set of workshop participants to study. Finally, the well-known unrepresentative nature of participants may contribute to workshop learning (Beatley, Brower, and Lucy 1994). In particular, it is hypothesized that the participants will score highly on Jackson’s scale of the *sensation seeking* and *goal orientation* personality dimensions (O’Connor and Jackson 2008).

**Hypothesis 1.1**: Interaction designs that provide feedback through embodied computation that increases interaction with the PSS will result in higher *reported learning*.

**Hypothesis 1.2**: Participants self-reported experience of high levels of Wenger’s constructs (imagination, alignment, and engagement) in the workshops will be positively correlated with *reported learning*.

**Hypothesis 1.3**: Participant *reported learning* will be positively associated with planner identity and high levels of *sensation seeking* and *goal orientation*.

The second research question focuses on the relationship between the sociotechnical process design and a higher-level form of social learning, double loop learning. While the dependent variable is also measured from participants at specific workshops, the question and hypotheses concern the relationship between a different type of social learning than in Question 1. The independent variables here are related to the process and take place across longer time scales than the interactions that are the focus of the first question. These include issues such as participation and familiarity with the planning support tool.
Q2: What characteristics of the sociotechnical PSS facilitate single loop and double loop learning?

The sociotechnical process design encompasses the type of PSS and how it is developed. These are hypothesized to impact learning through the self-reported perception of several additional concepts from Wenger’s theory, namely reification, participation, and identification. Wenger (1998) argues artifacts like models can play a role in learning if they are designed using negotiability. This refers to the ability of participants to impact the contents of the model through participation, either the ingredients such as indicators or base data, or specific proposals developed within it. In his words, “the communicative ability of artifacts depends on how the work of negotiating meaning is distributed between reification and participation” (Wenger 1998: 64). Identification refers to participants’ belief that the artifact reflects their values. The process of negotiability is complicated by unpredictability in the planning process, and increasing modularity of GIS-based land use models and heterogeneous data sources. However, since PSS contain extensive constructs and representations, it is hypothesized in this case the relationship will be negative, although Wenger argues it is required for some degree. Put differently, it is more likely for meaning to be distributed more heavily on reification than participation in this context.

As described further below, double loop learning is operationalized through a scale measuring four characteristics of participant’s reported experience at the workshop: evidence seeking behavior, valid information, free and informed choice, internal commitment to choice. Finally, PSS are viewed by many as providing “facts” and “information” to the planning process, associated with Argyris and Schön’s concept of single-loop learning, not supporting open deliberation about priorities and values, associated with double loop learning. However, Argyris and Schön argue that achieving dialog with double loop characteristics (in their terms, a Model II “behavioral world”), “tends to lead to both single-loop and double-loop learning” (Argyris and Schon 1974: 92).

Hypothesis 2.1: Workshops participants will report high double-loop index scores when they report greater participation in the creation of the PSS, and greater identification with the PSS.

Hypothesis 2.2: Workshop participants will report greater scores on the double-loop index when they report less reification of the PSS.

Hypotheses 2.3: Workshops where participants report high double loop index will also report high reported learning.

Hypothesis 2.4: Workshops with higher view diversity will have higher reported learning and lower double loop index scores.
The third research question concerns the issue of infrastructure design. Researchers have documented the existence of specific forms of “civic capacity” to design and implement new initiatives in specific policy areas. Stone argued this capacity, unlike Putnam’s cross-sector social capital, is not easily transferred from one policy area to another (Stone 2001). A city with high civic capacity for education reform may not parlay this experience into transportation, for example. Briggs applied this concept to planning, still with a focus on social, not technical dimensions (Briggs 2008). Drawing on institutional theory, Healey further specifies this idea for planning contexts, arguing an “institutional capital” for planning encompassed three dimensions: knowledge resources, relational resources, and capacity for mobilization (Healey 1998).

As discussed in Chapter 2, this literature on institutions in planning is connected to broader theories of institutions in the social sciences. In particular, theorists argue that social learning is one means by which institutions, including their technical artifacts, are changed (Kim 2008; Kim 2011). In a related development in transportation, Gudmundsson (2011) argued transportation models should be viewed as a “knowledge technology.” This question is also related to the extensive literature on spatial data infrastructures (e.g. National Research Council 1993), however adopts a sociotechnical approach advocated by Evans and Ferreira (1995).

**Q3: How do metropolitan regions develop a sociotechnical infrastructure for social learning in spatial planning?**

While the above theories provide descriptive theories of the infrastructures of institutions and regions, they do not provide an account for how such infrastructures are developed or evolve. Two theories are introduced to do this. First, the theoretical model of the diffusion of innovations is applied to evidence of the spread of PSS in the U.S. (Rogers 2003). This theory provides a description of the characteristics of an innovation that influence their rate of adoption. However, analysis of data from one case where the PSS was not adopted illustrates the need for a more nuanced theoretical perspective. In Rogers’ theory, innovations are envisioned as discrete artifacts, so while diffusion is influenced by social context, innovations do not contain social ingredients themselves. For a theory to account for sociotechnical development, the concept of *frames* and *frame reflection* are introduced to explain the nature and means of PSS adoption (Schön and Rein 1994; Ernste 2012).

**Focus Question:** What explains the creation, adoption, and development of spatial PSS?
4.3 Research Design

A triangulation multilevel mixed methods case study design is used, a type of design in which different but complementary data are collected on the same topic at different levels of analysis (Creswell and Plano Clark 2007). At the micro and meso levels, a quasi-experimental design utilizing surveys and quantitatively measured variables was used to test the theory of social learning proposed by Wenger that predicts design characteristics will influence positively the social learning for participants at planning workshops. Concurrent with this data collection, the researcher collected observations, photos, and interviews. At the macro level, additional qualitative data is collected to explore the character of distinct learning infrastructures through a survey, focus groups, open-ended interviews, and document review. The reason for collecting both quantitative and qualitative data is to bring together the strengths of both forms of research.

While the study research design, especially the case selection and definition, is influenced by Yin (2009), as a hybrid mixed methods case study, case analysis is supplemented with other analysis methods. In particular, the hypotheses for the first two research questions are tested with field surveys and quantitative analysis, combined with qualitative analysis of observation, audio recording, photographs, and other data sources. The third research question, intended for interpretative research, is not accompanied with specific hypotheses. To answer this question, evidence from the cases as well as additional data sources is used for a theoretically guided qualitative analysis.

This research design was used to maximize the strengths of diverse research methods. First, cases are used because they are appropriate for the type of research questions, the unit of analysis, and the phenomenon of study. Yin argues case studies are most useful when “how” or “why” questions are being asked about contemporary events over which the investigator has little control. As described below, the study of real-world processes was important to ensure finding validity, and the questions are of an explanatory nature.

Second, Yin defines case studies as an empirical inquiry that investigates a contemporary phenomenon in depth, within its real-life context, while the nature of the phenomenon and its boundaries are not clearly evident (Yin 2009: 13, 18). The topic investigated here, spatial planning projects, do not have clear boundaries. They are complex, socially embedded practices that involve a variety of individuals and institutions. As such, they are well suited for case analysis, to ensure the assumptions about case boundaries and context are empirically valid. As explained below, after analyzing their structure, multiple demonstration
sites in Austin will be treated as the same project because of the similarities of the PSS and planning activities. These distinctions are made after data collection, the result of an analysis of the actors, PSS, and nature of planning activities in each setting. Given their diversity, spatial planning projects cannot be treated as equivalent without this case analysis.

Cases are also appropriate for research where the units of analysis vary, meaning generalization must be qualified after considering the specific context. Assumptions about whether the world is composed of units which can be easily compared, or which must be considered unique, relates to the idea of ontology, which Morgan argues separates various research paradigms (Morgan and Smircich 1980). If all planning projects are similar, then quantitative large-sample research with homogenizing assumptions is appropriate. However, if every case is distinct, there is no possibility for generalization. Case studies are a compromise on this dimension, seeking some generalization while remaining mindful of the importance of local distinctiveness in explaining processes and outcomes (Gerring 2004).

Finally, the use of innovative technologies argues for the use of cases. Following the logic of Seawright and Gerring (2008), the research design follows a purposeful case selection related to their suggestion for studying extreme cases selected for their unusual characteristics. Here, planning projects are selected that are unusual in their use of innovative tools and techniques. This innovation-minded case selection method seeks to contribute to both social theory and professional practice by attempting to learn from professionals and investigating the effects of new techniques, while also providing critical examination potentially useful to professional practice.

The use of specific empirical data collection and analysis techniques is described further below, but in general they are informed by McGrath’s concept of inevitable dilemmas of social research (McGrath 1981). While in principle some hypotheses could be tested in a laboratory setting, as McGrath observes experiments provide maximum measurement precision but sacrifice generalizability over actors, as well as the realism of the context. Given the variety and composition of participants in public workshops, and the hypothesized importance of unique intrapersonal and political dynamics not easily replicated in laboratory simulations, the study adopts field research methods. A survey was developed and deployed at seven workshops, facilitating within- and cross-case comparisons. Additional data sources, such as observation, photographs, interviews, and audio recordings are used to provide detail about the sociotechnical context the survey explores.
4.4 Case Selection

This section describes how the cases were selected. The first sub-section describes four dimensions used as criteria for the types of cases sought for the study, dictated by the theoretical framework, research questions, and hypotheses. The second sub-section describes the specific means used to identify and select cases.

4.4.1 Case Selection Criteria

The four dimensions used to define the types of cases used for empirical investigation were: (1) the nature of the planning activity and process structure, (2) regional planning context, (3) the nature of the spatial PSS, and (4) participant characteristics.

As defined previously, the specific framing theory used here for strategic spatial planning describes several features of planning: a long-term vision, long- and short-term actions (which can be bundled as planning “scenarios”), and participation. These products require a process that combines value, strategic, communicative, and instrumental rationality. The planning process is commonly structured around interrelated activities, and processes differ in their sequence and structure. Although the following steps may be organized sequentially, they can also be overlapping or iterative. Present conditions and trends are analyzed using existing data and participant knowledge, largely instrumental rationality. The general vision or goals are decided through communicative and value rationality. Actions and scenarios are designed and evaluated using all four forms of rationality. Underlying these stages are single- and double-loop learning processes.

In particular, these projects are characterized by a need to design regulations, a concern for local externalities, a deliberative process where conflicting preferences must be reconciled, and a topic where many stakeholders have ambivalent or vague preferences. Specific cases may deviate somewhat from this general model, or differ in their emphasis on different aspects. Diverse planning methods (such as different types of scenario planning) will not affect the study outcomes so long as they involve similar learning processes. In cases where the use of the PSS is oriented towards single-loop learning and instrumental rationality, and discussion of values is excluded, the usefulness for studying double loop learning is reduced. However so long as the design conditions are met, the anticipated outcomes are predicted to occur whether or not the project planners consciously intended it. This means, participants may engage in double loop dialog about values, whether or not project planners view this as a valid or important goal for the workshop.
Another dimension is the context, which has two components: the types of cities, and types of specific participants and planners involved in each case. As a socially embedded practice, planning is practiced in country, and place-specific ways (Sanyal 2005; Ernste 2012). This study will focus on U.S. metropolitan areas, which allows for some institutional variation while minimizing the more dramatic differences of planning cultures seen across national boundaries. Subsequent research is anticipated to develop a broader international perspective on the research questions. The case projects are led by regional planning agencies, which introduces somewhat different priorities than local participants. However, the geographic territory covered by various plans varies. However, in practice all projects have a local emphasis with planners introducing regional perspectives to some degree. The local-regional tension is a defining feature of regional planning, and can be viewed as a specific type of a more general pattern of difference among participants, or between planners and participants such as those identified by anthropological studies such as Tauxe (1995) or Peattie (1987).

The third dimension is the nature of the GIS tool and associated modeling system. The three functions of interest to this study are:

- **Interactive representation** of current contextual information or specific proposals in map or tabular form;
- **Rule extrapolation** to explore whether and how regulations will interact;
- **Indicator construction and calculation** to facilitate exploration of current conditions or compare actions or scenarios.

Based on existing practice, it was anticipated these will be present together, therefore the research will not be able to isolate the effect of each independently. In addition, the PSS may have other functions related both to the effect to these theorized functions, as well as the outcomes of interest. The cases selected use several distinct commercially available tools, and are customized by different planners with different data. The result is variation in the system interaction and process design.

The second part of project context is the characteristics of the participants. Argyris and Schön link an organization’s learning culture to individual behaviors (Argyris and Schön 1996). They also make a distinction between *espoused theory* (what people say) and *theory-in-action* (what people actually do) (Argyris and Schon 1974). These suggest the composition and behaviors of the participants will influence the observed learning outcomes. Specifically, Wenger argues identity is particularly important. Rogoff highlights culturally distinct learning styles despite generalizable elements to social learning (Rogoff 1990). Jackson argues learning styles
vary according to personality dimensions (Jackson 2011; O'Connor and Jackson 2008). Since planning participants are self-selected, they are not expected to be representative of the general population (Beatley, Brower, and Lucy 1994; Rich 1986; Redburn et al. 1980). This potentially limits the generalizability of the theoretical findings to the population at large. Measuring participant personality and demographics will allow this limitation to be examined. The composition of the participants is the most difficult to anticipate, since the backgrounds of participants is influenced by a host of exogenous variables, and the potential population participating in each case is heterogeneous. However, it suggests conclusions about the effects of different workshop designs, in particular, may vary according to the culturally-specific set of skills and models of guided participation available to participants.

In summary, the basic criteria used for case selection are as follows:

1. The cases should be spatial planning projects, involving the identification of a long-term vision, long- and short-term actions, and involve participation. The substantive focus of these activities should be the location and pattern of urban development and related transportation and other infrastructure and public facilities.

2. The cases should be within large U.S. metropolitan regions, which provides common institutional and cultural contexts while allowing for some variation. Within these regions, the cases are led by regional planning agencies. This is to allow the exploration of the third research question, on the development of infrastructure. This will result in a common context of regional planning for the studies.

3. The cases should involve a spatial PSS used for interactive representation, rule extrapolation, and indicator calculation with participants. Some variation in how the PSS is used is desired, as well as at least one case with otherwise similar planning goals, but no PSS.

4. Participant non-representativeness will limit generalization to the entire population, but not to the practically relevant universe of similar populations encountered in future planning projects. This may limit the ability to fully explore issues of ethnicity, race, and class, as they relate to the hypotheses.

4.4.2 Case Selection Procedure

In addition to theoretically-guided criteria, case selection was influenced by practical concerns of timing and access. In addition to the criteria above, the cases needed to hold public workshops between June 2012 and April 2013. Because of previous full-time employment, the author had personal relationships with managers at the MAPC, and the Boston case projects were selected in consultation with the staff based on the projects’ suitable timelines. One possible Boston project, a municipal master plan where a PSS was planned, was removed from the study when the existing town planner resigned and the project was delayed. The Boston
case led by the Boston Redevelopment Authority (BRA) arose serendipitously, through a former student of the author who was working at the BRA during an internship.

In order to identify additional cases, a snowball method was used to conduct a nationwide U.S. search. Exploratory emails and interviews were conducted with several leading planning consultants, which generated additional ideas for potential cases. In addition, a general solicitation was circulated on the email list of a professional organization comprised of PSS developers and users.\(^9\)

This outreach resulted in a number of possible cases. The Thrive 2055 project, a planning process for a large multi-state area centered on Chattanooga, Tennessee, did not hold workshops in the desired time. Similarly, Imagine Central Arkansas, a planning process covering a large region was also considered by eliminated because it did not involve in-person planning workshops. The Seattle-based group Decision Commons developed a technically distinctive PSS prototype, however funding limitations meant it was not deployed in the context of a planning project as anticipated. Through a professional contact at the Cambridge-based organization Consensus Building Institute, two possible projects were identified that involved spatial planning without PSS. Both concerned small scales and nonmetropolitan contexts, and one was abandoned due to workshop timing, and the other when the project committee declined to allow the survey to be given.\(^10\)

As described below, the Austin and Kansas City cases were developed through a series of conversations with professional planners and consultants involved in the projects. In particular, the resources and involvement of University of Texas probably contributed to the willingness of the Austin project managers to provide access to the project. The Kansas City case was challenged by the departure of two project managers at the regional planning agency halfway through the implementation of the corridor projects, however the replacement project manager was willing to continue the relationship.

4.5 Overview of Cases

This section contains a brief overview of the case structure and terminology, and a description of the case contexts.

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\(^9\) The Open Planning Tools Group, see Appendix E.

4.5.1 Case Terminology and Structure

As it involves embedded units of analysis, this study will use a specific terminology to refer to the cases and their sub-components. Cases refer to a particular geographic and institutional context. Each case contains one or more specific projects, which refers to spatial planning projects with discrete budgets, goals, and timelines. Finally, each project involves one or more workshops, open meetings with participants from the general public or project stakeholders. Workshops are sometimes also referred to by their project-specific names, such as planning charrette, public forum, or community meeting. As summarized in Figure 4.1, the two primary cases are in metropolitan Austin and Boston. Austin contains one project, with five demonstration sites. Four demonstration sites are used for this analysis. The project also included a demonstration site in the City of Austin, however this was excluded because it focused on urban design issues and did not involve a workshop during the study period. However, the same staff conducted the planning exercise in all four sites, and the PSS and meeting formats were highly similar. Therefore they will be considered one project. In Boston, although both projects were conducted by MAPC and some staff were involved in both; they have distinct purposes, goals, and involve different professional staff. In addition, the nature of the PSS that was used differed. Therefore, these are considered as separate projects.

Fig. 4.1 Overview of Cases, Projects, and Workshops
Finally, there are two secondary cases, which featured more limited data collection, which are used to focused on specific issues and provide comparison for the primary cases. The State Avenue project in Kansas City is funded by the Mid-America Regional Council’s Creating Sustainable Places project. Although other corridors under that project were considered, the planning activities and timelines did not match the case criteria. Finally, Upham’s Corner is part of the Fairmont-Indigo Planning Initiative. Managed by the Boston Redevelopment Authority and entirely contained within the City of Boston, it is considered as a secondary case distinct from the primary Boston case.

4.5.2 Sustainable Communities Program Funding

The Austin, Boston, and Kansas City cases were all substantially funded by grants issued by the U.S. Department of Housing and Urban Development (HUD) during the first round of the Sustainable Communities Regional Planning Grant program, issued in 2010. This program provided grants to support metropolitan and multijurisdictional planning, and is part of the Federal government’s Partnership for Sustainable Communities, an initiative launched in June 2009 by the Obama Administration. The first round of grants resulted in funding totally nearly $100 million to 45 cities, and a second round of grants were issued in 2011. The grants were awarded to regional consortia that HUD required include regional planning organizations or councils of governments. The consortium led by the Austin’s CAPCOG was awarded $3.7 million, the group led by Boston’s MAPC was awarded $4 million, and the Kansas City group led by MARC was awarded $4.25 (U.S. Department of Housing and Urban Development 2013).

Since these funds are used for a range of activities, the portion spent on the projects described here varies widely. The greatest share of the total project budget was spent on the Austin project. In Boston and Kansas City, a smaller portion was used for the projects described below. The Boston (BRA) case was not funded through this program. Despite the common funding source, which influenced the project design and scope, the case research uncovered no evidence of HUD staff providing specific guidance for specific planning projects or how PSS should be developed or deployed. However, the Sustainable Communities Program as a whole encouraged planners to adopt PSS, use indicators, and broadly apply sustainability principles, however in practice the researcher observed deference to local priorities.
4.5.3 Cartographic Representations as the Visual Language of Spatial Planning

Each case described below involves the use of representations, specifically cartographic representations, three-dimensional visualizations, and quantitative indicators. While the computer-based forms of representation will be discussed in the research, this chapter includes maps used by professionals to represent the boundaries and contexts of the projects. As Dühr has described, cartographic representations take on the role of a “visual language” in spatial planning, as maps “influence people’s conception of space, but dominant conceptions of space likewise influence the style of cartographic representations,” resulting in “mutual reinforcement.” However, their use for communication provides opportunity for multiple interpretations and distortions (Dühr 2007: 73). They therefore reflect understandings in these projects about spatial structure, boundaries, and concepts, and they were actively used on project websites, presentations, and meetings to convey meaning. How or whether they align with the perspectives of participants and stakeholders cannot be assumed.

4.5.4 Boston

The capital of Massachusetts, Metropolitan Boston serves as an economic hub for New England, and is the northern anchor of the Boston-Washington megalopolis. Although a region with a relatively slow-growing population, several factors are driving changes in the metropolitan region that create a need for spatial planning. Ongoing deindustrialization has resulted in economic recession in former mill towns such as Brockton, Lawrence, and Lowell, where low housing costs have attracted immigrants. Simultaneously, the state’s thriving high technology and medical sectors have resulted in job growth in specific areas, such as Cambridge’s Kendall Square and the Route 128 corridor. Finally, declining household sizes, an aging population, and changing preferences have meant increasing housing demand and population in Boston and the region’s inner core, as well as demand for age-restricted and cluster housing in suburban towns (Melnik 2011; Jacobi et al. 2010).

Like the rest of New England, Massachusetts has a strong tradition of municipal independence, and traditionally land use regulation has been very decentralized. However, state policy has created several exceptions. Under the state’s “anti-snob zoning” law, Chapter 40B, municipalities that do not have a housing stock that is 10% affordable may have their local zoning overturned for certain types of mixed-income developments (Fisher 2012). Similarly, Chapter 40R creates financial incentives for municipalities to adopt mixed-use, smart growth zoning districts. Other state programs provide funding for municipalities to identify priority
development and conservation areas (OEHED 2013). Although municipalities retain significant powers to regulate land use and manage local services, state and regional entities retain key roles in transportation investments and policymaking. In 2009, the state’s transportation agencies were merged into the Massachusetts Department of Transportation (MassDOT). Transportation planning in metropolitan Boston is coordinated by the Boston Metropolitan Planning Organization (MPO), which is composed of institutional members that include state agencies, municipalities, and MAPC. Thus while according to popular perception governance in metropolitan Boston is dominated by “local control” and the legal principle of home rule, in reality spatial planning involves power shared by a diverse set of stakeholders.¹¹

Regional spatial planning for Metropolitan Boston is the responsibility of MAPC, an independent state agency created as one of the state’s 13 regional planning agencies in 1963. MAPC’s state-designated regional boundary contains 101 municipalities (Figure 4.3). The agency possess limited regulatory powers, and conducts independent and contract planning projects, as well as programs in fields including public health, energy efficiency, and collective purchasing. While in some regions regional agencies are the federally-designated metropolitan planning organization, in Boston MAPC is one member of the MPO. The MPO employs a separate technical staff, the Central Transportation Planning Staff, housed in MassDOT. For practical purposes, MAPC further sub-divides the region into subregions, which hold regular meetings as well as sponsor joint planning activities (see Figure 4.3). In this regional context, this study includes one primary case and one secondary case, encompassing three projects, located within three distinct subregions: Marshfield is located in the South Shore, Boston in the Inner Core, and the North Suburban project concerns the entire North Suburban subregion.

In this metropolitan context, significant spatial planning generally takes place at two scales: by municipalities and by MAPC at region or subregional scales. Municipalities frequently complete local master plans, although these plans are not required by state law. In a review conducted by the author in Summer 2012, 73% of metropolitan Boston municipalities had completed master plans, although their contents and recency vary. Of these, 50% were less than 10 years old, but 27% of municipalities had no plan whatsoever. MAPC completed a regional plan in 2008 called MetroFuture (Figure 4.2). For this plan, MAPC created a CommunityViz model that was used to construct a specific growth scenario describing population, housing units at the Traffic Analysis Zone level. In addition, the plan contained a set

¹¹ In their analysis of municipal powers in Massachusetts, Barron, Frug and Su (2004) described the “myth of home rule.”
of policy goals and recommendations, as well as a map illustrating priority growth and preservation areas (Metropolitan Area Planning Council 2008, 2008).

Therefore the dissertation cases in metropolitan Boston are set in an institutional context where municipal land-use regulations are jealously guarded, and a regional agency seeks to promote regionalization of services, regional thinking, and a normative agenda for growth that emphasizes compact development, alternative transportation, and affordable housing. Metropolitan Boston also exhibits strong city-suburb divide along racial and economic lines, influencing the context for planning discussions. The region’s low-income and non-white population is concentrated in Boston and surrounding Inner Core municipalities; most suburbs are overwhelmingly white, with higher household incomes and rates of home ownership (Arcaya and Grogan 2011).

One effort to promote constructive dialog in this general context was the Community Preservation Initiative and related Executive Order 418, a state program that funded detailed GIS analysis of the existing municipal zoning codes across the state in the early 2000s. The vertically integrated initiative sought to encourage dialog between state, regional, and local decision-makers. A qualitative evaluation of the project found that while it resulted in improved information and broader engagement in land use planning, it did not significantly impact land use dialog between towns, or between regional agencies and towns (Hodges 2004). While some states have engaged in statewide spatial (or “growth management) planning, as described above Massachusetts has chosen to focus on specific “priority” areas and infrastructure investments, leaving detailed spatial planning to municipalities.

While taking place within this broader regional and institutional context, the cases in metropolitan Boston have modest links with regional planning. Marshfield, a site of one case, is not identified as a town targeted for growth by MetroFuture, although the project involved an effort to analyze existing zoning to support broad goals of MAPC to encourage greater housing diversity, affordable housing, and clustered development patterns. Similarly, the case set in the North Suburban Planning Council involved working closely with existing municipal priorities, with the goal of encourage cross-municipal discussion and coordination. This subregion, located at the intersection of two major highways served by a commuter rail station, is already the location of significant development such as a regional mall and offices, and was identified by MetroFuture as a targeted growth area (Figure 4.2).
Fig. 4.2 MetroFuture Growth and Preservation Areas. Map from Metropolitan Area Planning Council (2008).
Fig. 4.3 MAPC Region and its Subregions.
Map source Metropolitan Area Planning Council (2010).
The goal of the **North Suburban Priority Mapping Project** is to “promote dialog about land use issues that transcend municipal boundaries” to identify “areas where growth and development should be emphasized (priority development areas) as well as areas that should be preserved to protect natural resources and the character of each city and town (priority preservation areas)” as well as significant transportation and infrastructure investments (Metropolitan Area Planning Council 2012). This project involved collective information from each of the nine separate towns in the subregion about local priorities, conducting analysis, and organizing public forums. For illustrative photos of the project sites, see Figure 4.4, and for a map of the region containing the “priority sites” collected from the towns, see Figure 4.5.
Fig. 4.5 North Suburban Planning Council Local Priorities Map. Source: North Suburban Priority Mapping Project

North Suburban Planning Council Local Priorities Map

Priority Sites

Local Priorities:
- Development, Preservation, and Transportation Infrastructure
- Significant Transportation Improvement Areas
- Priority Development Areas
- Priority Development/Preservation Areas
- Priority Preservation Areas

Please refer to index sheet for project descriptions.

Legend:
- MSFC Town Boundaries
- Perennial Streams
- Winter Bodies

The information contained on this map is for planning purposes only. It is not suitable for legal boundary definition, regulatory interpretation, or parcel level analysis.

Produced by: MAPC Data Services
881 Temple Street, Suite 300, Boston, MA 02111 | 617-542-3778

Data Sources:
- Massachusetts Department of Transportation (MassDOT)
- U.S. Census Geographies
- Massachusetts Department of Environmental Protection (DEP)
- Metropolitan Area Planning Council (MAPC)

Nov 2013

North Suburban Planning Council
The project was modeled after the process used to create the 495/MetroWest Development Compact Plan, a plan created for 37 municipalities in Boston’s fast-growing western suburbs (The 495/MetroWest Development Regional Compact Study Interagency Coordinating Team 2012). The project entailed collected data, plans, and policy priorities from the municipalities in the project area, conducting data analysis. The two workshops described in this dissertation are the Regional Priorities Screening, where preliminary results of the data collection and analysis were shared with municipal staff, and a Public Forum, where the results and proposed criteria were presented to a broader audience of stakeholders.

The **Marshfield Buildout and Alternatives Future Project** is a joint project between MAPC and the town of Marshfield, a town in the South Shore subregion located in the extreme southeastern part of the region (Figure 4.3). Although not served by the region’s subway or commuter rail, the proximity to Boston via Route 3 and access to the ocean has sparked development pressures (Figures 4.6 and 4.7). In addition, the community has not reached its affordable housing threshold under the 40B legislation making it vulnerable to zoning overrides. This has sparked a broader discussion about the proper location and density of affordable housing in the town (Reardon 2011). In particular, in recent years developers have built age-restricted cluster housing near the highway, as well as a large complex including affordable housing, permitted under the 40B legislation (see Figure 4.6). In response to these changes, the municipality had begun planning to create a master plan.

![Illustrative Photos of Marshfield](image1)

**Fig. 4.6 Illustrative Photos of Marshfield:** *left,* Ocean Shores Apartments, age-restricted affordable housing permitted under the 40B legislation, photo © Waypoint Construction Consultants, used with permission; *right,* single-family homes facing the Atlantic along Ocean Avenue. Photo © Linda C. Seifried, used with permission.
In preparation, the town planner and housing coordinator commissioned an analysis from MAPC in order to “estimate potential future housing units and commercial development under current zoning” (Reardon 2011). The project also included analyzing the potential effect of making an inclusionary zoning bylaw mandatory, as well as testing other possible zoning changes. A low-lying coastal community, Marshfield has detailed wetlands and aquifer protection regulations, and the project attempts to estimate how the various regulations might interact (Figure 4.7).

Fig. 4.7 Marshfield Zoning Map. Map source: Town of Marshfield.
4.5.5 Austin

Located in the heart of Texas, Austin is simultaneously a state capital, high technology hub, and cultural center and self-proclaimed “live music capital of the world.” The city is economically linked with several other nearby large cities, San Antonio, Dallas, and Houston, in what the Regional Plan Association has dubbed the “Texas Triangle” megaregion (Seltzer and Carbonell 2011). Anchored by the University of Texas and the state capitol, Austin has seen rapid urban growth in the past three decades. Since the early success of University-affiliated high technology firms in the 1980s, the city’s technology cluster has driven rapid urban growth (Orum 1987; Engelking 1999).

Several initiatives characterize the recent planning history of the city and its surrounding region. The City of Austin has a turbulent history of development politics. After holding an elaborate process to create a comprehensive plan called “AustinPlan” in the early 1990s, the city council did not approve the document, meaning the city was without a comprehensive plan for nearly two decades. In the face of increasing development pressures, proliferating land use regulations, and controversy over new high-density development downtown, the city launched Imagine Austin in 2008 (Office of the City Auditor 2006). After another extensive process, the Imagine Austin Plan was adopted by the City Council in 2012. This plan features a set of concept maps detailing environmental resources, bicycle and pedestrian networks, transit networks, roadways, and an overall growth concept (City of Austin 2012). However, urban growth increasingly extends beyond the municipal boundaries into surrounding counties.

Austin is one of several metropolitan regions with two regional agencies. The Capital Area Council of Governments (CAPCOG) and Capital Area Metropolitan Planning Organization (CAMPO) are regional agencies responsible for land use and economic planning, and transportation planning, respectively. These organizations led Envision Central Texas, a regional visioning process that forms the basis of the CAMPO 2035 Long-Range Transportation Plan, and “envisions future regional growth being accommodated in a network of 37 mixed-use, mixed-income, walkable, connected and transit-supportive Activity Centers,” shown in Figure 4.8 (Capital Area Council of Governments 2012; Envision Central Texas 2004). CAPCOG led an effort to apply for a HUD Sustainable Communities Regional Planning Grant, which they were awarded in 2010.

The project funded by this grant is called the Sustainable Places Project. The consortium planned three strategies related to the activity centers: develop a sustainable places analytics tool, conduct demonstration projects as selected activity center sites, and conduct a
program of citizen engagement (Capital Area Council of Governments 2012). After securing the grant, CAPCOG identified the activity centers that would serve as demonstration sites, and selected sub-consultants through a request for proposals to conduct planning work for the demonstration projects. The winning team included Austin-based urban design firm McCann Adams Studio and public relations firm Hahn, Texas, and Portland-based Fregonese Associates. A research group at the University of Texas headed by Robert Paterson led the development of the analytical tool, in close collaboration with Fregonese Associates.

The five demonstration sites, selected by CAPCOG from among nine applicants, are Austin, Dripping Springs, Elgin, Hutto, and Lockhart. The projects used for the purposes of this dissertation are the four suburban sites, designated as metropolitan sub-centers by the regional plan (Figure 4.9). In each demonstration site, a preliminary “visioning workshop” was held to generate preliminary ideas and discuss a vision for future development. The workshops studied here, called “planning charrettes” feature a sketch planning exercise using the Envision Tomorrow PSS. The project timeline presented at the Lockhart Planning Charrette is shown below as Figure 4.8. The other demonstration sites contained the same sequence of meetings, only at slightly differing dates. The structure of all case projects will be discussed after each of the cases are introduced.

**Planning Process and Time Line**

![Image of project timeline](image)

Fig. 4.8 Austin project timeline presented at Lockhart Planning Charrette. All four sites had the same sequence of meetings and similar timelines.
Fig. 4.9 Centers Concept from CAMPO 2035 Long-Range Transportation Plan. Sustainable Places Project demonstration sites are indicated by arrows, clockwise from top, Hutto, Elgin, Lockhart, and Dripping Springs. Map from Capital Area MPO (2010).
There are several important institutional differences between Austin and Boston. First, because of differing annexation rules, in general municipal boundaries in Texas are much more elastic. The land in each of the demonstration sites falls within each municipal boundary, although as described below this issue is relevant for one demonstration site in particular, Dripping Springs. Similar to metropolitan Boston, the region has two regional planning agencies, one focusing on transportation (CAMPO) and one focusing on land use and economic issues (CAPCOG). Unlike in Massachusetts, the latter is a council of governments, not a regional planning agency, so it lacks MAPC’s modest statutory powers. The metropolitan region is politically diverse, including both people who are suspicious of all government regulation and activities, but also those with more positive views towards planning. The demonstration sites were required to demonstrate local interest and support for the project during the competitive selection process, so they most likely have more well-developed planning cultures and populations more interested in affirmative spatial planning than other parts of exurban Austin.

**Hutto**

Hutto is a small town in the northeastern exurbs of Austin with the motto “growing a quality community.” The demonstration site selected in Hutto includes a traditional downtown, but also vacant land that has been undergoing rapid development. Located adjacent the new State Highway 130 tollway, Hutto is experiencing the most rapid growth of the four demonstration sites, with new commercial and residential subdivisions visible throughout the town (Figure 4.11). The town had already adopted a form-based overlay zoning and architectural design standards for the “Old Town Hutto” district, the result of the Heart of Hutto Master Plan completed in 2009 (Gateway Planning Group 2009). In addition to residential growth, Temple College and the Texas State Technical College have both proposed new educational campuses in the city. Major issues included creating a holistic plan for this development, as well as creating more housing diversity. Adjacent to the highway, the town has designed a “Gateway Overlay District,” but does not have specific plans for the uses and design of this anticipated highway-adjacent development.

The demonstration site (Figure 4.10), designated by the municipality, includes Old Town Hutto, the Gateway Overlay District, two schools, and a large area containing both new subdivisions and vacant land. The city’s application observes the “housing supply adequately serves a specific market, but very few residences exist for those who cannot afford or simply do not desire a single-family home” (City of Hutto 2011). The application observes that residents for
higher-end homes also must relocate to adjacent cities. The proposal also described an interest in additional sidewalks and other bicycle and pedestrian connections between neighborhoods and the schools. Stakeholders include the Hutto Economic Development Corporation, which helped attract the new educational campuses. In addition, the stakeholder committee includes five residents, including two property owners. Notably excluded from the stakeholders committee is formal representation from neighborhood associations from the newly developed neighborhoods.

The participants in the planning charrette described in the following chapter supported the broad goal of improving transportation connectivity in the town, including east-west connections between the Old Town and future educational campuses. However, the potential for new roads generated concern from some residents of the existing neighborhood about whether the additional traffic would divide the neighborhood and post a safety hazard. This group discussed several possible measures, such as the location of paths exclusively for bicycle or pedestrian use and traffic calming measures.

Fig. 4.10 Hutto Demonstration Site Map. Old Town Hutto is located on the bottom right, and new residential subdivisions are visible in the center. The two campuses are planned for tracts of land at the extreme left, bordering State Highway 130. Map source Sustainable Places Project.
Elgin

Elgin developed in the late 19th Century around a railroad crossroads with the motto “perfectly situated.” Today, the town is adjacent to several highways, commuter bus routes, and the rail line is the route of a proposed commuter rail system for Austin under development. The historic town center is listed in the National Register of Historic Places and protected by a local historic preservation ordinance. The proximity to the railroad means the town has attracted
various industries, including sausage making and brick manufacturing. Today an operating cotton gin is located near the historic main street, and the downtown contains remnants of this industrial heritage (Figure 4.13). The city completed a master plan in 2009 that called for preserving agricultural uses and revitalizing the downtown (City of Elgin 2009). The proposed stakeholder group for this project included property owners, transportation and parks agencies, and representatives from local employers. The demonstration site (Figure 4.12) has a dumbbell shape and includes a portion of the downtown, as well as a parcel of city-owned land along the proposed route of the commuter rail system, where transit oriented development (TOD) is proposed. The specific planning issues involve planning this TOD site, as well as a design for a proposed park to be located on land adjacent to the railroad the city has acquired. Elgin has a well-developed planning and civic culture. The city launched the “Envision Elgin Community Development Strategy” in 2004, a planning process that contains annual implementation steps and updates, and active chamber of commerce, and other entities. In addition, the city completed a Parks, Recreation and Open Space Master Plan in 2011.

Fig. 4.12 Elgin Demonstration Site Map. Including historic downtown and city-owned parcel for potential transit-oriented development. Photo: Sustainable Places Project.
Comments collected at the visioning meeting from residents contained a variety of topics, including further developing tourist attractions, developing the former Union Pacific land into a park, mixed use development at the TOD site, and locations for urban agricultural and medical facilities (McCann Adams Studio 2012). Categories that had the most comments included parks and gathering spaces (13), improved bicycle and pedestrian access (9), and mixed-use development (7). However, the comments also included “No Agenda 21,” a reference to an activist group opposed to government planning activities. The role of this group at the workshop studied will be discussed in the following chapter.

Fig. 4.13 Illustrative Photos of Elgin, Texas: top, photo of Elgin main street; bottom, nonresidential buildings near historic downtown. Photo source the City of Elgin.
Dripping Springs

Known as the “Gateway to the Hill Country,” Dripping Springs has the most rural character of the four project sites. Located to the southwest of Austin, it is in the Texas Hill Country, a rolling landscape in central Texas known for rugged hills and unique culture that combines influences from Mexico as well as the European countries of origin of early migrants.

Described by CAMPO as a “Small Activity Center,” Dripping Springs is the least urbanized as the others, however as a “crossroads town,” there is a small traditional main street and several new commercial strip malls (Figure 4.14). The city’s project application anticipated a demonstration site centered the historic district, with three discrete rings: a core, a broader activity center, and a broader “planning influence zone” in order to integrate redevelopment and new development within one plan (City of Dripping Springs 2011). The actual demonstration site coincides with this anticipated area (4.16). Located at the terminus of Highway 290, Dripping Springs stands along a busy commuting corridor into Austin. The city adopted a comprehensive plan in 2010, as well as recent land development ordinances (2005), parks, recreation, and open space master plan (2008), and other regulations. The comprehensive plan focused on finding a balance between anticipated growth and rural character, but remained focused on the city limits, not the city’s extra-territorial jurisdiction (City of Dripping Springs 2010).

Dripping springs has an unusually extra-territorial jurisdiction (ETJ), a unique feature of municipal law in Texas and other U.S. states. Under this state law, residents of the area outside of the municipal boundary are subject to municipal regulations, but do not pay taxes and only vote for referenda that specifically effect them. The municipality has exclusive ability to annex these territories. The approval of several large residential projects in the ETJ by the City of Dripping Springs has angered neighbors who opposed them (Smith 2002). The city, with a population of 1,788, has an ETJ with a population estimated in 2010 to be 15,170. Recent development in and adjacent to the city includes a new Home Depot and supermarket, and several large residential developments in the planning stages (Mistretta 2007). This tension is evident in comments from a City of Dripping Springs Planning and Zoning Commissioner whose comments are included as an appendix to the comprehensive plan:

For all those residents in the ETJ and those in the [Dripping Springs] school district who feel they need to help direct the future of the City of Dripping Springs, there should be a minimal amount of attention paid. They may have many wonderful ideas about park

12 For more on this issue, see Frug, Ford and Barron (2010: 373-384) and Briffault (1996).
systems and other improvements but the bottom line is that they aren’t paying for it. (City of Dripping Springs 2010: 146)

In the visioning workshop, the discussion focused on how to accommodate the development of Dripping Springs as a sub-center without sacrificing its character. Popular categories for comments included improved roads (14), parks and gathering spaces (12), retail and restaurants (11), and improved pedestrian and bicycle facilities (10). Specific comments mentioned developing a mixed-use town center, new music venues, expanding the tax base, and creating a farmers market (McCann Adams Studio 2012). There were also varied comments about roads and traffic: descriptions of problem areas, the need for new roads, and comments about the need for slowing traffic speeds.

Fig. 4.14 Illustrative Photos of Dripping Springs, Texas: top, example of rural character within city limits; bottom, Mercer Street, location of historic buildings containing businesses. All photos from the City of Dripping Springs.
Mercer Street, a traditional commercial street, is visible at the center bottom. New suburban-type commercial development has occurred just outside the demonstration side boundary to the south of US 290. The two large building complexes at the bottom left are an elementary and high school that serve the area. Map source Sustainable Places Project.

Lockhart

The “Bar-b-que Capital of Texas,” Lockhart is a county seat with a well-defined urban core known for a cluster of popular restaurants. Like Hutto, the community is compact, surrounded by rural land, and has a well defined physical and civic identity (Figure 4.16). Located to the south of Austin, like Hutto, the city is served by State Highway 130, a newly completed toll road.

Two main issues dominate the planning discussion: how to plan for the anticipated development near the highway exit, and how to revitalize and redevelop the downtown area. In the past decades, retail has left the downtown, and now it is dominated by real estate, attorney, and other offices related to the county government. The city’s application to be included in the
project notes that the mayor had recently appointed a task force to focus on downtown development issues, noting that “in general, the vision is moving toward more diversity in land uses in central Lockhart, including higher density residential development.” In addition, the application and town residents participating in the workshops expressed interest in additional retail and entertainment businesses at the street level, and additional public realm improvements. From the city’s view, the missing component to implementing these ideas are detailed plans and implementation strategies this project could provide (City of Lockhart 2011). As a compromise between a downtown focus and the need to plan for highway-adjacent growth, the demonstration site (Figure 4.17) includes portions of downtown and land adjacent to the new highway exit.

Fig. 4.16 Illustrative Photos of Lockhart, Texas: top left, aerial view of downtown and surrounding neighborhoods; top right, historic neighborhood adjacent downtown; bottom left, downtown street; bottom right, downtown with county courthouse at right. Image: top right by author, remaining photos from the City of Lockhart.
The visioning workshop collected many comments related to downtown revitalization, including parks and gathering spaces (20), retail and restaurants (16), and improved pedestrian and bicycle access (13). Specific comments included “2,200 tourists – nothing to do,” “music & entertainment and night life” and specific ideas for new parks, pedestrian amenities, and trails (McCann Adams Studio 2013). No sharp differences were observed in the workshop.
discussions, although project participants had varied perspectives on what type of development would be desirable near the freeway, or whether all attention should be focused on the downtown.

4.5.6 Kansas City

Kansas City’s central geographic location in the U.S. has led to its development into a regional-serving city and national logistics crossroads, spurring the growth of a metropolitan region of roughly 2.3 million that straddles the border between Missouri and Kansas. Founded at the confluence of the Missouri and Kansas Rivers, near the center of the continental U.S., the city subsequently developed into a major hub for rail freight and air travel. The city has a diversified economy including automotive manufacturing, service firms, and corporate headquarters. However, the U.S. Federal Government is the single largest employer, and federal agencies with a significant presence in the city include the Internal Revenue Service, the Department of Energy, and the Social Security Administration. With a well-developed freeway network and few physical constraints on urban growth, the metropolitan area extends across an area nearly 7,952 square miles in two states. In comparison, Metropolitan Boston contains over double the population in a land area roughly 40% smaller. An association of city and county governments, the Mid-America Regional Council (MARC) serves as regional planning body and MPO.

Kansas City’s large size and context straddling two states has resulted in a fragmented region containing nine counties and 119 municipalities. Many of MARC’s activities focus on serving as a conduit for funding or administering public services, such as managing a regional 911 system or funding Head Start child development programs. Recent regional planning activities were linked with the process to create a federally-required long range transportation plan, which was approved in 2010 (Mid-America Regional Council 2010). The plan, called Transportation Outlook 2040, included a land use direction, which identified planned activity centers and transportation corridors, a 30-year forecast of population and employment, priority major investments in transportation infrastructure to serve the activity centers, and a set of performance “factors” (indicators) to measure progress. As described below, the identified corridors from this plan were adopted as the corridors for the Creating Sustainable Places project. For the corridor that serves as a case for this research, local jurisdictions plans also described the corridor as the preferred location for mixed-use development.

The modeling to create the plan’s growth scenarios was organized by MARC’s Technical Review Committee. Because the planners were “very nervous about telling property owners
what to do,” the group chose to create a model that would predict the likely location of future growth (Lenk 2013). The outputs from this analysis were then manually adjusted to create a scenario where more growth was concentrated in sub-centers. The MARC staff perceived a lack of political support for increasing the costs of greenfield development or creating a growth boundary, so the planning focus has been on attempting to steer growth through incentives and transportation infrastructure. Public involvement in this process was through public meetings and “60 or 70” presentations with various groups (Lenk 2013).

The Mid-American Regional Council led a consortium that won a HUD Regional Planning Grant, and used it to launch a Creating Sustainable Places project. This project was organized around plans and demonstration projects for six key corridors in Kansas City (Figure 4.19), the development of a decision support tool, as well as the creation of a set of indicators to track regional trends. Each corridor was bid out to a separate consulting team, and local stakeholder groups have tailored the focus of these projects further (Mid-America Regional Council 2012). Although the project documents described using PSS, only one of the corridors are implementing them in a workshop setting. However the workshops for this corridor, North Oak, occurred too late for inclusion in this dissertation.

The State Avenue Corridor project focuses on a corridor beginning in Kansas City, Kansas and extending to suburban areas. Although downtown Kansas City, Missouri has seen new residential development, there is limited market interest in Kansas City, Kansas or other close-in suburbs for new residential or commercial development. Therefore, the focus of this project is provide both site-specific development plans, as well as conducting a detailed economic feasibility analysis or redevelopment. The streets used to define each corridor is served by regional bus lines, and the region has launched a new bus rapid transit service called Metro Area Express, and enhanced bus service is planned for State Avenue and another corridor project not included in this study (Troost).

Downtown Kansas City, Missouri has seen an economic resurgence linked to residential growth, as well as investment in public facilities like the Sprint Center and the Kauffman Center for the Performing Arts. The city’s twin on the Kansas City is both much smaller and economically depressed, with many vacant storefronts visible along Minnesota Avenue, the main street. Wyandott County and Kansas City, Kansas share boundaries and a unified government, which completed a City-Wide Master Plan in 2008. The plan called for “walkability and access to transit should be a priority within all new development and redevelopment projects,” and
Fig. 4.18 Transportation Outlook 2040 Activity Centers & Planned Transit Corridors, from the “Land Use Direction” element (Mid-America Regional Council 2010). The State Avenue Corridor is contained in Wyandott County, at center left.
Fig. 4.19 Kansas City Creating Sustainable Places Project Focus Corridors. Map from MARC Creating Sustainable Places project.
identified the State Avenue Corridor as a location for new “mixed use” development (Figure 4.20).

### 4.5.7 Boston (BRA)

The final case is a project located within the city of Boston, managed by the Boston Redevelopment Agency (BRA). Created by the state legislature in 1957, the BRA is Boston’s planning and economic development authority, and has broad legal powers including urban planning, regulating large development projects, exercising eminent domain, and conducting economic development activities.

The **Fairmount-Indigo Planning Initiative** is a planning project in Boston with indirect involvement by MAPC. The project is being conducted by a consultant group led by The Cecil Group on behalf of the BRA. The project was sparked by planned transportation improvements along one of the city’s commuter rail routes. The rail corridor passes through low-income communities.
neighborhoods with relatively less transit access than the rest of the city. The project involves construction of at least four additional infill stations, as well as additional service frequency along the existing commuter rail tracks, shown in Figure 4.23. In anticipation of these changes, the BRA launched a study to “identify corridor wide opportunities for commercial and residential development, transit access, public realm enhancements, and community building initiatives” with the purpose of improving economic opportunity and resident quality of life (Boston Redevelopment Authority 2013). In addition to the corridor-wide study, a detailed plan is being created for **Upham’s Corner**, a neighborhood home to a commuter rail station which will see increased service. The case research focuses on this project, and in particular the “Upham’s Corner Visioning Forum” held in February 2013, which featured a paper-based planning exercise used to compare with workshops which involved PSS.

The project area includes a broad cross-section of Boston’s diverse neighborhoods, including large portions of Roxbury and Dorchester, the geographic heart of Boston’s African American community. The project area also includes multi-ethnic neighborhoods home to Irish-American, Cape Verdean, Asian, and other communities. The corridor is 54.3% African American, 14.8% white, and 18.8% Hispanic (Boston Redevelopment Authority 2013). While 23.9% of residents lives below the poverty level, this is only slightly higher than for Boston overall, and incomes are mixed, with many high- and low-income residents.

**Upham’s Corner**, the neighborhood centered on the intersection of Dudley Street and Columbia Road, is a commercial center and contains several historic sites including the Strand Theatre and the North Dorchester Burying Ground (Figure 4.21). In this context there are many stakeholders, including neighborhood associations, community-based organizations, community development corporations, elected officials, and others. However one group which has taken a large role in the planning process is the Dudley Street Neighborhood Initiative (DNSI), a longstanding community-based organization (Medoff and Sklar 1994).

![Fig. 4.21 Illustrative Photo of Upham’s Corner.](image)

Photo © George Hoffmann, used by permission.
Fig. 4.22 Fairmount Indigo Planning Initiative Study Area. Upham’s Corner is the third station from top. Station key: blue and green, newly constructed stations; orange, under consideration; hollow, existing commuter rail stations to receive enhanced service. Image from the Fairmount-Indigo Planning Initiative.

4.5.8 Planning Process Analysis

This section discusses the structure of the planning processes studied, summarized in Figure 4.23. Given the framing theory discussed in Chapter 2, it seems likely that the forms of rationality and therefore learning varies throughout the planning process, due to the...
chronological stage and also the planning context. The focus of this research design is on meetings at the middle of the planning process, where “what if?” questions are asked, and concrete spatial planning ideas are formulated and discussed. While earlier and subsequent meetings may be essential to the overall process, these middle workshops constitute the heart of the planning process and where theoretically we would expect to find the greatest intensity and diversity of learning taking place.

In Austin, the planning process for each demonstration site was conducted similarly, which ensures these factors are held constant. For each demonstration site, a local advisory committee was convened, and three workshops were planned. At the first, vision workshops, participants learned about the project goals and provided comments on provided maps. The next set of workshops, the “planning charrettes,” featured the planning exercises that are the focus of this research. Finally, open houses were planned for each demonstration site to present final plans, and the plans will be formally adopted at public meetings of official bodies.

In the Boston North Suburban Priority Mapping Project, professional planners held meetings with professional staff at each of the municipalities. Data was collected from the next two meetings. At the regional priorities screening meeting, participants were municipal staff who provided input on early criteria and analysis. At the public forum, the sites and proposed criteria were discussed among a group of broader stakeholders. The final results will be discussed at a planned subregion discussion, to be held during a regularly scheduled subregional meeting organized by MAPC. While open the public, municipal staff and elected and appointed officials are the primary audience at these meetings.

The Marshfield Buildout and Alternative Futures Project involved only the single workshop studied here. The only other meetings were private meetings between MAPC and the town planner to discuss the analysis details. The possibility of additional public meetings were discussed, however the municipality decided to wait until the broader master planning project to engage in broader participation.

The Kansas City State Avenue Corridor project involved two public workshops. At an earlier community meeting, stakeholders were briefed and the locations for priority notes were discussed. At the workshop included in the study, the proposed draft site plans were presented and discussed. This meeting deviated from the others the most, but it was not used to answer most hypotheses since the survey was not administered.

In Boston, the Upham’s Corner project involved an earlier community forum, and two subsequent meetings were planned to present and solicit comments on refined proposals.
4.6 Case Research Methodology

This section discusses the components to the case research methodology: (1) the field survey instrument, (2) workshop data collection protocol, and the (3) case data collection protocol.

4.6.1 Field Survey Instrument

A field survey was developed to collect several categories of variables: participant demographics, general views about urban growth, previous planning experience, self-identity, learning styles, and learning. In addition, it was used to record perceived presence of constructs about the workshop related to interaction and process design. The survey contained one optional open-ended question. The seven surveys are included as Appendix A. The remainder of this section describes how the variables were operationalized on this survey.
Variable Operationalization

Learning

Learning was measured in two ways. First, the survey included the question “I learned a great deal,” which was taken to measure factual learning, called reported learning. The question was asked on a bi-directional likert scale with extremes of “Strongly Agree” and “Strongly Disagree” and the central choice labeled “Neither Agree Nor Disagree.” This question is used widely in higher education research and course evaluation, dating back to at least 1971 when an it was found in a factor analysis to relate to the broader concept of student stimulation (Holmes 1971).

Chapter 2 described how Argyris and Schön’s concept of double loop learning can be operationalized to serve as a means of relating deliberation with the more abstract idea of communicative rationality. It was measured through five questions asked on the same likert scale as above, related to the “governing variables” for the Model II theory-in-use hypothesized by Argyris and Schön (Table 4.1).

<table>
<thead>
<tr>
<th>“Governing Variables” (Argyris and Schön 1996)</th>
<th>Variable Name</th>
<th>Question</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence seeking</td>
<td>Answer questions</td>
<td>• I was able to get answers to the questions I had.</td>
<td>Strongly Agree (5), Somewhat Agree (4), Neither Agree nor Disagree (3), Somewhat Disagree (2), Strongly Disagree (1)</td>
</tr>
<tr>
<td>Valid information</td>
<td>Open discussion</td>
<td>• Workshop participants discussed the issues in an open way.</td>
<td></td>
</tr>
<tr>
<td>Free and informed choice</td>
<td>Others listened</td>
<td>• Other participants at the workshop listened to what I had to say.</td>
<td></td>
</tr>
<tr>
<td>Free and informed choice</td>
<td>Alternative views</td>
<td>• Alternative viewpoints were considered.</td>
<td></td>
</tr>
<tr>
<td>Internal commitment to choice</td>
<td>Commitment to choice</td>
<td>• I would support recommendations created by the participants of this workshop.</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.1 Survey Instrument Double Loop Index.

The Likert scale was coded quantitatively, with “Strongly Agree” as 5, and “Strongly Disagree” as 1. Where valid responses were present from all five questions, these five questions were summed to create a double loop index, with possible values ranging from 5 to
25. Summated ratings scales constructed from multiple questions using Likert-type scales are used widely in the social sciences, since they have improved reliability, precision, and validity over single questions (Spector 1992). Scales allow researchers to measure constructs precisely, and reduce the impact of the inevitable errors associated with each question caused by respondents misreading or misinterpreting questions, poor wording, or other sources of item response error. In this case, a scale was especially appropriate because theory argued the central construct (Model II behavior) should be associated with diverse “variables,” which on their face may be only appear loosely related.

The traditional measure of the internal consistency of a scale used widely in social research is the Cronbach alpha coefficient, which is a direct function of the number of items and their intercorrelation. The coefficient takes values between 0 and 1, and higher values correspond with higher internal consistency. A widely accepted rule of thumb for internal consistency is a value of at least 0.70 (Nunnally 1978). When computed for the 175 survey observations from all workshops where complete responses were available from all five scale items, the double loop index has a Cronbach alpha scale reliability coefficient of 0.82. When computed for the 100 survey responses collected at the four Austin workshops, the Cronbach alpha coefficient is 0.86.

Learning Styles

Jackson has developed a Learning Styles Profiler instrument that has been used in several studies on the relationship of personality and learning (Jackson 2005; Jackson 2008, 2009; Jackson 2011). The original instrument was obtained from Jackson, which contains 75 questions, 15 on each of five dimensions. Two questions each were selected from the scales for sensation seeking and goal orientation, seeking the most distinctly worked among the two (Table 4.2). Following this instrument, these questions are scored on the following scale, from the instrument: true (2), false (0), and can’t decide (1). The scores for the responses from the

\[ \alpha = \frac{k}{k-1} \times \frac{s_T^2 - \sum s_i^2}{s_T^2} \]

where \( k \) is the number of items (questions) in the scale, \( s_T^2 \) is the total variance of the sum of the items (here, the index), and \( s_i^2 \) is the variance of an individual item. Its use is explained further in Cronbach (1951), Nunnally (1978), and Spector (1992).

In all cases, missing data are encoded as null. The summative or derived scales double loop index, sensation seeking, goal orientation, and view diversity were only constructed where valid responses for each scale item were present.

13 Cronbach’s Coefficient alpha is given by

14 In all cases, missing data are encoded as null. The summative or derived scales double loop index, sensation seeking, goal orientation, and view diversity were only constructed where valid responses for each scale item were present.
two questions for each dimension were summed to create the variables *sensation seeking* and *goal orientation*. These variables have possible values ranging from 0 to 4. In the analysis, the responses to these questions are compared with the population distribution of these personality dimensions.

<table>
<thead>
<tr>
<th>Constructs/Variable Name</th>
<th>Questions¹</th>
<th>Scale¹</th>
</tr>
</thead>
</table>
| Sensation Seeking        | • I like to do things that are new and different.  
• I have new ideas all the time. | True (2), False (0), Can’t Decide (1) |
| Goal Orientation         | • Experience suggests I achieve hard goals.  
• I am often one of the first to come up with a possible solution to a problem. | |

¹Questions and scale after Jackson (2005).

Table 4.2 Survey Personality Questions

General Views

The survey included several questions focusing on general views about urban development for two reasons: first, to use to gauge within-workshop shifts in views, and second, to use to construct a measure of ideological diversity for cross-workshop analysis. The questions were selected from among those used by Beatley in a study of the view representation of participants in a comprehensive planning process, in Austin, Texas in 1989 (Beatley, Brower, and Lucy 1994). The questions selected covered topics thought likely to be covered by the planning projects studied, including the need for planning, location of high density development, importance of jobs, need for affordable housing, and importance of historic preservation (Table 4.3). During pre-testing the questions were revised to provide greater clarity and eliminate double-barreled wording.

Two of the original questions were removed at the request of project planners as a condition of implementing them at workshops. A question on property rights was removed because the staff in Austin wanted to avoid the subject, which they felt was politically charged. The question on historic preservation was removed from the North Suburban Planning Council at the request of the project manager. The mean standard deviation of the responses was used to construct a *view diversity index*.

¹ These constructs arise in the psychology literature, for example on *sensation seeking* see Zuckerman (1979), and on *goal orientation* see Locke and Latham (1990).
Table 4.3 Survey View Questions

Planning Support System Questions

A database was constructed containing survey questions from eight studies which used a survey to evaluate participatory GIS or other computer models used in planning and policy (Arciniegas, Janssen, and Rietveld 2012; Jones et al. 2009; Salter et al. 2009; Smith et al. 2012; Nyerges and Aguirre 2011; Schively 2007; Van den Belt 2004; Cockerill, Tidwell, and Passell 2004). Although these studies were theorized in diverse ways, among the 128 questions, some referred to constructs from this study. Eight were used as the basis for the development of the questions for the study model constructs: engagement, envisioning, alignment, identification, participation, and reification (Table 4.5).

Other Workshop Questions and Demographic Variables

The database of similar studies was also used to create several additional questions concerning the workshop in general (Table 4.4). In addition, the survey included demographic questions about community participation, length of residence, age, sex, education, and previous meeting attendance (Table 4.6).

Table 4.4 Other Survey Workshop Questions

<table>
<thead>
<tr>
<th>Construct</th>
<th>Variable Name</th>
<th>Question</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>Shared views</td>
<td>I was able to share my views and opinions with others.</td>
<td>Strongly Agree (5), Somewhat Agree (4), Neither Agree nor Disagree (3), Somewhat Disagree (2), Strongly Disagree (1)</td>
</tr>
<tr>
<td>Imagination</td>
<td>Creativity</td>
<td>The workshop encouraged creativity and new ideas among participants.</td>
<td></td>
</tr>
<tr>
<td>Alignment</td>
<td>Others perspectives</td>
<td>The workshop helped me to get to know the perspectives of the other participants.</td>
<td></td>
</tr>
<tr>
<td>Construct</td>
<td>Variable Name</td>
<td>Question¹</td>
<td>Scale</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Identification</td>
<td>Unique issues</td>
<td>The computer tool reflects my unique issues and concerns.</td>
<td>Strongly Agree (5), Somewhat Agree (4), Neither Agree nor Disagree (3), Somewhat Disagree (2), Strongly Disagree (1)</td>
</tr>
<tr>
<td>Identification</td>
<td>Influenced design</td>
<td>I influenced the design of the computer tool.²</td>
<td></td>
</tr>
<tr>
<td>Identification</td>
<td>Tool familiarity</td>
<td>I am familiar with the terms and concepts used in the computer tool.</td>
<td></td>
</tr>
<tr>
<td>Imagination</td>
<td>Ability to imagine</td>
<td>The computer tool improved my ability to imagine what urban development might happen.</td>
<td></td>
</tr>
<tr>
<td>Imagination</td>
<td>Changed perception</td>
<td>What I learned from the computer tool changed what I thought could happen in my community.</td>
<td></td>
</tr>
<tr>
<td>Alignment</td>
<td>Group discussion</td>
<td>The computer tool improved the group’s ability to identify areas of agreement and disagreement³</td>
<td></td>
</tr>
<tr>
<td>Reification  (reverse)</td>
<td>Question outputs</td>
<td>Workshop participants felt free to question the outputs from the computer tool.</td>
<td></td>
</tr>
<tr>
<td>Negotiation</td>
<td>Adjust policy</td>
<td>The computer tool is useful for making adjustments to current policies.</td>
<td></td>
</tr>
</tbody>
</table>

¹ Question wording varied slightly, for example the cases without a PSS referred to “materials”. See Appendix A for full survey instruments.
² Similar to questions used by Van den Belt (2004)
³ Similar to questions from Van den Belt (2004) and Salter (2009)

Table 4.5 Survey Planning Support System Questions

Survey Development

The layout and structure of the survey was designed using guidelines from Dillman, including formatting the response choices in smaller fonts than the question text, use of a consistent question alignment on the page to minimize confusion, and avoiding subordinating language in the verbal and written instructions, among other steps (Dillman, Smyth, and Christian 2009). A pre-test was conducted with a total of 19 respondents, including staff from one case agency (MAPC), university faculty and staff, graduate students, and the researcher’s friends and family. The pre-test resulted in clarifications and improvements to most questions.
### Variable Name | Question | Scale
--- | --- | ---
**Planner Identity** | To what extent do you agree with the statement: “I play an active role in the planning of the community where I live.” | Strongly Agree (5)  
Somewhat Agree (4)  
Neither Agree nor Disagree (3)  
Somewhat Disagree (2)  
Strongly Disagree (1)  

**Meeting Attendance** | In the last ten years, how many public meetings have you attended, here or elsewhere, about urban planning (development, transportation, land use, etc)? | None (1)  
Less than 1 per year (2)  
1-2 per year (3)  
3-5 per year (4)  
5-12 per year (5)  
More than 12 per year (6)  

**Length of residence** | How long have you been a resident of (various wording)? (Years) | Open Response (integer)  

**Sex** | What is your sex? | Male (0), Female (1)  

**Age** | What is your age? (Years) | Open Responses (integer)  

**Education** | What is the highest level of education you have completed?  
[1] | Some high school (1)  
High school/GED (2)  
Some college (3)  
Associate or bachelors degree (4)  
Graduate or professional degree (5)  

**Hispanic Ethnicity** | Are you of Hispanic, Latino, or Spanish origin?  
[1] | Yes (1), No (0)  

**Race** | What is your race? Mark one or more boxes.  
[1] | White  
Black or African American  
American Indian or Alaska Native  
Asian  
Native Hawaiian or Other Pacific Islander  
Some other race:  


---

### Table 4.6 Survey Demographic Questions

**4.6.2 Workshop Data Collection Protocol**

The dissertation reports the results of nine planning workshops, where data was collected through a variety of techniques (Table 4.7). The survey was given at the conclusion of the seven workshops, with the exception of the first North Suburban Planning Council where a pre- and post-survey was conducted. Originally a pre and post-survey was anticipated for all workshops, but the project staff did not allow this design due to the time requirements. For Marshfield, the survey instrument was not yet prepared, and in the State Avenue project in Kansas City, the planning staff denied the request to distribute the survey. Project staff in the Boston/BRA case originally declined to allow the survey to be distributed at the workshop, but
were subsequently convinced to allow the researcher to distribute it to attendees by email. As a consequence, the coverage for this workshop is lower than the other workshops.

<table>
<thead>
<tr>
<th>Case</th>
<th>Project</th>
<th>Survey Responses</th>
<th>Survey Coverage</th>
<th>In-Person Observation</th>
<th>Photos</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austin</td>
<td>Hutto</td>
<td>17</td>
<td>95%</td>
<td>✓</td>
<td>109²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elgin</td>
<td>14</td>
<td>85%¹</td>
<td>✓</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dripping Springs</td>
<td>45</td>
<td>90%¹</td>
<td>✓</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lockhart</td>
<td>31</td>
<td>95%¹</td>
<td>✓</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Boston</td>
<td>NSPC #1</td>
<td>12/10</td>
<td>N/A</td>
<td></td>
<td>3²</td>
<td>Pre/Post Survey</td>
</tr>
<tr>
<td></td>
<td>NSPC #2</td>
<td>47</td>
<td>N/A</td>
<td></td>
<td>72²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marshfield</td>
<td>No survey</td>
<td>N/A</td>
<td>✓</td>
<td>4</td>
<td>Audio Recording</td>
</tr>
<tr>
<td>Secondary Cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kansas City</td>
<td>State Ave</td>
<td>No survey</td>
<td>N/A</td>
<td>✓</td>
<td></td>
<td>Audio Recording</td>
</tr>
<tr>
<td>Boston/BRA</td>
<td>Upham’s</td>
<td>22</td>
<td>26.8%</td>
<td>✓</td>
<td>20</td>
<td>Email Survey</td>
</tr>
</tbody>
</table>

¹ Estimated based on observed participants departing before completing the survey, official sign-in sheets for the Austin project were not available.
² Includes non-researcher photos.

| Table 4.7 Workshop Data Collection Summary |

After attending the Hutto and Elgin workshop and the importance of the model facilitators emerged, a short follow-up survey was implemented in order to complement the data collected from observations. The following questions were sent to digitizers after the Dripping Springs and Lockhart workshops:

1. Did you report back indicators to the group during the workshop exercise? If so, can you briefly describe:
   - How many times you were called in to report in?
   - What did you tell the group?
   - How did the group react to the information you provided?

2. Did participants ask you any other questions about [Envision Tomorrow], such as a reminder of what a chip represented, how it worked, etc? I am also interested if they did not seem interested or engage in the tool, and why you think that might be.

3. Did anything else occur at your table related to the exercise and [Envision Tomorrow] that you found interesting?

Data collected from this survey is used in the discussions in Chapter 6, as well as to help characterize the interaction design.
As a mixed-methods study, in-person observation and data collection provided valuable evidence that was used to triangulate the survey results, as well as provide additional qualitative evidence used to describe the workshop interaction design. The research protocol used at all workshops indicated in Table 4.7 was as follows. First, the researcher documented the meeting space by taking photographs before the start of the meeting, and collected copies of all handouts being distributed to participants. During the workshop exercise, at the Austin workshops the researcher divided time among the multiple discussion groups, taking several photographs of each group, and making notes of the discussion. The observation was focused on (1) the nature of the discussion, including the nature of side-conversations and interactions between the participations, (2) confirming participants received the feedback from the PSS (if present), and (3) any evidence of dissatisfaction with the workshop. The Marshfield and Kansas City State Avenue workshops did not involve break-out groups. At the Upham’s Corner workshop, the researcher stayed with one group, serving as a note taker.

### 4.6.3 Case Data Collection Protocol

Finally, to provide data for the case analysis and provide context for the study, additional data was collected including project documents, interviews, and participating in project meetings. A summary of interviews and meetings participated in for each case is enclosed in Appendix B. In addition, the researcher was able to review all internal electronic project files for the North Suburban Planning Council and Marshfield projects, as well as internal files shared on a website for collaboration between the consultants and various agencies for the Austin Sustainable Places Project.

### 4.6.4 Additional Data Source

As part of a project related to the Marshfield Buildout and Alternatives Future Project, MAPC hosted two focus groups with municipal planning staff and consultants experienced in municipal planning to discuss a proposed “scenario modeling platform” to be used for local planning activities. The groups included a purposeful convenience sample of municipal employees and consultants known for their use of, or interest in, PSS. These meetings were semi-structured discussions of the specific structure, functions, and features of a future tool, and thus presented a good opportunity to analyze the frames of professional planners. The meetings were facilitated by MAPC staff, but the focus group protocol was designed in consultation with the researcher. Consent was obtained from all participants to use the results for research
purposes. A textual analysis is completed on transcripts made of audio recordings made at these meetings.

4.7 Conclusion

This chapter has described the study hypotheses, case selection and structure, a brief description of case contexts, and the case research methodology. As a hybrid mixed methods case study, the primary data collection and analysis technique is a field survey and quantitative analysis. However, these results are contextualized within cases, and additional data collection methods are used to provide construct validity, probe for evidence supporting alternative theoretical perspectives, and triangulate the results. Given the trade-offs inevitable in social research, this study has chosen to maximize context realism, since theory argued this was required due to the importance of power, and participant characteristics that would be difficult to replicate in a laboratory experiment. However as a consequence, the study encountered field research challenges, such as limited survey access, which was partly mitigated by collecting data from a variety of workshops and cases. The next section reports the study results.
Chapter 5

Results

5.1 Overview

This section reports the research results. First, the data and results are reported for each hypothesis at the interaction and process levels. Second, two theoretical perspectives, diffusion and framing, are applied to analyze evidence related to the last research question.

5.2 Hypothesis 1.1 Interaction Design

5.2.1 Introduction

Hypothesis 1.1: Interaction designs that provide feedback through embodied computation that increases interaction with the PSS will result in higher reported learning.

The first research question focused on the relationship between interaction design and reported learning. The section proceeds as follows. First, to test hypotheses 1.1, the interaction design for each workshop is described based on analysis of observations, photos, and interviews. These designs are presented as schematic diagrams, which are analyzed for the extent to which they reflect a design principles espoused by the embodied computation paradigm. Finally, the designs and aggregate reported factual learning of participants at each workshop are compared to answer the hypothesis. Hypothesis 1.2 seeks to add theoretical detail by applying Wenger’s theory of the three infrastructures of learning. To test this hypothesis, a regression analysis is used to analyze the Austin case, which used an embodied interaction design at four workshops. Finally, hypothesis 1.3 explores the extent to which the reported learning can be explained by characteristics of the participants themselves, in particular, two dimensions of personality: sensation seeking and goal orientation. This hypothesis is answered by exploring the regression analysis presented in hypothesis two, as well as data from the seven workshops where a survey was conducted.
This section reviews the interaction design used at each workshop. Each section contains a brief narrative description, illustrative photos from presentations given at the workshops, as well as photos of the workshops in progress.

5.2.2 Austin Sustainable Places Project

All four workshops in Austin shared a similar consulting team and planning approach, however differences in venue and self-conscious adjustments introduced minor variation in the interaction design among the four workshops studied. This section first describes the general approach used, and then briefly describes how each workshop differed. Although the focus here is on interaction design, unique features that effected the overall workshop context is noted, such as the presence of a vocal activist group.

The workshop was divided into an orientation presentation, table exercise, and report-out. The orientation presentation, contained 50 slides, and included a project overview, summary of results from keypad polling from the previous workshop, themes that emerged from the previous workshop, an overview of the planning exercise and development type chips, and a description of how the results from the workshop tables would be used. The presentation concluded with a short animation illustrating a 3D rendering of a hypothetical redevelopment as an example of what could be done with the final plans (Figure 5.2). Two handouts were provided to participants: (1) an “explanatory handout” featuring project overview and themes from the first workshop, and (2) a key to the development types.

The photos and diagram below illustrate the general interaction design of the PSS during the table exercise in the Austin workshops (Figure 5.1 and 5.3). The meeting attendees are divided into tables with roughly ten participants at each table. Each table has a facilitator and a digitizer, who operates a laptop running the PSS software. Group participants are provided with stickers, or chips, that correspond to development types presented earlier. In the PSS, the development types have a set of quantitative attributes, as well as the land uses that they contain. These land uses, in turn, have quantitative attributes. As the participants place the chips on the map, a digitizer enters them into the PSS, which then computes a set of indicators that describes the “scenario” they have designed. The digitizer is then responsible for reporting the indicators back to the group.

The four quantitative indicators used at all four workshops were population, jobs-housing balance, housing balance (represented as mix of housing types), and fiscal impact revenue/cost ratio. Each indicator was introduced during the orientation presentation. The first three were
computed from the attributes of the development type chips. The fiscal impact was estimated using these attributes in a spreadsheet model tailored for each of the four demonstration sites by the project team members at the University of Texas, Austin. The land use pattern created by each table was referred to as a “scenario.” The PSS contained values for these four indicators from a “trend” forecast created in a previous planning project. These values were created for the Capital Area Metropolitan Planning Organization’s 2035 Regional Transportation Plan.

The paper base map used for the exercises contained several GIS layers presented on top of a color aerial photograph. These included wetlands, parcels likely to change obtained from local planning staff and stakeholders, and key landmarks. In addition, proposed roads, off-road trails, and other changes from existing plans were represented on the map. The participants were also encouraged to annotate the maps with notes and other information that was retained and used by the planners to generate the composite plans.

This overall design differed slightly at the workshops in the following ways:

The Hutto workshop was held on November 8, 2012 and featured large, square tables in a school auditorium. The first workshop, the principle of the consulting planning firm attended, personally conducting a report-out during the meeting. One group of participants in particular
attend with a specific fear about traffic along a proposed connector street would divide their residential neighborhood.

The Elgin workshop as held on November 29, 2012, in a large school gym. The tables were round, and the site also included two separate parcels, one in the town’s historic core and the other on a large tract of land purchased by the municipality. The meeting also featured attendance by a group of Agenda 21 activists. These grassroots groups of conservative activists have appeared in urban planning meetings in several states (Norton, forthcoming). They distributed a flyer that described planning as related to a United Nations conspiracy (Appendix D). These members interrupted the orientation presentation with several questions, and were involved in some table-level arguments at the beginning of the exercise, before withdrawing. During the majority of the planning exercise, this group sat separately in the meeting room. By the end, most had left except for a small group. The police officer present asked one of the attendees to leave. Their attendance had the effect of creating a much more tense tone than in the other workshops, and partly as a consequence of this distraction, the facilitators and digitizers did not emphasize reporting out the tool’s findings.

The Dripping Springs workshop was held on January 17, 2013 in a large school gym. This workshop was the largest, with 45 survey respondents. Because of the lack of feedback from the Elgin Workshop, the digitizers reported reporting back the indicators twice from most tables.

The Lockhart workshop was held on January 31, 2013, in in a function hall near the town center. The county seat with a clearly defined downtown, the workshop was dominated by discussions for how to reinforce downtown through place making strategies, as well as how to accommodate the growth that was anticipated as a result of the new toll road that has recently opened adjacent the town center. As in Dripping Springs, the facilitators ensured indicators were reported out at least once during the planning exercise, and at the concluding group reports.
Fig. 5.2 Illustrative slides from Austin workshop introductory presentations introducing; *left*, a development type; *right*, an idea from a previous workshop.

Fig. 5.3 Photos of Austin Sustainable Places Project workshop exercises: *a*, Hutto; *b*, Elgin; *c*, Dripping Springs, *d*, Lockhart.
5.2.3 Boston North Suburban Priority Mapping Project

This project contained two workshops. The first Regional Priorities Screening workshop was held on February 13, 2013 in a conference room in a municipal office (Figure 5.5). The attendees saw a five-slide orientation presentation about employment growth and demographic changes in the subregion. The remainder of the time was spent investigating spatial data and indicators that had been pre-calculated in CommunityViz. The meeting was led by a presenter/facilitator, with assistance from a computer operator. The project manager attended and served as a secondary facilitator.

The second workshop for this project was held on March 27, 2013 (Figure 5.6). The three stated goals of this meeting were to (1) develop a shared understanding of the process to identify local and municipal priorities, (2) develop a shared understanding of the criteria for evaluating local priorities to identify regionally significant priority areas, and (3) collect feedback on additional criteria to be considered and how certain criteria should be weighted when screening different types of priority development areas.

The meeting was divided into an introductory period and a table discussion. The introductory presentation included the following elements: a discussion of the state policy context, overview of project context, and keypad polling questions. The introduction took about 40 minutes, and the table discussions took about 50 minutes. The closing report-out took about 30 minutes. Participants were asked to review an “atlas” of seven maps showing the town-identified priority development and preservation areas. These maps show data from the summary criteria: travel choices, walkable communities, open spaces, healthy watersheds, current assets, growth potential, and preservation. Each one of these showed the priority areas
categorized into low, medium low, medium high, and high, as well as containing the spatial information for the underlying indicators.

Participants were then asked during a table exercise to complete a worksheet containing weights for the different indicators for two development types: multifamily housing, and office/medical. The facilitator then collected the scores from each of the table participants on a central worksheet, recording any notes (Figure 5.7).

Fig. 5.5 Images from North Shore Priority Mapping Project Regional Priorities Screening: top, photo taken after conclusion of meeting; bottom, screen image of CommunityViz PSS used interactively by the meeting. Images by Bill Wang, MAPC.
Fig. 5.6 Illustrative images from North Suburban Priority Mapping Project Public forum; bottom right, example atlas map. Images by MAPC staff.

Fig. 5.7 North Suburban Priority Mapping Project Public Forum Exercise Interaction Design
5.2.4 Boston Marshfield Buildout and Alternative Futures Project

The Marshfield project involved one workshop, held on May 14, 2012, in a meeting room in the town hall (Figure 5.9). At this workshop, the results of an analysis were presented, and a discussion was held with members of the town’s Planning Board and Housing Partnership. The results were projected onto a vertical screen. The meeting included a 14-slide presentation, composed mostly of maps illustrating various features of the town, including current housing stock, recent development, subsidized housing, and land value. After the slide presentation, the results of the analysis were presented from a laptop using ArcMap and CommunityViz software (Figure 5.8). The meeting presenter served as the primary speaker and facilitator, and the operator responded to requests to display different types of information. The attendees included the following groups:

- **Municipal employees** – Included a full-time professional town planner, and an administrative employee who took notes.
- **Planning board members** – Citizens who have been appointed to the planning board, a public board charged with reviewing proposals and overseeing other planning activities.
- **Housing partnership members** – Also citizens, a town committee charged with overseeing affordable housing.
- **Citizens** – Several citizens attended the meeting, which was a publically announced regular meeting of the two committees.
- **MAPC Staff** – Included the presenter/facilitator, one operator, and one planner who observed. Only the presenter/facilitator spoke.

The event featured a presentation by the presenter/facilitator, with some questions from the audience. There was no exercise or designated open discussion period, however some limited discussion occurred in response to questions.

![Fig. 5.8 Marshfield Planning Board Presentation Interaction Design.](image)
Fig. 5.9 Marshfield Planning Board Presentation: top, meeting attendees and layout; bottom left, example slide from presentation, bottom right, results map presented to attendees.
5.2.5 Kansas City Sustainable Places Project

The Kansas City case includes multiple corridor projects, only one of which is included here due to project timing.

The State Avenue Corridor Third Community Meeting was held on April 3, 2013 at the Kansas City Chamber of Commerce (Figure 5.11). The stated purpose of the workshop was to share preliminary results of the analysis that had been conducted by a consulting team. A brief keypad polling exercise was held, but the meeting was composed of several speakers presenting a 44-slide presentation, and taking some questions from the audience. The meeting had approximately 22 total attendees, and they included municipal employees, an employee from a nonprofit housing developer, and some local residents. The meeting took approximately 110 minutes.

The presentation was organized around four nodes that had been pre-identified by a previous planning process. The consultants presented a massing diagram and land use program, as well as the results from a preliminary economic feasibility analysis to estimate the public subsidy necessary to implement the proposed developments.

Fig. 5.10 Kansas City State Avenue Corridor Community Meeting Interaction Design
5.2.6 Boston (BRA) Fairmount-Indigo Planning Initiative

The Upham’s Corner Visioning Forum was held on February 2, 2013 as part of the Fairmount-Indigo Planning Initiative (Figure 5.13). Held on a Saturday, the event was scheduled from 9:30 a.m. to 1:00 p.m. and contained several parts: (1) a sign-in and breakfast, (2) orientation presentations, (3) a break-out discussion and lunch, and (4) concluding presentations and group report-out. The orientation presentations were held in an auditorium and the break-out groups were held in a function room.

The group exercise was titled “creating a shared vision and setting priorities.” The participants were separated into groups and asked to identify the aspects of the neighborhood they linked best, and identify what “needs to change.” The groups were provided with two maps of the neighborhood, each containing an aerial photograph and circle marking a one-half mile radius from the station. One map was labeled “opportunities and issues” and the other was...
labeled “shared vision.” Group participants were provided with “game pieces” they were asked to use to describe a “shared vision” for the neighborhood, contained in Appendix C. They were labeled: new housing, new park, infill housing, new athletic field, improved streetscape, new mixed use, new commercial, new plaza, and parking. Each group had a facilitator and note-taker, and the exercise is described in Figure 5.12. After the group exercise concluded, a representative from each group was asked to present the major conclusions the group had come to.

![Fig. 5.12 Upham’s Corner Visioning Forum Exercise Interaction Design](image)

**5.2.7 Workshop Design Comparison**

The workshops studied here differed widely in their design. As previously discussed they all shared similar project scope and goals, namely strategic spatial planning with the goal of identifying the location and characteristics of new development, and related public facilities and improvements. The case that deviated the most from this general type of planning was the Kansas City State Avenue project, which was included as it will be discussed for the third research question below.

Several characteristics of the workshops are compared in Table 5.1 below: the total length, division of time between workshop sections, whether keypads were used, and nature of the PSS or materials used.
Fig. 5.13. Photos from Upham’s Corner Community Forum: top left, Orientation presentations in auditorium; top right and bottom left, group exercise; bottom right, detail from group exercise results map.

<table>
<thead>
<tr>
<th>Case</th>
<th>Austin</th>
<th>Boston</th>
<th>Kansas City</th>
<th>Boston (BRA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop</td>
<td>Hutto Charrette</td>
<td>Dripping Springs, Lockhart, Elgin Charrettes</td>
<td>North Suburban Priorities Screening</td>
<td>North Suburban Public Forum</td>
</tr>
<tr>
<td>Introduction/Orientation</td>
<td>35</td>
<td>30</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Exercise</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>45</td>
</tr>
<tr>
<td>Report-Out</td>
<td>30</td>
<td>30</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>Total Length (minutes)</td>
<td>155</td>
<td>140</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Tool(s)</td>
<td>Envision Tomorrow (interactive)</td>
<td>Envision Tomorrow (interactive)</td>
<td>CommunityViz (presented)</td>
<td>Paper map exercise, Keypads</td>
</tr>
</tbody>
</table>

Table 5.1 Workshops Overview
Three of the workshops also featured audience response keypads. These are small devices distributed to the audience members. They are connected to a laptop through a radio receiver. They are integrated into a presentation, enabling real-time polling. The presenter must pre-determine the response choices, which are limited to 11 responses. Table 5.2 summarizes the number and type of keypad questions observed at these workshops. They included introductory questions (“Who are you rooting for in the Super Bowl tomorrow?”), demographics (“Do you own a home or rent?”), market research questions about attendee behavior (“What is your primary reason for visiting Upham’s Corner?”), input questions on specific policies (“Assuming this site is redeveloped, what mix of uses do you think would be most beneficial?”) and one meeting evaluation question (“Did this forum help increase your understanding of the North Suburban study area?”).

<table>
<thead>
<tr>
<th></th>
<th>Introductory</th>
<th>Demographics</th>
<th>Market Research</th>
<th>Input</th>
<th>Meeting Evaluation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston North Suburban Priority Mapping Project – Public Forum</td>
<td>1</td>
<td>8</td>
<td>0</td>
<td>9</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Boston Upham’s Corner Visioning Forum</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Kansas City Sustainable Places State Avenue Corridor – Community Meeting</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 5.2 Summary of Keypad Questions

These questions were integrated into the workshops in different ways. In the Upham’s Corner Visioning Forum and North Suburban Priority Mapping Project Public Forum, the keypad questions were asked before a hands-on exercise. At the Kansas City State Avenue Corridor Third Community Meeting, the keypads were distributed and integrated throughout the meeting. The only demographic questions at this meeting concerned participants’ place of residence. Four of the remaining questions solicited structured feedback about the preliminary plans for each of the nodes. The final two questions concerned which nodes should be prioritized, and the type of housing preferred.

5.2.8 Learning Outcomes

A survey was used to evaluate the self-reported learning, reported below. The workshop with the highest reported learning was in Hutto, then Lockhart and North Suburban Regional Priorities Screening workshop. Next are the two other Austin workshops, Elgin and Dripping
Springs, Upham’s Corner, and the North Suburban Public Forum. Among the Austin workshops, the workshops with the greatest emphasis on the PSS, Hutto and Lockhart, had the highest learning. However, as previously noted, the Elgin workshop was disrupted.

<table>
<thead>
<tr>
<th>Case</th>
<th>Austin</th>
<th>Boston</th>
<th>Boston/BRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop</td>
<td>Hutto</td>
<td>Elgin</td>
<td>Dripping Springs</td>
</tr>
<tr>
<td>N</td>
<td>17</td>
<td>14</td>
<td>45</td>
</tr>
<tr>
<td><em>Reported learning</em> (mean)</td>
<td>4.38 (0.72)</td>
<td>4.17 (0.83)</td>
<td>4.19 (0.97)</td>
</tr>
<tr>
<td><em>Double loop index</em> (scale)</td>
<td>22.44 (2.48)</td>
<td>20.73 (3.04)</td>
<td>21.95 (3.65)</td>
</tr>
<tr>
<td>Sex (percent female)</td>
<td>62.5%</td>
<td>54.5%</td>
<td>59.1%</td>
</tr>
<tr>
<td>Length of residence (mean)</td>
<td>9.3</td>
<td>6.8</td>
<td>10.5</td>
</tr>
<tr>
<td>Age (mean)</td>
<td>39.5</td>
<td>51.4</td>
<td>55.4</td>
</tr>
<tr>
<td>Education (mean)</td>
<td>3.7</td>
<td>4.0</td>
<td>4.3</td>
</tr>
<tr>
<td>Hispanic (percent)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>White (percent)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Black (percent)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

1 Race and ethnicity questions not included in surveys at these workshops
2 Percent who identified this category, inclusive of those who selected multiple categories
Standard deviations shown in parentheses for dependent variables.

Table 5.3 *Reported learning* and *double loop index* and demographic profile by workshop.

The seven workshops where learning outcomes were available were separated by interaction design: mediated PSS, an interactive PSS, and paper map exercises. *Reported learning* at the interactive PSS was highest, however the low sample size restricts conclusions that can be drawn. Two-sample t tests were conducted to compare the means for mediated PSS with the remaining two groups. For both tests, the null hypothesis is there is no difference between the two means, and the alternative hypothesis is the difference is not equal to zero.
The null hypothesis, cannot be rejected at the 95% confidence level for interactive PSS. However, the null hypothesis is rejected for the paper map exercises at the 99% confidence level.

<table>
<thead>
<tr>
<th>Interaction Design</th>
<th>Mediated PSS (Austin Workshops)</th>
<th>Interactive PSS (North Suburban Priorities Screening)</th>
<th>Paper Map Exercises (North Suburban Public Forum and Upham’s Corner)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>101</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td>Reported learning (mean)</td>
<td>4.248</td>
<td>4.300</td>
<td>3.239</td>
</tr>
<tr>
<td>t statistic, two-sample t test (compared with mediated PSS)</td>
<td>-0.179</td>
<td>6.501**</td>
<td></td>
</tr>
<tr>
<td>Double loop index (scale)</td>
<td>22.230</td>
<td>21.650</td>
<td>19.739</td>
</tr>
<tr>
<td>t statistic, two-sample t test (compared with mediated PSS)</td>
<td>0.590</td>
<td>5.123**</td>
<td></td>
</tr>
</tbody>
</table>

** Significant at the 99% confidence level.

Table 5.4. Reported learning by workshop interaction design type.

5.3 Hypothesis 1.2 Wenger’s Model and Reported Learning

Hypothesis 1.2: Participants’ self-reported experience of high levels of Wenger’s constructs (imagination, alignment, and engagement) in the workshops will be positively correlated with reported learning.

This hypothesis is tested by looking exclusively at the Austin workshops. Held in four diverse exurban sub-centers, it provides an opportunity to investigate the same planning technique and tools implemented in multiple places. A regression analysis was conducted to test the hypothesis, with reported learning serving as the dependent variable. The independent variables were self-reported demographics and characteristics of the workshops and PSS.

Three models were fit to the data to see which variables were correlated with self-reported learning. First, Model A includes all variables. Three workshop variables are significant: shared views and others listened (engagement) are significant at the 90% and others perspectives (alignment) is significant at the 95% confidence level. The only PSS variable that is significant is changed perception (imagination) significant at the 95% confidence level. A related measure of alignment, group discussion, was not significant. Notably, no demographic variables,
such as sex, education, or personality characteristics, are significant. In addition, tool familiarity and influenced design were not significant.

Model B included only the workshop and tool variables for Wenger’s model. The magnitudes of some coefficients shift slightly and the overall adjusted R-Square increases, partly because of the reduction in the number of independent variables and multicollinearity. Finally, Model C is Wenger’s model with one variable omitted and one added. The resulting adjusted R square is 0.5148.

Beta coefficients allow the relative impact of each variable on the dependent variable, reported learning, to be assessed. The Beta coefficients for Model C show the single variable with the largest impact on the dependent variable is other perspectives, followed by shared views, and then changed perception. Two variables have negative coefficients. While others listened is negative, it is correlated with shared views. When shared views is removed from the model others listened remains negative, but is no longer significant. Ability to imagine is also negative, and only somewhat correlated with the very similar changed perception (0.4746). This puzzling result is discussed further in the conclusions, however it could be that respondents were influenced by the 3D rendering for one question, and the PSS for another. However, on the questionnaire, participants were instructed to answer both these questions about the “computer tool that was used during today’s meeting” (Appendix A).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Reported learning</th>
<th>Share views</th>
<th>Others listened</th>
<th>Creativity</th>
<th>Others perspectives</th>
<th>Ability to imagine</th>
<th>Changed perception</th>
<th>Unique issues</th>
<th>Meeting attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reported learning</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share views</td>
<td>0.2689</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others listened</td>
<td>0.2008</td>
<td>0.8338</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creativity</td>
<td>0.4952</td>
<td>0.7198</td>
<td>0.6504</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others perspectives</td>
<td>0.6038</td>
<td>0.0195</td>
<td>0.0640</td>
<td>0.3569</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to imagine</td>
<td>0.2517</td>
<td>0.2768</td>
<td>0.1636</td>
<td>0.3120</td>
<td>0.2587</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changed perception</td>
<td>0.4524</td>
<td>-0.0220</td>
<td>0.0286</td>
<td>0.2083</td>
<td>0.4041</td>
<td>0.4746</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique issues</td>
<td>0.4037</td>
<td>0.4130</td>
<td>0.3748</td>
<td>0.4920</td>
<td>0.2261</td>
<td>0.3356</td>
<td>0.2541</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Meeting attendance</td>
<td>-0.0974</td>
<td>0.0102</td>
<td>-0.0178</td>
<td>0.0426</td>
<td>-0.0208</td>
<td>-0.0681</td>
<td>-0.0043</td>
<td>-0.0089</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Table 5.5 Correlation matrix for variables included in Model C, coefficients with an absolute value greater than 0.5 are bold.
<table>
<thead>
<tr>
<th>Variable Cats.</th>
<th>Variables</th>
<th>Constructs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Model A</th>
<th>Model B</th>
<th>Model C</th>
<th>Model C Beta Coef.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Model A</strong></td>
<td><strong>Model B</strong></td>
<td><strong>Model C</strong></td>
<td><strong>Model C Beta Coef.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop</td>
<td>Share views</td>
<td>Engagement</td>
<td>4.667</td>
<td>0.7031</td>
<td>0.4820 (1.96)*</td>
<td>0.4856 (2.20)**</td>
<td>0.4601 (2.12)**</td>
<td>0.3476</td>
</tr>
<tr>
<td>Others listen</td>
<td>Engagement</td>
<td>4.5278</td>
<td>0.7730</td>
<td>-0.3663 (-1.94)*</td>
<td>-0.3196 (-1.88)*</td>
<td>-0.3432 (-2.06)**</td>
<td>-0.2850</td>
<td></td>
</tr>
<tr>
<td>Creativity</td>
<td>Imagination</td>
<td>4.5611</td>
<td>0.8067</td>
<td>0.1838 (1.09)</td>
<td>0.2417 (1.63)</td>
<td>0.2273 (1.55)</td>
<td>0.1970</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>Alignment</td>
<td>4.6389</td>
<td>0.5458</td>
<td>0.6922 (3.99)**</td>
<td>0.7536 (4.84)**</td>
<td>0.7391 (4.85)**</td>
<td>0.4334</td>
<td></td>
</tr>
<tr>
<td>PSS Specific</td>
<td>Ability to imagine</td>
<td>4.1888</td>
<td>0.8466</td>
<td>-0.1850 (-1.45)</td>
<td>-0.1949 (-1.72)**</td>
<td>-0.1868 (-1.84)**</td>
<td>-0.1699</td>
<td></td>
</tr>
<tr>
<td>Changed</td>
<td>Imagination</td>
<td>3.6389</td>
<td>0.9687</td>
<td>0.2641 (2.61)**</td>
<td>0.2719 (2.92)**</td>
<td>0.2817 (3.16)**</td>
<td>0.2931</td>
<td></td>
</tr>
<tr>
<td>perception</td>
<td>Alignment</td>
<td>3.8167</td>
<td>0.9375</td>
<td>0.0217 (0.17)</td>
<td>0.0936 (0.93)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other PSS</td>
<td>Unique issues</td>
<td>Identification</td>
<td>3.7556</td>
<td>0.9157</td>
<td>0.1217 (0.98)</td>
<td></td>
<td>0.1561 (1.74)*</td>
<td>0.1536</td>
</tr>
<tr>
<td>Constructs</td>
<td>Tool familiarity</td>
<td>Identification</td>
<td>3.5889</td>
<td>1.1406</td>
<td>0.0652 (0.77)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Influenced design</td>
<td>Participation</td>
<td>3.4444</td>
<td>1.1814</td>
<td>-0.0738 (-0.86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question outputs</td>
<td>Reification</td>
<td>3.667</td>
<td>1.0705</td>
<td>0.0851 (0.89)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographics</td>
<td>Planner identity</td>
<td></td>
<td>3.8944</td>
<td>0.9671</td>
<td>0.0619 (0.60)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meeting attendance</td>
<td></td>
<td>3.7667</td>
<td>1.5654</td>
<td>-0.0745 (-1.30)</td>
<td>-0.0679 (-1.54)</td>
<td>-0.1143</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sex (1=female)</td>
<td></td>
<td>0.5222</td>
<td>0.5023</td>
<td>0.6221 (0.42)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td></td>
<td>4.1444</td>
<td>0.8287</td>
<td>-0.0221 (-0.23)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Sensation seeking</td>
<td></td>
<td>3.7889</td>
<td>0.5299</td>
<td>-0.1611 (-1.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Goal orientation</td>
<td></td>
<td>3.4111</td>
<td>0.8332</td>
<td>-0.0368 (-0.36)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependent Variable</td>
<td>Reported learning</td>
<td></td>
<td>4.2560</td>
<td>0.9309</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 90% level of confidence; ** Significant at the 95% level of confidence. Coefficients significant at 90% or greater are bold, and coefficient t-statistics are shown in parentheses.

Table 5.6 Regression analysis of *reported learning* at Austin workshops.
5.4 Hypothesis 1.3 Participant Personality

Hypothesis 1.3: Participant reported learning will be positively associated with planner identity and high levels of sensation seeking and goal orientation.

The coefficient for sensation seeking in the model reported in Table 5.6 is not significant, suggesting it is not related to reported learning. However, the dataset contains very little variation in this variable, and its standard deviation (0.5299) is second lowest, only to the dummy variable sex. The index was constructed from two questions, and has five possible values, from 0 to 4. As shown Table 5.7, 81.9% of all attendees achieved the highest score for sensation seeking, answering “true” for both questions. For goal orientation, 56.7% achieved the highest score, responding “true” to both questions. So, the workshop participants reported uniformly high scores of sensation seeking and goal orientation. Hence, the hypothesis may be true for the general public, but does not differentiate the attendees. If participants answered the remainder of the full instrument consistent with these results, it would place a majority of all attendees among the 95% percentile of the general population at large along these two personality traits (Jackson 2005). This is not a surprising result, and suggests innate curiosity may be one reason people become involved in planning activities like workshops.

<table>
<thead>
<tr>
<th>Case</th>
<th>Austin</th>
<th>Boston</th>
<th>Boston/BRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop</td>
<td>Hutto</td>
<td>Elgin</td>
<td>Dripping Springs</td>
</tr>
<tr>
<td>N</td>
<td>17</td>
<td>14</td>
<td>45</td>
</tr>
<tr>
<td>Sensation seeking (4/4)</td>
<td>88.2%</td>
<td>61.5%</td>
<td>84.1%</td>
</tr>
<tr>
<td>Goal orientation (4/4)</td>
<td>56.3%</td>
<td>33.3%</td>
<td>76.7%</td>
</tr>
<tr>
<td>Sensation seeking (mean)</td>
<td>3.87</td>
<td>3.38</td>
<td>3.84</td>
</tr>
<tr>
<td>Goal orientation (mean)</td>
<td>3.33</td>
<td>3.08</td>
<td>3.70</td>
</tr>
</tbody>
</table>

Table 5.7 Sensation seeking and goal orientation personality traits of workshop attendees. Shows percent of attendees with maximum score on each scale (4/4), and mean score by workshop.
5.5 Hypothesis 2.1 and 2.2 Wenger’s Model and the Double Loop Index

Hypothesis 2.1: Workshops participants will report high double-loop index scores when they report greater participation in the creation of the PSS, and greater identification with the PSS.

Hypothesis 2.2: Workshop participants will report higher scores on the double loop index when they report less reification of the PSS.

Perceived participation was measured with the variable influenced design, measured with the question “I influenced the design of the computer model,” and identification was measured with the variable unique issues measured with the question, “the tool reflects my unique issues and concerns,” and reification was measured with question outputs, the negatively worded question “participants felt free to question the outputs of the model” (higher scores correspond with less reification). Two types of analysis were conducted to test this hypothesis. First, the pairwise correlation between these variables and double loop learning are calculated.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Correlation with reported learning</th>
<th>Regression Adj R²</th>
<th>Correlation with double loop index</th>
<th>Regression Adj R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenced design</td>
<td>0.2510</td>
<td>0.053</td>
<td>0.1235</td>
<td>0.005</td>
</tr>
<tr>
<td>Unique issues</td>
<td>0.4137</td>
<td>0.163</td>
<td>0.3738</td>
<td>0.131</td>
</tr>
<tr>
<td>Question outputs</td>
<td>0.4296</td>
<td>0.176</td>
<td>0.4257</td>
<td>0.173</td>
</tr>
</tbody>
</table>

Table 5.8 Correlation between participation, identification, and reification and reported learning and double loop index.

Contrary to the hypothesis, influenced design in the GIS tool was not strongly related with either reported learning or the double loop index. In fact, in the multivariate model explaining double loop index, the coefficient on influenced design in the model is negative, but not significant at the 95% confidence level. In contrast, unique issues, was much more strongly related to both learning outcomes, correlated with reported learning by 0.4137 and the double loop index by 0.3738. This suggests participants who thought their concerns were reflected in the PSS reported learning more overall, regardless of whether they were involved in creating it. Therefore, based on these findings, participants need not participate in the creation of the PSS, only believe it reflects their concerns. This relates to the broader issue of credibility of the PSS and process, which is discussed further in Chapter 6.

All variables were included in an initial model, labeled A, reported in Table 5.6. Two variables were significant at the 95% confidence level: others listened and others perspectives. One variable was significant at the 90% confidence level, ability to imagine. The second model, B, included only variables from Wenger’s model, both for the tool and the workshop as a whole.
Three coefficients were significant at 95% in this model, *others listened, creativity, and others perspectives*. These correspond with engagement, imagination, and alignment. Notably, none of the variables asking about the PSS explicitly are significant.

Two final models are presented, C and D. This is because the two workshop engagement variables, *shared views and others listened*, were highly correlated, and when considered separately, resulted in different levels of significance for coefficients, as well as some changes in magnitude for other variables (although none resulted in reversed signs). In these models, variables positively associated with the *double loop index* include *creativity, others perspectives*, and the engagement variables included in the model. *Planner identity* is positively related with the *double loop index*, although only significant in one model. *Meeting attendance* is negatively related in both, but also only significant in Model C. Finally, the models include distinct PSS variables. *Influenced design* is negatively related to the *double loop index* in Model C, but it is not significant. The variable about reification, *unique issues*, resulted in a significant and positive coefficient, but this question is worded reverse, so higher scores means less reification.

The two negative coefficients warrant mention. Although the literature on participatory GIS might imply greater participation may result in improved dialog, higher scores on *influenced design* is related to lower *double loop index*. This could be related to the finding that those who attend frequent meetings reported lower learning; it could be the most active participants are less interested in an open discussion because they already have developed a position. Another variable with a negative relationship with the *double loop index* in Models C and D is *ability to imagine*. The coefficients have the same signs in the models created to explain *reported learning*. This is puzzling since another variable designed to measure the same construct (imagination), *changed perception*, is positive in Model C and positive but not significant in Model D. One possible explanation for this is that participants may have interpreted these questions in light of different PSS. In addition to Envision Tomorrow, used during the workshop exercise, at all four Austin workshops participants were shown a presentation that included representations of possible development types, and a short video of a computer-generated 3D “flythrough” created part of a separate planning project (see Figures 5.2 and 5.4).16

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16 One survey respondent at Dripping Springs specifically noted this video: “The fly-over at the beginning of the presentation was impactful, and the workshop materials were exciting.” Additional qualitative data from the surveys are included in Chapter 6.
<table>
<thead>
<tr>
<th>Variable Cats.</th>
<th>Variables . Constructs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Model A All Vars</th>
<th>Model B Wenger Model</th>
<th>Model C</th>
<th>Model D</th>
<th>Model D Beta Coef.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop</td>
<td>Shared views Engagement</td>
<td>4.667</td>
<td>0.7031</td>
<td>0.5660 (1.19)</td>
<td>0.5050 (1.19)</td>
<td>2.9560 (7.53)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others listened</td>
<td>Engagement</td>
<td>4.5278</td>
<td>0.7730</td>
<td>2.5205 (7.02)**</td>
<td>2.642 (8.09)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creativity</td>
<td>Imagination</td>
<td>4.5611</td>
<td>0.8067</td>
<td>0.4923 (1.54)</td>
<td>0.6689 (2.35)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others perspectives</td>
<td>Alignment</td>
<td>4.6389</td>
<td>0.5458</td>
<td>1.2110 (3.68)**</td>
<td>1.2570 (4.21)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS Specific</td>
<td>Ability to imagine</td>
<td>4.1888</td>
<td>0.8466</td>
<td>-0.4393 (-1.80)*</td>
<td>-0.3538 (-1.61)</td>
<td>-0.7353 (-2.97)**</td>
<td>-0.3938 (-2.13)**</td>
<td>-0.1080</td>
</tr>
<tr>
<td>Changed perception</td>
<td>Imagination</td>
<td>3.6389</td>
<td>0.9687</td>
<td>0.1123 (0.59)</td>
<td>0.1495 (0.83)</td>
<td>0.4649 (2.07)**</td>
<td>0.0191 (0.11)</td>
<td>0.0059</td>
</tr>
<tr>
<td>Group discussion</td>
<td>Alignment</td>
<td>3.8167</td>
<td>0.9375</td>
<td>-0.0908 (-0.37)</td>
<td>-0.0853 (-0.43)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other PSS Constructs</td>
<td>Unique issues Identification</td>
<td>3.7556</td>
<td>0.9157</td>
<td>-0.0727 (-0.30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool familiarity</td>
<td>Identification</td>
<td>3.5889</td>
<td>1.1406</td>
<td>0.1585 (0.99)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influenced design</td>
<td>Participation</td>
<td>3.4444</td>
<td>1.1814</td>
<td>-0.0792 (-0.49)</td>
<td></td>
<td>-0.1748 (-1.10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question outputs</td>
<td>Reification</td>
<td>3.667</td>
<td>1.0705</td>
<td>0.3285 (1.80)*</td>
<td></td>
<td>0.2498 (2.14)**</td>
<td>0.1146</td>
<td></td>
</tr>
<tr>
<td>Demo-graphics</td>
<td>Planner identity</td>
<td>3.8944</td>
<td>0.9671</td>
<td>0.2920 (1.49)</td>
<td></td>
<td>0.7039 (3.14)**</td>
<td>0.2498 (1.44)</td>
<td>0.0779</td>
</tr>
<tr>
<td>Meeting attendance</td>
<td>3.7667 1.5654</td>
<td>-0.1314 (-1.21)</td>
<td>-0.3384 (-2.63)**</td>
<td>-0.1143 (-1.15)</td>
<td>-0.0579</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex (1=Female)</td>
<td>0.5222 0.5023</td>
<td>-0.1866 (-0.60)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>4.1444 0.8287</td>
<td>0.0412 (-0.60)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensation seeking</td>
<td>3.7889 0.5299</td>
<td>-0.3902 (-1.34)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal orientation</td>
<td>3.4111 0.8332</td>
<td>0.0776 (0.39)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependent Variable</td>
<td>Double loop index</td>
<td>22.315</td>
<td>6 3.1027</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>89</td>
<td>89</td>
<td>89</td>
<td>89</td>
<td>89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-Squared</td>
<td></td>
<td>0.8321</td>
<td>0.8325</td>
<td>0.7320</td>
<td>0.8400</td>
<td>0.8400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 90% level of confidence; ** Significant at the 95% level of confidence. Coefficients significant at 90% or greater are bold, and coefficient t-statistics are shown in parentheses.

Table 5.9 Regression analysis of double loop index at Austin workshops.

These representations, or some other aspect of the overall workshop, may have suppressed imagination, or it may be imagination is not as strongly related to learning in these contexts. The models were tested with a dummy variable to test for fixed effects specific to one or more workshops, however these were not significant. The F-test revealed all models were significant (P<0.001). Broadly speaking, these results validate Wenger’s theory, with the additional finding that PSS can augment learning by supporting imagination.
However, this finding is mixed – some type of imagination is negatively related to double loop learning, while others is positively related. In addition, it seems important that the PSS have low reification; that participants feel free to question its assumptions and outputs. The analysis also confirms that the most important demographic variables are not conventional descriptive variables (educational, sex) but instead the extent to which the participant views themselves as someone involved in the planning of their community (planner identity), and attends frequent meetings (meeting attendance).

5.6 Hypothesis 2.3 Relationship Between Learning Types

Hypothesis 2.3: Workshops where participants report high double loop index will also report high reported learning.

This hypothesis concerns the amount and types of learning reported at the workshops. As previously discussed, Argyris and Schön argue that both types of learning are expected to be positively correlated. A contrary point of view would hold that these types of learning are fundamentally different, and time focused on single loop learning would crowd out deliberation of values, goals, and broader concerns that characterize double loop learning. To test this, a scatterplot was created including all seven workshops where survey data is available. The measure of single loop learning is reported learning, and the measure of double-loop learning is the double loop index previously described. The observed positive correlation provides evidence in support of this hypothesis, although the small sample size is a limitation. In addition, the measure of single-loop learning may not accurately capture the essential distinction between the two in Argyris and Schön’s theory.

![Fig. 5.14 Reported learning and double-loop index, by workshop. Key: Hutto (X), Elgin (hollow square), Dripping Springs (asterisk), Lockhart (hollow circle), North Suburban #1 (solid square), North Suburban #2 (plus), Upham’s Corner (solid triangle)](image-url)
5.7 Hypothesis 2.4 View Diversity and Learning

Hypothesis 2.4: Workshops with higher view diversity will have higher reported learning and lower double loop index scores.

In order to evaluate the impact on view diversity on learning outcomes, five questions were included on surveys given at each workshop concerning general views on topics relevant to spatial planning. The standard deviation of the responses for each of these five questions was averaged to create a view diversity index for each workshop. A higher score means the participants provided more diverse responses to these questions. They were chosen to measure independent concepts, and no two have a Pearson’s correlation coefficient with an absolute value greater than 0.3. To test the hypothesis, two scatterplots were constructed, comparing workshop view diversity with mean reported learning and mean double loop index score. No strong relationship can be seen on either of these two charts. However, the conclusions have several caveats. The sample size of workshops is very small, and the observed view diversity may be less than in the population at large or in specific communities.

Fig. 5.15 Scatterplots illustrating relationship between workshop view diversity and reported learning, and the double loop index. Key: Hutto (X), Elgin (hollow square), Dripping Springs (asterisk), Lockhart (hollow circle), North Suburban #1 (solid square), North Suburban #2 (plus), Upham’s Corner (solid triangle).
Infrastructure

5.8 Introduction

Focus Question 1: What explains the creation, adoption, and development of spatial PSS?

Two theoretical perspectives will be used to examine evidence from the cases to propose a convincing account of the origin of spatial PSS. First, the theory of the diffusion of innovations, popularized by Rogers (2003), will be applied. Results from surveys of regional planning agencies in U.S. metropolitan regions, and PSS users will provide some evidence supporting this perspective. In particular, this theory’s “innovation characteristics” provide an explanation for why PSS have not spread easily or quickly. However, as described in Chapter 3, both PSS and urban systems models rely on particular representations of the city, which inevitably embeds them within the broader debate about how problems should be framed. Since this involves both popular and specialized ways of knowing, it raises tensions around the role professionals, making PSS use contingent on the broader legitimacy and role of planning as an institutionalized practice. Representational choices, in turn, affect the possible uses of PSS or urban systems models, such as the nature of questions that can be asked using them, their spatial detail, the uncertainty of estimates, and other issues.

Given the leadership role of planning professionals in designing planning processes, and deciding how project resources will be allocated, entertaining any of the issues above first requires professionals to view the role of IT in spatial planning practice in new ways. This will be illustrated by drawing on evidence from the Kansas City case, where despite funding, lengthy trainings, and public statements, the novel features of the PSS available to the project were not used. In this case, PSS were not adopted partly because of the nature of the planning project, but also because of the durability of professional frames about the purpose of digital tools and the nature of professional practice.

A second theoretical perspective, frame reflection, will be introduced to provide an account of endogenous PSS development, as well as explain the slow observed diffusion. Using data from focus groups conducted in Metropolitan Boston, a frame analysis will be used to show how professionals can hold contrasting, unexamined assumptions about the design, purpose, and use of PSS. However, these professional frames necessarily focus on relatively discrete, short-term tools, methods, and projects. As a social institution, the design and use of PSS rest not only on the politics of epistemology described above, which impact their internal design and social legitimacy, but also on broader social factors: the structure and organization of
governmental activities, the development of spatial data infrastructures, and the political climate. These issues are taken up in more detail in Chapter 6.

5.9 Diffusion Perspective

This section will apply Rogers’ theory of the diffusion of innovations to PSS. First, evidence for national diffusion is reviewed. Next, the five innovation characteristics are applied to PSS, finding the theory predicts limited adoption. However, this theory imperfectly describes PSS, which are embedded with political and epistemological questions about how problems should be framed and what models are accepted or appropriate. Finally, evidence from the Kansas City case is used to argue for the need for an alternative theoretical perspective on how PSS are developed and adopted in professional practice.

5.9.1 Evidence of National Diffusion

This section applies the diffusion paradigm to PSS in two ways. First, the results of a national survey are briefly reported, which shows that PSS have diffused relatively slowly, and among geographically clustered cities. This evidence alone does not prove or disprove the usefulness of the theory. Second, the five innovation characteristics that explain diffusion are applied to spatial PSS. In conclusion, the diffusion of innovations perspective is most useful to explain why spatial PSS are not expected to diffuse quickly or easily, but omits all-important internal structure of PSS or urban systems models. For a more detailed account of the development of locally specific tools, the analysis turns to the idea of frames.

The history of the development of various tools and their adoption is poorly documented, and would require substantial research to fully research. However some evidence is available that explains the nature of these tools and how they are used. The creators of INDEX report that it has been applied widely, in 690 locations. However, the number of organizations that licensed the software was much smaller, 157, suggesting the tool’s creator, the consulting firm Criterion Planners, implemented the majority of the projects. They report licensing the software to roughly 33 MPOs or other regional agencies between 1994 and 2006 (Allen 2008). CommunityViz was developed as a partnership between the Environmental Simulation Center and the Orton Family foundation, emerging as a complete tool in 2001 (Kwartler and Bernard 2001) and was transferred in 2005 to a for-profit company, Placeways LLC. Envision Tomorrow was developed by a consulting firm, and has only recently been transferred to the University of Utah. Among a Fall 2012 survey of the 53 MPOs for metropolitan regions with populations over 1 million, 22
provided responses to a survey question asking about use of PSS. Among these, eight reported using a tool. Three were cases in this dissertation, Austin (CAPCOG), Boston (MAPC), and Kansas City (MARC). Two California MPOs are developing web-based tools (SCAG and SACOG). The remaining three are Chicago (CMAP), Portland (Metro), and Salt Lake City (WFRC). In every case the tool capacity was developed through a planning project. Many other regions reported that they maintained more complex travel models, which they would “run” on request for localities. In addition, in the literature there is an account of a PSS used by stakeholders in Portland Oregon’s regional government (Moore 2008).

Rogers argues the adoption of an innovation depends on how they are perceived by potential adopters. A small survey of interested planners and participants in a professional group dedicated to PSS development illustrates how this innovation is perceived among some of the most interested and informed participants (Holway et al. 2012: 52-53). The survey revealed awareness of the tools is low. The most well-known tool is CommunityViz, which 60.3% of respondents reported having used or were aware of. However awareness of the remainder, including Envision Tomorrow, INDEX, MetroQuest, and What If? ranged from 14% to 8.3%. Respondents were asked to identify “barriers” to using these PSS. Users and nonusers alike reported they were complex (61.4% of users, 41.2% of nonusers), costly (45.7%/39.2%), required limited staff resources (35.7%/43.1%) and data hungry (24.3%/23.5%) (Holway et al. 2012: 52-53).

In summary, spatial PSS are an innovation that has been implemented largely by the innovation creators, namely a small group of consultants. Very few regions have adopted spatial PSS for regular use, and those that have fit into two general categories: those that adopted it as part of a major planning project, and in California, where its use corresponds to changes at MPOs to comply with a new state law. Large percentages of interested planners and tool users perceive spatial PSS as labor-intensive, data hungry, costly, and complex, although potentially useful. Next, spatial PSS are analyzed according to Rogers’ innovation characteristics.

5.9.2 Innovation Characteristics

In light of this evidence of relatively modest diffusion across U.S. regions, PSS are analyzed using the five characteristics from Rogers’ theory. These characteristics suggest a

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richer theoretical perspective is needed for PSS, as they omit the uniquely embedded nature of PSS within broader regional contexts.

The first key characteristic explaining diffusion is *relative advantage*. Given the findings presented here, planning projects who adopt the technology will realize greater social learning outcomes, and by implication improved plans and planning outcomes. However two factors dilute the importance of this characteristic in this context. First, planning agencies are generally monopoly providers of planning services for their jurisdictions. This might be a reason that consulting firms and agencies which serve as consultants for smaller units of government have been earlier adopters of the technology. Another reason this factor may not speed adoption in this case is the existence of alternative planning paradigms not based on social learning, such as those described in Chapter 2. Finally, institutional theorists argue organizations in “institutionalized” sectors that do not have readily observable outputs will tend to conform to professional norms and standards instead of attempting to measure performance (Meyer and Rowan 1991).

The second characteristic is *compatibility* with existing technologies and practices. This characteristic explains why PSS are used in conjunction with new professional practices, such as scenario planning or alternative futures. While technically compatible with existing GIS data, existing planning practices may not emphasize spatially-specific plans or participatory processes. Professionals with an expertise-based theory of practice may not see the value of “sketch planning” tools which could provide only rough estimates, and choose to invest in more complex forecasting models which claim more precise (or at least more complicated) analysis.

The third characteristic is *complexity*, and several types of complexity are possible. The most straightforward type is how complex the PSS is to set up and use by a single individual. PSS vary in this type of complexity, which may explain why they seem to differ somewhat in their rate of adoption. Most require proficiency with the GIS software, ArcGIS, which although widespread, is not ubiquitous in the profession. PSS also have a second layer of complexity, the nature of the underlying data and the structure and relationships contained in the PSS. This *knowledge complexity* is imperfectly addressed by Rogers’ theory, and described in further detail below.

The fourth characteristic is *trialability*, the ability for potential users to test the innovation. Although all the tool providers are happy to provide evaluation copies, installing and testing the software requires time and expertise. Furthermore, installing the software is only one component of the innovation, the others are tailoring it to local data and planning questions, and
implementing it in a local planning context. Therefore, in practice PSS require a full-fledged pilot study as a trial. This approach was used in Minneapolis, which used a Sustainable Communities grant to conduct a pilot study. The Austin case is described as a pilot study, although institutionalization of the tool is planned.

The fifth characteristic of the innovation is observability. The innovation, and its resulting relative advantage, must be easily observable for outsiders. The existence of several high-profile demonstration projects, in Portland, Salt Lake City, provided limited observability in the form of case studies and professional accounts. However, the low familiarity with most spatial PSS in the user survey discussed above indicates the observability has been low. Furthermore, the relative advantage of PSS may be learning, which is difficult to reliably observe in practice, although survey methods such as those used in this dissertation may be feasible to implement.

Applying Rogers’ theory to PSS provides a theoretical framework to analyze them as innovations. The theory’s innovation characteristics described in this section provided a useful starting point to analyze PSS adoption. According to this theoretical viewpoint, PSS seem unlikely to spread quickly or rapidly: planning organizations may not focus on relative advantage, PSS may not be compatible with existing practices, they are too often complex, difficult to test, and difficult to observe. However, this analysis has pointed to a deeper limitation of this theoretical approach. PSS are not merely an “innovation” like a new gadget, poised for adoption by a clear set of adopters, but instead are embedded within a complex and nuanced social and institutional context. The next section discusses Kansas City and the concept of frames. The chapter closes with a description of context: PSS as knowledge technologies, and the evolving knowledge and expectations of participants in the planning process.

5.9.3 Kansas City as Case of Non-Adoption

The research identified two regions that obtained financial resources to implement a spatial PSS, but did not. One region, Minneapolis, explored developing decision support tools using funding from a HUD Sustainable Communities grant but the project was abandoned (Graham, Greco, and Pitt 2012). According to an informant there, they concluded the technology was too complicated to be easily deployed to municipalities or community organizations and have shifted investment towards other areas: “economic competitiveness strategic planning” as well as more advanced modeling. The second region that did not adopt the innovation was Kansas City. The results of interviews with consultants involved, reported below, probe the reason for the non-adoption. In the Kansas City project, original plans called for applying
Envision Tomorrow. One consultant, from an economic development firm, described his role as analyzing the market and “figuring out what out to be the right development program” for the different node. For example, “one can say on the Kansas side, the downtown can be forgotten, some of the market numbers would say don’t do anything here … we did get a positive IRR on a couple project ideas on the western end of the corridor.” In his view, Envision Tomorrow was similar to models they have used for many years in their consulting practice. “We didn’t need the Envision Tomorrow model to do what we do.” Therefore, the project team:

“did the planning in the normal old fashioned way, which works, and used the model to try it again and see if it came up with the same answer. […] Possible, the ET might have been handy, just didn’t know how to do it. We felt we didn’t need to. We went back to the model, now that we know what we want to build, customize them to the specific locations, and see what comes out. See what the impact is. Worked fairly well that way.”

He seemed aware that there was something additional that could be done. “If we were using it more appropriately, none of us could perceive it could be handy that way. We saw a bunch of quantitative numbers, we’ll use that when we need to, didn’t realize it could be used in a visionary planning kind of way. I know we didn’t use the model to its full potential, did we use it OK for what we did. Something needs to be done to educate the consultants.” However, the training described is quite extensive:

All the teams had a representative to an initial training for using the model, I went with [another consultant] and got a briefing on it. We asked a lot of questions about the inputs, and when and how to work with the outputs. Once we got started on our assignments, it didn’t really occur to us during the planning process to use it. We conceived of it as a tool that could be handy towards the end of it as we were evaluating the proposals. [The regional planner] in particular wasn’t all that familiar with the model, but since she went through the trainings is a better resource today. […]

One of our difficulties or we didn’t have time or exposure of all the packages and how it all fits together. We just didn’t know what it is telling us. There needs to be maybe a longer training period or a tutorial step by step, where are the inputs, how do you interpret them, a bit slower pace so we can all grasp it. The initial training, it was all day, six hours. We went away and our heads were spinning.

To this professional, the PSS Envision Tomorrow was viewed as similar to quantitative financial impact models. Therefore, its assumed purpose is to provide answers about the market feasibility of certain programs, and the financial feasibility of proposed projects under current

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18 In real estate, the Internal Rate of Return (IRR) of an investment “is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.” In theory, projects with an IRR that exceeds the cost of capital are profitable.
assumptions. When presented with Envision Tomorrow they saw “a bunch of quantitative numbers” similar to the models they had been using for years. Therefore they conducted the planning the “normal old fashioned way,” since nobody on the planning team could “perceive” or “conceived of it” it to be useful for anything else, such as a “visionary planning kind of way.” However he retained skepticism for why it would be useful for visionary planning. “Do we need a visionary model, or is that what we do as planners anyway? … Working that all into a model didn’t make sense to any of us.” His account of the training focuses on the elements of the model similar to the economic models he is familiar with, namely the inputs and outputs and how to interpret them. Towards the end of the interview he commented, “I couldn’t figure out the painting land use thing. Pretty much involved with the Excel component. Had exposure to the painting, [but] it never quite made sense.”

What might have led to a different outcome? This professional was interested in learning a new practice, but the interview suggests the answer might not have been longer training but a different type of training. In addition, the project managers didn’t promote an alternative approach, if anything showed interest in learning from the project team. The concept of frames, and frame reflection, will be used to explain this puzzle of why experienced professionals did not adopt a new PSS, despite interest, funding, and lengthy training.

5.10 Framing Perspective

As introduced in Chapter 2, frames are “culturally determined frameworks, perspectives, systems of meaning, paradigms or positions from which the actor or a group of actors order social reality and make sense of his or her actions” (Ernste 2012). Ernste proposes frames as a useful approach to study spatial planning cultures in general as they (1) encompass the broad systems of meaning at play, (2) allow for multi-level analysis, and (3) fit with an “action theoretical approach” that focuses on individuals, not abstract institutions or structures, as the proper unit of analysis (Ernste 2012). This section argues that given the leadership position of planning professionals in spatial planning, their frames for the nature of PSS play an important role in determining whether and how they are used. Therefore professional reframing is a prerequisite for innovative spatial planning practices that incorporate PSS, such as the participatory workshops studied in this dissertation.
5.10.1 Frame Analysis Applied to Planning Support Systems

This section extends the analysis of professional frames used to analyze transcripts of focus groups of municipal planners collected in Metro Boston. The moderator is a regional planner, and in attendance is a planning consultant from a local planning firm as well as several municipal planners. Emphasis has been added to the following transcript excerpt.

Regional Planner (RP): [...] Are there examples you can provide where planning processes compared the impacts of these different alternatives?

Consultant (C): We did a project in Hopkinton, the Weston Nurseries Project, 500 acres or whatever [...] we did in several public meetings an option to consider A, B, or C: you could do existing zoning, we called it lose green, more progressive zoning, we called it grow green with some more conservation, and uh.


C: Yeah, we had a cute little thing. We have software called smart plan, not unlike Community Viz but different, we would model in public meetings key impacts of these three different options. Mostly around traffic, fiscal impacts, water and sewer, I forget, a few other things. The software would do the scenario, re-modeling, so if you changed the density of this you get new numbers. In fact, we did it. We learned the hard way the first time we made it way to complicated for 100 people to sit there and look at a screen and try the developments. I'm telling you I couldn't even model it. It was too whiz-bang. So we kind of simplified it for subsequent meetings. For the planning board level people they got it, they could play what-if scenarios, but in a public meeting you had to make it really, really simple almost to the point of why bother because it lost its effectiveness. It worked for a sophisticated crowd, for the planning board, but for large public consumption I would give ourselves a C-, it worked better the third time when we kind of dumbed it down. We almost always represent scenarios with numbers and visuals, that's just the way we work. [Continues to describe a similar project in Des Moines, Iowa]

[...]

C: Surveys [collected through a planning support system] tabulate results so you can add things up and make planning judgments from this. And argue about what it means.

RP: it sounds like both in the Weston example and Des Moines there are ways in which, how has that supported the discussion of tradeoffs, for example we want all this tax revenue but no traffic generation. [...] How does that discussion play out? Are there examples which you've seen in a public dialog, there's this tradeoff, we need to reconcile these competing values?

C: In Hopkinton, we had three public meetings. And I think we got people, at the third public meeting there was a bit of a common language about this project, had people approaching what you just said. Yeah, it did start to change the way intelligent, thoughtful people who paid attention and did their homework and didn't want to come and complain about something, people who came prepared and we would facilitate small break out groups, and it resulted in a new zoning bylaw voted on in open town meeting where 1,500 people showed up and voted in favor 80% for it. Which was, to do a conservation based plan that actually increased the density and allowed for multifamily housing over the underlying single-family zoning. 80% people came out and said that is what we want. It was one of those things up to the town meeting there were vote yes, vote no in the yards. That's the one example I can point to I was personally involved in that data made a difference.
In this section, the regional planner and consultant seem to have different views of the possible use of PSS. The regional planner inquires about a tool for facilitating the comparison of alternatives, or making tradeoffs to reconcile “competing values.” The consultant’s story is a bit different. What he means by “working” or “effectiveness” is unclear in the first passage, only that he felt it wasn’t working very well until they “dumbed it down.” Afterwards, however, the tools facilitate arguing about “what it means,” and contribute to the development of a “bit of a common language,” resulting in agreement on a new bylaw for this parcel. The purpose of the practice – including the tools and workshops – is therefore to generate a new understanding for the future of their town, as well as generate individual commitments to this choice reflected in the public election. Later in the discussion, a municipal planner raised another example:

Regional Planner (RP): Have you been engaged in processes that have been intentionally designed to force participants to reconcile their own competing values?

C: We do that all the time in public meetings, in fact that’s what we try to do.

Municipal Planner #1 (MP): We’re selling the Powderhouse school site, over by Tufts, by Teal Square. We tried to develop a focus group, and 70 people signed up to be on it, and we realized we needed to put all 70 on because people would be unhappy if they weren’t, so we have a 70-member focus group. Of which, probably about 30 have been actively participating. We did a program, where we brought in foam blocks, and made a model of the neighborhood, and cut the foam blocks so they were the height of different stories, and painted them for the different use types, and cut them based on the shape of double loaded residential corridor, retail floor plates, town houses, and then what we did is developed a very crude, but the idea was good, but it wasn’t completely executed, but it was a spreadsheet where you had to put blocks on the site, entered numbers onto the computer how many of what color blocks you put there, and it popped out of the bottom whether or not and on what basis it as financially feasible to the developer. So we challenged, so the neighborhood has said all along we want density and were giving us very low numbers, we were up here, we were kind of all over the place. What we ended up doing was here’s the challenge, develop some scenarios for things that you would actually put on this site, but the catch is the scenarios have to actually work. And so we got a whole range of different ideas that worked, and a range that didn’t work, and I had a number of people who as I went up and took pictures of the blocks they’d come up to me and say “just because I put this down here doesn’t mean I think it is a good idea, I think the site should be a park”, so we kind of struggled with that a little bit, but we made them think. We finally made them put the trade-offs together. A lot wanted to save half the site to be a park. But that means a lot of the density that is developable that works financially and we’re pushing it on the other side, and we’re stacking blocks on top of each other and we’re saying maybe half doesn’t work. It allowed some question to be asked, we kept all the blocks because they’re scaled to a scale we can use. It’s very hands on, it took a group that has spent three meetings that has been bickering with each other, yelling at each other, and us and to get into a kind of interactive sort of discussion.

C: You can have these conceptual, intellectual discussions, but when you can see what they did, it changes the whole character of the thing.

Municipal Planner #2 (MP2): You mean a model? In the Shipyards we made them make a really detailed model.

RP: Did that help the …
MP2: Tremendously, totally made it. It was very expensive for the developer, but it was so worth it. People keep changing, so now that we have it people can pull buildings out and in, it is fantastic.

RP: I know you have to leave, I wanted to check in on this question I asked about trade-offs and processes […]

MP2: We probably don’t do that enough. I think that the shipyard was all about that. Because it was about something that was financially, something a developer would develop, and something that the community wanted. And sort of different ways of doing it, and I think that was probably one example.

RP: That was more, kind of serial alternatives, […]

MP2: Basically we don’t do that enough. They don’t feel like they should have to settle for one way or another. A lot of people understand what is going on, but they’re not going to get up and saying yeah, you should settle.

Here a planner describes a case where there is disagreement about what should happen on a site. In the planner’s words, the group has been “yelling at each other” for three meetings. The tool they developed involved physical blocks, as well as a spreadsheet. The role of the artifacts was to construct a “kind of interactive sort of discussion” that “made them think” that not only put the “trade-offs together” but also “allowed some questions to be asked.” The second planner also described using a physical model, although not to consider alternatives. On that, she concludes “we probably don’t do that enough.”

Therefore the preliminary PSS frames that can be identified from the transcript above are as follows. The regional planner has a frame where the PSS is to reconcile competing values and explore trade-offs, with less emphasis on finding collective meaning. The consultant’s perspective is a bit more expansive, resulting in facilitating the group arguing about meaning, creating a common language, and ultimately coming to an agreement that resulted in a public vote to change zoning. The municipal planner describes a case of a situation which began as a situation where a tool was created to facilitate a discussion about design trade-offs, but also extended to making people think, allowing questions to be asked, and supporting an interactive discussion.

These frames, encompassing ideas about the nature of planning and role of artifacts like PSS, influence whether and how practice changes. While Schön and Rein introduce the concept of frame reflection, the precise mechanisms and character of how frames are developed and change is beyond the scope of this work. However, it may explain why new spatial PSS are adopted together with concepts like scenario planning, providing a more discrete, recognizable package of innovations.
5.11 The Broader Context of PSS in Spatial Planning

The professional frames above, and professional re-framing, are necessary but not sufficient for innovative spatial planning practices that involve PSS or other information technologies. While PSS require an organizing frame for their general purpose, design, and use, the professional frames above are understandably limited. Not merely discrete “innovations,” PSS exist in a nuanced and multifaceted institutional context, containing not only formal planning institutions, but also a potentially vast set of topics related to the place of planning in society. This section will consider only two of these important contextual factors, necessary to understand how PSS are used. The first reprises a topic discussed in Chapter 3. Not merely tools, PSS are knowledge technologies, containing internal structures that reflect a particular view of the relationships and causal pathways that define cities. Second, this dissertation found that the learning measures were not only related to the design and use of the PSS, but also participants’ views, personalities, and identity. The topic of the evolving knowledge, expectations, and skills of the public is briefly described. This section serves as a close to the chapter, introducing broader themes taken up in Chapter 6.

5.11.1 PSS as Knowledge Technologies

As discussed in Chapter 3, PSS and urban systems models contain not only systems of representations about the city, but also a description of the relationships between these representations. As described, these reflect not only competing views of how cities should be represented, but also multiple alternative paradigms. Environmental systems may be modeled more easily in a raster data structure, and economic patterns may require parcel boundaries. Choices between representation cannot avoid broader issues of what the model will do and how it will be used.

Writing about the topic of models in transportation planning, Gudmundsson (2011) proposes an intriguing perspective to consider the relationship between the knowledge represented in PSS and the planning process. While conceding “we are probably a long way from an integrated explanation of the use and influence of models” on the policy process, he suggests adopting perspectives promoted by Weiss (1979) and Innes (1990). Under a rational decision-making paradigm, knowledge technologies provide facts to decision-makers. Therefore, the implicit assumption is developing a more precise and accurate model is the key to improving policy. However research has found this instrumental use of knowledge either rare or difficult to document. Weiss proposes other uses, such as “conceptual” use and “symbolic” use, where the
knowledge is used to legitimate and sustain predetermined position. Writing about evaluation, Henry and Mark (2003) further argue the search for effects should not be limited to the *individual* level, but also consider *interpersonal* use (such as facilitating dialog), and *collective* use to develop shared understandings.

This perspective means at the *individual* level, the analysis and use of PSS need not hinge on participants agreeing on one single complex frame of reality. The PSS studied actually avoid specifying controversial causal relationships (such as specifying how markets function) and focus on analytically simpler, “rule based” calculations that can be easily explained. As discussed in the next chapter, certain types of analysis remove the importance of trust, since PSS errors can be detected. However, the study also found that a more complex calculation of fiscal impact did contain quantitative errors, which went undetected during one Austin workshop.

Secondly, at the *interpersonal* level, this perspective emphasizes the benefits of PSS use may not rely heavily on the knowledge represented. The two forms of learning reported earlier in this chapter are most heavily related with engagement: the interactive dialog with other participants. The entire exercise, including the PSS, may instead function as useful structuring device that facilitates focused discussions involving social learning.

Finally, at the *collective* level, PSS provide an opportunity to instantiate indicators and further develop shared understandings. While not avoiding the conceptual and practical challenges of communicative planning, or the specific legitimacy or usefulness of PSS at any individual meetings, PSS are a medium where shared understandings such as indicators could be developed and used (Innes 1998; Innes and Booher 2000).

Of course, the above perspectives do not eliminate the relevance of more overtly political perspectives, and the role of PSS or more complex models may play in political conflict between alternative worldviews, or symbolically legitimating a privileged perspective. The issue of the broader legitimacy of participation in planning is discussed in Chapter 6.

### 5.11.2 PSS and an Evolving Public

The results reported earlier in this chapter point to the importance of participants' characteristics, such as their views, personality, and identity, in explaining learning outcomes. Largely unexplored here, and poorly documented by empirical research in general, are the evolving skills, expectations, and experiences with computers of participants. Evolving IT in organizations and in the consumer market, also described in Chapter 6, will continue to impact the technical and social possibilities of PSS.
Chapter 6

PSS as Tools for Pragmatic Inquiry in Spatial Planning

“Only continuous inquiry, continuous in the sense of being connected as well as persistent, can provide the material of enduring opinion about public matters.” — John Dewey (1985 [1927]: 178)

6.1 Overview

Seen from a certain point of view, the contributions of the PSS to the planning processes described in this dissertation are extremely modest. Their analytical contribution is limited to, in the Austin workshops, only four indicators: three were summative calculations and one an analysis of the impact of development on tax revenues. The analytical content of the PSS in the North Suburban Planning Council workshop is more extensive, involving a set of quantitative indicators. However, the broader public workshop resulted in less learning, likely due to the complexity of the task and design of the meeting. Even a more innovative use of PSS at this workshop could only reduce, but not eliminate the fundamental challenges of introducing a large volume of technical information into a discussion. Another key finding is that the PSS does not seem to harm overall reported learning and the robust dialog required both by organizational learning theory and also many normative view of participatory planning. While reassuring for those concerned with the potential harms of technology in planning, this hardly justifies the expense and hassle required to instantiate the PSS.

Despite these limitations, this conclusion situates the specific findings within a broader argument that PSS provide a model of tools of pragmatic inquiry with potentially exciting and far-reaching implications for practice. The conclusion is organized into two sections. The first section defines the concept, which augments ideas from Dewey’s political pragmatism with theoretical perspectives on the role of professionals. Next, a brief summary of the research findings is provided, and the idea of pragmatic inquiry is used to guide the discussion of some of
the findings. Finally, the potential for new IT to continue to democratic inquiry, and further research inspired by this research that could further develop the idea is described.

The second section applies the idea of PSS as pragmatic tools of inquiry to the specific spatial planning context of U.S. metropolitan regions. First, two dominant normative ideas in spatial planning today, participation and sustainability, are analyzed from a pragmatic perspective. Next, the several venues for metropolitan spatial planning are described. Diverging from scholars who envision ideal institutional arrangements, these arise from diverse geographies and political histories and traditions. As such, they are distinct starting points with distinct possibilities. The section concludes with recommendations and sketches technical choices facing professionals in these contexts who aspire to create or expand PSS as a means of increasing the level of intelligence in spatial planning.

6.2 PSS as Tools of Pragmatic Inquiry

6.2.1 Overview

This inquiry was undertaken with an open-minded sensibility: the artifacts were not evaluated a priori as tools with determined functions, and their use was empirically questioned and examined. However, this conclusion returns to a more normative orientation. The research was framed within the theory of strategic spatial planning in order to provide a perspective on the nature of the planning process, even while in the empirical research this theory was not taken to define reality, only serve as one possible explanation.

In Chapter 2, one alternative theoretical paradigm introduced for PSS was “structured coercion,” and it was argued would be empirically evident if this was the most appropriate theoretical lens to describe the workshops. However, the evidence suggests the social learning perspective provided a better description, based not only on the plain statements of the participants involved, but also through triangulation between surveys, observations, and photographs. However, coercion cannot be ruled out since, there are power imbalances between professionals and participants. Professional experts largely design the methods and tools present in planning processes, and professionals have unique knowledge that provides a store of ideas about what types of spatial development that places them on an unequal footing with participants. The participants in the workshops studied are relatively active in community planning and reported they attended between one and five planning meetings per year on average. Despite this, their responses to the questions about views are highly varied (no two
questions sharing a correlation coefficient of greater than 0.2), suggesting few participants had
developed any kind of systematic position on urban growth. While reinforcing the importance of
deliberation and learning, it raises the specter of professionals who can provide ready concepts
to an impressionable public

To seriously address the potential for manipulation, we turn to social theory from
Allmendinger’s typology. In his framework, this type of theory provides a set of assumptions
about society, such as whether it is best conceived from top down or bottom-up ways. The
social theory used is Dewey’s pragmatism. This conclusion describes the nascent theory he
proposes for how technology can be applied to public deliberation, and how expertise can be
used in democratically legitimate ways. His concept of the role of knowledge and artifacts as
tools of inquiry argues that experts and technical artifacts can play a role in democratic decision-
making, if they are subordinated to the community, which ultimately defines the nature of
problems and decides on policy options. Within this context, technology containing embodied
intelligence can be used in deliberative settings to raise the level of intelligence.

While useful, this theory contains two primary defects, both understandable for a work
first published in 1927. First, the issue of the growing power of professionals is only briefly
mentioned and his view on the power of professionals too sanguine. For a more nuanced
picture of the role of professionals in society, we turn to Parsons (1970). He argued that
the professional members of the “professional complex” (the related activities of professional
practice, research and teaching), cannot be held accountable exclusively through conventional
mechanisms for accountability, such as the market, governmental authority, or public opinion.
Ultimately professional groups must be self-regulating. In addition, he argued that due to the
“competence gap” between professionals and their clients, the relationship must be founded on
trust.

Second, Dewey could only dream of the vast expansion of information technologies in
recent years, often deployed, as in this dissertation, by professionals and powerful institutions.
Therefore some recent developments in information technology, and their potential application
to spatial planning, are briefly described in light of their potential use as tools of inquiry. In light
of the proposed concept of PSS as tools of pragmatic inquiry, the first section concludes with a
discussion of future research that emerges from this dissertation, both specific issues that arose
in the fieldwork, and the broad outlines for larger studies on these topics.
6.2.2 Dewey’s Theory of Technology as *Embodied Intelligence*

Dewey, like many humanist philosophers, argued technology need not lead to inevitable dehumanization, but instead could be used to serve humanistic goals: “if the technological age can provide mankind with a firm and general basis of material security, it will be absorbed in a humane age” (1985 [1927]: 217). Therefore his work in this area is connected to a broader field in STS and the philosophy of technology that has sought to place technology within social contexts theoretically, with the broader purpose of arguing for the social oversight and regulation of technology (Hackett 2008; Latour 1993; Scharff and Dusek 2003). Despite this broader context, few theorists have taken Dewey as a starting point for analyzing technology, with the notable exception of Hickman (2003; 2001), who treats it at a more general level than described here. Others in this tradition choose to work historically (Edwards 1996) or ethnographically (Star 1999). This is understandable, since as described below, Dewey’s ideas about technology are sketchy and undeveloped. However, his theory provides several valuable features that make it particularly useful to diagnose and analyze professional IT in spatial planning contexts.

First, his theory is anchored in a broader view of democracy provides the concept of always-contested “problems,” the inevitable outcome of collective life that links with planning theories. Defining these problems, and shaping collective action to address them, such as governmental institutions, is something subject to ongoing debate. However the process is anchored in face-to-face dialog. This links design theorists’ concept of “wicked problems,” (Rittel and Webber 1973) with the insights of the communicative literature described in Chapter 2, which provides greater theoretical richness to deliberative settings than Dewey alone. Defining planning as focusing on problems linked to urban places, provides a definition that that avoids the fruitless task of demarcating sharp institutional or topical boundaries. The more specific spatial planning theory invoked in Chapter 2 anchors spatial planning as an activity that shapes and frames “what a place is and may become,” but the boundaries and nature of this remain to local contexts to define (Albrechts 2004).

Second, Dewey’s pragmatism provides a valuable epistemology of practice. While it does not eliminate the problem of professional accountability and trust discussed below, it provides a valuable perspective on the role of expertise in public life. Dewey saw great potential in the “improvement of the methods and conditions of debate, discussion and persuasion,” and argued democratic governance required expert inquiry. However, the role of experts is facilitating investigation, not “framing and executing policies” (1985 [1927]: 208-209). This investigation should be experimental, and he took care to point out this does not mean the logic
of laboratory experimentation. Instead, the logic would follow two principles: first, that “concepts, general principals, theories … which are indispensable to any systematic knowledge be shaped and tested as tools of inquiry” and second, that “policies and proposals for social action be treated as working hypotheses … they will be experimental in the sense that they will be entertained subject to constant and well-equipped observation…. The result was inquiry that functioned as an “apparatus for conducting investigation,” not “taken to be itself knowledge,” consistent with pragmatism’s broader stance that all knowledge was provisional and should be subjected to empirical testing. The result of this process is that “beliefs formed and held in the absence of evidence will be reduced in quantity and importance” (1985 [1927]: 202-203). While leaving open practical issues of how to implement this vision, it helpfully argues that technical expertise is required for good policy, but need not be applied in a rigid, technocratic manner.

Given this context of a broader theory of “problems” in democracy, and a pragmatic epistemology that understands expertise and expert knowledge as both necessary and provisional, we turn now to his specific concept of technology:

Just as the specialized mind and knowledge of the past is embodied in implements, utensils, devices and technologies which those of a grade of intelligence which could not produce them can now intelligently use, so it will be when currents of public knowledge blow through social affairs. The level of action fixed by embodied intelligence is always the important thing. […] Capacities are limited by the objects and tools at hand. They are still more dependent upon the prevailing habits of attention and interest which are set by tradition and institutional customs. Meanings run in the channels formed by instrumentalities of which, in the end, language, the vehicle of thought as well as communicate, is the most important. […] A more intelligent state of social affairs, one more informed with knowledge, more directed by intelligence, would not improve original endowments one whit, but it would raise the level upon which the intelligence of all operates. The height of this level is much more important for judgment of public concerns than are differences in intelligence quotients.” (Dewey 1985 [1927]: 209-211, emphasis added)

In this view, the role of technologies is to function as tools of inquiry, that enhance collective capacity by making available embodied intelligence that raises the level upon which “the intelligence of all operates”. In the terms of this study, PSS may not make participants more intelligent, but it will allow the group to raise the level of their discussion in various ways: allowing them to ask new and different questions, drawing on new sources of knowledge, and considering more variables than possible using alternative techniques. Of course, the embodied intelligence within artifacts is not unproblematic. Dewey described expertise as both necessary
and requiring examination, and as developed further below ultimately rests on some degree of
trust in professional planners.

This description Dewey provides above links well with additional theoretical perspectives
brought to bear in this dissertation. In particular, the importance of “tradition and institutional
customs” links to the institutional literature described in Chapter 2. Dewey notes the importance
of “instrumentalities” like language, an idea that has been broadened and refined in the literature
on frames, and in a technical context, on the status of representations and indicators described
in Chapter 3. While meaning is always contested, communicative rationality can produce
collective understandings like indicators (Innes 1975; Wong 2006; Innes and Booher 1999;
Innes 1990). In turn, PSS can allow participants in the planning process to draw on and apply
knowledge, like indicators, although necessarily mediated through institutions, traditions, and
language.

6.2.3 Professionals, Trust, and Tools of Pragmatic Inquiry

Given the privileged role of professionals in designing, implementing, and interpreting
PSS, Dewey’s vision of technology as a tool for practical inquiry must be augmented with a
discussion of the roles of professionals in modern society. This section draws quite selectively
on the literature on professionalization, identifying the key issue of trust as an essential and
unavoidable element for PSS use. While Dewey notes the rising prominence of professionals in
the Public and Its Problems, their role is underdeveloped. For example, he proposes the
metaphor of professional as craftsman, which downplays issues of power and authority: “The
man who wears the shoe knows best that it pinches and where it pinches, even if the expert
shoemaker is the best judge of how the trouble is to be remedied,” while noting elsewhere
experts can only aid in inquiry and not design policies (Dewey 1985 [1927]: 207).

The role of professional planners has been particularly fraught, making a more nuanced
view of professional accountability particularly important. Klemek has documented the
relationship between growing institutionalization of urbanist professionals and urban renewal.
He argues the intellectual leadership of modernist architects and planners constituted one of the
four pillars of the “urban renewal order,” the others being the rise of modernism as an aesthetic,
federal policy, and urban political reform movements. “The creation of an urbanist establishment,
so to speak, was certainly just one part of a larger trend toward the enshrinement of
technocratic expertise in American life. … It was in large part through this very process of
professionalization that urbanists obtained powerful authority in mid-twentieth-century American
life” (Klemek 2011: 53). It was precisely the received wisdom of professional planners and its implementation in urban renewal projects that Jacobs targeted in the introduction to her The Death and Life of Great American Cities, arguing planners sought to impose “Radiant Garden City Beautiful” on cities to neatly organize functions in disregard of their actual dynamics, and the “land-use master plan for a bit city is largely a matter of proposed placement, often in relation to transportation, of many series of decontaminated sortings” (Jacobs 1961: 25).

Amid the tumultuous 1960s, Rein described four possible sources of authority for planners: expertise, bureaucratic position, consumer preferences, and professional values. However, he argued these are mutually exclusive, and cannot be pursued together by any single planning organization (Rein 1969). While the legacy of urban renewal, and broader involvement of professional planning in activities like racial zoning and residential exclusion casts a long shadow, particularly in some communities, Parsons provides a useful description for the unique role of professionals that portrays the client-professional relationship in a new light.

Parsons argues that the “professional complex” is composed of the interrelated areas of professional practice, research, and teaching, often centered on the modern university. In this complex there is a distinction between the professional (practitioner, professor, researcher) and the “lay” public (clients, students, research subjects). Conventional accountability mechanisms, such as markets, governmental authority, and public opinion struggle to regulate these relationships, since specialized knowledge is required to judge the actions of professionals. Parsons argues that ultimately professional groups must be to some degree self-regulating, and ultimately professional relationships must be characterized by trust, casting doubt on the ethical nature of “informed consent.” However, instead of viewing these relationships as essentially one-sided, Parsons argues they involve the joint production of common values: “not only whether the pretension of competence is justified, but whether, if it exists, it will be used to exploit or benefit the participating lay elements or, as I much prefer to put it, be used in in a higher-order common interest” (Parsons 1970: 127).

Importantly, in Parson’s view, the people involved in these professional relationships are active participants, whose participation is required to achieve the broader professional goals being pursued. Interestingly, this is in line with views from normative democratic theory described in the second section that argue that participation is required for effective governance, since for example, it can provide a means to communicate values, local knowledge, and innovative ideas (Fung 2006). In this view, participants don’t merely serve professional interests,
but work jointly with professionals to accomplish shared goals. Interestingly, this view aligns with an argument Dewey proposes for experts. If they aren’t engaged with the public, their knowledge is by definition irrelevant: “a class of experts is inevitably so removed form a common interests as to become a class with private interests and private knowledge, which in social matters is not knowledge at all” (Dewey 1985 [1927]: 207).

This topic, and the underlying central concept of trust, poses a rich set of questions for subsequent research on the origins of trust in professional planning necessary to develop and use PSS effectively. The topic of trust is the subject to a large and diverse literature, especially in business, economics, computer science, and psychology. Trust has been viewed as an “irreducibly social” phenomenon “not reducible to individualistic psychological factors” (Lewis and Weigert 2012) and therefore especially suited to in-depth ethnographic research. Theorists argue that trust has emotional, cognitive or rational, and behavioral dimensions, and that these dimensions together define different types of trust (Lewis and Weigert 1985). The highly dynamic nature of these dimensions means trust eludes ready identification through cross-sectional studies, and they likely share mutual causal linkages. For example, Weigert (2011) argues that eliciting trusting behavior can encourage cognitive and emotional trust, while much research assumes the reverse. Paradoxically, modern life may require both trust and distrust. A healthy democratic systems, for example, requires both trust in the system, but distrust of incumbents and bureaucracies.

Researchers examining information systems argue that system dependability is in relation to the underlying concept of trust, and should not be analyzed from only technical perspectives (Clarke 2006). As a result, the same system used in different contexts can result in different levels of trust and therefore different levels of perceived dependability. In one intriguing case, a hospital information system was trusted during normal operations, despite the fact that during peak times it could report negative beds available. However, the system was made reliable through manual accounting during these “bed crises,” and regular management that used a “bed board” which complemented the computer system with nuanced information, such as slanted cards that indicated a patient would be leaving soon (Clarke et al. 2006). Similarly, in the workshops in Austin, participants were encouraged to make notes on the paper maps of information not readily captured by the PSS, and the maps were collected for subsequent analysis. It seems likely that in the context of PSS, trust is interrelated with the reputation of the professionals involved, as well closely interrelated with processes which unfold over time where
communities develop planning cultures through many distinct projects. Possible research designs to explore this issue further are discussed at the close of this section.

6.2.4 Summary of Research

Having developed the concept of PSS as professionally-developed tools of pragmatic inquiry, the next section contains a brief overview of the dissertation research findings. The ideas are then used to discuss two issues: qualitative evidence that PSS were used for inquiry, and the presence of errors in the PSS.

Theoretical Framework and Dependent Variables

This dissertation examines spatial planning processes. Chapter 2 describes a set of theories: strategic spatial planning served as a framing theory, which notably describes spatial planning as involving not only communicative rationality, but also instrumental, strategic, and value rationality. The study’s underlying social science philosophy is Sayer’s critical realism, and the social theory is American pragmatism. Several exogenous theories are also used. It is argued that the abstract forms of rationality present in planning mutually rely on social learning, which can provide measurable constructs for the empirical study. In addition, the concept of frames and institutional theory provides useful perspectives which link social learning with spatial planning. Chapter 3 characterizes PSS as focused on practical usefulness in everyday planning contexts, and involve interactive representation, indicators, and rule extrapolation. PSS are contrasted them with urban system models, which are computer models that attempt to maximize concern for the complexity of urban systems instead of practical usefulness. There is some evidence that blurring between these categories is occurring, but practical other considerations suggest they will remain separate despite technical innovation.

After STS scholars, especially Edwards (1996), the research design was organized around research questions at three scales: spatial planning workshops, processes, and infrastructure. At the workshop level, the key independent variable is interaction design, the design of participatory exercises, and the dependent variable is (self-) reported learning. Wenger’s concept of infrastructures of learning provides a social learning theory to guide the investigation. At the meso level, the key independent variable is process design. The dependent variables are both reported learning and double loop deliberation. Drawn from the organizational learning literature, double loop learning is characterized by Model II behavior, which Argyris and
Schön argue is characterized by several “governing variables.” These variables form the basis of the novel double loop index.

A limited investigation is also conducted at the macro, or infrastructure level. This section applies two theories to qualitative materials drawn from the cases and focus groups of professional planners: Rogers’ (2003) theory of the diffusion of innovations, and the concept of frames. While providing insights, the section also discusses the need to consider context more fully to understand PSS diffusion.

**Cases**

The research questions were investigated in four cases, described in Chapter 4. These cases are all set in metropolitan contexts in Boston, Kansas City, and Austin. While involving in some cases innovative PSS and funding from the HUD Sustainable Communities Program, they are in most respects examples of fairly routine U.S. spatial planning practice. In Austin, the case is a planning project led by a regional council of governments focusing on conducing spatial planning for four demonstration sites. The locations are exurban communities where growth is anticipated, partly due to new highway infrastructure and the region’s growing economy.

The primary Boston case includes two projects, both led by the regional planning agency MAPC. The North Suburban Priority Mapping Project seeks to involve participants from several towns in a project to identify priority areas for development and conservation. The other Boston project, the Marshfield Buildout and Alternative Futures Project, involved analyzing a town’s current land use regulations in light of changing housing preferences and a concern for the location of affordable housing. Lastly, two secondary cases are included in order to provide additional perspective on the primary cases. In Kansas City, the Sustainable Places State Avenue Corridor project is a case where a PSS was anticipated but was not used. In the City of Boston, the Fairmount-Indigo Planning Initiative provides a case in a mixed-income, multiethnic neighborhood, and a workshop that was very similar to Austin except it also did not include a PSS.

While regional agencies played a key role in several of these cases, the projects are largely typical of local spatial planning practice in the U.S. The Boston Marshfield project and Kansas City case deviated the most from conventional land use planning practice, but provide an opportunity to investigate other aspects of PSS use and were not sites where survey data was conducted. The study follows a mixed-methods research design that involved observation of workshops and meetings, workshop photographs, a field survey, interviews, and focus groups.
Workshop Findings (Micro)

In general, a survey found high levels of reported learning and double loop index among the planning workshop participants. The participants with the highest levels of reported learning, as well as the highest level of the double loop index, were participants in the Austin workshops. Held in geographically and democratically diverse settings, these workshops each involved an embodied computation interaction design that featured a digitizer to operate the PSS, and who verbally reported back to the discussion the PSS outputs. A paper map was used as a model input. Participants at a workshop held as part of the North Suburban Priority Mapping Project where the PSS was used interactively reported the next highest levels of learning. Participants at a different North Suburban public workshop that featured only an exercise with many paper maps, and participants at a workshop in the City of Boston, reported the lowest levels of learning.

While these findings confirmed PSS could be present at workshops with high levels of learning, in order to examine their role in more detail, two statistical models were constructed from the survey data using responses from the Austin workshops only, where the interaction design was constant across the four workshops. These models found correlations between learning outcomes and interaction with other participants. The PSS primarily contributed to both learning measures by helping participants imagine how the community could be different. In both cases, participants who reported attending planning workshops more frequently reported less learning, but other demographic variables, such as level of education, or gender, were not related to learning. The two personality dimensions, sensation seeking (a measure of innate curiosity) and goal orientation (the degree participants pursue goals) are not significant in these models, however the workshop participants were very high on these measures, so it might be that these contribute to learning for the population at large.

Planning Process Findings (Meso)

Several hypotheses were examined at the process level. In particular, the statistical models revealed that the extent two which participants felt the model reflected issues they cared about is related to reported learning. Self-reported participation in creating the PSS was not related to learning, but this may differ for different types of PSS. Finally, at the workshop level, the two forms of learning appear to be correlated, supporting the position that planning discussions do not face a trade-off between focusing on substantive issues, and holding a more
open-ended discussion. No relationship was found between the diversity of opinion of workshop participants and the learning measures.

**Infrastructure Findings (Macro)**

Finally, through a review of published surveys and other materials, it is found that only a limited number of metropolitan regions have adopted PSS. Rogers’ (2003) theory of the diffusion of innovations provides some explanation, since PSS are complex, not easily tested, and the benefits are not easily measured. However, the Kansas City case is used to argue that the concept of frames provides a more useful explanation for how and why PSS are developed. In this case, professionals did not use a PSS despite being provided funding, training, and access to consultants. This is explained by analyzing the frames held by planners about the appropriate use of IT in spatial planning. One key informant interpreted the PSS in the terms of the existing spreadsheet analysis tools he already used, which resulted in ignoring the novel features and practices associated with the PSS. This perspective is used to analyze focus groups where professional planners discuss their experiences with PSS, and several contrasting perspectives are revealed. The section closes by describing the importance of considering the complex context of spatial planning, including the knowledge contained by PSS and a rapidly changing public.

**6.2.5 Discussion**

**Implementing the Discussion Feedback Loop**

The evidence cited previously relied on the surveys to evaluate whether and how the PSS were used for collective inquiry. Drawing on qualitative evidence from survey responses, interviews, and observations, this section describes in more detail the evidence PSS were used interactively during deliberation at the workshops. This section seeks to characterize the nature of the discussion, and describe how the PSS was used for pragmatic inquiry.

First, participants at nearly all the workshops reported high levels of learning as well as high scores on the *double loop index*. In many written comments, the participants reported overall positive impression of their experience. For example, survey comments from the Austin workshops included: “Loved it!” (Hutto), “Good meeting” (Hutto), “The workshop was very informing” (Elgin), “Great session!” (Dripping Springs), “Fun, thought provoking, visual, informative” (Lockhart), and “Excellent” (Lockhart). The positive response is not a surprise, since
as a result of purposeful selection of innovative workshops, they were likely better organized, staffed, and managed than other public meetings the participants may have attended. This introduces a research challenge, since perhaps their enthusiasm for the workshop and reported learning is due merely to the project resources and organization. However, some of the comments support a view that the tool supported the interactive discussion. One digitizer from the Dripping Springs survey provided a typical description of the interaction, which the researcher observed at all of the workshops to varying degrees:

Upon first reporting the [PSS] output measures, one of the participants found an opportunity to critique the process, saying something along the lines of "there's no way Dripping Springs can support that many jobs." I think initially in her mind she saw this as a shortcoming in the software. I reminded her that the software is only interpreting what the participants were putting on the map, and that part of the process is responding to the output measures to come up with something more feasible. In this case, I suggested either adding more housing to support the employment areas that the participants had planned, or reduce the employment areas to something more feasible. At this point, the software began to register a feedback loop to support the design process, and I think this was apparent to the participants. (Dripping Springs, Table 2 Digitizer, emphasis added)

Participants were not universally satisfied, however. In particular, participants at the North Suburban Priority Mapping Project Public Forum reported widespread dissatisfaction. The workshop design included a multitude of maps, complex quantitative rating exercise, and relatively short time for the exercise in comparison with the other workshops (Table 5.1). Some comments received from participants on the survey reflected their reactions: "More discussion less worksheets," "It was too short for much real learning," "This process was poor. People were confused. The weighting made little sense." As a result of the frustration, at the time of this writing the project planner was considering attempting to hold another meeting, despite limited funds, for the purposes of "discussion." The need for more time was a common sentiment across all of the workshops, for example in Dripping Springs a respondent wrote "Workshop is helpful, but it's hard to cover all the work and discussion in the time allowed."

It is noteworthy that participants at the Upham’s Corner workshop had lower reported learning and double loop index scores, although the workshop was longer and involved a paper map exercise very similar to that used in Austin, but without a PSS. Unprompted, the participants provided two comments on workshop surveys that suggest the additional structure and feedback that a PSS could have provided may have improved the ability of the group to inquire into the consequences of proposals:
It was very good. An ideal workshop would have helped participants decipher the results of the activity where we put stickies on items/ideas that were most important to us.

The second half of the workshop was not well organized and lacked the direction for people to be creative. (Upham’s Corner, survey responses)

However other factors should be kept in mind interpreting the data from the Upham’s Corner workshop. The participants in Upham’s Corner were more ethnically and racially diverse, and drawn from several community-based organizations. In addition, they reported attending public meetings more frequently than participants from the other workshops, a variable which was found to be negatively associated with learning outcomes in the statistical analysis. The differences may also be due to the differing nature of the planning topics discussed.

**PSS Transparency: Opening the Black Box**

The discussion above suggests that trust is required to implement tools of pragmatic inquiry like PSS. One view is that this is produced through participation in creating the PSS, but other sources of trust are possible. This section discusses this issue in light of the evidence collected. The statistical analysis of the double loop index suggests that it is important for participants to feel that they are able to question the PSS. However, contrary to the assumption implicit in some of the participatory modeling literature, double loop deliberation was not related to participants participating in the creation of the PSS. This could be interpreted in several ways. First, a relatively small number of attendees may have had the opportunity to participate. Therefore, the variable might not be significant because not enough variation was present in the data. Put differently, it may be that the issue cannot be explored here because the participation in the PSS was so limited. A contrary perspective is also possible. The participants were relatively experienced, and with high educational attainment. This audience may be sufficiently comfortable with the representations in order to develop trust in a model on the basis of a verbal description alone, or through questions and answers with the facilitators. There is some qualitative evidence that participants investigated the structure of the PSS, even after hearing it briefly described in the introductory presentations:

The participants did ask how [the PSS] "came up with" the output measures. I described the housing and jobs numbers represented by each chip, and how that was connected to the software, and that seemed to register with most of the participants. (Dripping Springs, Table 2 Facilitator)
They were interested in how the results came out from the program. And I told them the color, development type and the attributes of each development type. (Dripping Springs, Table 6 Digitizer)

No real visibility into the tool. The meeting really gave me insight into the character of the community & some opposing viewpoints. (Dripping Springs, survey response)

The results were uneven since several digitizers reported they were not explicitly asked about the PSS or how the indicators were calculated. This relates finally to two issues where calculation errors made their way into the PSS, although participants noticed one but not another. This experience suggests that the complexity of the calculations plays an important role in effecting which errors are detectable and whether other forms of professional accountability are required. One of the indicators used in the Austin case was a “fiscal impact” analysis produced by a spreadsheet model that was adjusted to account for the varying tax rates and policies of each jurisdiction. This model was created by a research group at the University of Texas at Austin. During the Elgin workshop, the staff discovered the formulas had not been updated to reflect Elgin, and in fact the tool was using the Hutto data. However, none of the participants noticed this, nor was it feasible for them to observe it. A different error at a subsequent workshop was noticed, however.

At Lockhart, participants observed that the housing units associated with one “development type” were coded as multifamily instead of single family. However, there was some uncertainty about whether they referred to a development type that did not contain any multifamily, or misinterpreted one that was actually supposed to represent a mix of single family and multifamily buildings. Regardless of which was the case, it provides evidence of the limits of an approach with limited participation and no opportunity for participants to closely examine the PSS either before or after the workshop. Where the PSS must rely on complex formulas, avoiding misunderstandings and correcting errors may require participatory modeling, and in general greater openness. One professional report focusing on several PSS advocated for adopting practices originating in the “open source” software community more broadly to PSS. This means not only “open access to the underlying source code of the program” but also an approach that “allows others to comment and improve on planning problem statements, methods, data and best practices, and then makes these refinements available to all users” (Holway et al. 2012: 7). However, given limited resources and complexity, some level of
professional accountability may be required, such as norms of precision and professional accountability mechanisms like external auditing.

While normatively valuable, adopting an open source approach requires developing business models that generate sufficient revenue for ongoing software development. This is particularly difficult for fields where the primary users are public sector professionals, often working on limited budgets, which means that they cannot afford either expensive license fees or buggy, time-consuming software. This is particularly acute for many PSS, since they must be updated when never versions of the ArcGIS software are released. This may be one reason several of the tools arose in consulting firms, since these organizations can rely on regular consulting income to subsidize the ongoing costs of PSS development.

Writing about the software used for ecosystem-based management, Curtice et al. (2012) describes the practice of providing software for free meant inadequate revenue for software development. They argue this dynamic may threaten the widespread adoption of ecosystem-based management in general, since it is a management practice that relies on software embodying scientific knowledge to develop and test policies. Therefore they argued for new approaches for both software developers and funders that combines pragmatic combinations of new fees, open source licensing, and multi-year funding strategies.\(^{19}\)

While funds for planning activities are limited, two dynamics within organizations can result in new information technology resources. First, governments make significant investments in organizational IT systems. Planners with technology savvy can work to ensure these investments are useful for spatial planning. For example, operational work order management or permitting databases can be designed to allow for extracting spatial information to use in planning processes, or produce regular monitoring indicators.

### 6.2.6 Potential Application of New IT for Tools of Pragmatic Inquiry

Not only has IT grown exponentially, technology is often closely allied with institutionalized professions. This section surveys several recent developments, discussing their potential to contribute to the development of tools of pragmatic inquiry like PSS.

Technology prediction is notoriously difficult, especially about IT embedded within social institutions. This section adopts the perspective held by organizational theorists Zuboff (1988) and Fountain (2001) that the institutional impacts of IT can vary, and depend on whether

\(^{19}\) Thanks to Todd BenDor for bring this article to my attention.
institutions take advantage of opportunities to modify or reinforce existing practices. While uncertainty cannot be banished, technology develops unevenly, enabling limited speculation about the future. Innovations can often be spotted while only used by a few “early adopters,” before spreading to wider use. However, some innovations never extend beyond a small group, or are made irrelevant by subsequent “disruptive” technologies (Christensen 1997). Despite these challenges, this section will attempt to identify three broad areas of IT development and speculate on some of their use for pragmatic inquiry in spatial, and other forms of planning. They are: architectures for distributed computing, ubiquitous computing, and mass engagement. This topic also serves to provide a backdrop for the concluding section, which will consider more explicitly the relationship between IT and U.S. metropolitan spatial planning institutions.

In Zuboff’s view, IT can be used by organizations not only for enhanced operational management and control, but also to monitor and learn about their activities in new ways. Drawing from her ethnographic research, she calls a strategy that exclusively does the former automating, and a strategy viewing information technology as a source to transform work processes as informing: “the informed organization is a learning institution, and one of its principal purposes is the expansion of knowledge—not knowledge for its own sake, but knowledge that comes to reside at the core of what it means to be productive. […] To put it simply, learning is the new form of labor” (Zuboff 1988: 395). Rejecting the view that IT has been exclusively implemented to control their work force, she argues for a more “complicated reality” where managers are “captive to a wide range of impulses and pressures” and “instead, there is a concentration of forces and consequences, which in turn develop their own momentum” (Zuboff 1988: 389). The result is a combination of expected and unexpected effects, and IT may be used to reproduce existing practice, respond to local needs, or the result of a deliberate plan. These conclusions align with the findings of Fountain, who argued that government agencies use IT to enact institutional values and perspectives (Fountain 2001): “new information technologies are enacted […] through the mediation of existing organizational and institutional arrangements with their own internal logics or tendencies […] therefore, outcomes are unpredictable and variable in their rational, political, and social features” (Fountain 2001: 12). Therefore IT could be, but is not necessarily, a force for change in institutions. Below

20 For an alternative view, see the intriguing forecast prepared by the Institute for the Future titled: “A Planet of Civic Laboratories: The Future of Cities, Information and Inclusion” (2010).
is a discussion of three trends and how they might impact the loosely institutionalized practice of planning.

Architectures for Distributed Computing

The first trend encompasses several related developments. The creation of service-oriented architectures (SOA) has revolutionized inter-organizational data systems, but made possible new forms of data sharing (Erl 2005). In contrast to earlier, integrated computing approaches where data could not be easily shared between applications, a service-oriented architecture combines multiple computing systems that are interconnected through interoperable application programming interfaces (API) enabled by standards. APIs form the core of new technologies that are enabling new data sharing and interoperability. Along with adoption by public agencies, SOA underlies multi-platform apps, and increasingly are selectively opened to outsiders. This means large private databases can be queried on demand. While these developments technically enabling greater sharing, as described in Chapter 3, representations carry a political dimension as they reflect particular frames of reality. Therefore, taking advantage of these technologies depends on common points of reference that can be produced through planning processes, but also evolve over time.

These technologies collectively make possible new developments in planning, such as mashups (Ferreira 2008) and on-demand urban modeling (Ferreira, Peng, and Flaxman 2008; Flaxman and Li 2009). This architecture also underlies Peng’s concept of Internet or distributed GIS, which “allows a variety of client devices to access geospatial data and processing tools in servers anywhere and at any time. […] Different types of GIS data and functionality could reside on different servers on the Internet and could be assembled and integrated locally on demand” (Peng and Tsou 2003; Alameh 2001).

These developments could impact spatial planning in several ways. First, as already noted, these technologies enable new forms of data sharing that extends beyond downloading large files. A range of new data formats and APIs are already emerging which can be applied to spatial planning problems, including standards created by the Open Geospatial Consortium and APIs providing transit routes and walkability information. Urban models and PSS could draw on public and private data sources utilizing standards and APIs, ensuring the inclusion of most up-to-date data. In addition, in theory SOA could be used to enable analyses to be run “on demand,” especially as server-side geocomputation becomes more efficient. However, implementing this type of approach requires new standards, such as the Planning Analysis and Modeling Markup
Language (PAMML) proposed by Singh (2004; 2003). These technical developments may have unexpected and possibly negative effects. For example, SOA does not guarantee openness of the system elements, only transparent inputs and outputs. Therefore while an API for an urban model could allow stakeholders to “run the model” using alternative assumptions, it does not necessarily enable stakeholders to access the technical details or check for coding errors. In addition, the technical facilitation of data sharing and model interoperability may reduce social interaction between users of data and models and technical staff who can aid in their interpretation, frustrating the goals of improved communication and understanding.

Finally, the arrangements described above could be implemented both within and between organizations, potentially forming the basis for greater inter-organizational data sharing. Such a federated data system would combine technical elements for data sharing with formal and informal mechanisms such as legal contracts, policies, rules, and procedures (Nedovic-Budic and Warnecke 2011; Ferreira et al. 2010).

Ubiquitous Computing

Ubiquitous computing refers to the trend that people are increasingly interacting with many small networked computers, often embedded in the environment, instead of using conventional desktop workstations (Weiser 1991; Theng and Duh 2008). This world is made possible by the proliferation of both networks and computing devices: wireless data connections, improved home broadband speeds, and the related proliferation of computing devices. Laptops and tablet computers continue to decline in price, cost, and weight, as the technology of their underlying components (namely processors and memory) continually improve. While a general development, as previously described the access to relatively powerful laptops is a prerequisite to PSS use as it was described here. In addition, Internet-connected mobile devices promises to not only connect people, but result in an “internet of things” providing society-wide informing opportunity (Atzori, Iera, and Morabito 2010).

These trends could impact planning in several ways. Researchers in the emerging field of urban informatics are exploring how sensors and embedded computation devices can create both new data about the city, but also support fundamentally new interactions by individuals in urban life (Foth 2009; Senseable City Lab 2012). The use of technology for real-time urban management is a motivating force behind corporate attempts to promote the “smart city,” and planners will play a role in defining and implementing these technologies (Singer 2012; Falconer and Mitchell 2012; Harrison et al. 2010; Chourabi et al. 2012). Innovative use of existing data or
the collection of new data could create new sources of knowledge about cities, however this also raises the issues of privacy, public safety, and licensing (Goodspeed 2011), and the practical issues of how to build the “data pipes” required for sharing (Evans and Ferreira 1995).

Ubiquitous computing may have unexpected effects on spatial planning processes. Already laptops are being used for PSS, and increasingly audience members may bring their own smartphones or tablets to public meetings. In the Kansas City State Avenue Corridor project, one attendee at the kick-off meeting brought a tablet computer, and used it to pull up information about proposed projects and reference maps of areas being discussed. Widespread use of smartphones also allows participants to communicate with each other, and it has become commonplace for participants to discuss meetings and conferences on Twitter using hashtags on a “backchannel,” even as the event is going on. New computing devices may also create new means for city residents to interact with planning as they navigate the city, such as through interactive displays installed in public areas or by viewing proposed changes on smartphones or displays embedded within eyeglasses.

Mass Engagement

Finally, the two previous developments have resulted in a society equipped with the ability for unprecedented communication and participation. Two recent reports by the Pew Internet and American Life project have documented this change, observing that large numbers of citizens are turning to the Internet as a venue for civic engagement and to engage with government (Smith et al. 2009; Smith 2010). The low communication costs of new technology makes possible new forms of mass engagement, which may effect planning in several ways. First, it can be used for knowledge creation, including for example OpenStreetMap, volunteered geographic information, and the “citizen sensing” or “citizen science” movements (Boulos et al. 2011). These efforts collect information by asking for input from large groups of volunteers, instead of commissioning costly survey or data creation projects.

Second, mass engagement can be used for pioneering models of participation in the planning process. These include use of social media (Evans-Cowley and Griffin 2011; Loader and Mercea 2012), crowdsourcing, defined by Brahburn as an activity dominated by design (Brabham 2009) and discussed in management more broadly (Malone, Laubacher, and Dellarocas 2010). It also makes possible crowdfunding, the concept of collecting financial donations for public goods or facilities online. The ethical and practical dimensions of these phenomena are still as yet unexplored (Seltzer and Mahmoudi 2012). These developments
raise the question of the relative role of computer-mediated versus in-person communication. While these developments are worked out, it has become clear that new technologies are creating a highly connected and engaged society. This is creating not only the intriguing new forms of information, participation, and collective action described above, but also a volatile arena where misinformation can spread quickly and activists can readily attract attention or cause disruption.

6.2.7 Topics for Future Research

The research raises a range of questions and issues that could spark fruitful future research. First, several issues are discussed which emerged from an analysis of the workshops, including the layout of the room, role of gender, and relationship between online and offline participation. Second, this section will describe future research in three particular areas: examining greater workshop diversity, considering social learning over longer time scales, examining the impact of ongoing technical innovation.

Workshop Discussion

While the focus of this research has been individual learning and the quality of the discussion, in each case the professional planners intend to use the workshop outputs (maps, notes, worksheets, etc) as inputs to create refined spatial plans. At these workshops, no formal effort was made to link the exercises at each table except for a report-out at the end, where representatives of each group were asked to report what they had decided.21 However, this raises the important issue of how the table outputs should be considered. Do they represent “consensus visions” for the table, or instead only a fragmentary records of the discussion? Evidence reported below suggests that group participation is uneven, although mitigated somewhat by facilitation. In particular, women in one group seemed to have been excluded. A related concern is the process by which the chips were placed or changed. One digitizer reported:

It's just when people got to know what they were doing and became really excited during the middle of the exercise, they put the chips everywhere all by oneself, later others just tore them down without notifying. It's kind of...chaos. But it was getting better when people began to really talk to each other, trying to understand others' reasons and preferences, and making some compromise. (Dripping Springs, Table 6 Digitizer)

21 The nonprofit AmericaSpeaks has collected themes from small tables during the discussion using networked computers at their “21st Century Town Hall Meetings” (Lukensmeyer and Brigham 2002).
A related phenomenon observed at all four Austin workshops was participants moving between the tables, even if they were assigned and spent most of their time at one table:

I thought it was interesting that at this particular charrette, other tables would come to our table to see what we decided and vice versa. This might have happened at the other events, but the mood was more friendly and of excitement. Personally, I think this was due to the set up and design of the room. (Dripping Springs, Table 1 Digitizer)

As the digitizer mentioned, the physical design of the room played a role in this type of discussion. For example, the widely spaced tables at the North Suburban Priority Mapping Project Public Forum, and to a certain extent the Upham’s Corner Visioning Forum, discouraged this type of circulation (Figures 5.6 and 5.13). Related to this, the shape of the tables possibly also influenced the nature of the group discussions. At Austin’s Elgin workshop in particular, the auditorium contained round tables. Since the demonstration site was divided into two sections, each group formed around two tables, one for each map. As a result, at times some groups subdivided into two clusters, one focused on each map (see Figure 5.3 for a photo of this phenomenon, and 4.12 for the site boundary). The large square tables used at the other Austin workshops minimized this to a certain extent, although side conversations were common at all workshops.

Issues related to gender and facilitation also emerged as important factors to explaining double loop dialog, as well as create a context for pragmatic inquiry. At the Dripping Springs workshop in Austin, the researcher encountered a table where at approximately two-thirds of the way into the group exercise, the men stood around the map designing scenario, and all the woman in the group sat to the side with crossed arms, not participating in the discussion. A follow-up survey of the female table digitizer revealed this was not a brief episode, and she characterized the discussion this way:

My table (#3) had really good and respectful discussions. It was dominated, though, by the men present at the table, especially when doing the final placement of the stickers. There was plenty of discussion in the beginning, people seemed a little shy to start placing the stickers, but by the end the shyness was gone and stickers where all over the place. Again, everything went smoothly in our table. (Dripping Springs, Table 3 Digitizer)

A subsequent analysis of the data found intriguing but ultimately inconclusive results about whether this gendered pattern of interaction extended beyond this table. Women’s mean score on the double loop index was lower than men’s, but the difference is not statistically
significant. The difference between the means for men and woman is larger for the Dripping Spring workshop than for all the workshops combined, but the difference is not significant for this workshop alone. Women also reported lower scores for the question that asked “other participants at the workshop listened to what I had to say.” However, the difference was also not statistically significant. The lack of statistical significance does not mean there were not gender dynamics at play. Instead, it seems likely that it varied by table, with at only a few (and perhaps only one) did strongly gendered patterns of interaction play out.

In fact, at a subsequent workshop where the researcher sought corroborating evidence of this phenomenon (Lockhart), facilitators were observed specifically asking the opinion of woman who were not actively participating in the conversation. It may be good facilitation provides more equal participation between more or less talkative group members, which may vary by gender. It may be possible other nuanced differences existed between men and woman, which were not visible in the data due to the “noisy” character and relatively small sample sizes.\(^{22}\) One survey respondent at the Hutto workshop wrote, “The instructor did a nice job, in constantly bringing the topic back into focus. (We got off the path) I hope our opinions count because Hutto matters and is a great city.” The facilitators, which in general were experienced planning professionals, demonstrated a well-honed skill in managing the discussion. These skills may in fact be vital in achieving the normative and practical goals of participatory planning, and it is encouraging that it is widespread. For example, MAPC has encouraged employees to complete facilitation training (Metropolitan Area Planning Council 2012).

A trained facilitator who attended a simulated exercise using a similar PSS also concluded facilitation played a critical role: weak facilitation allowed one group to be dominated by a few and devolve into side conversations, and at another group the facilitator’s lack of technical skills frustrated participants which largely agreed on development priorities. The author recommends each group have two staff members: a technologist operating the computer and a facilitator to run the group conversation (Huntsman 2004). Incidentally, this is the staffing arrangement used at the Austin workshops.

Similarly, the research design choice to rely on existing planning processes provided limited ability to explore the potential impact of class or socioeconomic status. Analysis did not find statistically significant difference between racial and ethnic groups on reported learning or the double loop index, although this analysis is limited by small sample sizes. On the basis of

\(^{22}\) On gender and professional negotiations, see for example Babcock and Laschever (2003), and in jury deliberation see Marder (1987).
Rogoff (1990), the research design speculated cultural differences could exist on learning, the dissertation data did not contain sufficient diversity to fully explore this topic. In addition, a fruitful topic for future research is to extend this research into contexts exhibiting wider cultural diversity.

The final concern about the workshop focus is the inevitably limited audience that can participate. In Hutto in particular, relatively low turnout for the workshop resulted in participants raising the importance of expanding participation in the project: “More advertising needed to make residents aware of meetings like this” and “GIS tool great, we need more citizen involvement.” As previously mentioned, a body of research from political sociology has explored the causes for citizen participation that suggests how this problem could be addressed (Verba, Schlozman, and Brady 1995; Nie, Junn, and Stehlik-Barry 1996; Beatley, Brower, and Lucy 1994). While an advertisement for the meeting appeared prominently in the community newspaper at Elgin, it was unclear how much recruitment had taken place for the meeting. In general in the Austin case, the project staff delegated the task of outreach to city staff and advisory committees, with varied results.

An emerging body of research is exploring how the Internet can be used in combination with in-person workshops to facilitate expanded engagement in the planning process. The researcher’s early research showed that the project website, when used in conjunction with other participation opportunities, served as a central communications hub in the planning process (Goodspeed 2010). A study of environmental policymaking came to a similar conclusion, arguing the website served primarily for one-way communication, but partly because of the design and use of the tool and partly for pragmatic reasons (Kelly et al. 2012). In this case, the Internet was useful to support focused discussion on specific technical details: “by providing a forum for targeted questions and feedback from the public. There were few, but nonetheless vibrant discussions on the website on research results and methods presented by researchers at public meetings” (Kelly et al. 2012). Furthermore, the researchers concluded the website and in-person meetings served as complements, with the face-to-face interaction facilitating networking and relationship building. Other researchers are investigating intriguing avenues for online engagement, including through social media (Evans-Cowley and Griffin 2012), or through new paradigms like crowdsourcing or open innovation (Brabham 2009; Seltzer and Mahmoudi 2012). This topic is discussed further below in the section on technology trends.
Potential Future Studies

First, additional workshops with contrasting formats and tools will enable greater triangulation about the robustness of the findings, and further disentangle the relationship between workshop design, participant identity, and learning outcomes. This research could extend in several directions. First, the overall format of each of the workshops is relatively similar, and research could examine additional techniques and methods developed by practitioners and researchers, such as such as Renn’s three-step procedure (Renn et al. 1993; Renn 1999), group techniques like nominal group process (Van de Ven and Delbecq 1971; Van de Ven and Delbecq 1974; Stephenson, Michaelsen, and Franklin 1982; Clark and Stein 2004), or games (Light 2008; Poplin 2012; Feldt 1965).

Research could also consider social learning over longer time scales, identifying the links between planning processes, intermediate changes such as plans and regulations, and final implementation outcomes. There are many anecdotal reports of this type of change. For example, planning frequently results in changes to regulations, and therefore the form of new construction. One innovative study by Ryan observed design ideas taken from a series of downtown plans implemented in the city of Providence, Rhode Island, and subsequent research could investigate the mechanism and process by which these ideas were created and implemented (Ryan 2006). Changes to formal institutions are another possible long-term result of social learning. In one recent high-profile example, the agencies responsible for transportation and land use were merged in Chicago after a regional planning exercise (Metropolitan Planning Council 2005). Of course, whether this constituted a significant institutional reform or merely a cosmetic shift must be empirically determined.

There are relatively few examples of this type of study because of the many research challenges they pose. Planning processes can be lengthy, and causal pathways in the public sphere are murky and difficult to empirically document. Furthermore, such research may result in place-specific findings, rendering generalization across cities difficult. However, just as in comparative politics there has been an interest in identifying general mechanisms (McAdam, Tarrow, and Tilly 2001), theories emerging from individual cases could be useful to complement more micro or meso views. Edwards observes that such multi-scalar research on sociotechnical processes requires “genuine team-based approaches, which require a complex process of coordination, agreement on methods, and division of intellectual labor” which are rare in social scholarship (Edwards 2003: 224).
Next, innovations in PSS will create new tools that could be subject to research because they will differ significantly from those studied here. As observed in Chapter 3, tools with increased analytical complexity post unique practical and theoretical questions. The expanding sophistication of software to create visual simulations, as well as rapidly evolving public perceptions of digital imagery, make them ripe for empirical investigation. Furthermore, research designs could follow the lead of Zellner (2012) and attempt to trace deliberative processes in microscopic detail, or measure in more detail what the tool is contributing to the workshop format. In addition, a shift is underway that will result in PSS that will be available through web interfaces. This holds the potential to make possible novel process designs that combine remote and in-person manipulations. Finally, the issue of cultural diversity, and how it relates to participation, deliberation, and learning in planning is relatively unexplored, and is an increasingly important topic given increasing cultural diversity and social polarization in cities worldwide.

6.3 PSS for Pragmatic Inquiry in U.S. Metropolitan Spatial Planning

This section considers the broader development of PSS for pragmatic inquiry within U.S. metropolitan spatial planning contexts. It does this through three sections: a discussion of two powerful normative ideals in planning practice, participation and sustainability, a description of current routine U.S. metropolitan spatial planning practice which considers why PSS are not more widely used. Next, three general institutional contexts for metropolitan spatial planning are described. Professional recommendations and the possible technical paths for each of these contexts concludes the section.

6.3.1 Normative Ideals from a Pragmatic Perspective: Participation and Sustainability

This section analyzes two topics from the perspective of pragmatism: the legitimacy of participation, and the emerging public problem of sustainability. As human activity stresses natural systems to an unprecedented degree while material inequality has widened dramatically, the paradigm of sustainability has become dominant in planning. From the viewpoint of pragmatism, they are interrelated, not separate or contradictory “process” and “substance” ideals. Participation can take various forms, and unlike in normative democratic theory must be

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23 Exploring this novel terrain may shed light on the emerging issue of Massive Online Open Courses or MOOCs, where course instructors are also grappling with how to combine on- and offline media to achieve learning outcomes.
evaluated and judged by their specific context. Similarly, sustainability is the currently a dominant metacultural frame for the “problem” addressed by spatial planning. As such, it will resist definition except in specific contexts when communities decide on what it means in concrete terms. Nevertheless, sustainability provides the social and political impetus for PSS, and serves as a source of topics and questions by the public where the application of tools of inquiry to improve the level of intelligence is particularly needed.

Participation

The topic of participation is the subject of a varied and lively literature, as it touches on long-running debates about the nature of democracy, pluralism and elitism, and technocracy (Day 1997). Focusing specifically on the urban planning literature, this section will discuss two approaches to participation, as well as participation as it is presented as part of professional ethics. In light of this review, it is argued that the legitimacy of participation must be determined in local contexts.

One approach to participation focuses on how much power is delegated to citizens. In this view, sharing power is the overriding purpose of participation, and this issue provides a normative lens to evaluate all ostensibly participatory practices. The most-cited proponent of this viewpoint in planning is Arnstein’s article proposing a ladder of citizen participation (Arnstein 1969). Written in the context of the civil rights era, the ladder has eight “rungs,” defined by how much power is delegated to the citizens. Arnstein argues that citizen participation “is the redistribution of power that enables the have-not citizens, presently excluded from the political and economic processes, to be deliberately included in the future.” These rungs are divided into three categories. The first two rungs are forms of nonparticipation: therapy and manipulation. The next three rungs are “degrees of tokenism”: informing, consultation, and placation. Finally, the top three are “degrees of citizen power”: partnership, delegated power, and citizen control. The increasing amount of power transferred through participation remains an influential idea in participation literature and practice. As an example, the International Association for Public Participation (IAP2) has published a “Spectrum of Public Participation,” which identifies five goals, labeled as having an “increasing level of public impact”: inform, consult, involve, collaborate, and empower (IAP2). Advocates for “public participation GIS” promote a citizen participation ladder where the bottom rungs are “public right to know” and “informing the public” (Craig, Harris, and Weiner 2002).
While demonstrating a link with Arnstein’s focus on power, the IAP2 spectrum also contains discrete goals for participation. This view of participation, as meeting narrow objectives aside from power delegation, suggests the second approach to participation, which is focused on its use to achieve more narrow goals. One contemporary proponent of this viewpoint is Fung, who argues that although Arnstein’s ladder “still provides a useful corrective to naive and untempered enthusiasm for public participation,” he finds it “obsolete and defective” as an analytic tool, since it “improperly fuses an empirical scale … with normative approval,” and fails to incorporate subsequent theoretical and practical developments. His own typology proposes a cube with three dimensions: communication and decision mode, authority and power, and participants involved. Any particular example of participation is justified by the extent to which it rectifies normative flaws in representative democracy, such as legitimacy, justice, and effectiveness (Fung 2006). These ideas are related to his earlier empirical work which investigated the devolution of power to school and neighborhood crime committees in order to improve effectiveness achieving educational and public safety goals, however within a regime of “accountable autonomy” where the central authority could take back authority if these objectives were not being met (Fung 2004). This goal-focused perspective, whether defined as meeting agency goals or in reference to the goals defined by normative democratic theory, has a history in planning as well. For example, Glass (1979) identified five “objectives” for planning: information exchange, education, support building, decision-making supplement, and representational input, identifying participatory techniques appropriate for each.

How can these two views be reconciled? Bailey et al. argue that improving public participation requires enhanced techniques, promoting a model they call “structured public involvement” which involves (in their case) creating digital renderings of a range of scenarios for development that are used in public workshops (Bailey et al. 2011). However, any technique requires decisions about how the question will be framed, what variables will be represented, and how the project boundaries will be defined. In this project, the design elements which were used to compose the development scenarios that were presented to the public were obtained from “local planning officials,” and the five design elements are mix of housing types, mix of land uses, green space, extent of sidewalk coverage, and street network connectivity. These categories relate clearly to professional concepts of land use planning. Without consulting with participants, they cannot be assumed to reflect their perspective. Public views about land use planning often involve topics not neatly limited to those easily handled through zoning and subdivision ordinances (such as the five above), such as protecting local businesses,
encouraging local foods, or protecting aesthetic or cultural character. While this is be true, this dissertation also argues participation can benefit from structure.

One way to determine the suitability of a particular participatory episode is to examine the broader context. In all of the dissertation cases, specific concepts, forecasts, and measures were drawn from previous planning processes. While some aspects of the workshops were novel, participants could draw on previous knowledge and experiences as they chose how to engage in the given process. This collective repository of spatial planning knowledge relates to the theoretical concept of the public sphere, an ongoing forum where public action is discussed and scrutinized. (Habermas 1991 [1962]; Dewey 1985 [1927]) (See also Chapter 2). While Habermas himself argued this public sphere had ended, it has retained as a useful concept by other theorists. While critiquing his account as historically inaccurate and pointing out women and lower classes were excluded from the public sphere, Nancy Fraser nonetheless calls it an “indispensable resource,” proposing instead the idea of subaltern counterpublics where minority groups can develop a common perspective before entering into the broader public sphere (Fraser 1997).

One final view is that participation is merely a matter of professional ethics, and need not be linked to a broad social theory. Participation appears within the code of professional ethics that applies to professionals who have obtained the American Institute of Certified Planners (AICP) professional certification. The code contains eight “aspirational principles,” and the fifth reads, “We shall give people the opportunity to have a meaningful impact on the development of plans and programs that may affect them. Participation should be broad enough to include those who lack formal organization or influence” (American Institute of Certified Planners 2009). While referring to an earlier version of this document, Lucy raised the concern that the code of ethics included “simplistic planning theories.” On the issue of participation he argued it was “unfortunate” this section did not describe elections, the well-known challenges of participation such as representativeness, and a lack of “any larger sense of public concern” (Lucy 1988). The AICP Code of Ethics and Professional Conduct also contains principles about social justice and a commitment to conserve and preserve the “natural and built environments.” These multiple normative objectives raise a related issue of whether they are compatible. In particular, does a focus on participation and democratic processes mean professionals must sacrifice the concrete objectives of sustainability? This issue is taken up in the next section, which addresses the divide between “substance” and “process” in planning practice and theory.
To conclude this section, the ideas that participation should delegate power, achieve narrow goals, or even satisfy professional values cannot establish any firm universal rules about how it should be conducted. Any participation practice is not imposed on a neutral landscape, and instead draws its meaning and legitimacy from its unique context. Whether a specific participatory practice is justified depends on its relations to existing social arrangements, which means structure may be appropriate or resisted. This is cold comfort to professional planners, who seek replicable and accepted participatory blueprints that “work” without eliciting controversy. It also means that structured participation can be legitimate in specific processes, and through ongoing debate in the public sphere build up planning cultures capable of sophisticated collective action.

**Sustainability**

Sustainability is often juxtaposed against the normative ideals of participation described above. One is presented as merely “process,” the other, the hard “outcomes.” Allmendinger, argues there is no distinction between these two since all “theories are normative, variable through time and space and contextualized through social and historical” (Allmendinger 2002). As previously described, the projects in this dissertation are funded by HUD’s “Sustainable Communities” program, and the innovative techniques were used to specifically encourage a deviation from the existing development patterns.

Campbell observes that “sustainability” involves reconciling conflicts between competing goals: equity, economy, and environment (Campbell 1996). This approach should be updated in two ways. First, the typology omits the role of design in finding creative ways of reconciling conflicts between values. For example, innovative buildings and neighborhoods could ease environmental damage while accommodating human uses. However, even innovative design may merely shift the terms of the debate, not eliminate conflict but changing the nature of substantive disagreement. Second, it omits an account of how the ways of thinking about sustainability itself is framed. The three-dimension conceptualization from Campbell may not in fact reflect the understanding of specific communities. For example, the MIT Community Innovators Lab has created an alternate tripartite division to describe their work on urban sustainability: shared wealth generation, urban sustainability, and democratic engagement (MIT CoLab 2013). This is only one example of a myriad of possible normative formulations for sustainability.
Instead of attempting to define an overarching theoretical framework for sustainability, another approach begins with a specific, apparently uncontroversial goal to organize activities. For example, some have proposed that greenhouse gas (GHG) emissions become an overriding criterion for shaping urban growth (Ewing 2008). The need to estimate the GHG emissions of various urban growth scenarios has been a key factor of the development of PSS and improved modeling in California, where:

“[metropolitan area planning organizations are] devising analytical approaches and moving toward systematizing modeling and measurement. The benefits of more systematic and transparent data analysis and modeling across MPOs should not be underestimated in facilitating effective engagement and program monitoring by stakeholders and the public.” (Barbour and Deakin 2012)

However, any specific decision or plan involves a range of positive and negative externalities for various stakeholders. Even if there was agreement about a single dimension, such as GHG emissions, it does not resolve how the remainder should be addressed, or how the costs and benefits of reducing GHG should be distributed.

This interrelationship between substance and process may explain the success of two of the most flexible PSS, Envision Tomorrow and CommunityViz. With a range of “apps,” Envision Tomorrow can be customized for a variety of topics and applications. As observed by Bartholomew (2007), spatial planning practice has become increasingly linked with GIS, and the related use of PSS for participation.

At least some participants at the workshops studied observed the intrinsic links between the PSS and planning concerning sustainability. One respondent from the Hutto workshop wrote, “Greatly valued it's help bring a balance between multiple goals and sustainability of a growing community. GREAT Tool!” This approach, which views scientific factual knowledge as interrelated with values, that must be resolved through participatory planning, is consistent with a broad shift in scientific inquiry that Funtowicz and Ravetz (1994) have called post-normal science.

In their view, the complexity and uncertainty of contemporary environmental problems, such as global climate change, dissolve the distinction between objective “facts” and political “values” because all analysis must grapple with a social dimension. What is required, then, is an iterative process of “open debate” about the definition of the problem, nature of the scientific knowledge, and what research is useful, similar to the model described by Dewey. Since the
enactment of policy requires value commitments, they are rendered “soft” instead of easily studied “hard” parameters:

The traditional fact/value distinction has not merely been inverted; in post-normal science the two categories cannot be usefully separated. The uncertainties go beyond the systems, to include ethics as well. All global environmental issues involve new forms of equity, which had previously been considered “externalities” to the real business of the scientific-technical enterprise. These involve the welfare of new stakeholders, such as future generations, other species, and the ecosystem as a whole. The intimate connection between uncertainties in knowledge and in ethics is well illustrated by the problems of biodiversity and extinctions of species, either singly or on a global scale. It is impossible to produce a simple rationale for adjudicating between the rights of people who would benefit from some development, and those of a particular species of animal or plant that would be harmed. However, ethical uncertainties should not deter us from searching for solutions; nor can decision makers now overlook the political force of those humans with a passionate concern for those of other species who cannot speak or vote. (Funtowicz and Ravetz 1994)

From this perspective, even seemingly straightforward substantive definitions of sustainability are rendered moot. For example, the Brundtland Commission famously defined sustainable development as that which “meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations 1987). This definition raises the question of how “needs,” of both the present and the future, are to be defined, what costs are justified to meet them, and who should bear the costs.

An intriguing literature on “ecological democracy” argues that institutional reform and information about natural systems may help alleviate the tension between democratic and environmental values. While liberal democracy creates a sharp distinction between humans (who have a voice and vote) and non-human entities that are excluded from politics, Dryzek argues that creative forms of deliberation and institutions could provide democracy with a greater attention to natural systems (Dryzek 2000). In particular, he calls for institutions attuned to the “feedback signals emanating from natural systems,” championing institutional innovations such as bioregionalism, where institutions are aligned with boundaries defined by ecosystems (Dryzek 2000: 156). Goodin has proposed the related idea that democracy should involve individuals that are asked to represent the interests of mute others, such as nature or future generations (Goodin 1996). Like the ideas above, these positions imply a prominent role for IT, the medium for the monitoring, analysis, and simulation required both to “listen” to nature and also analyze effects of proposed actions on natural systems.
6.3.2 Characterizing Current Practice

The professional practice of routine spatial planning in the U.S. has thus far largely not adopted sophisticated IT. The analytical potential of GIS has remained largely untapped in professional practice, associated with the mere automating (to use Zuboff’s term) of processes previously conducted with pen and paper. This is in sharp contrast with other areas of planning and policymaking where IT has been used to implement elaborate data collection, analysis, and modeling. These include transportation planning (National Research Council 2007), environmental impact analysis (Costanza and Ruth 1998), and macroeconomic policymaking (Brayton et al. 1997).

This initial description presents a puzzle. Despite widespread data and a topic amenable to analysis, sophisticated tools are the exception, not the rule. Due to the operational needs of municipal engineering and property assessing, and statewide GIS data-creation projects, municipalities increasingly possess rich spatial data useful for modeling and analysis. The discrete nature of many aspects of spatial planning, from the finite number of legal parcels to fixed parking ratios, suggest it could be readily analyzed by software. In fact, the field has a ready-made set of concepts about the density and structure of housing and commercial development that are reflected in professional jargon: FAR, SRO, TOD, TDR, GFA, etc.

The social and institutional context of spatial planning in U.S. metropolitan regions may provide an explanation of the puzzle, and help explain why advocates have struggled to find broad adoption of new computational tools. Spatial planning is usually conducted by local municipalities, which have limited resources at their disposal and often only conduct spatial planning episodically. A focus on small areas leads to a focus on urban design and aesthetic considerations, since the marginal impact of new growth on the city or region is modest. However, these contextual reasons extend beyond mere pragmatics or a narrow topical focus. As described in Chapter 2, spatial planning in the U.S. has often been practiced in a technical paradigm that stresses instrumental rationality. In this approach, planners constructed population and employment forecasts, and the practice of land use planning required ensuring sufficient land was zoned to satisfy the “demand” for each use. At the same time as this technocratic approach was practiced, land use planning and decisionmaking have been the locus of political mobilization and struggle. Countless neighborhood groups rallied against unwanted development (Robin 1990), and the proximity of low-income communities of color to polluting industrial activities sparked the environmental justice movement (Maantay 2002).
In sum, limited resources, small scales, technocratic practice and political realities have combined to make spatial planning practices contested and unstable, foiling efforts to create more institutionalized PSS or urban models. In keeping with the sociotechnical view of this dissertation, the future of IT in U.S. metropolitan spatial planning itself is intertwined with evolving spatial planning practices and institutions. The following sections describe three general contexts for metropolitan spatial planning, since they influence how these recommendations are implemented: state-dominated, regional-dominated, and small cities and rural areas.

Finally, the technical paths open to these contexts are described. This section next describes a set of recommendations for professional planners. Regions with state- or regional-dominated contexts can choose to emphasize urban systems models or PSS, according to their local political culture and substantive planning issues. Small cities and rural areas, with constrained resources, have fewer choices. In these places, web-based PSS hold the most promise for professional innovation, since they can leverage national or statewide spatial data infrastructures and simplify tool access. In all regions, the development and use of IT require what Healey called institutional capacity, which is comprised not only of knowledge resources like IT, but also relational resources and a capacity for mobilization. Ultimately the uneven distribution of the latter two helps to explain uneven regional capacities and outcomes.

6.3.3 Institutional Contexts for Metropolitan Spatial Planning

In the U.S., three general institutional contexts are emerging for spatial planning.

**State-Dominated Spatial Planning**

The first general context for spatial planning in the U.S. are cities located in states which play a large role in the spatial planning process. In these regions, the heavy involvement of state government in spatial planning and related issues leads to a blurring between state and local policymaking. In Maryland, while political forces have blunted the impact of the statewide smart growth policies pioneered by Governor Parris Glendening (Lewis, Knaap, and Sohn 2009), the Maryland Department of Planning and the National Center for Smart Growth Research and Education at the University of Maryland remain institutional loci for the development of spatial data and analytical capacity which can be used for metropolitan scale planning exercises. These statewide entities, in turn, share close ties with regional planning bodies. Similar
dynamics are at play in Massachusetts, where MAPC’s region contains half the state’s population, and the agency enjoys close ties with the statewide GIS office and state policymakers. Other states include New Jersey, which has conducted statewide planning, and to a lesser extent Florida (Innes 1992). In these contexts, sharp differences in priorities between state and local officials remain, since each remain accountable to distinct electorates, although in these states it is more likely to see the robust resources of state government turned to spatial planning issues, whether it was the statewide fair-share housing policy in New Jersey, Maryland’s priority funding areas, or Massachusetts’ state-directed economic development or 40B housing policies.

Regional-Dominated Spatial Planning

The arrangements described above are less likely in larger states with diverse, and sometimes more conservative electorates. In these states, the locus of spatial planning institutional development will be the metropolitan region. Examples of this include Portland, Oregon, Salt Lake City, Utah, and cities in Texas. The extensive and sophisticated local planning described in this dissertation may surprise readers accustomed to Texas’ libertarian political culture, and familiar with Houston, famous for lacks conventional zoning. However, the state’s legal framework for municipal planning and zoning has led to diverse outcomes. Annexation rules have allowed cities to grow with their populations, and the practice of ETJ enable land use regulation beyond municipal boundaries. Therefore, more than their northern peers, Texas cities can capture growing populations and tax bases. For example, Fort Worth has a sophisticated planning culture centered on a Comprehensive Plan, which is systematically updated annually (City of Fort Worth 2013). Cities also exhibit strongly distinctive approaches to transportation: Dallas has planned and constructed an extensive light rail system, and Houston operates an extensive and heavily-used bus system. However, their location in a large and diverse state largely uninterested in spatial development patterns means spatial planning in these cities will remain based at the regional level, and therefore it will be incumbent upon regional actors to develop innovative data, models, and practices.

Small Cities and Rural Areas

While roughly half the U.S. population lives in metropolitan regions with populations over 1 million, which could fall under the two categories above, the other half of the U.S. lives in smaller cities and rural areas. While large, sophisticated cities attract attention, their size and
distinctive political cultures mean their practices cannot be easily adopted elsewhere. With even more limited resources and varied political climates, these places often lack even the modest resources required to host the types of workshops studied in this dissertation, since they require a relatively large staff, laptop computers, GIS expertise, and inter-agency coordination. In addition, regions with active planning cultures can draw on ideas, forecasts, and other elements from previous plans, resources which may be lacking where planning activities are sporadic.

6.3.4 Recommendations for U.S. Metropolitan Spatial Planning

Considering these three general contexts, this section discusses sociotechnical choices U.S. cities face as they consider whether and how to develop spatial planning infrastructures to support pragmatic inquiry. First, larger metropolitan regions in state- or regional-dominated contexts can take as a general starting point the two general approaches described in Chapter 3. In particular, urban systems models, or PSS. As previously described, the former has the advantage of allowing for more detailed analysis and simulation, but the associated challenges of cost, complexity, and effectively communicating the results. PSS, on the other hand, can facilitate discussion but at the risk of oversimplification of urban systems or inadequate consideration of region-wide growth dynamics. The substantive concerns play a role in informing the general approach and how it is tailored also. For example, despite developing elaborate travel demand models, the need to accurately estimate the influence of growth patterns on VMT has pushed the California MPOs towards PSS, which ironically can provide greater sensitivity to this issue (California Department of Transportation 2007). However, urban systems models may be more appropriate in contexts where the substantive policy issue involves large natural systems, such as the Florida Everglades or water quality in Maryland’s Chesapeake Bay (Jantz, Goetz, and Shelley 2004).

Smaller cities and rural areas, lack the financial and human resources the above approaches require. However in light of the technology trends described above, these cities may have new technical options that can be tailored to their capacity and needs. In particular, web-based PSS tools and simplified urban system models built on new Internet technologies could combine easy access, low technical overhead, and the capacity for customization. While necessarily analytically simpler than the options described above, it could be possible to design and deploy tools that could be customized and used at multiple scales by professionals with minimal training. These systems would take advantage of newly scalable data storage and computation made possibly by distributed, or “cloud” computing, as well as statewide or national
spatial data infrastructures. As an example, researchers at the University of Utah are working to develop nationwide datasets to power Envision Tomorrow “apps” that can be easily used nationwide.

Despite the promise of this path it also has drawbacks, as small cities may lack the ability to track locally relevant data or indicators, or become dependent on external tool providers. There is some limited evidence cities in these contexts are moving towards online applications. In the dissertation research, potential cases in large regions in Arkansas and Chattanooga, Tennessee opted against focusing on in-person meetings, choosing to focus efforts instead on more casual drop-in events and online engagement due to large geographic size. Working with the consulting firm Sasaki, the Des Moines Area MPO developed an interactive online tool to allow participants to explore the trade-offs between priorities involved in regional growth as part of the recent Tomorrow Plan project. Whether the multiple forms of learning described here can be replicated on the web, and how online tools and spatial planning practices evolve, will remain an active area of professional innovation and scholarly investigation.

This section concludes with some specific recommendations for implementing PSS as tools for pragmatic inquiry.

1. **Planners should incorporate PSS into projects, focusing on their use to facilitate stakeholder dialog and learning.** As discussed in Chapter 5, existing professional frames may form an obstacle for PSS development. While it may be appropriate for some situations, this dissertation argues for starting with relatively analytically simple PSS that can support dialog, not assuming the purpose of the PSS is to provide technical exacting results. Similarly, visualization may be important in contexts, but achieving highly realistic visual simulations may not be required in contexts where issues of design and fine-grain urban form are not the subject of planning. Dewey’s contention that expertise far removed from public debate will not be used has largely been confirmed by the literature on the use of knowledge in policymaking (e.g., Weiss 1979).

2. **Metropolitan planning agencies should use projects to develop PSS and broader IT capacity.** While spatial planning may never enjoy the substantial financial resources dedicated to other policy areas, like transportation or macroeconomic modeling, many

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24 The planning process is The Tomorrow Plan, www.thetomorrowplan.com, the tool is available at interactive.thetomorrowplan.com, and has been released for re-use as the open-source framework CrowdGauge, crowdgauge.org, also included in Appendix E.
consultants and agencies have shown that many small projects can be used to systematically
develop innovative PSS tools. Agencies like MAPC have sufficient planning work to employ
several planners with technical skills in using CommunityViz. Increasing this technical capacity
at the regional level has the potential to create a virtuous cycle, where increased capacity
attracts new projects. Local capacity has the added benefit of embedding individual projects
within broader planning initiatives both in a general sense and through the specific use of
existing data and indicators.

3. Planning agencies should cultivate organizational learning, including
evaluating workshops and projects. The theoretical insights developed by Argyris and Schön
and Wenger that figure so prominently in this dissertation were developed in the context of
organizational learning, not public sector planning. However, developing innovative practices
such as implementing PSS, require planning organizations which themselves have the capacity
to learn and change. The related fields of organizational learning and knowledge management
have developed a rich set of theories and practices to improve organizational dynamics and
foster innovation (e.g., Rumizen 2002; Morey, Maybury, and Thuraisingham 2000). It is notable
that in the planning workshops observed, very few used the keypad polling devices to explicitly
evaluate the workshop, although in all cases the professionals participated in this research with
the express purpose of learning from the survey results. Evaluation need not involve
cumbersome and costly outside consultants or overly complex statistical analysis, but relatively
simple practices like brief evaluation surveys and staff meetings where “pluses and deltas” are
openly discussed.25

4. Spatial planning practices should develop models to integrate diverse ways of
knowing. As described in the literature review in Chapter 2, models of spatial planning practice
have too often focused on specific dimensions to the exclusion of others. For example, the
communicative paradigm describes one dimension to planning, but lacks adequate attention to
strategic and instrumental forms of rationality that are often at issue in land use disputes.
Scenario planning has emerged as a useful heuristic for professional planners, and it has
several desirable features such as an explicit focus on value rationality and uncertainty, but
practitioners are left to improvise the structure of the planning process.26 The strategic spatial

25 A plus/delta evaluation technique involves brainstorming items that went well (pluses) and things that
should be changed (deltas).
26 For an interesting discussion of the design of participatory processes, see Faga (2006).
planning theory used here is drawn from a European literature, which can provide a source of ideas that can potentially be adapted to a U.S. context.

6.4 Closing

The question of the scope, nature, and possibility of planning has remained open since first emergence of planning as an identifiable profession over 100 years ago. As a socially embedded practice that contributes to the collective creation and maintenance of sociospatial order, planning enjoys especially close links with society and social institutions. As such, its function is not normatively determined: planning is urban renewal and community development, urban parks and low-density sprawl, zoning for segregation or inclusion, and much more. However this indeterminacy need not be a source of vulnerability, but a resource. Conflict over the nature of planning has produced a rich trove of ideas for how to forge collective agreement and connect a yearning for a better future with concrete actions today. With ongoing sociotechnical evolution producing crises of environment, equity, and health, the sensibilities and methods forged in the acrimonious 20th Century city are now needed at all scales of public life. Like all artifacts of social life, while technology is durable, it is also changeable and can support transformed social processes, where it is a tool for pragmatic inquiry, not an alienating force of manipulation. Therefore this dissertation is a modest attempt to investigate what they do in light of a broader notion of planning.

Yet such an effort faces many challenges. Cynical views of politics or human behavior render learning or collective action theoretical impossibilities, despite the empirical evidence to the contrary. The individualistic logic of the marketplace has extended further than ever before, making collective commitment more difficult than ever, encouraging narrow thinking that focuses on measurable costs and benefits. Powerful interests seek to redefine the problem of the city as one of purely profit or, possibly in the case of smart cities, the profitable production of urban efficiency. Within the field, fruitful controversies about perspectives can turn into divisive debates, and parochial professional worldviews can produce a self-limiting myopia that focuses exclusively on narrow dimensions of urbanism. Perhaps the greatest theoretical challenge is that planning requires holding the ontological middle ground between structuralism (the view that choice is impossible or illusory) and voluntarism (that collective action is impossible). This debate will persist so long as there exists a debate about free will and if individuals can freely choose collective actions.
This dissertation has adopted a framing theory rooted, to a certain extent, in western philosophies of pragmatism and a related liberal conception of political and social life. This may by no means be the only possible or even most useful perspective. However, regardless of the theoretical trappings, as I see it the central problem of planning remains seeing beyond the present into a possible future, where current problems are addressed, and seeking to realize that vision in a way fitting a multicultural, democratic society. Doing so requires grappling with the dilemmas of knowledge, action, and politics this implies. This requires learning and therefore deliberation, and as a result the creative use of artifacts to support these activities is absolutely essential.
Planning Workshop Evaluation Survey

This survey is part of a research project on participatory urban planning being conducted by Robert Goodspeed, a graduate student. Your participation will be a great help to me, and the responses will be kept anonymous and will be used to compare different planning processes and tools. In addition, summarized data will be provided to the project planners to use to evaluate tonight’s meeting. Attached is a form titled “Consent to Participate in Survey” form, which includes more information about the study and your rights. Please complete the form and this survey before you leave tonight. Thank you for your participation.

Please respond to the following questions about your general views regarding urban development by selecting one answer for each question.

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<tr>
<th>Question</th>
<th>Strongly Agree</th>
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<td>5. A lack of affordable housing for low and moderate income residents is a problem in the municipality where I live.</td>
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<td>6. Buildings in the city’s historic areas should be protected from demolition.</td>
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Please respond to the following questions about your views regarding urban development in your community by selecting one answer for each question.

7. Which of the following do you think is the most important housing need in your community?
   - [ ] More rental housing for young people and/or seniors
   - [ ] More affordable housing for working families
   - [ ] More upscale housing for higher-income households

8. Which of these would do the most to improve economic vibrancy?
   - [ ] More retail shops and restaurants
   - [ ] More offices and employers
   - [ ] More people living downtown
   - [ ] More public gatherings, events and festivals

9. Which best describes your view of growth?
   - [ ] There is no problem. Growth should be welcomed.
   - [ ] Growth is endangering our small town identity and rural character.
   - [ ] Our downtown can no longer compete with suburban strip centers and big-box stores.
   - [ ] Growth is bringing more people, but not more jobs or tax base to support the services those people need.
Please answer the following questions about the workshop in general.

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Please answer the following questions about the computer tool that was used during today’s meeting.

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Please answer the following questions that relate to your personal learning style.

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Please answer the following questions about your background.

31. To what extent do you agree with the statement: “I play an active role in the planning of the municipality where I live.”
   - [ ] Strongly Agree
   - [ ] Somewhat Agree
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32. In the last ten years, how many public meetings have you attended, here or elsewhere, about urban planning (development, transportation, land use, etc)?
   - [ ] None
   - [ ] Less than 1 per year
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   - [ ] 5-12 per year
   - [ ] More than 12 per year

33. Did you attend the Hutto Visioning Workshop held on September 13, 2012?
   - [ ] Yes
   - [ ] No

34. What is your sex?
   - [ ] Female
   - [ ] Male

35. How long have you been a resident in this municipality? Report 0 for less than one year.
   - [ ] Years

36. What is your age?
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37. What is the highest level of education you have completed?
   - [ ] Some high school
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38. Please provide any general comments about the workshop, or the GIS tool below. (optional)

35. If you are interested in being interviewed about your experiences at this workshop, please provide your name and contact information below (optional):

   Name
   Phone or Email

Thank you for your assistance with this research project! Please return this survey during the workshop.

For more information contact Robert Goodspeed, MIT Department of Urban Studies and Planning, 77 Massachusetts Ave., Room 9-415, Cambridge, MA 02139, rgoodspe@mit.edu, tel. 1-202-321-2743.
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32. In the last ten years, how many public meetings have you attended, here or elsewhere, about urban planning (development, transportation, land use, etc)?
   - None
   - Less than 1 per year
   - 1-2 per year
   - 3-5 per year
   - 5-12 per year
   - More than 12 per year

33. Did you attend the Lockhart Visioning Workshop held on October 11, 2012?
   - Yes
   - No

34. How long have you been a resident of Lockhart or its surrounding area (ETJ)? Report 0 for less than one year.
   - Years

35. What is your sex?
   - Female
   - Male

36. What is your age?
   - Years

37. What is the highest level of education you have completed?
   - Some high school
   - High school/GED
   - Some college
   - Associate or bachelors degree
   - Graduate or professional degree

38. Are you of Hispanic, Latino, or Spanish origin?
   - Yes
   - No

39. What is your race? Mark one or more boxes.
   - White
   - Black or African American
   - American Indian or Alaska Native
   - Asian
   - Native Hawaiian or Other Pacific Islander
   - Some other race: _____________________

40. Please provide any general comments about the workshop, or the computer tool below. (optional)

41. If you are interested in being interviewed about your experiences at this workshop, please provide your name and contact information below (optional):

   Name ____________________________ Phone or Email ____________________________

Thank you for your assistance with this research project! Please return this survey during the workshop. For more information contact Robert Goodspeed, MIT Department of Urban Studies and Planning, 77 Massachusetts Ave., Room 9-415, Cambridge, MA 02139, rgoodspe@mit.edu, tel. 1-202-321-2743.
Boston North Suburban Priority Mapping Project
Regional Priorities Screening Workshop Pre-Survey

Planning Workshop Evaluation Pre-Survey

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1. Urban growth should be managed to reduce negative side effects (such as environmental damage or traffic congestion).
   - Strongly Agree
   - Somewhat Agree
   - Neither Agree nor Disagree
   - Somewhat Disagree
   - Strongly Disagree

2. High density development should only be allowed near where it already exists.
   - Strongly Agree
   - Somewhat Agree
   - Neither Agree nor Disagree
   - Somewhat Disagree
   - Strongly Disagree

3. New jobs created by growth should outweigh environmental protection.
   - Strongly Agree
   - Somewhat Agree
   - Neither Agree nor Disagree
   - Somewhat Disagree
   - Strongly Disagree

4. A lack of affordable housing for low and moderate income residents is a problem in the municipality where I live.
   - Strongly Agree
   - Somewhat Agree
   - Neither Agree nor Disagree
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   - Strongly Disagree

5. When thinking about priority locations for new residential development (including mixed use that includes residential), how important are the following criteria?

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<tr>
<th>Impact on environmental resources, such as habitats, wetlands, and floodplains.</th>
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6. When thinking about priority locations for new commercial and/or industrial development (including mixed use that includes a mix of commercial and industrial), what criteria do you think are most important to consider?

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Please answer the following questions that relate to your personal learning style.

<table>
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<th>Question</th>
<th>True</th>
<th>False</th>
<th>Can’t Decide</th>
</tr>
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<td>7. I like to do things that are new and different.</td>
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Please answer the following questions about your background.

11. To what extent do you agree with the statement: “I play an active role in the planning of the community where I live.”
   - Strongly Agree
   - Somewhat Agree
   - Neither Agree nor Disagree
   - Somewhat Disagree
   - Strongly Disagree

12. In the last ten years, how many public meetings have you attended, here or elsewhere, about urban planning (development, transportation, land use, etc)?
   - None
   - Less than 1 per year
   - 1-2 per year
   - 3-5 per year
   - 5-12 per year
   - More than 12 per year

13. How long have you lived or worked in the North Suburban Subregion? Includes Burlington, Lynnfield, North Reading, Reading, Stoneham, Wakefield, Wilmington, Winchester, and Woburn.
   - Years

14. What is your sex?
   - Female
   - Male

15. What is your age?
   - Years

16. What is the highest level of education you have completed?
   - Some high school
   - High school/GED
   - Some college
   - Associate or bachelors degree
   - Graduate or professional degree

17. What is your race? Mark one or more boxes.
   - White
   - Black or African American
   - American Indian or Alaska Native
   - Asian
   - Native Hawaiian or Other Pacific Islander
   - Some other race: ___________________

18. Are you of Hispanic, Latino, or Spanish origin?
   - Yes
   - No

19. What is your annual household income?
   - $0 - $19,999
   - $20,000 - $34,999
   - $35,000 - $49,999
   - $50,000 - $84,999
   - $85,000 - $139,999
   - $140,000 or more

20. Do you own a home or rent?
   - I own a single family home
   - I own a multi-family home (e.g. triple-decker)
   - I own a condominium or townhouse
   - I rent my home or apartment
   - Other (none): ___________________

21. What language do you speak at home?
   - English
   - Spanish
   - Portuguese
   - Chinese dialect
   - Haitian Creole
   - Other: ___________________

Thank you for your assistance with this research project! Please return this survey during the meeting.

For more information contact Robert Goodspeed, MIT Department of Urban Studies and Planning, 77 Massachusetts Ave., Room 9-415, Cambridge, MA 02139, rgoodspe@mit.edu, tel. 1-202-321-2743.

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Planning Workshop Evaluation Post-Survey

This survey is part of a research project on participatory urban planning being conducted by Robert Goodspeed, a graduate student. Your participation will be a great help to me, and the responses will be kept anonymous and will be used to compare different planning processes and tools. In addition, summarized data will be provided to the project planners to use to evaluate tonight’s meeting. Attached is a form titled “Consent to Participate in Survey” form, which includes more information about the study and your rights. Please complete the form and this survey before you leave tonight. Thank you for your participation.

*Please respond to the following questions about your general views regarding urban development by selecting one answer for each question.*

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<tr>
<th>1. Urban growth should be managed to reduce negative side effects (such as environmental damage or traffic congestion).</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
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1 of 3
6. When thinking about priority locations for new **commercial and/or industrial** development (including mixed use that includes a mix of commercial and industrial), what criteria do you think are most important to consider?

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Please answer the following questions about the workshop in general.

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<th></th>
<th>Strongly Agree</th>
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<td>7.</td>
<td>I was able to share my views and opinions with others.</td>
<td></td>
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<td>8.</td>
<td>Other participants at the workshop listened to what I had to say.</td>
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<td>9.</td>
<td>I was able to get answers to the questions I had.</td>
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<td>10.</td>
<td>The workshop encouraged creativity and new ideas among participants.</td>
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<td>11.</td>
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<td>12.</td>
<td>Workshop participants discussed the issues in an open way.</td>
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<td>13.</td>
<td>Alternative viewpoints were considered.</td>
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<td>15.</td>
<td>I would support recommendations created by the participants of this workshop.</td>
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</table>
Please answer the following questions about the computer tool (ArcMap and CommunityViz) that was used during today’s meeting.

<table>
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<tr>
<th>Question</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
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<td>16. The computer tool reflects my unique issues and concerns.</td>
<td></td>
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<tr>
<td>17. I influenced the design of the computer tool.</td>
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<tr>
<td>18. I am familiar with the terms and concepts used in the computer tool.</td>
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<tr>
<td>19. The computer tool improved my ability to imagine what urban development might happen.</td>
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<tr>
<td>20. What I learned from the computer tool changed what I thought could happen in my community.</td>
<td></td>
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</tr>
<tr>
<td>21. The computer tool improved the group’s ability to identify areas of agreement and disagreement.</td>
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<tr>
<td>22. Workshop participants felt free to question the outputs from the computer tool.</td>
<td></td>
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<tr>
<td>23. The computer tool is useful for making adjustments to current policies.</td>
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<tr>
<td>24. Please provide any general comments about the workshop, or the computer tool (ArcMap and CommunityViz) below. (optional)</td>
<td></td>
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25. If you are interested in being interviewed about your experiences at this meeting, please provide your name and contact information below (optional):

Name
Phone or Email

Thank you for your assistance with this research project! Please return this survey during the meeting.
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Continued On the Next Page
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<td>I learned a great deal.</td>
<td>![ ]</td>
<td>![ ]</td>
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<td>![ ]</td>
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Please answer the following questions about the computer tool (GIS analysis) that was discussed, as well as the maps and other materials.

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<td>15.</td>
<td>I influenced the design of the analysis and materials.</td>
<td>![ ]</td>
<td>![ ]</td>
<td>![ ]</td>
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<tr>
<td>16.</td>
<td>I am familiar with the terms and concepts used in the analysis and materials.</td>
<td>![ ]</td>
<td>![ ]</td>
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<td>17.</td>
<td>The materials improved my ability to imagine what urban development might happen.</td>
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<tr>
<td>20.</td>
<td>Workshop participants felt free to question the information and analysis presented.</td>
<td>![ ]</td>
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<td>21.</td>
<td>The materials and analysis are useful for making adjustments to current policies.</td>
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Please answer the following questions that relate to your personal learning style.

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Please answer the following questions about your background.

26. To what extent do you agree with the statement: “I play an active role in the planning of the community where I live.”
   - [ ] Strongly Agree
   - [ ] Somewhat Agree
   - [ ] Neither Agree nor Disagree
   - [ ] Somewhat Disagree
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27. In the last ten years, how many public meetings have you attended, here or elsewhere, about urban planning (development, transportation, land use, etc)?
   - [ ] None
   - [ ] Less than 1 per year
   - [ ] 1-2 per year
   - [ ] 3-5 per year
   - [ ] 5-12 per year
   - [ ] More than 12 per year

28. At this meeting, which identity best describes you?
   - [ ] Resident
   - [ ] Property Owner or Developer
   - [ ] Municipal Staff or Consultant
   - [ ] Member of City/Town Council, Board, Commission, etc.
   - [ ] Representative of a Neighborhood Organization
   - [ ] Advocate
   - [ ] Other: _______________________

29. How long have you lived or worked in the North Suburban Subregion? Includes Burlington, Lynnfield, North Reading, Reading, Stoneham, Wakefield, Wilmington, Winchester, and Woburn.
   - [ ] Years

30. What is your sex?
   - [ ] Female
   - [ ] Male

31. What is your age?
   - [ ] Years

32. What is the highest level of education you have completed?
   - [ ] Some high school
   - [ ] High school/GED
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   - [ ] Associate or bachelors degree
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33. What is your race? Mark one or more boxes.
   - [ ] White
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34. Are you of Hispanic, Latino, or Spanish origin?
   - [ ] Yes
   - [ ] No

35. What is your annual household income?
   - [ ] $0 - $19,999
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37. What language do you speak at home?
   - [ ] English
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38. Please provide any general comments about the workshop, or the analysis or materials used. (optional)

39. If you are interested in being interviewed about your experiences at this meeting, please provide your name and contact information below (optional):

   ________________________________  ________________________________
   Name                                               Phone or Email

Thank you for your assistance with this research project! Please return this survey during the meeting.
For more information contact Robert Goodspeed, MIT Department of Urban Studies and Planning, 77 Massachusetts Ave., Room 9-415, Cambridge, MA 02139, rgoodspe@mit.edu, tel. 1-202-321-2743.
This survey is part of a research project on participatory urban planning being conducted by Robert Goodspeed, a graduate student. Your participation will be a great help to me, and the responses will be kept anonymous and will be used to compare different planning processes and tools.

Please read the statement below about the survey, and if you agree click "next" at the bottom of the page. Thank you for your participation!

Consent Statement:

You have been asked to participate in a research study conducted by Robert Goodspeed from the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (M.I.T.). The purpose of the study is to examine social learning in participatory land use planning, and the results will be included in Robert Goodspeed’s dissertation, which will be published online when it is complete. You were selected for the survey because of your participation in the Upham’s Corner Community Forum. You should read the information below, and ask questions about anything you do not understand, before deciding whether or not to participate.

- This survey is voluntary. You have the right not to answer any question, and to stop the survey at any time or for any reason. We expect that the survey will take about 15 minutes.
- You will not be compensated for the survey.
- The information you tell us will be confidential.

This project will be completed by 12/1/13. The recordings will be kept in a secured workspace. All personal material will be destroyed at the completion of the study, on or before 12/1/13. With any questions or concerns, please contact Robert Goodspeed, M.I.T. Department of Urban Studies and Planning, Room 9-415, 77 Massachusetts Ave., Cambridge, MA, 02139, rgoodspe@mit.edu, phone 1-202-321-2743.

If you feel you have been treated unfairly, or you have questions regarding your rights as a research subject, you may contact the Chairman of the Committee on the Use of Humans as Experimental Subjects, M.I.T., Room E25-143b, 77 Massachusetts Ave, Cambridge, MA 02139, phone 1-617-253-678.

By clicking "continue" below, you indicate you agree to the following statement: "I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study."

Next
1. Please respond to the following questions by selecting one answer for each question.

<table>
<thead>
<tr>
<th>The participants in my group reached a consensus about the future of Upham’s Corner.</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>All forum participants reached a consensus about the future of Upham’s Corner.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Please respond to the following questions about your general views regarding urban development.

<table>
<thead>
<tr>
<th>Urban growth should be managed to reduce negative side effects (such as environmental damage or traffic congestion).</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>High density development should only be allowed near where it already exists.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New jobs created by growth should outweigh environmental protection.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A lack of affordable housing for low and moderate income residents is a problem in the municipality where I live.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings in the city’s historic areas should be protected from demolition.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. What is your main priority for improving the Upham’s Corner station area?

- Retail and restaurants
- Jobs and opportunities
- Housing
- Parks and open spaces
- Transit and transportation
- Public safety
- Arts and culture
- Other
### 4. Please answer the following questions about the workshop in general.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was able to share my views and opinions with others.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other participants at the workshop listened to what I had to say.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I was able to get answers to the questions I had.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The workshop encouraged creativity and new ideas among participants.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The workshop helped me to get to know the perspectives of the other participants.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop participants discussed the issues in an open way.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative viewpoints were considered.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I learned a great deal.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would support recommendations created by the participants of this workshop.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My vision for the future of Upham's Corner changed as a result of this workshop.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 5. Please answer the following questions about the workshop exercise that involved placing the small "chips" onto the map to indicate locations for housing, streetscape improvements, etc.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The exercise reflects my unique issues and concerns.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I influenced the design of the exercise.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am familiar with the terms and concepts used in the exercise.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The exercise improved my ability to imagine what urban development might happen.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What I learned changed what I thought could happen in my community.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The exercise improved the group's ability to identify areas of agreement and disagreement.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop participants felt free to question the presented information.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The exercise is useful for making adjustments to current policies.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. Please answer the following questions that relate to your personal learning style

<table>
<thead>
<tr>
<th>True</th>
<th>False</th>
<th>Can't Decide</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to do things that are new and different.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have new ideas all the time.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience suggests I achieve hard goals.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am often one of the first to come up with a possible solution to a problem.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. To what extent do you agree with the statement: "I play an active role in the planning of the community where I live."

- Strongly Agree
- Somewhat Agree
- Neither Agree nor Disagree
- Somewhat Disagree
- Strongly Disagree

8. In the last ten years, how many public meetings have you attended, here or elsewhere, about urban planning (development, transportation, land use, etc.)?

- None
- Less than 1 per year
- 1-2 per year
- 3-5 per year
- 5-12 per year
- More than 12 per year

9. Did you attend the Fairmount Indigo Planning Initiative Community Forum held on November 17, 2012?

- Yes
- No

10. How long have you been a resident of Dorchester? (If you live outside Dorchester, please leave this question blank)

<table>
<thead>
<tr>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

11. What is your sex?

- Female
- Male

12. What is your age?

<table>
<thead>
<tr>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
13. What is the highest level of education you have completed?
- Some high school
- High school/GED
- Some college
- Associate or bachelor's degree
- Graduate or professional degree

14. Are you of Hispanic, Latino, or Spanish origin?
- Yes
- No

15. What is your race? (Mark one or more boxes.)
- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Other Pacific Islander
- Some other race: [ ]

16. Please provide any general comments about the workshop. (optional)

17. If you are interested in being interviewed about your experiences at this workshop, please provide your name and contact information below (optional):

Thank you for your assistance with this research project!

For more information about this research project, contact Robert Goodspeed, MIT Department of Urban Studies and Planning, 77 Massachusetts Ave., Room 9-415, Cambridge, MA 02139, rgoodspe@mit.edu, tel. 1-202-321-2743
Appendix B
Case Meetings and Interviews

Primary Cases

Austin

Public Workshops Attended
• Hutto Charrette (11/8/12)
• Elgin Charrette (11/29/12)
• Dripping Springs Charrette (1/17/13)
• Lockhart Charrette (1/31/13)

Project Staff Meetings Attended
• Technical Team Meeting (10/5/12)
• Envision Tomorrow University of Texas App Development (webinar) (10/12/12)
• Technical Team Planning Meeting (11/9/12)
• Elgin Charrette Debriefing and Staff Meeting (11/30/12)
• Workshop Planning Meeting (phone) (12/7/12)
• CATS Consortium Partners Meeting (1/18/13)
• Sustainable Places Project Austin Demonstration Site Planning Meeting (2/1/13)

Interviews
• Chad Coburn, Capital Area Council of Governments (7/27/12, 8/24/12, 11/1/12)

Boston

In addition to the following interactions, the researcher worked at MAPC roughly one day per week between January 2012 and April 2013, primarily on assignments unrelated to this research. The researcher was paid for some work related to the development of the Marshfield Buildout and Alternative Futures project, as well as for work related to the design and implementation of the scenario modeling platform focus groups. The only involvement with the North Suburban Priority Mapping Project was the research survey. The researcher’s identity as a student was known to all agency staff and project participants during this period, and verbal or written consent was obtained for all information used for this dissertation according to the approved research protocol #1203004956 with the MIT Committee On the Use of Humans as Experimental Subjects.

Scenario Modeling Platform Focus Groups
• MAPC Focus Group (1/20/13)
• Natick Focus Group (1/31/12)

North Suburban Priority Mapping Project

Planning Meetings
• Evaluation Question Development (3/25/13)
• Internal Public Forum Debrief (4/1/13)
Marshfield Buildout and Alternative Futures Project

Public Workshop
  • Marshfield Buildout and Alternative Futures Project Planning Board Presentation (5/14/12)

Planning Meetings
  • Initial Marshfield Data Collection Meeting (1/17/12)
  • Marshfield Scenario Modeling Meeting (2/24/12)
  • Reconciling Zoning into Model Framework (3/20/12)

Secondary Cases

Kansas City

Public Workshops
  • State Avenue Corridor Third Community Meeting (4/3/13)

Interviews
  • Jeff Hirt, Mid-America Regional Council (8/24/12, 12/12/12, 1/31/13)
  • Bob Lewis, Development Strategies (3/25/13)
  • Frank Lenk, Mid-America Regional Council (3/19/13)
  • Yogesh Saoji, Wallace Roberts & Todd, LLC (3/15/13)

Boston (BRA)

Public Workshop
  • Upham’s Corner Visioning Forum (2/2/13)

Planning Meetings
  • Upham’s Corner Community Forum Volunteer Meeting (1/30/13)

Other Interviews
  • Tim Moreland, Chattanooga-Hamilton County Regional Planning Agency (2/13/12)
  • C.J. Gabbe, Fregonese Associates (7/24/12)
  • Critter Thompson, Decision Commons (4/12/12)
  • Ken Snyder, Placematters (8/10/12)
  • Michael McKeever, Sacramento Council of Governments (12/27/12)
Appendix C
Exercise Chips from Austin and Upham’s Corner Workshops

Development Type Chips (Stickers) Used in Austin Sustainable Places Project Workshops (actual size)

Development Chips Used at Boston (BRA) Upham’s Corner Visioning Forum (actual size)
Appendix D
Activist Flyer Distributed at Elgin Workshop

NOTICE

YOU ARE BEING DELPHI’D
This meeting is designed to manipulate and direct public opinion to approve the Sustainable Places Project Plan

The Delphi Method is being used to create the illusion that this is your plan and that you have some part in crafting the outcome. This is a technique developed by the RAND Corporation in the 1960’s which is used by meeting facilitators to block opposition and discard opinions that do not support their plan. This propaganda method uses peer pressure to shame and silence you.

ELGIN SUSTAINABLE PLACES PROJECT is being used by CAPCOG to regionalize the Central Texas area and erase the city, county, and ultimately, State boundaries. Your transportation tax dollars will be used to build apartments and condos in designated areas of your city—and nowhere else. Your money will directed to favored developers building stack and pack housing. You are losing the ability to direct your elected officials through this plan to destroy local representation. This is happening across the US. There are now 11 Mega Regions designed to replace States.

Sustainable Elgin is UN Agenda 21

THIS INFORMATION IS PROVIDED FOR YOU AS A SERVICE BY CENTRAL TEXANS AGAINST UN AGENDA 21
www.ElginAgenda21.com
www.infowars.com

[Page 1 of 2]
WHY IS EVERYONE TALKING ABOUT UN AGENDA 21?

UN Agenda 21/Sustainable Development is the action plan to inventory and control all land, all water, all minerals, all plants, all animals, all construction, all means of production, all information, all energy, and all human beings in the world. INVENTORY AND CONTROL

Have you wondered where these terms 'sustainability' and 'smart growth' and 'high density urban mixed-use development' came from? Doesn't it seem like about 10 years ago you'd never heard of them and now everything seems to include these concepts? Is that just a coincidence? That every town and county and state and nation in the world would be changing their land use/planning codes and government policies to align themselves with...what?

Far from being a 'conspiracy theory' or a 'tin-foil hat' fantasy, this is an actual United Nations plan, signed onto in 1992 by President George HW Bush along with 178 other world leaders. The UN called it Agenda 21 because it is the Agenda for the 21st century. According to UN Secretary General Maurice Strong, the 'affluent middle-class American lifestyle is unsustainable.' That includes single family homes, private vehicles, appliances, air-conditioning, & meat-eating. They are a threat to the planet.

This might sound like a silly plan that doesn't affect you. But look around. This economic collapse is UN Agenda 21. You'll hear that this plan is non-binding, that it's a dusty old plan with no teeth. That is a lie. In fact over the last 20 years this plan has been implemented all over the United States. It's called Sustainable Development. The 3 E's: ecology, economy, equity.

After George Bush signed it in 1992, it was brought back to the US by President Clinton (1993) when he created the President's Council on Sustainable Development for the sole purpose of getting it into every city, county, and state in the US through federal rules, regulations, and grants. This is a global plan but is implemented locally. You'll see it as a regional plan. It might be called Vision 2035, or Your Town 2025, or Sustainable Places Project, ...all of these regional plans are the same. They call for stack and pack housing, restricted mobility, and regional government. Domestic surveillance, smart meters, GMO's, loss of freedom—all UN Agenda 21/Sustainable Development. You are losing your rights. You are being manipulated. You are being lied to. You are the Resistance.

This is a non-partisan worldwide grassroots movement.
PLEASE COPY AND DISTRIBUTE. AWARENESS IS THE FIRST STEP IN THE RESISTANCE.
Appendix E
Spatial Planning Support Systems
Created May 2013, check with organizations for current offerings

Available for Purchase

CommunityViz
Architecture: ArcMap extension
PlaceWays, LLC
placeways.com/communityviz/
info@placeways.com

What If?
Architecture: PC application
What If? Inc.
www.whatifinc.biz
info@whatifinc.biz

INDEX
Architecture: ArcMap extension, web-based INDEXscenarios (under development)
Criterion Planners
www.crit.com
info@crit.com

Available Through Consulting Services

Envision Tomorrow
Architecture: ArcMap extension (proprietary) and Excel spreadsheet (downloadable on website)
Fregonese Associates, Inc.
www.frego.com/services/envision-tomorrow/
info@frego.com

UrbanFootprint and RapidFire
Architecture: Web-based (under development)
Calthorpe Associates
www.calthorpe.com/scenario_modeling_tools

CorPlan
Architecture: ArcMap extension and Excel spreadsheet
Renaissance Planning Group
www.citiesthatwork.com
csinclair@citiesthatwork.com

MetroQuest
Architecture: Web-based
Envision Sustainability Tools, Inc.
www.metroquest.com
info@metroquest.com
Other

**UPlan**

*Urban growth model*

Architecture: Visual Basic Application that runs within ArcMap (downloadable from website under Apache 2.0 free software license)

UC Davis Information Center for the Environment

ice.ucdavis.edu/project/uplan

neroth@ucdavis.edu

**CrowdGauge**

*Scenario construction game*

Architecture: Web-based (free and open source)

Sasaki/PlaceMatters/Des Moines Area MPO

crowdgauge.org

**Madrona**

*Software for place-based planning*

Architecture: Web-based (free and open source)

Ecotrust

madrona.ecotrust.org

madrona@ecotrust.org

**SeaSketch**

*Marine spatial PSS*

Architecture: Web-based

University of California, Santa Barbara McClintock Lab

www.seasketch.org

mcclintock@msi.ucsb.edu

**Decision Commons**

*PSS for urban visualization, design, and analysis*

Architecture: PC application (prototype)

Runstad Center for Real Estate Studies

College of Built Environments at the University of Washington

www.decisioncommons.org

Institution-Specific

**I-PLACE³S**

Sacramento Area Council of Governments

www.sacog.org/services/scenario-planning/

rporter@sacog.org

**MetroScope**

Portland Metro

www.oregonmetro.gov/index.cfm/go/by.web/id=24906

dennis.yee@oregonmetro.gov
Additional Resources

Open Planning Tools Group
Network of PSS developers and users
www.scenarioplanningtools.org

PlaceMatters
Nonprofit focused urban planning tools and techniques
www.placematters.org
Works Cited


———. 2013. Fairmount Indigo Planning Initiative Corridor Profile.


Capital Area MPO. 2010. CAMPO 2035 Regional Transportation Plan.


City of Austin. 2012. Imagine Austin Comprehensive Plan.


Evan Thomas Paul. 2012. *Interview with the author*.


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Lenk, Frank. 2013. Interview With The Author.


Massachusetts Geographic Information Council Strategic Plan Steering Committee. 2007. A Strategic Plan For Massachusetts' Spatial Data Infrastructure. Boston, MA.


———. 2012. Request For Qualifications: Creating Sustainable Places Rfqs For Multiple Corridors.


The 495/Metrowest Development Regional Compact Study Interagency Coordinating Team. 2012. 495/Metrowest Development Compact Plan.


