

# An Evaluation Framework for the Use of Scenarios in Urban Planning

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## **Abstract**

Professionals in urban planning have increasingly adopted scenario planning methods for projects that address urban land use, transportation, economic development, resilience, and other issues. This paper proposes an evaluation framework for urban scenario planning, derived from a review of scenario planning evaluation studies in the urban planning, environment, and management fields. The framework describes psychological, institutional, and system outcomes at the individual, organizational, and geographic unit levels. The proposed framework extends the performance approach to plan evaluation since it includes, but extends beyond, whether the plan was useful for public-sector decision making. A limited empirical validation of the framework was conducted by interviewing five professionals who have been involved in three urban scenario planning projects. Finally, the paper discusses how the framework can be applied in evaluation research, including preliminary evaluation instruments for the measurement of individual and collective learning, institutional changes, and community capacity.

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# **An Evaluation Framework for the Use of Scenarios in Urban Planning**

## **Introduction**

Professionals in urban planning have increasingly adopted scenario planning methods for projects that address urban land use, transportation, economic development, resilience, and other issues. In general, scenario planning techniques involve creating plans which describe a set of plausible futures, instead of defining either a single preferred future (visioning), or planning to accommodate the most likely future (forecasting) (Hopkins and Zapata 2007). Scenario planning proponents argue this approach is superior to other planning methods since it draws attention to key uncertainties about the future, and also integrates normative preferences with analysis (Avin and Dembner 2001, Chakraborty et al. 2011). Although the number of projects using these methods has grown dramatically in recent years, their evaluation has lagged behind their adoption (Bartholomew 2007). As described below, only a few evaluations of scenario planning projects have been carried out. Improved evaluation of scenario planning would clarify its benefits, as well as help practitioners to understand how scenario planning methods might be tailored to particular contexts. However, existing evaluations have adopted diverse methods and outcome measures. This paper proposes an evaluation framework for scenario planning practices, derived from a review of scenario planning evaluation studies in three fields. In order to further develop the framework, a limited empirical validation is conducted by interviewing five professionals who have been involved in three urban scenario planning projects. Finally, the paper discusses how the framework can be applied, including proposing preliminary evaluation instruments.

## **Scenario Planning Defined**

Scenario planning refers to a family of methods originally developed in the context of military strategy. Due to the unprecedented nature of nuclear conflict during the Cold War, military strategists such as Herman Kahn advocated the development of scenarios which “describe in more or less detail some hypothetical sequence of events,” as an “aid to imagination” for war planning (Kahn 1962). Scenario methods were adopted and further developed within the field of corporate strategy, especially by a group within the Royal Dutch Shell corporation (Schwartz 1991, Wack 1985, Schoemaker 1995). For the purposes of this paper, scenario planning is defined as methods that involve the analysis of driving forces or key uncertainties and the creation of multiple alternative plausible scenarios. In addition to these basic characteristics, scenario planning typically also has the following characteristics, some of which are shared with other planning methods: (1) it utilizes systems thinking where the connections between issues are explored, (2) it integrates quantitative and qualitative information, (3) it explicitly considers visionary or normative elements, (4) it is a process and product, and (5) it involves learning and conceptual change as key outcomes.

Within urban planning, scenario methods have been developed primarily in Northern Europe (Khakee 1991), the Netherlands (Salewski 2012), and in North America where it has grown in popularity since the 1990s (Bartholomew 2007, Xiang and Clarke 2003). Two forms of scenario

planning practice are the particular focus of this paper. First, the development of integrated land use-transportation plans, which constructs scenarios that describe alternative configurations of land use and transportation infrastructure (Bartholomew 2007). Second is the use of methods developed by the Global Business Network, which features a facilitated process of considering driving forces and their interactions, to develop several alternative scenarios which are typically described through a scenario narrative (for example, Ralston and Wilson 2006). This is sometimes called exploratory scenario planning (Roberts 2014). Recently, Chakraborty and McMillan (2015) have proposed a typology for scenario planning in urban planning, including as dimensions scope, scenario type (normative, predictive, explorative), scenario construction and analysis tools, intended outcome, and stakeholder engagement.

## **Need for Evaluation Framework**

In research, a conceptual framework is “primarily a conception or model of what is out there that you plan to study, and of what is going on with those things and why—a tentative theory of the phenomena that you are investigating,” the purpose of which is to inform the more specific research design (Maxwell 2013). Frameworks are particularly useful for topics which can be investigated from multiple perspectives. The evaluation of urban scenario planning is at its nascent stage, and existing research utilizes diverse theories, measurement, and outcomes. For example, theorists have described the goals of scenario planning in diverse ways, such as to enhance understanding, challenge conventional thinking, and improve decision making, among others (Wright, Bradfield, and Cairns 2013). Xiang and Clarke (2003) propose that one role of scenario planning is that it “stretches people’s thinking and broadens their views” in planning. To do this, they argue that effective scenarios should have *plausible unexpectedness*, *informational vividness*, and *conceptually ergonomic design* (number, themes, and timeframe of scenarios is effective for project goals). Relatedly, scenario planning proponents in management also argue it improves decision-making by addressing four well-known conceptual defects: bounded rationality, focus on external variables, knowledge frictions, and fixed mental models (Chermack 2004). However, these papers do not describe how these outcomes might be measured, and they differ from the outcomes typically considered in planning evaluations. Therefore, an evaluation framework can serve to organize existing research and guide future evaluations. Another important function for an evaluation framework is to facilitate the comparison of scenario planning with alternative planning methods, to understand their relative strengths and weaknesses.

## **Framework Development Process**

The framework was developed in several steps. The project is framed by a discussion of the literature on performance of plans in urban planning and scenario planning in management. Next, a literature review was conducted in the areas of scenario planning evaluation and urban planning performance. The 17 empirical evaluations of scenario planning projects identified from this literature review were then analyzed and a preliminary framework developed. These studies come from the fields of urban planning, environmental planning, and management. Next, the framework was validated through interviews with practitioners who had been involved in three recent scenario planning projects in urban planning. Two projects were conducted as part of the Austin Sustainable Places Project, and featured normative land use-transportation planning

for demonstration sites. The DenveRight project featured the application of exploratory scenario planning. Finally, drawing on the interviews and a review of the methods used by the existing research, the paper discusses how the framework might be applied and proposes evaluation instruments to measure various outcomes.

## **Performance Evaluation**

### **Performance of Urban Planning**

Various criteria have been proposed for evaluating planning activities and plans: whether outcomes match what is described in the plan (conformity), whether the plan was created through a rational process, or an evaluation of the plan's completeness, consistency, participation, optimality of recommendations, and utilization (Alexander and Faludi 1989). Reviewing several types of plans, Baer (1997) proposes that "the appropriate criteria to evaluate a plan are implicit in the concept that the plan embodies." The focus here is on ex post evaluation, conducted after the completion of a plan or application of scenario planning methods.

In considering how to evaluate plans, Mastop and Faludi (1997) make a helpful distinction between *project* and *strategic* plans. Presenting each as ideal types, a project plan "provides blueprints of the intended end-state of the physical environment, including the measures necessary to achieve that state" (1997, 819). As a result, the most appropriate evaluation for project plans is the *conformance* between the plan and what actually occurs. A growing body of research has adopted this perspective, investigating whether plan policies are implemented, or whether subsequent decisions align with plan guidelines (for example, Brody and Highfield 2005, Talen 1997). In contrast, Mastop and Faludi (1997) argue that a *strategic* plan serves as "frame of reference" for future decision-making. To do this, strategic plans state intentions, coordinate diverse actors, and are somewhat conjectural in nature since they rely on uncertain information and incomplete knowledge. To evaluate such plans, Mastop and Faludi propose the performance principle, which states that "a strategic plan is performing well, that is, serving its function, if and only if it plays a tangible role in the choices of the actors to whom it is addressed" (1997, 822). Hopkins (2012) has promoted a related view, proposing that conformance examines the relationship between the plan and final outcomes, while performance examines the role of the plan in influencing intervening decisions and actions. Similarly Kaza, Hopkins, and Knaap (2016) critique the conformance perspective by citing many examples of plan elements where a narrow focus on implementation is inappropriate, such as setting goals or describing contingent actions which should only be taken under specific circumstances.

The performance approach to plan evaluation was proposed and developed primarily in the Dutch planning context as a method to evaluate the effectiveness of strategic plans, which are created at the national, provincial, and local level to complement more specific legally-binding project plans (Faludi 2000). Empirical investigations adopting a performance perspective have investigated the performance of national (de Lange, Mastop, and Spit 1997) and local (van Damme et al. 1997) plans, but these investigations rely on case studies and interviews. Few studies have followed up Mastop and Needham's (1997) call for improved theory and methods for plan performance studies.



Although useful, this theoretical perspective must be modified somewhat before it can be used to evaluate scenario planning. First, although Mastop and Faludi espouse a social interaction perspective, they argue performance should be evaluated by investigating the “decisions to whom planning statements are addressed,” resulting in many of the empirical studies on a narrow focus on public-sector decisions. However, more recent views of planning have highlighted the importance of coordinating multiple actors, suggesting that effective planning must move beyond governmental actors and influence the decisions of a broader set of stakeholders (Healey 1997, Innes and Booher 2010). In addition, a narrow focus on decisions may obscure other ways plans may influence outcomes, such as by shifting preferences or changing the mental models through which problems are understood. In addition, successful plans may not be explicitly cited if they become deeply internalized and are therefore “taken for granted.” These critiques suggest the importance of investigating earlier shifts in thinking due to planning activity, in addition to use in formal decision-making. Millard-Ball (2012) has proposed five causal pathways for planning to impact outcomes (which he takes to include legislation, regulations, and outcomes): coordinate interdependent decisions, knowledge, preference shaping, preference aggregation (agenda setting), and imposing reputational costs for violating plans. The pathways concerning coordinating interdependent decisions or imposing reputational costs for violating plans describe policy plans which contain specific proposals; the remainder—knowledge, preference shaping, and agenda setting—apply well to strategic planning and plans.

To summarize, the empirical evaluation of the performance of strategic planning and plans should include whether they are utilized in subsequent decision-making by various stakeholders, as well as an analysis of their influence on participant’s thinking. Of particular importance is public-sector decisions, such as regulations and legislation, but other stakeholder decisions also matter. Furthermore, plans may perform by resulting in new knowledge or shifts in preferences. The limited empirical plan performance literature does not adequately address these outcomes. In order to take this broader perspective, the next section turns to the management literature where theorists have discussed how to conceptualize these broader effects of scenario planning practices.

## **Performance of Scenario Planning in Management**

The management literature provides a useful starting point for a framework which incorporates the broader influences of scenario planning on participants. To evaluate scenario planning used as a corporate strategic planning method, Chermack (2003) argues that performance can be measured at the three levels of corporate performance proposed by Rummler and Brache (1995): the organization, the business process, and the job/performer. Performance at each level can be evaluated from one of three theoretical perspectives proposed by Swanson (1995) in the context of human resources development: economic, psychological, and systems (taken to mean systems thinking and modeling such as the ideas discussed in Senge (1990)). These categories result in a 3x3 framework matrix (table 1) which Chermack proposes as a guide for the evaluation of scenario planning in management. As described further below, together with other researchers Chermack has carried out a theoretical and empirical research program explicitly organized according to this framework.

**Table 1: Chermack's Scenario Planning Evaluation Framework**

Level of Performance	Theoretical Foundation		
	Economic	Psychological	System
Job/Performer			
Process			
Organization			

Source: Redrawn from Chermack (2003)

The only other competing evaluation framework for scenario planning in management appears in Harries (2003). This framework is organized into three dimensions: whether the assessment is *subjective* or *objective*, whether the *decision maker's goals* or *technique's goals* are primary, and the *evaluation method* used (theoretical analysis, simulations, experiments, or real-world decision making). The framework is too encompassing for our aims, since it includes purely subjective outcomes which we exclude, as well as non-empirical evaluation methods such as theoretical analysis and simulation. Although this type of evaluation has a role in scenario planning (for example, checking the accuracy of scenario models), they are beyond the scope of this paper. The use of non-empirical evaluation methods to evaluate plan contents is what Baer (1997) calls *plan assessment*.

Therefore, Chermack's framework provides the most suitable starting point for urban scenario planning evaluation, however it requires several modifications. The first group of changes concerns the performance levels. The job/performer performance level is renamed simply *individual* and organization renamed *organizational*. An additional performance level is needed, that of the *geographic unit* as a whole, since plans aim to achieve outcomes across the project area. Their order is also inverted to indicate the primacy of the geographic unit performance level. Finally, *process* is removed, since improving specific practices of participants (Chermack means business processes like production or marketing), although potentially valuable, is not a central aim of urban scenario planning.

The second group of changes concerns the columns associated with evaluation dimensions. Theoretical foundations is renamed "categories," since each contain many theories, some of which overlap. The *economic* category was removed, since public sector plans are typically created as a public good since the benefits accrue to many parties and are often difficult to value. However, an additional category is needed to complement the *psychological*, with its focus on individuals, and *system*, with its focus on social-environmental-physical systems. Researchers in several fields have concluded that individual-level theories alone are inadequate to explain divergent system outcomes in cities, such as economic performance or natural resources protection. Institutions—made up of rules, norms, and shared mental models (Mantzavinos, North, and Shariq 2004)—describes the durable aspects of society which powerfully shape individual behavior and therefore help to explain differences in outcomes between places (for a review in planning, see Kim 2011). Institutions might be particularly important to planning for two main reasons. First, many planning problems can be described as common pool resource collective action problems, which Ostrom's (1990) research has found can be addressed through institutions. Second, achieving various goals typically requires creating policies, programs, and practices aimed at that goal; therefore, it is not enough to generate consensus about strategic

questions of community goals or vision, to achieve these system outcomes, planning must also stimulate institutional changes. The dimensions of the framework resulting from these modifications appears in table 2.

**Table 2: Urban Scenario Planning Evaluation Framework Dimensions**

<b>Level of Performance</b>	<b>Categories</b>		
	Psychological	Institutional	System
Geographic unit			
Organizational			
Individual			

### **Scenario Planning Evaluation Research**

To further develop the framework, the following sections reviews the 17 empirical evaluations of scenario planning found in the urban planning, environment, and management literatures. The outcomes from these studies are used to develop the framework contents.

#### **Urban Planning**

Five of the empirical studies came from the urban planning field. Zapata (2013) adopted a portion of Chermack's framework for her qualitative evaluation of the Valley Futures Project in California, which examined individual and organizational outcomes. She concluded that although participants experienced some individual transformative learning, few long-term changes to professional practices or within organizations occurred as a result of the project. Allred and Chakraborty (2015) evaluate the implementation of the Sacramento Blueprint Plan, by asking whether building permits applied for after the plan was adopted are occurring in places which are described by the plan's principles, and also by examining whether the plan is being incorporated into local jurisdiction general plans. They find growth occurring in places indicated by the plan in some jurisdictions, and find only some general plans reference the blueprint plan, and conclude the case illustrates the limits to voluntary regionalism. However, they do not examine whether all growth is improving the region on plan criteria irrespective of its location (i.e., if the region as a whole is performing better). These outcomes also fit within the framework, as building permits are a system outcome at the geographic unit level, and general plans are an institutional outcome at the organizational level.

Two projects tested short-term changes in participants through the use of pre-post survey designs as part of scenario projects in transportation. Zegras and Rayle (2012) found modest changes to actor networks and inconclusive evidence for changes in perceptions about the problem and project among participants in a transportation planning project in Portugal. Also in transportation planning, Phadnis et al. (2015) found only modest changes to professional judgements after being exposed to scenarios. In environmental planning, Groves et al. (2008) reports on changes of water manager's attitudes regarding uncertainties, modeling, and risk. In contrast to these short-term studies, Bowman et al. (2013) report on a long-term case study of the use of scenario planning by a Scottish authority. Using storytelling theory they argue the two projects, which

used different methods, either enabled or inhibited meaning through storytelling. They organize comments about the project success into the categories *strategic thinking*, *meaning-enabling*, and *joined-up strategic planning*, which seem to fall within psychological outcomes.

Studies of urban scenario planning drawing on case studies have critiqued the practices that exist, which may help explain the modest outcomes which have been found thus far. For example, Zapata and Kaza (2015) observe that scenario planning methods are often applied in limited ways in urban planning: they sometimes do not use multiple scenarios, or engage diverse organizations, people, and interests through deep deliberations.

## **Environment**

Although scenario planning has been used widely in the environmental field (Peterson, Cumming, and Carpenter 2003), these applications have not been widely evaluated. In the context of natural climate scenarios, Hulme and Dessai (2008) propose they might be evaluated by their predictive success, decision success, and learning success. They conclude that there is no easy success metric for scenarios since they should be evaluated in light of their project-specific goals. A review of 23 case studies of participatory scenario planning in place-based social-ecological research found that 15 cases conducted some form of evaluation, through surveys, interviews, and observation (Oteros-Rozas, Ravera, and Palomo 2015). The primary reason for conducting evaluation was to assess participant's learning. Project leaders from nine projects said there was strong evidence of short-term (<1 year) and long-term (> 1 year) outcomes and impacts, but only two conducted formal long-term evaluations. However, since all of the projects which conducted formal short-term and long-term evaluations found strong evidence of impact, the authors speculate more rigorous evaluations of the other cases may have discovered evidence of their effects.

The two projects which conducted a formal long-term review in the review described above have separately published articles describing their methods and results. This project is conceptualized as adaptive co-management (ACM), a natural resources management approach aimed at achieving ecological, livelihood, and process outcomes (Plummer and Armitage 2007), which have been refined into indicators for evaluation (Butler, Young, et al. 2015). The particular ACM project which utilized scenarios was implemented in the Nusa Tenggara Barat Province of Indonesia and the West New Britain Province of Papua New Guinea by an international team, and the overall project and use of scenarios is presented in Butler, Bohensky, et al (2016). The project had three phases: priming stakeholders (where scenario methods were used), enabling policies and programs, and implementing adaptation. One of the evaluation activities involved implementing pre-post surveys at the project workshops, which found that the primary outcome of the workshops was innovative ideas, with less than 20 percent reporting new contacts, new information, or sources of funds. However, many respondents also report that they identified potential new partners at the workshops (Butler, Wise, et al. 2015).

A separate evaluation of the project was conducted via a structured interview where Likert responses were collected from 17 stakeholders who had participated in the project on a range of questions after the project completion (Butler, Suadnya, et al. 2016). The indicators include learning, trust, new institutional arrangements, and management plans and agreements. This

project is notable for its inclusion of the implementation phase in the evaluation, as well as for providing a model of an evaluation method which could collect information about perceived institutional changes in an efficient manner. The drawback is the lack of in-depth case information needed for validation and deeper understanding of the stated results. The section below on evaluation discusses their instrument further.

## **Management**

The largest collection of empirical scenario planning evaluations can be found in the management literature, where studies have analyzed applications of scenario planning for strategic planning within corporations or other large organizations like universities. Among the nine studies identified in this area, Chermack is involved in seven, so they are explicitly designed to fall within his evaluation framework described above.

One of the best-known evaluations of scenario planning applied for corporate strategic planning examined whether its use was related to performance outcomes in the water and IT industries (Phelps, Chan, and Kapsalis 2001). The study considered both subjective and objective performance measures, including financial performance and measures of service quality. For water industry companies, the study found some evidence scenario use was related to greater financial performance and worsened customer service levels, but neither relationship had strong statistical significance. The study of IT consulting firms found scenario use and improved financial performance were related, but a less strong relationship with client growth, a proxy for service quality (Phelps, Chan, and Kapsalis 2001). Harries presents four critiques of the study: the definition of scenario planning used differs from standard definitions, other characteristics of the firms which might explain both performance and scenario planning use are unexamined, firms may differ in their organizational goals, and finally the most appropriate objective measure for strategic planning may not be average financial performance used by the study but instead financial performance during unlikely periods such as industry crises or recessions (Harries 2003). Another study focusing on overall firm performance which complements Phelps, Chan, and Kapsalis is Visser and Chermack (2009), which reports the results of a purely qualitative study of multinational firms who utilize scenario planning methods. Interviewees report scenario planning is useful to explore the business environment and risks, isolate trends, understand interdependent forces, and consider the implications of decisions, although the paper does not propose how to measure these outcomes.

The collection of more detailed empirical studies provides complementary findings, but focuses primarily on psychological and organizational outcomes measured at the individual level through pre-post research designs. Two studies examine whether participation in scenario planning results in changes to participant's self-reported conversation and engagement skills utilizing the conversation quality and engagement checklist (Chermack, van der Merwe, and Lynham 2007, Visser and Chermack 2009). An experiment conducted with business students compared changes in framing bias and decision quality among four groups: a control, strategic planning, full scenario process, and partial scenario analysis group. Participants in the full scenario process group reported the highest decision quality and greatest reduction in decision bias among the groups (Meissner and Wulf 2013).

Another group of studies investigates issues at both the individual and organizational levels. Chermack finds evidence of improvement to the perceptions of learning organization characteristics, but the study is limited by a small sample size (Chermack, Lynham, and van der Merwe 2006). A follow-up utilized four standard survey instruments to test individual communication and mental model styles, and group learning and decision making styles (Chermack and Nimon 2013). Glick et al. also investigate mental model style using an instrument which results in five styles: political, financial, efficiency, social, and system (Glick et al. 2012). Finally, Chermack et al. (2015) tests the effects of scenario planning on perceptions of creative organizational climate.

## **Overview of Evaluation Research**

The 17 studies presented above are summarized in a table in Appendix A, which lists each study, assigns a performance level and outcome type, and provides basic information about the specific evaluation design and findings. Overall, the most common type of study are pre-post designs utilizing surveys conducted among participants in scenario planning workshops. These studies are able to directly investigate the psychological outcomes which theorists have posited are the primary benefits for scenario planning methods. Only a few studies investigate possible institutional changes, including Zapata (2013), Allred and Chakraborty (2015), and Butler, Suadnya, et al. (2016). Finally, only two studies investigate the relationship between the practices and system outcomes. Despite study weaknesses, Phelps et al. (2001) stands alone in the management literature as establishing a relationship between strategic planning methods and firm-level outcomes. Similarly, Allred and Chakraborty (2015) present a unique evaluation of regional outcomes after a regional scenario planning project.

## **Urban Scenario Planning Evaluation Framework**

This section presents the full evaluation framework (table 3). The framework is presented by each of the three categories, within which the outcomes at the individual, organizational, and geographic unit level are discussed. Appendix B contains an outline which presents the outcomes from the scenario planning evaluation studies, organized according to the framework categories.

**Table 3: Urban Scenario Planning Evaluation Framework**

<b>Level of Performance</b>	<b>Category</b>		
	<b>Psychological</b>	<b>Institutional</b>	<b>System</b>
<b>Geographic Unit</b>	Community Learning	Community Capacity	Goal Performance
<b>Organizational</b>	Collective Learning	Policies, Programs, and Practices	General Plan, Laws, Regulations, and Implementation
<b>Individual</b>	Conceptual, Normative, Relational Learning	Shared Mental Models	Behavior Change

Before continuing, it should be noted that as previously discussed, the primary goal described within the scenario planning literature is improved decision-making. This in turn is defined specifically based on the particular context, such as avoiding biased thinking in business (Chermack 2004), identifying robust strategies which work across multiple decisions in exploratory scenario planning (Chakraborty et al. 2011), or allowing for more informed decisions based on an expanded set of information in normative scenario planning (Holway et al. 2012). While it may be possible to evaluate these specific outcomes, the approach taken here is to describe more abstract outcomes which enable them to be applied to a variety of scenario planning projects.

### **Psychological**

The relationship between scenario planning methods and psychological outcomes is the most well-developed area of evaluation research. At the individual performance level, after Haug et al., we propose the relevant psychological outcomes are cognitive (we call conceptual), normative, and relational learning. We furthermore subdivide conceptual learning into single-loop learning, which concerns acquiring new knowledge which does not require re-evaluating basic assumptions, and double-loop or transformative learning where fundamental goals are re-considered. Normative learning refers to shifts in preferences, values, and attitudes, such as the changes in professional judgements and attitudes examined in Phadnis et al. (2015) and Groves et al. (2008). Finally, relational learning concerns changes to relationships with others, such as new contacts or relationships (Butler, Bohensky, et al. 2016, Zegras and Rayle 2012), changes to trust (Butler, Suadnya, et al. 2016), and improvements to engagement skills (Chermack, van der Merwe, and Lynham 2007, Veliquette et al. 2012).

At the organizational level, collective learning refers to changes to organizational climate or environment which corresponds to greater interest in development of shared knowledge. Among the existing research, two studies apply the Dimensions of the Learning Organization questionnaire, and another investigates the creative climate within the organization using scenario planning. Bowman et al. (2013) investigates the quality of the long-term strategic thinking and planning. Finally, at the geographic unit level, learning could refer to shifts in

broadly shared knowledge, which may be revealed through shifts in public opinion, which I call community learning.

## **Institutional**

The institutional dimension describes outcomes which, although related to psychological outcomes, are characteristics of the durable social structure of a place. These may be confined to within a formal organization, or instead be shared among organizations. At the individual level, institutional theory stresses the shared mental models which explain the persistence of institutions. Therefore, this is where the concept of shared mental models from scenario planning fits. In addition, individual institutions could include practice change and decision-making style. At the organization level, institutional changes refer to changes to policies, programs, and practices, which Butler, Suadnya, et al. (2016) and Zapata (2013) each investigate. Finally, at the geographic unit level, outcomes include changes to the broad institutional environment. Healey (1998) conceptualizes the institutional capital of a place as part of planning. Butler et al. (2016) provides a rare approach to empirical measurement of institutional outcomes, investigating the implementation of innovations, enabling changes to institutions, and changes to community capacity.

## **System**

The system dimensions focuses attention on observable changes to the physical and social elements of the city system. Therefore, at the individual level, the relevant outcome is behavior change in regards to daily life, such as switching usual transportation modes or making other observable changes. At the organization level, system changes are changes to general plans, laws, and regulations. From the perspective of some theorists these are viewed to be institutional outcomes, but here they are placed in the system category since they have a concrete effect on decisions and administration of material resources. This outcome includes direct implementation activities, such as government-led infrastructure construction. Finally, at the geographic unit level is goal performance, the achievement of plan-designated goals.

## **Empirical Validation**

In order to develop the framework, a preliminary empirical validation was conducted with four cases where scenario planning has been applied in urban planning contexts. The cases were selected to contain examples of two contrasting approaches. First, the Lincoln Institute of Land Policy and Sonoran Institute has developed a practice they call Exploratory Scenario Planning (XSP) (Roberts 2014). This method adapts the inductive method described above, which involves an analysis of the driving forces, the use of a matrix to consider their interaction, and discussion and qualitative analysis of the resulting scenarios. One recent XSP case was selected for analysis, the Denveright XSP Demonstration Project.

The other approach, which falls within Chakraborty's category of normative scenarios, utilizes methods pioneered for planning projects such as Envision Utah and the Sacramento Blueprint to create land-use scenarios. These projects define a set of possible future development patterns,



which are described qualitatively and in terms of a set of quantitative attributes. These development patterns are used by stakeholders to develop a set of transportation and land-use scenarios for the study area, from which a preferred scenario is typically selected. These techniques typically involve the use of planning support systems (PSS) to calculate indicators to facilitate the comparison of the scenarios, sometimes as the scenarios are being created (Holway et al. 2012). Three projects were selected which utilize these methods, completed in Hutto and Lockhart Texas, two cities in the exurbs of the Austin region. These projects were all completed as part of the Austin Sustainable Places Project (SPP), funded by a grant from the Federal Government's Sustainable Communities Regional Planning Grant program (Minner 2015). In all three communities, similar techniques were used, although the demonstration site boundaries and topical focus of each project were locally tailored.

The empirical validation was conducted through key informant interviews, which were conducted through the use of a set of questions which probed the preliminary framework categories. In addition, we reviewed the project reports, as well as in the case of the Texas communities, the community master plans if they had been updated since the project completion. Since we only spoke to one or two people involved in each project, these findings are necessarily tentative and may not capture outcomes which are unknown to the professional staff, such as stakeholder learning or decision-making which is not yet well known.

## **DenveRight**

The Denveright XSP Demonstration Project was conducted by the staff of Western Lands and Communities, a joint program of the Lincoln Institute of Land Policy and the Sonoran Institute in the spring and summer of 2016. The project involved a set of preliminary interviews, and two workshops among project participants. The participants were the Blueprint Denver Working Group, comprised of city staff and consultants involved in the Blueprint Denver project, a large project to create an integrated land use and transportation plan for the city. The project focal question was "As Denver continues to change and evolve over the next 25 years, how can the city provide greater access to opportunities, services and amenities for current and future residents?" The critical uncertainties considered included the level of economic growth, extent of mode shift away from automobile travel, political will, and net migration of millennials. All scenarios assumed several certainties such as an overall aging population, and more frequent droughts and extreme weather events caused by climate change. The project resulted in four scenarios, titled "Denver Today," "Boom!," "Brown Cloud," and "Denverisco," which were used to analyze strategies such as improving alternative transportation modes, articulating the value of planning, and improving affordable housing policies.

We conducted two interviews with city staff who participated in the workshops. Overall, they reported a limited amount of individual and collective learning, and some changes to how the subsequent project conducted outreach. They attributed the limited impact of the project on its short duration, and the limited diversity of the project participants. Despite the limited impact, they felt it was useful. The first interviewee felt the project helped to facilitate an "honest" internal discussion about the city's future. The project created a venue where staff felt comfortable "talking about our hopes and dreams for the city, and an opportunity for us to share the things that were keeping us up at night." These included excitement about the benefits of the

city's recent and future growth, but also concerns about affordability and whether desired transportation mode shifts would occur. This type of conversation was not the anticipated benefit of the project, but helped the group realize they had common goals and prioritize the focus of the subsequent project. The project also resulted in ideas in how to conduct public outreach as part of the broader planning project. The interviewee felt the project helped participants remind themselves how to talk about urban development in a way which would make sense to the public, for example focusing on tangible improvements to daily life instead of engaging in an abstract discussion using density numbers. The interviewees felt the project did not succeed in developing shared understanding or transformative learning, because it was a short process, after which "everybody goes back to their jobs and they have to face the realities of current policies and current regulations." The second interviewee similarly agreed the primary benefit of the project was the ability to step back and have a broader conversation about the plan. In doing so, it continued to help foster cross-departmental collaboration within the city. The informant felt it also contributed to a shift from a more static planning to plans which are adaptable and resilient.

### **Hutto, Texas**

The Austin SPP demonstration site projects all involved a similar methodology, conducted by the same group of consultants. The projects all featured a visioning meeting, where a general discussion about the issues and vision for the demonstration site was held. At a charrette, local stakeholders engaged in a participatory expertise to create draft land use and transportation scenarios, which were then refined by the consultants for presentation at a final meeting. The projects resulted in final project reports which presented the scenario, along with specific implementation recommendations, including changes to zoning and other local ordinances (for more background, see Goodspeed 2013).

In Hutto, we interviewed two project staff involved in the project, although both have subsequently left to work for other cities. The staff felt that the project helped certain elements gain greater support in the community, for example an interest in developing a bicycle network and improving walkability. However, the interviewees felt that the short duration of the project meant it did not result in major changes to participant's perspectives. Another specific idea which the plan contained was creating a new road which would connect newer subdivisions to the older existing downtown, which the interviewees reported had led to the decision to reserve land within a new development. The interviewees felt that the consultant did a "great job" showing how the street could provide a connection while using design to ensure slow traffic speeds, easing community concerns about the traffic the street might create. The staff reported that this idea, along with some others, were incorporated into a revised comprehensive plan and related plans that the community compiled after the project completion. Although a detailed analysis of the city's comprehensive plan was not conducted, it does mention the Sustainable Places Project by name as one component of the public involvement which was used to develop its contents, and the future land use map contains some mixed use residential areas which are shared with the land use concept resulting from the SPP. Other elements of the plan have not been implemented, including changes to a state route managed by the Texas Department of Transportation, and the redevelopment of a city-owned property.

Although the interviewees described that learning about the specific planning method was intended to be one project outcome, it did not occur. One interviewee recalled attending a training session where computer problems occurred, and both pointed out that staff turnover limited the institutional memory at the particular city. Overall, the project seems to have reinforced community consensus on a set of planning priorities, as well as providing specific ideas which to a certain extent have become incorporated into subsequent decision-making and formal planning documents. The primary weaknesses of the project cited by the interviewees include a lack of leadership from external stakeholders, and to a certain extent, within the city government.

### **Lockhart, Texas**

A similar planning process was conducted in Lockhart, Texas. While similar in population to Hutto with a population of around 15,000, as the county seat Lockhart has a larger traditional downtown centered on the county courthouse. The resulting plan focused on downtown, as well as land near the newly constructed toll highway on the outskirts of town. The project plan proposed revitalizing downtown through re-designing the streets around the courthouse, and developing vibrant street life to attract visitors. In addition, the plan proposed creating parks along creeks, creating a system of public open spaces, creating a gateway to the community near the tollway exit, and developing mixed-use housing.

The interviewee felt the project was “very educational and useful,” creating the opportunity for residents to discuss issues like the benefits of more compact housing types and preserving a local creek, which had not been the subject of detailed discussion in the past. The plan contained a proposal to re-configure the streets in the downtown square, which the interviewee described the city as working with TxDOT and city staff on implementing now. In addition, the interviewee reported that the city’s newly hired economic development director has been using the plan as a guide for his activities. Use of the plan by nongovernmental stakeholders has been limited, but one property owner is seeking tenants for a new mixed-use building, after learning this was proposed in the plan by a city planner. However, the land use plan has not been amended to reflect the ideas from SPP, but the interviewee reported this was still on his to-do list. The widening and reconstruction of a major street to include bike lanes and sidewalks, which predated but was incorporated into the SPP, is now underway.

In terms of the framework, the interviewee felt the project resulted in some modest individual and collective learning. Although the land use recommendations have not been incorporated into city plans and regulations, this is because implementation activities have concerned the planning, design, and construction of streetscapes directly by the city. The reconstruction of the street, is underway, although the project was only refined as part of the SPP. In addition, while downtown streetscape improvements have not been constructed, the interviewee reported extensive implementation discussions with stakeholders like the city engineer and TxDOT and felt that it probably would occur in the near future. Therefore, there is evidence that the plan’s recommendations for the design of this part of the city are influencing decision-making.

## **Discussion**

Broadly speaking, the comments confirm the relevance of the framework dimensions, as well as highlighting the challenges facing any scenario planning evaluation. First, the interviewees agree that learning outcomes existed and are important, even if they felt that transformative learning did not occur due to the project limitations. Among learning at the three levels of performance, they provided the fewest comments regarding “community learning,” however this may be due to the nature of these projects, which did not engage in extensive public outreach. However, one interviewee’s comment that although memory of the project seems to have faded, “Except for the downtown people, who keep asking us, ‘When are we gonna do that?’” which suggest some degree of community learning has occurred as a result of the project. Concerning institutional outcomes, although the interviewees hesitated to agree that “shared mental models” had occurred, they did feel the projects played a role in developing community consensus about community issues or specific proposals, which would exhibit some degree of changes to mental models. Similarly, although the projects had only modest impacts on policies, programs, and practices, the interviewees did provide examples of changes in these areas. None of the informants felt the projects resulted in changes to community capacity, but they may be related to their small scale. Finally, regarding system outcomes, interviewees could not comment on potential behavior or performance changes. They did describe a variety of general plan, laws, regulations, and other implementation activities, providing examples of how the document was being utilized in decision-making, and to a certain extent becoming incorporated into planning documents.

### **Applying the Evaluation Framework**

This section discusses prioritizing and applying the evaluation framework, and describes a preliminary evaluation instrument for measuring framework outcomes.

#### **Prioritizing**

Any particular evaluation will need to consider which outcomes should be prioritized for measurement. One consideration for this choice is that the outcomes may be related to one another. In general, these relationships correspond to moving to the right or upward in the framework. For example, many theories argue that behavior changes arise from shifting understandings, which themselves relate back to conceptual, normative, or relational learning. Similarly, within each category, the individual-level outcomes are often related to organization or geographic unit outcomes. For example, goal performance often implies changes to plans, laws, and regulations, and also behavior change. However, it should be noted that these may not be *necessarily* related, and each outcome is probably explained by many factors which are not encompassed here. For example, behavior change can occur without learning, if an outside force abruptly changes the choices available to urban residents (e.g., mortgage credit becomes more difficult to obtain). Similarly, Zapata (2013) highlights a cautionary case where a project seemingly resulted in individual transformative learning, but which was not translated into organizational and geographic unit-level outcomes.

Another consideration for prioritization is that the outcomes differ in their importance and ease of measurement. In particular, four outcomes are either difficult to measure, or relatively less important from a theoretical perspective. At the individual level, behavior change is typically relatively easy to measure, but is less important for the evaluation to scenario planning for theoretical reasons. Motivating individual behavior change is not typically a primary objective in urban planning, which aims to shift collective decision-making by organizations. In addition, as previously noted, behavior has many influences, and even where measured, it may be difficult to link particular behavioral shifts to involvement in a scenario planning project. Also at the individual level, the outcome of shared mental models is difficult to measure and therefore may be omitted from practical applications, even if it remains of interest to research studies. No transdisciplinary concept for mental models exists, and the concept is operationalized in a wide range of ways (Mohammed, Klimoski, and Rentsch 2000). The existing empirical research seeking to document shifts in mental models among project participants has been conducted utilizing methods such as interviews (Otto-Banaszak et al. 2011), questionnaires (Stone-Jovicich et al. 2011), textual analysis (Carley 1997), or others (Langan-Fox, Code, and Langfield-Smith 2000). In systems analysis, the properties of causal loop system diagrams created by participants before and after an intervention can be rigorously compared (Schaffernicht and Groesser 2011), but most planning projects do not create such diagrams. Therefore, it seems that testing shifts in mental models may not be feasible for most scenario project evaluations.

Two outcomes at the geographic unit level of performance are also difficult to measure. Community learning could be measured through public opinion surveys conducted before and after a project, or through extensive case research such as that conducted by Holden (2008) in her study of sustainable development practices in Seattle. Similarly, community capacity is well-recognized within planning, but difficult to measure. Healey (1998) proposed the related concept of institutional capital, which she defined as including the knowledge resources, relational resources, and capacity for mobilization of a particular place, however it is unclear how these attributes can be systematically measured. Stone (2001) proposed the concept of civic capacity to explain a city's varying ability to mount reforms to their educational systems, relying on extensive case research. Although new methods like network analysis may be useful for operationalizing the concept (Weir, Rongerude, and Ansell 2009), it will likely remain difficult to measure outside of specialized intensive research projects. As a result of these considerations, the following section describes detailed measurement issues for only the five remaining outcomes. However, the relative importance of the remaining outcomes depends on the project's specific goals.

## **Applying**

After considering which outcomes will be considered, an evaluation must decide on timeframe and unit of analysis, two issues for which there are no firm guidance in the literature.

In general, the levels of performance suggest increasing units of analysis, from the individuals who participate in various parts of a scenario planning project, organizations who are formally involved, to potentially all organizations or individuals in the geographic area at the time. However, in practice each must be defined more precisely. If the unit is individuals, will all participants be included, or only those who attended specific meetings or participated in all

phases of the project? Similar questions can be asked of organizations, who may exhibit similar gradations of involvement. At the level of a geographic unit, residents and organizations are ever-changing, and furthermore the evaluation must decide on definite temporal and spatial boundaries for their study, whether a particular jurisdiction or a specific definition of a larger region.

Similarly, the categories suggest increasing timescale of analysis. Psychological outcomes are typically measured before and after individual workshops, although the results from Meissner and Wolf's (2013) experiment provides evidence that some of the benefits of scenario planning may only result from the complete application of the method. Therefore, the most appropriate way to measure psychological changes may be to document change among a group of people at the beginning and end of a project, which introduces administrative challenges since it requires returning to the same participants months or years after the initial survey. Institutional and system changes are measured through post-hoc analysis, although there is no consensus for how much time should be allowed to pass before an evaluation of these outcomes should be conducted. Allred and Chakraborty (2015) investigate utilization of the Sacramento regional blueprint seven years after its adoption in 2004, but only find 14 of 29 jurisdictions had updated their general plans by then. Institutional outcomes like the development of new policies or programs may be expected to occur more quickly than system outcomes, however both may be subject to unpredictable external influences such as shifting political priorities and economic cycles. Although speed may be desired, new policies which take several years to develop may still have a large impact if, once adopted, remains in place for many years.<sup>1</sup>

## **Measuring**

Drawing on the discussion above, this section proposes the general measurement approach for the remaining outcomes, presented in table 4.

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<sup>1</sup> Measuring institutional changes over time would also allow the durability of the decisions to be evaluated, which is also a valuable secondary outcome since it shows a consensus has been created and the need for revisiting issues has been avoided. However, this is not presented as an outcome here since durability itself may not be desirable in light of changing conditions.

**Table 4: Measuring Selected Urban Scenario Planning Evaluation Outcomes**

<b>Outcome</b>	<b>Category and Level</b>	<b>Measure(s)</b>	<b>Unit of analysis</b>	<b>Data Source(s)</b>	<b>Evaluation Design</b>
Goal Performance	System, geographic unit	System performance indicators	Project geographic unit (region, city, n'hood)	government census, city data	Post-hoc analysis, 5+ years
General plan, laws, and regulations	System, organization	Utilization, conformance	Project target jurisdictions	Documents, key informants	Document review, surveys, interviews
Policies, programs and practices	Institutional, organization	Utilization, conformance	Project participating organizations	Documents, key informants	Document review, surveys, interviews
Collective learning	Psychological, organization	Double-loop or transformational learning	Participating organizations	Individuals at participating organizations	Pre-post surveys, Post-hoc interviews
Conceptual, Normative, Relational Learning	Psychological, individual	<i>Various</i>	Project participants	Project observation, individuals, materials	Pre-post surveys

### Goal Performance

The measurement of project goal performance is done with system performance indicators, which Innes and Booher describe as an indicator that “can help the community to see how the system is working and anticipate potential breakdown or changes in direction.” (2000, 180). Innes and Booher describe these system performance indicators as useful for providing feedback to stakeholders so the city can function as an adaptive learning system which can effectively respond to unpredictable futures. For that reason, many places already compile such indicators, and many plans designate specific indicators. The specific indicators used in the evaluation may be drawn from the plan itself, outside sources, or some combination. External indicators are useful since not all plans contain them, they can be constructed from readily available data, and they facilitate critical evaluation through the use of normative criteria. One notable example using this approach evaluated state smart growth policies through the use of 52 performance indicators which described five assumed goals (Ingram 2009). However, this study illustrates one drawback of using external indicators, which is they found performance varied according to which goals were stressed by the policies in each state. An evaluation using indicators identified by the plan or project evaluates the project in terms of its intended aims. However, this raises the issue of whether an evaluation should consider the unintended effects a plan might have.

## General Plan, Laws, Regulations and Implementation

The evaluation of general plans, laws, regulations, and other implementation steps can be conducted through document review and interviews with key informants in the relevant organizations and jurisdictions involved in the project. As described above, a performance perspective would result in this evaluation considering utilization: did the plan prove useful for subsequent decision-making? The alternative perspective, conformance, would investigate the extent to which policies or implementation substantively align with the recommendations made by the plan. As described above, a key question for this outcome is the amount of time after the conclusion of the plan which is deemed appropriate.

## Policies, Programs and Practices

Evaluating policies, programs, and practices is conducted among a broader set of project participating organizations. Similar to the investigation of the outcome above, this could be done through document review, but more likely the use of interviews or surveys of key informants. Similarly, this review could be conducted from a performance perspective, which would investigate utilization, or a conformance perspective, to see the extent to which adopted policies, programs, and practices conform to the plan's objectives.

## Collective Learning

Since the collective learning outcomes of a project are shared among a group, they are experienced not only by project participants, but also potentially by all individuals involved in participating organizations with a more peripheral involvement in the project. Although management evaluations described above measured organizational climate, this is relatively less important for urban scenario planning. Therefore, the more salient outcome is double loop or transformative learning, which occurs through collective learning processes (Zapata 2013, Deyle and Slotterback 2009).

## Conceptual, Normative, Relational Learning

Finally, scenario planning may result in a variety of conceptual, normative, and relational learning outcomes. These are observed among the project participants via pre-post surveys conducted either pre/post selected workshops, or at the start and conclusion of the project. In addition, more ambitious evaluations may seek to utilize audio and video recording, or other participant observation techniques to analyze interactions among participants (for example, Radinsky et al. 2014).

## **Evaluation Instruments**

The specific instruments used by the existing evaluation research were reviewed for applicability (Appendix B). These generally fell into three categories. First, Chermack and his collaborators generally used existing survey instruments from the management field. Although having the benefit of rigorous validation, they have the drawback of describing individual or organizational outcomes primarily of interest for management, such as individual skills (Conversation Quality



and Engagement Checklist), organizational culture (Dimensions of Learning Organization, Situational Outlook Questionnaire), or individual attributes (Mental Model Style Survey, Decision Making Style). Although these specific outcomes may exist for urban scenario planning projects, they are not the primary objective and therefore the instruments are not well suited for our purposes. Second, some studies developed tailored questions which relate specifically to the substance of the project. For example, Phadnis et al. (2015) investigated shifts in judgments about specific transportation infrastructure projects, Meissner and Wulf (2013) developed a framing bias question based on a hypothetical business decision, and Butler, Wise et al (2015) ask project-specific questions about climate change perceptions and reactions to project materials.

However, the existing studies reviewed does include one evaluation instrument which is useful for scenario planning, the structured interview protocol utilized in Butler et al. (2016). This instrument, conducted with stakeholder participants in a development project which uses scenario planning, contains questions where Likert responses are collected for a large number of indicators. The main drawback of this approach is its lack of case detail, but it would facilitate rapid and efficient evaluation of institutional outcomes which are rarely investigated. These questions are adapted for use in scenario planning, and several are added to encompass additional framework dimensions. The result in Appendix C.

Second, scenario workshops are another venue which has been the focus of evaluation activities. Although it is desirable to track changes in learning outcomes across an entire project, this is not always feasible. In addition, even if longitudinal data are collected, it may be useful to gauge the importance of particular workshops. Therefore Appendix D contains proposed generic workshop evaluation questions for conceptual and double-loop learning, adapted from Goodspeed (2013).

## **Conclusions**

This working paper aimed to propose a novel framework to guide the empirical evaluation of scenario planning practices applied in the urban planning field. The framework was developed through a literature review of existing evaluation studies of scenario planning practices in urban planning, natural resources, and management. The preliminary framework was validated with practitioners who had been involved in recent scenario planning projects. Finally, the paper discusses issues related to the measurement of the proposed outcomes, including two evaluation instruments for use among project participants.

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## Appendix A

### Evaluation Studies Comparison

Citation	Category	Study Context	SP Form	Performance Level	Outcome Types	Specific Outcomes	Evaluation Method(s)	Evaluation Design (controls?)	Findings
Butler et al. (2015)	Environment	Indonesia and Papua New Guinea	Explorative w/ normative back-casting (described in Butler et al 2016)	Individual	Psychological	Livelihood challenges, strategy priorities, social learning * knowledge exchange, empowerment, bridging social networks	Survey	pre-post surveys (different qs), N=141	Project resulted in innovative ideas, less empowerment
Butler et al. (2016)	Environment	Indonesia	Larger project, incld. Explorative w/ normative back-casting (described in Butler et al 2016)	Individual, Organization	Psychological	Various theory of change indicators: leaders, trust, empowerment, networks, solutions, partnerships, etc	Structured interview	Post N=17	Priming (trust, leaders, networks, knowledge) emerged, implementation more limited
Groves et al. (2008)	Environment	Water managers	Traditional, probabilistic, and RDM scenarios	Individual	Psychological	Attitudes RE cc, uncertainties, long-term planning, modeling, actions, managing risk	Survey	pre-post surveys	Some changes to attitudes, not for action prefs.
Chermack and Nimon (2013)	Management	8 Orgs	Inductive logics 2x2	Individual, Organization	Psychological	Communication and mental model style (individual); org learning and decision making style (org)	Surveys: DLOQ, GDMS, CQEC, MMS	pre-post, N=129	Analyzes multiple variables, not role of SP
Chermack et al. (2006)	Management	Educational Inst SE US	Inductive logics 2x2	Individual and Organization	Psychological	Learning organization	DLOQ Survey	pre-post, N=9	Improvement in learning org perception
Chermack et al. (2007)	Management	Educational Inst SE US	Inductive logics 2x2	Individual	Psychological	Strategic conversation quality	CQEC Survey	pre-post, N=9/10	Null findings
Chermack et al. (2015)	Management	Four organizations	Inductive logics 2x2	Individual	Psychological	Perceptions of Organizational Climate	Dimensions of situational outlook quest.	pre-post, treatment & control, N=100	Improvement in creative climate perception
Glick et al. (2012)	Management	10 Orgs	Inductive logics 2x2	Individual	Institution	Mental model style	MMS	pre-post, N=129	SP promotes efficiency, social, and systems MMS
Meissner and Wulf (2013)	Management	Management	One-day Schoemaker workshop, 2x2, control	Individual	Psychological	Cognitive Biases and decision quality	Framing bias questionnaire McNeil, Three Decision quality Qs	Pre-post experiment, N=252	SP reduces framing bias and improves decision quality
Phelps et al. (2001)	Management	Water and IT firms	Inductive logics 2x2	Organization	System	Financial performance, client growth, service level	Data analysis; survey	Post hoc, N=28 each cat	Some support for improved financial performance

Veliquette et al. (2012)	Management	Ten US Orgs	Inductive logics 2x2	Individual	Psychological	Strategic conversation quality skills	CQEC Survey	pre-post, N=137	SP related to increases in conv. and engt. skills
Visser and Chermack (2009)	Management	9 big firms	Various	Individual, Organization	Psychological, Institutional	Firm performance	Interviews	Post hoc, N=9 firms	SP results in qual. benefits to decision-making
Allred and Chakraborty (2015)	Planning	Sacramento Region	Regional blueprint	City	System	Housing unit types	GIS analysis, plan review	Post hoc, N=28 cities	Overall, post-plan dev. was not more prevalent in highly rated neighborhoods
Bowman et al. (2013)	Planning	Scottish local authority	Inductive logics	Individual, Organization	Psychological	Improve long-term strategic thinking & planning	Interviews	Post hoc N=5	Various qual. benefits
Phadnis et al. (2015)	Planning	Transportation agencies	Inductive logics 2x2	Individual	Psychological	Expert judgement	Judgment survey	pre-post, N=343	Tested multiple scenarios, not sig
Zapata (2013)	Planning	CA Central Valley	Inductive logics 2x2	Individual, Organization	Psychological	Transformative learning; behavior change	Interviews	Post hoc, N=13	Some individual transformative learning & actions; limited org. outcomes
Zegras and Rayle (2012)	Planning	Portugal transportation planning	Inductive logics 2x2	Individual, Organization	Psychological	Networks and perceptions	Survey	Pre-post, N=22/17	Modest changes to networks and collaboration, inconclusive effect on views and understanding

## Appendix B

### Outcomes from Scenario Planning Evaluation Literature in Urban Planning, the Environment, and Management

- System Performance
  - Individual
    - Behavior change (Zapata 2013)
  - Organization
    - Firm financial performance, client growth, service level (Phelps et al. 2001)
    - Firm performance (Visser and Chermack, 2009)
  - City
    - Performance Indicators (Allred and Chakraborty 2015)
- Institutional
  - Individual
    - Mental Model Style (Chermack and Nimon 2013; Glick et al. 2012)
    - Practice change (Zapata 2013)
    - Decision-making style (Chermack and Nimon 2008, 2013)
  - Organization
    - Org. change (Zapata 2013)
    - Management plans, new inst. arrangements, implem. resources, new partnerships, new issues - ACM Phase 2 (Butler et al. 2016b)
  - City
    - Implementation of innovations, enabling changes to institutions, cross-scale social networks, new partnerships, enhanced community self-organization & community capacity - ACM Phase 3 (Butler et al. 2016b)
- Psychological
  - Individual
    - *Cognitive - Single Loop*
      - Cognitive, normative, relational learning (Haug et al. 2011)
      - Framing bias questionnaire (Meissner and Wulf 2013)
      - Strategy priorities, livelihood challenges (Butler et al. 2015)
      - Knowledge (Butler et al. 2016b)
      - Perceptions of common objectives, shared definition of problem (Zegras and Rayle 2012)
    - *Normative*
      - Cognitive, normative, relational learning (Haug et al. 2011)
      - Expert Judgement [infrastructure investment] (Phadnis et al. 2015)
      - Professional attitudes on climate change, specific policies (Groves et al 2008)
    - *Relational*
      - Cognitive, normative, relational learning (Haug et al. 2011)
      - Conversation quality and engagement skills (Chermack et al. 2007, Veliquette et al. 2012)
      - New contacts (Butler et al. 2015)

- New relationships (Zegras and Rayle 2012)
  - Trust, social networks (Butler et al. 2016b)
- Organization
  - Organizational learning
    - Dimensions of the learning organization questionnaire (Chermack et al. 2006, Chermack and Nimon 2013)
    - Situational Outlook Questionnaire - creative climate (Chermack et al. 2015)
    - Long-term strategic thinking & planning (Bowman et al. 2013)
  - Collective learning
    - Transformative learning (Zapata 2013)
    - Innovative ideas, new information, empowerment (Butler et al. 2015)
    - Question norms, creative solutions - ACM Phase 1 (Butler et al. 2016b)
- City
  - *Public opinion*

## Appendix C

### Stakeholder Rapid Evaluation Survey Instrument

Specific Outcome	Indicator <sup>1</sup>	Question <sup>1,2</sup>	ACM Phase (s) <sup>3</sup>
Conceptual learning	Enhanced knowledge of the problem	... has their understanding and knowledge of the problem increased?	1
Relational learning	Trust created amongst key stakeholders	... has trust been generated amongst them?	1
Relational learning	Cross-scale social networks	... have new relationships grown between them as a result of the project, where they exchange information, ideas, and resources?	1, 2, 3
Conceptual learning	Different knowledge types successfully integrated and accepted	... has their different kinds of skills and knowledge been successfully integrated?	1
Normative/Collective learning	Questioning of values, norms, routines and governance underlying the problem, and awareness of its complexity	... have they reconsidered the underlying causes community problems, and the way they are currently being thought about and managed?	1
<i>Other: empowerment, leadership</i>	Empowerment of communities	Has the project empowered marginalized community members?	1
<i>Other: empowerment, leadership</i>	Emergence of leaders prepared to champion the process	... have leaders emerged who can engage politically to take and create action?	1
Policies, programs and practices	Creative solutions and innovations	... have new and innovative skills, tools and solutions been developed?	1
Policies, programs and practices	Enabling changes to. or new institutional arrangements	... have they changed policies or planning practices?	2, 3
Policies, programs and practices	New partnerships and cooperative initiatives	... have new partnerships or collaborations been formed?	2, 3
Policies, programs and practices	Outgrowth from the initial arrangements to address additional issues within or beyond the problem domain	... have new projects been designed or implemented to deal with subsequent issues?	2
Policies, programs and practices	Implementation of innovations in arenas that trial, monitor and learn	... have strategies been implemented as trials with monitoring and evaluation?	3
Community Capacity	Enhanced community self-organization that matches scales and anticipates external drivers	Can the community now better tackle their own problems?	3
General Plans, Laws, and Regulations	General plans, laws and regulations <sup>4</sup>	... have they adopted new plans, laws, and regulations? <sup>4</sup>	3
Community Capacity	Enhanced community capacity to live with uncertainty and change	Can the community now better anticipate unexpected changes and adapt to them?	3
Goal Performance	Goal performance <sup>4</sup>	... have their actions resulted in improvements to performance indicators measuring project goals? <sup>4</sup>	3

<sup>1</sup> Adapted from Butler et al (2016). Removed one indicator, “vision and goal for an alternative pathway.”

<sup>2</sup> Butler et al (2016) used the following scale: “Each question was then presented as a proposition, and the interviewee was asked to give a score on a 5-point Likert scale from ‘strongly agree’ (score = 2), ‘agree’ (1), ‘maybe’ (0), ‘disagree’ (1) and ‘strongly disagree’ (2).” During Phase 1 statements were prefaced by “Amongst the project team, Steering Committee and project participants,...” during Phase 2 statements were prefaced by “Amongst the project team, Steering Committee, project participants and new partners ...” and during phase 3 questions were prefaced by “Amongst the project team, steering committee, project participants, new partners and other communities, ...”

<sup>3</sup> In the adaptive co-management process, Phase 1 is “Priming stakeholders” and includes the planning process, Phase 2 is “enabling policies and programs” involves developing more specific implementation plans, and Phase 3 is “Implementing adoption” and refers to implementation activities.

<sup>4</sup> Not adapted from Butler et al. (2016).

## Appendix D

### Workshop Participant Survey

#### Conceptual Learning

Construct	Question	Scale
Learning	<ul style="list-style-type: none"> <li>I learned a great deal</li> </ul>	Strongly Agree (5), Somewhat Agree (4), Neither Agree nor Disagree (3), Somewhat Disagree (2), Strongly Disagree (1)

**Explanation:** This question is used widely in higher education research and course evaluation, dating back to at least 1971 when it was found in a factor analysis to relate to the broader concept of student stimulation (Holmes 1971). Adopted for planning workshop evaluation in Goodspeed (2013).

#### Double Loop Learning

“Governing Variables” (Argyris and Schön 1996)	Variable Name	Question	Scale
Evidence seeking	<i>Answer questions</i>	<ul style="list-style-type: none"> <li>I was able to get answers to the questions I had.</li> </ul>	Strongly Agree (5), Somewhat Agree (4), Neither Agree nor Disagree (3), Somewhat Disagree (2), Strongly Disagree (1)
Valid information	<i>Open discussion</i>	<ul style="list-style-type: none"> <li>Workshop participants discussed the issues in an open way.</li> </ul>	
Free and informed choice	<i>Others listened</i>	<ul style="list-style-type: none"> <li>Other participants at the workshop listened to what I had to say.</li> </ul>	
Free and informed choice	<i>Alternative views</i>	<ul style="list-style-type: none"> <li>Alternative viewpoints were considered.</li> </ul>	
Internal commitment to choice	<i>Commitment to choice</i>	<ul style="list-style-type: none"> <li>I would support recommendations created by the participants of this workshop.</li> </ul>	

**Explanation:** These questions were created to operationalize the “governing variables” for the Model II theory-in-use hypothesized by Argyris and Schön (1996). Scale developed in Goodspeed (2013). 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. Goodspeed (2013) reports a Cronbach alpha scale reliability coefficient of 0.82 for 175 surveys conducted at planning workshops.