Scenario Planning for Urban Planners

Toward a Practitioner's Guide

Arnab Chakraborty and Andrew McMillan

Problem, research strategy, and findings: Scenario planning has promise as a planning tool when compared with more common approaches, yet planners have had limited success with scenario planning in part because of the complexities of the scenario-planning process itself. We address these issues by constructing the key building blocks of a scenario process for public sector planners. We review and synthesize 63 articles and 25 projects from 2004 to 2014 to construct a planning typology with nine components that capture the important variations in scenario projects, such as the project scope, desired outcomes, and the types of scenario construction and evaluation tools used by planners. Although the typology is based only on a select set of projects from the industrialized world in English, we nevertheless further use our review and synthesis to characterize the key subcomponents or possibilities within each component and discuss the overlaps and connections among them. We then use the typology to code a subset of the reviewed projects to identify the associations among the subcomponents of different components and to explore whether planners should promote or avoid these associations. Finally, we offer some instructions on how planners may use the typology to create a better scenario-planning process.

Takeaway for practice: Our typology illustrates the combination of variables that comprise a scenario-planning process and the tradeoffs planners make when choosing one set of factors over another. Planners can use our typology to construct a variety of scenario processes that are participatory, transparent, and future oriented and are an improvement over traditional planning approaches.

Keywords: scenarios, typology, future, uncertainty, plan making

Scenario planning refers to a variety of approaches that are able to capture and assess "different perspectives on the past, the present and the future" (van Notten, Rotmans, van Asselt, & Rothman, 2003, p. 424). Scenario planning is used widely in various disciplines ranging from business strategy to military applications as a tool that allows participants to think critically about how the future might unfold (van der Heijden, 1996) and to identify new insights that may not emerge through conventional decision-making processes (Malinga, Gordon, Lindborg, & Jewitt, 2013; Schoemaker, 1991). Urban planners have used scenario planning to analyze the future outcomes of present-day decisions, especially when working with multiple uncertainties and differing stakeholder values (Bartholomew, 2005; Hopkins & Zapata, 2007; Isserman, 1985; Shipley, Hall, Feick, & Earley, 2004; Throgmorton, 1992).

While neither new nor unique to urban planning, scenario planning is increasingly popular thanks to computer tools that support spatial data visualization and interactive analysis (Klosterman, 2014) and the inclusion of scenario analysis as a prescribed method in federally funded land use and transportation planning activities such as the Sustainable Communities Regional Planning Grants (SCRPGs; U.S. Department of Housing and Urban Development [HUD], 2010) and the Moving Ahead for Progress in the 21st Century program (Mica, 2012). But a number of issues remain when scenario planning is used in urban planning applications; these include inadequate consideration of uncertainties, an overemphasis on "picking" a preferred future (Chakraborty, Kaza, Knaap, & Deal, 2011), and a lack of effective public involvement (Bartholomew, 2006).

However, little assistance exists for planners to address these concerns and to develop a scenario process systematically. The literature on future studies discussing scenario planning is primarily aimed at private sector use. Planners,

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unlike those in private settings, often work with groups that have competing values and in environments where decision-making processes are not orderly (Healey, 1997). In this study, we develop a typology specifically to assist urban planners with scenario planning. To do so, we identify nine key components that capture the important variations in scenario projects, from scope and desired outcomes to the methods employed by planners, using our reading and synthesis of the literature and 63 scenario-planning-related articles and 25 scenario-planning projects from 2004 to 2014. For each component, we characterize the key subcomponents, which are the possibilities and choices available to planners. We use the typology to code a subset of the reviewed projects to identify the associations between subcomponents from different components and to explore whether planners should promote or avoid these associations. Finally, we conclude that scenario planning offers planners a way to bring together technical approaches and participatory planning in a systematic way to think creatively about the future. We suggest that planners can use our planning typology to create a scenario-planning process that is transparent, participatory, and effective.

Why Do Urban Planners Need a Scenario-Planning Typology?

To develop a scenario-planning process, planners need to understand a variety of underlying factors and make a number of interrelated decisions. A typology offers them a framework to make these decisions more systematically. While a number of scenario-planning typologies exist, they are either aimed at private sector use (see, for example, Ducot & Lubben, 1980; van Notten et al., 2003) or focus simply on the details of crafting and analyzing scenarios (Börjeson et al., 2006). Planners need a typology that goes beyond those narrow considerations and is more suitable to complex planning situations. We develop these ideas in more detail below, but begin with an overview of the promise of scenario planning and the limitations of the existing practice.

Scenario planning improves on traditional urban planning techniques in a number of ways. Scenario planning allows planners to add qualitative inputs into forecasts (Huss, 1998), which are otherwise not adept at dealing with situations with high levels of uncertainty (Schoemaker, 1991). Scenario planning also provides an opportunity for planners to involve nontechnical stakeholders in plan making (Al-Kodmany, 1999) and opens the possibility of creating a process that is inclusive and systematic. By associating planning with thinking about the future (Cole, 2001; Isserman, 1985), scenario planning has the potential to encourage visionary thinking, or "visioning" (Khakee, 1991).

Many planning and funding agencies offer directions to planners on how to construct and evaluate scenarios. However, the usefulness of these directions to meet the variety of goals that scenario planning engenders remains limited. For example, the Oregon Department of Transportation's (ODOT; 2013) scenario-planning handbook notes that:

> ...scenario planning...allows a community to look long-term and envision the future it wants, rather than accept the trend line embodied in most existing plans.... Scenario planning is not about predicting the future or providing a specific answer. Rather, it is a methodology for "seeing" futures not easily estimated using past trends or assumptions.... The expectation is that through the process of conceiving, developing, and evaluating a series of future scenarios and the outcomes they produce, a preferred and feasible course of action can be identified. (p. 6)

On its surface, ODOT's guidance appears helpful. Like other resources on the topic, it encourages planners to create alternative scenarios in addition to an extension of the current trends. The extension of current trends is often referred to as the "base case" or "business as usual" scenario and serves as a long-term projection for a community if "things don't change." Planners expect that the undesirability of at least some aspects of this future would trigger a debate about "what *ought* to change." The alternative scenarios, on the other hand, may reflect a variety of considerations, including the values and desires of the participants or the outcomes of a proposed policy. The comparison among trend and alternative scenarios provides the planners an opportunity to identify what, if anything, would be more desirable to current trends and how it can be achieved. According to Avin and Dembner (2001), scenario building is an iterative process; the final scenario may be a combination of elements from various alternatives.

In practice, however, a number of challenges are common. The expectation of conceiving, developing, and evaluating scenarios can be reduced to a very limited number of options, such as a sprawl scenario and a smart growth scenario. Such overly simplistic scenarios often reveal little more than the preferences of the planners (Klosterman, 2014); instead of engaging the participants in a meaningful dialogue, it may steer the participants toward some preconceived outcome. In addition, in a rush to identify the preferred scenario, planners may end up bypassing the iterative process and thus reducing the likelihood of

uncovering new possibilities. Furthermore, by using the preferred scenario as the basis for action, planners may ignore the potential impact of uncertainties and miss the opportunity to identify decisions whose outcomes are less vulnerable to future changes (Zapata & Kaza, 2015). Finally, the available advice to planners on scenario construction and evaluation techniques rarely extends to broader considerations or goals of the planning process.

To address these issues, the literature suggests that planners should not only consider the tradeoffs between scenario-building tools more systematically, but also go further and consider broader factors such as the purpose of the project. For example, Smith (2007) notes that scenarios should be used mostly as a prioritization and conversational tool. Hopkins and Zapata (2007) note that scenarios could be beneficial at least as a critical thinking tool. The work of these authors hints that purpose is a potential component of a typology. Others have argued for the value of using narrative-oriented methods (Hoch, 2014) to identify possible, though not necessarily likely, futures (Zapata, 2007) and using multiple projections to identify robust decisions (Chakraborty et al., 2011). The work of these authors suggests that the type of methods used and the outcomes sought for the scenario process are potential components of a typology useful for planners. Furthermore, factors that are only indirectly related to scenario construction and evaluation, such as the role of the planning agency, may also belong in the typology because of their strong influence on the project's outcomes.

A typology can help planners decide whom to involve and what tools to use in concert with the scenario-planning process. Tools should serve the broader goals of the scenario-planning project, with appropriate attention to the stakeholders who may be involved in the process and their abilities to interact with the chosen tools. Another rationale for a specific urban planning scenario typology is that scenarios are often created to work toward different goals; accordingly, planners use the term *scenario* to mean very different things. For example, Stone, Mednick, Holloway, and Spak (2007) use it to mean population growth. In most planning analyses, however, planners use population growth as a given and refer to various land use outcomes as scenarios (Shanley, Kofinas, & Pyare, 2013). These differences can be confusing to stakeholders and reduce the effectiveness of their participation. The typology we describe here may help participants understand the variety of factors in scenario planning and their meanings as well as adopt a common terminology.

In summary, we believe that practitioners require a typology crafted to urban planning needs that encourage them to consider a variety of factors when designing a scenario-planning process. Our typology for urban planners not only includes scenario principles and construction tools, but also addresses how a process fits within the broader planning context, including how the planners treat uncertainty, engage with stakeholders, or coordinate related decisions.

Approach and Methods

Our typology is based on an extensive review of published research articles and other scenario-planning project documentation. The building blocks of the typology are: a) *components*—key parameters that can vary among scenario projects (e.g., project scope or scenario tool); and b) *subcomponents* of each component—characteristics of the projects within those parameters (e.g., project scope can be single issue, problem focused, or comprehensive). To identify these building blocks, we formulate a review methodology that captures a broad range of ideas and innovations as well as a geographic spread of applications. For the sake of selecting review materials, we adopt van Notten et al.'s (2003) broad working definition: "Scenarios are descriptions of possible futures that reflect different perspectives on the past, the present and the future" (p. 424).

We selected a set of English-language planning journals and looked for scenario planning–related papers published from 2004 to 2014. We selected this timeframe to keep the projects relatively recent and bounded but also to ensure a long list of cases with a sufficient variety of approaches and an opportunity to track their evolution. We used the *Journal of the American Planning Association* (*JAPA*), *Journal of Planning Education & Research* (*JPER*), *Land Use Policy* (*LUP*), *Landscape & Urban Planning* (*LAUP*), *Town Planning Review* (*TPR*), *Urban Studies* (*US*), *Futures*, and *Systems Research and Behavioral Science* (*SRBS*). We selected *JAPA, JPER, LUP, LAUP, US,* and *TPR* because of their direct interest in planning practice and their popularity among planning practitioners and academics (Goldstein & Maier, 2010). We selected *Futures* because of its interest in future-oriented decision making and *SRBS* for its focus on systems-level decision-making techniques. The mix includes five journals (*LUP, SRBS, Futures, TPR,* and *US*) published outside of the United States, allowing us to capture an international spectrum. We should note, however, that we only consider English-language sources primarily from industrialized countries. In doing so, we may have missed some important ideas and considerations.

When selecting articles, we used the anchor term *scenario planning* as well as the following keywords: *scenario*

analysis, visioning, urban modeling, collaborative forecasting, and *multiple futures.* We also scanned the table of contents to identify article titles that may suggest scenario planning content. We conducted a preliminary review of the short-list of articles for fit with our working definitions and removed false positives, such as those purely about forecasting or modeling. In the end, we selected and closely reviewed 63 articles.

In addition to articles, we reviewed available documentation on 25 scenario-planning projects. Most of these were highly visible regional planning projects such as Envision Utah and Chicago GO TO 2040, or projects funded by the SCRPG program. We also reviewed municipal planning projects, such as in Punta Gorda (FL; Beever et al., 2011) and Phoenix (AZ; City of Phoenix Water Services Department, 2011). Our review of actual projects complements the review of journal articles by providing recent developments in the field as well as examples from smaller regions. After consolidating for duplicates and removing projects with little useful information, our list included 86 examples of scenario planning and spanned areas ranging from land use and transportation to water service provision and energy usage. Practitioners conducted 68 of these projects, and researchers conducted the other 18. As Table 1 indicates, our reading and synthesis of the literature helped us identify a long list of parameters that can vary among scenario-planning projects.

We reduced this list to nine key components, each with three subcomponents, for inclusion in our typology. We did this by consolidating some parameters with a high overlap and eliminating others that were largely co-occurring or for which we found incomplete information. We should note, however, that some parameters not included in our typology, such as spatial extent or timeframe, may indeed be important components in some places. The following typology offers scenario planners the flexibility to add or remove components and to redefine the parameters based on project specific needs.

Table 1. Preliminary list of scenario-planning components.

1. Goals	12. Scenario types
2. Area of focus	13. Number of scenarios
3. Spatial extent	14. Funding source
4. Geographic context	15. Commissioned by
5. Exercise timeframe	16. Lead agency
6. Planning horizon	17. Resources constraints
7. Scenario inputs	18. Agency types
8. Technical approach	19. Agency affiliations
9. Tools used	20. Participants by expertise
10. Stakeholder engagement	21. Participation by affiliation
11. Scenario construction approach	

A Scenario Typology for Practitioners

We created a typology with nine major components, each with relevant subcomponents, based on our analysis of the literature and the reviewed projects. Note that multiple subcomponents may be possible, especially in larger projects. We discuss the overlap and connections among the nine components in the next section.

1. Organizational Structure: Unitary, Strong Leader, or Loose Coalition

The *organizational structure* component captures the relationship among the entities involved in the scenario-planning process. If the process and decisions are internal to a single agency, we deem it *unitary.* For example, a small-town planning department evaluating alternative land use decisions is a unitary organizational structure. We deem processes that involve more than one organization but include an agency either clearly at the top of the hierarchy, in charge of enforcing the outcomes, or the primary initiator and manager of the process, a *strong leader* process. We deem processes that involve more than one group where there is no clear leader, or where different organizations lead different aspects of the scenario planning process, as *loose coalitions.*

For example, a metropolitan planning organization (MPO) leading a regional scenario analysis for its long-range transportation plan update is a strong leader structure. A U.S. Department of Housing and Urban Development (HUD) SCRPG-funded sustainability consortium, also coordinated by an MPO, is an example of a loose coalition. Strong leader and loose coalition structures may sometimes involve the same agencies. For example, the Greater Portland (ME) Council of Governments initiated a strong leader scenario-planning process through a Southern Maine transportation initiative, while simultaneously developing scenarios that focus on potential sea level changes through a loose coalition with state departments.

2. Scope: Single Issue, Comprehensive, or Problem-Oriented

The *scope* component captures the breadth or focus of a project. We classify the scope as *single issue* if the project is focused on a specific topic, such as only transport or only land use. While the analysis may consider other aspects of the built environment, decisions and actions are focused on a single issue, such as transportation infrastructure expansion.

We classify the scope as *comprehensive* if the project attempts to analyze a range of issues or planning domains. For example, the Oxfordshire (UK) workshops examined by Vervoort et al. (2012) encouraged participants to consider

changes in energy use and food provision alongside transportation and land use changes. Scenario analysis as part of a comprehensive plan update is another example.

Finally, instead of choosing one or a range of areas to study, a scenario-planning process may seek to address specific challenges. We classify these as *problem-oriented.* For example, Andrews, Jonas, Mantell, and Solomon (2008) describe a scenario-planning process that produced several future energy-use targets for the State of New Jersey as a means of reducing the state's carbon footprint. While a problem-oriented scope could include a single issue or multiple issues, the main purpose is to develop scenarios that address a well-defined challenge, such as climate change.

3. Scenario Type: Normative, Predictive, or Explorative

The *scenario type* broadly captures the primary motivation behind constructing and evaluating scenarios. Following Börjeson et al. (2006), this component includes *normative*, *predictive*, and *explorative* scenarios. We classify the scenario type as *normative* if the scenario-building process starts with a well-defined target or seeks participant inputs to first identify targets such as preserving remaining greenspaces. Normative scenarios may then compare the relative preference between these targets or attempt to identify how to attain such targets. We classify processes that seek a preferred scenario as normative because the preferred scenarios tend to become aspirational targets.

We classify the scenario type as *predictive* if the scenarios are designed to depict the most likely future based on data-driven trends and input from actors (forecasting), or if the future outcomes are a direct result of decisions made in an earlier period. For example, Zegras, Sussman, and Conklin (2004) develop several transportation planning scenarios within the Houston (TX) region based on different levels of population growth, finance, and technological innovations.

We classify the scenario type as *explorative* if it aims to generate scenarios that broadly identify what can happen (Börjeson et al., 2006), or develop not just likely or plausible futures but possible futures. These processes often explicitly incorporate variations in critical uncertainties and identify how the same policy may produce different outcomes based on variations in uncertainties. For example, Chang, Tseng, and Chen (2007) construct a scenario-planning response to emergency flooding that optimizes the placement of flood relief resources. The authors develop a range of potential flooding scenarios, not just the most likely ones; using these, the authors determine where to locate the resources.

4. Outcome: Awareness, Vision, or Policy Recommendation

The *outcome* component focuses on the desired product or result of the process. We classify the outcome as *awareness* if the activities are designed to primarily develop and exchange knowledge with stakeholders about planning issues. For example, Reality Check exercises organized by the Urban Land Institute are daylong events that generate scenario sketches. The events create lot of buzz about regional issues but rarely produce direct and tangible impacts (Chakraborty, 2011).

We classify scenario planning outcomes as a *vision* if they identify shared goals or a future state. These exercises often encourage participants to compare a number of future scenarios and identify a desired future that best reflects individual or shared hopes and values. We classify scenario planning outcomes as a *policy recommendation* if the scenarios are constructed as future outcomes of present-day decisions, or if the scenario approach can be used for a policy choice discussion. If a project aims to pursue multiple outcomes, planners may want to consider how these will be prioritized.

5. Stakeholder Engagement: General Public, Government Agencies, or Interest Groups

The *stakeholder engagement* component highlights the nature of participants involved in the process. We classify the engagement as *general public* when the public is involved directly. For example, engagement may involve collecting data from the general public, such as through semistructured interviews (Tzanopoulos et al., 2011), assembling focus groups (Carvahlo-Ribeiro, Lovett, & O'Riordan, 2010), distributing questionnaires (Pearson, Park, Harman, & Heyenga, 2010), or holding public meetings (Milligan, O'Riordan, Nicholson-Cole, & Watkinson, 2009). We also classify scenario workshops that are open to all as *general public* (Bourgion et al., 2012; Carvahlo-Ribeiro et al., 2010; Ernst & van Riemsdijk, 2013; Lemp, Zhou, Kockelman, & Parmenter, 2008; Milligan et al., 2009).

We classify the engagement as *government agencies* if the scenarios are developed primarily through interactions between public departments. A state transportation agency such as the California Department of Transportation (2014) working with local and regional governments in the state to streamline policies, such as developing regional planning workshops, would be an example.

Finally, we classify processes that engage stakeholders selected specifically from identifiable organized groups, such as representatives of environmental groups, chambers of commerce, and neighborhood and civic organizations,

as *interest group*. Large-scale projects may need to combine inputs from multiple stakeholders as well as from the broader public.

6. Participation Extent: Inform Only, Seeking Feedback, or Joint Fact Finding

The *participation extent* is our effort to classify the nature of involvement. We label processes *inform only* if the scenarios are designed to educate groups about potential futures and their impact. Tompkins, Few, and Brown (2008) describe a planning process in the Orkney Islands in which scenarios were used to reveal potential conflicts in future coastal management.

We categorize scenario-planning processes as *seeking feedback* if they allow opportunities for knowledge sharing between the scenario designers and outside groups. For example, Penker and Wytrzens (2005) describe land use scenario planning in Austria that allowed workshop participants to identify the most important driving forces. We categorize scenario-planning processes as *joint fact finding* (Andrews, 2002) if they allow collaborative discovery methods to inform scenario creation.

7. Engagement Medium: Web-Based, Face-to-Face, or Hybrid

The *engagement medium* component captures the mechanisms used to draw inputs from the participants. We classify scenario processes that allow inputs into scenario creation and comparison using primarily web-based tools as *web-based*. We classify scenario processes that develop or analyze scenarios at public forums, or with stakeholder or collaborator meetings, as *face-to-face*. Finally, we classify processes that use both approaches as *hybrid*.

8. Scenario Construction and Analysis Tools: Qualitative, Planning Support Systems, or Computer Modeling

We simplify the component *scenario construction and analysis tools* as *scenario tools;* this component covers the various tools and techniques available for crafting planning scenarios. *Qualitative* tools primarily use data gathered through interviews, essays, or opinion surveys, or constructed through narrative forms such as stories or personal experiences. For example, Jenssen (2010) describes a local visioning project led by a municipal planning department in Lundal (Norway) that involved the collection, organization, and analysis of the visioning statements from members of the community.

Planning support systems (PSS) include interactive computer-based tools that can provide mapping and analysis capabilities. Systems such as EnvisionTomorrow or CommunityViz (Fregonese Associates, 2012; Placeways LLC, 2012) are often used to encourage participants to specify spatial decisions and rules. The computer tools can then generate the impact of these decisions on a set of pre-programmed indicators such as new tax revenues or vehicle miles travelled.

Computer modeling tools have limited on-the-spot interactivity but have sophisticated computing capabilities to model the interaction of multiple urban phenomena and their response to policy interventions and uncertainties. For example, Lemp et al.'s (2008) scenario-planning process includes a land use modeling application for the Austin (TX) region. Like a number of other components, scenario projects are likely to use a combination of tools depending on the size and stage of the process.

9. Resources: Statutory or Recurring, Opportunity-Based, Fundraised

The *resources* category attempts to capture a variety of factors such as project funding, institutional capacity, and the intensity and tenure of the project. *Statutory or recurring* cases are those where planning activity is a required part of an agency's mission or where long-term support is assured. This may include large-scale infrastructure development projects or activities requiring environmental impact assessments.

Opportunity-based resources are those that may be one-time, or provide support of limited duration for scenario-planning activities. Examples include the SCRPGs to regional consortia around the country to conduct scenario-planning activities. Finally, *fundraised* projects are ones supported by myriad sources, mostly private, and tend to be for limited periods. These are often led by nongovernmental agencies such as the Urban Land Institute in its Reality Check scenario-planning exercises.

Table 2 shows how some of the reviewed projects can be organized according to this typology. We have purposefully varied the included projects to illustrate the breadth of the typology and of the projects.

Connecting the Typology Components

Planners should take into account three additional considerations when using this typology in decision making. First, not all components will allow the same level of choice to planners and decision-makers. For example, in statutory processes, the organizational structure, available resources, and project scope may be predetermined, whereas the scenario construction tool or engagement medium may be a choice for the planners.

Table 2. Using the typology to plot selected scenario projects.

No.	Scenario Planning Process	Org. Structure	Scope	Scenario Purpose	Outcome	Stakeholder Engagement	Participation Extent	Engagement Medium	Scenario Tools	Resources
1	Wasatch Choices 2040 (UT) (2010)	Loose coalition	Comprehensive	Exploratory	Vision	General public	Open to feedback	Face-to-face	Computer modeling, PSS	Opportunity-based
2	Idaho's Transportation Vision (Transportation for Communities, 2010)	Unitary	Single issue	Exploratory	Vision	General public	Open to feedback	Face-to-face	Computer modeling	Opportunity-based
3	ComPlan 2030: Auburn (AL) (City of Auburn, 2011)	Unitary	Single issue	Normative	Policy	Government agencies	Inform	Hybrid	Computer modeling	Opportunity-based
4	SACOG Blueprint (CA) (Sacramento Area Council of Governments, 2010)	Strong leader	Comprehensive	Normative	Vision	General public	Open to feedback	Face-to-face	Computer modeling	Statutory
5	Upper Verde River Watershed (AZ) (Upper Verde River Watershed Protection Coalition Watershed Taskforce, 2014)	Strong leader	Problem-oriented	Predictive	Awareness	Government agencies	Joint fact finding	Face-to-face	Computer modeling & qualitative	Opportunity-based
6	Reality Check Washington (DC)	Loose coalition	Comprehensive	Normative	Vision	Interest groups	Joint fact finding	Face-to-face	Qualitative & PSS	Fundraised
7	Bodegraven polder (The Netherlands)	Loose coalition	Problem-oriented	Normative	Awareness	Interest groups	Joint fact finding	Face-to-face	PSS	Opportunity-based
8	Dryland Development (Makanya, Tanzania) (Enfors, Gordon, Peterson, & Bossio, 2008)	Strong leader	Single issue	Predictive	Awareness	Interest groups	Open to feedback	Face-to-face	Qualitative	Fundraised

Notes:

1. Collaboration between regional and local governments; four transportation scenarios developed using the IMPACT model.
2. Transportation scenarios led by the Idaho Department of Transportation anticipated technological and population changes and new infrastructure using MetroQuest.
3. Land use planning. Business-as-usual, annexation, and infill land use scenarios modeled with the Auburn Interactive Growth Model.
4. Continuing trend and preferred scenarios modeled using I-PLAC3S.
5. Water management planning led by the Watershed Protection Coalition; sought to determine a future safe-yield water supply.
6. Nonprofit and public organizations; scenarios constructed by stakeholders to compare different types of growth.
7. Water management planning led by researchers with local and regional governments; scenarios created with stakeholders and CommunityViz.
8. Land use scenarios to identify uncertainties and responses; led by researchers and NGOs with farmers and government.

Second, more than one of the subcomponents may be selected in a scenario project. For example, a unitary agency may initiate a single-issue project, but it may become problem oriented over time and involve other agencies forming a loose coalition. Pursuing more than one possibility under some component may even be desirable. For example, targeting more than one funding source or creating more than one type of scenario may help provide additional resources and insights for the participants.

Third, when making decisions about a process, planners may want to sequence their decisions using the typology, generally starting with the components that set the broader parameters, such as who will be involved at the highest level and what resources they will require, before, for example, settling on a scenario construction tool. The participants in the project team may also find this a useful joint activity to establish a consistent understanding of the concepts and the project's goals. Figure 1 illustrates one possible way to organize the typology. We should note, however, that the project planners should determine the final ordering and classification of the scenario-planning process.

In this framework, planners may have the least flexibility with the *organizational structure* and available *resources* components. We consider these components the project's *context* or given. The scope may be a part of the context, such as in statutory processes, or be a *primary decision.*

Primary decisions are those that are within the purview of the project planners and are related to the higher level purpose of the project. In addition to the scope, other primary decisions involve selecting the scenario types and identifying the desired outcomes. Making these decisions earlier in the process may help identify the appropriate mechanisms for later stages. For example, planners interested in developing predictive scenarios may subsequently engage with technical experts or a selected focus group and use a forecasting tool. In contrast, a process focused on

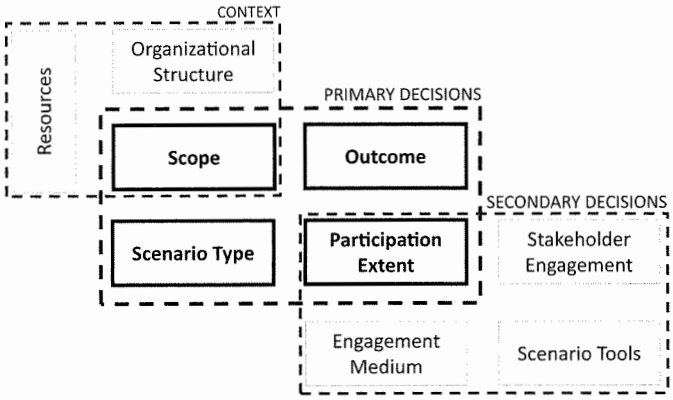

Figure 1. A scenario planning typology.

normative or explorative scenarios may prefer a general participant group and more interactive tools. Primary decisions may also be interlinked to some degree. For example, if a vision is the desired outcome, then normative or predictive scenarios are likely the most appropriate scenario types.

We include participation extent under primary decisions because meaningful engagement is fundamental to a good planning process. However, in practice, it may also be at the intersection with *secondary decisions.*

Secondary decisions are important and can greatly affect the legitimacy of the process and its impact. Nevertheless, they are made within the constraints imposed by the context and primary decisions. If higher-level constraints mean that the organization structure is a loose coalition aiming for awareness, the process cannot be limited to government agencies alone or just depend on informing the audience.

Last, no typology can include all the possibilities or guarantee a successful outcome. However, it can be useful as an organizing framework and is adaptable to local conditions. The framework discussed here, or an adjusted version, may assist scenario planners in outlining important parameters, considering broader choices and their implications before making decisions, and communicating information more effectively.

Typology for Comparative Analysis

We attempted to code all 68 of the reviewed projects using our typology to identify the associations between subcomponents from different components. For example, we find that projects led by loose coalitions rarely lead to policy recommendations, whereas projects led by unitary agencies often do. We then attempted to discover whether planners should promote or avoid these associations.

The coding process started with the authors coding a small subset of scenario projects independently. Once they reached a consistent understanding of the typology components and subcomponents, one of the authors took the lead on coding the remainder of the projects followed by the other verifying a randomly selected sample. The coding of the projects was revisited and refined over a year by both authors as the typology evolved through the publication review process. In the end, we found reliable data for only 42 of these projects across all the nine categories. For brevity, we summarize a select set of findings in Table 3 and discuss some observations.

About half of the projects focused on a single issue, such as transportation or land use, in project scope, while comprehensive and problem-oriented projects each

Table 3. Comparing reviewed projects for select categories.

	Lead agency type (total)		
	Unitary (17)	**Strong leader (19)**	**Loose coalition (6)**
Scope (total)			
Single (21)	10	8	3
Comprehensive (10)	1	6	3
Problem-oriented (11)	6	5	0
Scenario type (total)			
Normative (17)	4	9	4
Predictive (16)	10	4	2
Exploratory (9)	3	6	0
Outcome (total)			
Visioning (11)	1	5	4
Awareness (6)	2	4	1
Policy recommendation (25)	14	10	1
Stakeholders[a] (total)			
General public (13)	1	8	4
Stakeholders (14)	7	6	1
Government agencies (10)	7	2	1

Note:
a. For five of the projects, we did not have sufficient information on stakeholder type.

accounted for a fourth of the remaining projects. This finding may be an artifact of drawing the reviewed projects heavily from academic journals; it may also indicate that planners prefer to develop scenarios when the project scope is limited. Scenarios with many variables, such as those that may be found in comprehensive or problem-oriented scenarios, are not only more difficult to construct, but may also be more difficult to pursue with wider public engagement.

We also looked at the relationship between project outcomes and other typology components. We should first note that it is not our intent to imply a progression in quality from awareness to policy recommendation. The quality of the scenario process can only be judged using a deeper case-by-case analysis. Most scenario outcomes focus on policy recommendations ($n = 25$), with vision as the second most popular outcome choice ($n = 11$). Awareness scenarios are the least used ($n = 6$). Across the categories, unitary organizational structures overwhelmingly chose policy recommendation outcomes. Strong leader structures also chose more policy recommendations outcomes, yet nearly half of the strong leader structures also selected vision or awareness outcomes. Loose coalitions preferred visions as outcomes.

These patterns may indicate the relative role of each organizational structure. For example, unitary agencies have clear bureaucratic functions guided by policies and may have less incentive for creative exercises such as visioning. They are also restricted in their scope and authority. Loose coalitions, often unencumbered by strict requirements, may have the opportunity to envision scenarios more freely.

Unitary agency-led scenario-planning processes were also more likely to construct predictive scenarios over normative or explorative scenarios. In contrast, strong leader coalitions used all three scenario types, with normative scenarios ($n = 9$) slightly more popular than predictive ($n = 4$) or explorative ($n = 6$). Explorative scenarios were used the least often, as suggested by the critiques in the planning literature. Predictive scenario types were more likely to result in policy recommendations, while normative scenario-planning types included a mix of vision, awareness, and policy recommendation outcomes. In other areas, computer modeling was the most common scenario tool subcomponent, followed by planning support systems and qualitative tools. When computer modeling was used, stakeholder engagement was purely informative. Planning support systems and qualitative tools were used more when the planners were seeking feedback or when engaged in joint fact finding.

In summary, we find that the typology is robust as a coding tool that can provide a useful way to summarize scenario projects and to conduct comparative analysis. The findings from our analysis show that a number of subcomponents tend to co-occur. Such associations may be desirable in some cases, but in others they may limit the value of the process.

Planners Using the Typology

Planners can construct a variety of scenario-planning processes. In doing so, they may benefit from using our typology to a) identify and refine the pertinent components and subcomponents, b) explore the tradeoffs associated with one combination of factors over another, and c) consider how the scenario-planning project fits into the broader planning process. These tasks are closely related and have overlapping implications. Therefore, planners should make these decisions iteratively in practice.

Identify the Pertinent Components and Subcomponents

Planners may start with our basic typology, and identify and focus on its most pertinent components. For example, an environmental agency staff using future

land use possibilities as an input to assess air quality scenarios may need to consider only a subset of the typology components. These would include the project's scope, the agency's technical capacity (resources), an assessment of uncertainties and targets (scenario types), and the nature of the findings (outcomes). How the future land uses are generated or affected may be outside the purview of the agency. Projects with a broader scope, such as a regional planning consortium, may need to consider additional components. These include identifying the agencies with which to plan and their responsibilities (organizational structure) as well as determining the level of interaction with other participants in crafting scenarios (participation extent, stakeholder engagement, engagement medium, and scenario tools).

In some cases, planners may find it useful to add components to the typology. An example of this is *timeframe*. While it can be considered a part of the resources component, it may need to be considered separately, particularly when a variety of timeframe options are open and the timeframe chosen has a significant impact on who is involved and to what extent. Finally, the planners will need to recognize which subcomponents are possible and where they may have a choice. For example, a regional consortium may identify a preferred scenario (scenario type: normative) or conduct additional analysis to test whether the preferred future is robust across a variety of future conditions (scenario type: explorative). What planners do may depend on the availability of resources and the vulnerability of the vision to uncertainties.

Explore the Tradeoffs Between Combinations of Factors

Selecting one or more subcomponents affects the choices that planners may have in other areas. Thus, exploring the tradeoffs in making these choices may be useful for planners. For example, consider the connections between project scope and who might be involved, in what role, and to what end. To reach a policy recommendation on a controversial problem such as climate change adaptation, a strong leader or a unitary agency, along with dedicated resources, may be necessary. Otherwise, raising awareness or a reaching a vision might be the best outcome, at least in the early stages. Similarly, when the scope is single issue and narrow, such as with alternative infrastructure investment proposals, the participants may be more interested in specific details of the impacts. Computer models of land use change and travel may be useful in combination with relatable measures of future scenarios.

Planners may also cluster the components into *context*, *primary decisions*, and *secondary decisions* as a way to set priorities and sequence initial decisions. For example, if there is a funding opportunity that promotes regional scenario planning, the planners may want to get a sense of what constitutes a useful and fundable scope, and which agencies should be involved at the highest level of planning. In the next stage, the planners may want to identify which outcomes are desirable (and possible), who the critical stakeholders are, and which scenario types are needed given the scope and organizational structure. Only after resolving these questions should the planners consider how to create and evaluate the scenarios.

Connect Scenario Planning to Planning

For scenario planning to be useful, planners must integrate it with the broader planning process. One way the typology can assist planners is by including factors such as organizational structure, resources, and project scope explicitly in the scenario development and analysis process. For example, considering the choices planners have in involving a range of collaborators matters to the nature and legitimacy of the process and, ultimately, its outcome. Similarly, the ability of stakeholders to influence tangible outcomes as well as their capacity to grasp planning analysis may inform which engagement medium and tools are selected.

Finally, the proposed scenario-planning typology is flexible enough to accommodate a variety of analytical needs that planners may have. For example, planners working on a hypothetical new road project may need to select a different set of typology components and subcomponents depending on the specific problem or stage of the project. They may be tackling a question of community priorities (Does the community need a new road, a light rail system, or a bus rapid transit?), regional trends (Would building the road to the south of the town cause less sprawl than extending transit to the west?), specific investment decisions (Should we build a two-lane road, a four-lane road, or purchase a four-lane right-of-way but build a two-lane road?), environmental impact (Would alignment *X* or alignment *Y* cause greater damage to the creek?), and so on. Scenario planning may be a useful approach for each of these questions, but its exact application will vary a great deal. Our typology can assist planners in creating processes that are appropriate to their purpose.

Concluding Thoughts

Scenario planning offers many advantages to planners over traditional plan-making approaches. It brings together previously separate technical and participatory planning approaches into an integrated and systematic framework.

It allows for inclusion of new institutions and publics, and encourages participants to think creatively. It also focuses squarely on the future. However, planners have had limited success in using scenario planning as a tool for good planning, in part because of the complexities of the scenario-planning process itself.

In this study, we present a typology that can be useful to planners in developing a scenario-planning process by organizing a range of underlying and interrelated possibilities and decisions. Our typology could make a scenario-planning process more effective, and thus we offer guidance to planners on how to use the typology in their own projects. If our typology is carefully combined with local inputs, it can help foster collaboration, address uncertainty, and improve decision making.

Attempting to improve the efficacy of scenario planning will serve planners well. Scenario-planning projects are increasingly popular, not only in traditional planning activities, but also in emerging and crosscutting areas such as climate change, global migration, and resource conflicts. Scenario planning and related approaches are also being promoted as the method for intergovernmental coordination in large-scale initiatives such as the HUD SCRPG program and the European Future Cities project. Thus, there are excellent opportunities to develop novel concepts and tools that are more transparent, participatory, and effective. Our proposed typology adds to this movement and helps establish scenario planning as the gold standard for future-oriented urban planning.

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