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Land use-transportation scenario planning: promise and reality

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Abstract Land use-transportation scenario planning has become increasingly common in regional and sub-regional planning processes. The technique promises to provide citizens with opportunities to engage in constructive dialogue about the future of their communities, and to serve as a basis for assertive action to direct the course of that future. This study reviews 80 scenario planning projects from more than 50 U.S. metropolitan areas. The analysis reveals important gaps in the practice of scenario planning—particularly in the areas of public participation, methodology, and institutional structures—and recent efforts to address the shortcomings.

Keywords Land-Use · Planning · Scenario · Transportation

In recent years, many metropolitan areas in the United States have engaged in some form of visioning to chart a future for their communities. These ''vision quests'' frequently use some form of scenario planning to quantitatively evaluate several alternative development patterns and analyze their respective impacts on indices ranging from the affordability of housing to water quality. Consistent with traditional rational-comprehensive decision-making processes, this assessment, ideally, leads to a policy selection that optimizes for attainment of established goals (Bartholomew 2005). In such contexts, scenario planning can provide important opportunities for citizens to become involved in exploring a wide range of possible futures, leading to the adoption of new policies and implementation strategies that reflect a more desirable future than trend conditions might provide.

The actual practice of scenario planning in American metropolitan areas during the last 15 years, however, reveals substantial gaps in achieving these objectives, particularly in the areas of public participation, methodology, and institutional structures. In many cases, citizens have not been meaningfully involved, the processes have been agenda driven, the differences between alternative scenarios

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and trend projections are slight, and effective implementation strategies have not been adopted. While the most recent examples of scenario planning indicate that some of the weaknesses are being addressed, the disappointing results reported here suggest that planners have a large task ahead of them if they are to more completely realize some of the core promises at the root of scenario planning.

1 Introduction: The roots of land use-transportation scenario planning

A scenario is ''an internally consistent view of what the future might turn out to be—not a forecast, but one possible future outcome'' (Porter 1985). A process that uses scenarios to assess the future—a ''scenario planning'' process—utilizes a series of scenarios to gauge possible future conditions. The expectation is that through the process of conceiving, crafting, and evaluating a series of scenarios, an appropriate course of action can be identified.

The current use of scenario planning techniques in land use-transportation planning is derived, in part, from the history of military and business strategic planning (Ringland 1998). It also has roots in the tradition of alternatives analyses that sprang from various federal environmental and planning mandates adopted in the 1960s/1970s, including the ''3C'' planning process required by the Federal-Aid Highway Act of 1962 and the environmental impact reporting requirements of the National Environmental Policy Act (NEPA). Although these two precursor threads share some similarities, their respective treatment of internal and external influences are important to note. Internal influences, as used in this context, refer to those factors that the decision-maker can affect in some significant way. By contrast, external influences—such as environmental, political, or economic conditions—are forces over which the decision-maker has little or no control. Business and military scenario planning has traditionally focused on assessing interactive causal relationships *between* external and internal influences (Avin and Dembner 2000). Most 3C and NEPA-style alternatives analyses, on the other hand, have focused on the unilateral effect of decision-maker controlled actions on external resources and conditions, with little attention to internal/external interactions.

Nowhere is this difference more apparent than in the traditional type of planning and decision-making for transportation systems and projects. Largely as a result of the 1962 Highway Act, a style of transportation planning developed that is highly dependent on computerized modeling systems. These now familiar systems use current trends to project into the future the possible operation of a proposed new system or facility. Among the system inputs are socio-economic data, including the location of future household and employment growth. In the traditional form of these planning processes, the allocation of future land uses does not vary across alternatives. In other words, the future land use pattern is involved in the study process only as a single, specified *input* to the analysis, not as a variable or as a possible outcome.

The desire to remedy this limitation is at the root of many land use-transportation scenario planning processes (see, e.g., 1000 Friends of Oregon 1997). By incorporating techniques that capture or reflect the interactive nature of land use and transportation, these projects essentially grafted the military/business approach to scenario planning onto NEPA-type alternatives analysis. The early examples of this

hybrid technique include several seminal investigations of basic highway and transit networks (see, e.g., SEWRPC 1966; Lockwood 1973) and a series of academic studies of the impacts of land use patterns on energy consumption (see Edwards and Schofer 1976; Mazziotti et al. 1977; Peskin and Schofer 1977). In the 1980s, a pair of studies sponsored by nonprofit organizations shifted the focus to the effects of land use patterns on transit ridership and the need for highway expansion (1000 Friends of Oregon 1997; Middlesex Somerset Mercer 1988). When these and other studies (Replogle 1993) were underway, they were considered to be ''state of the art.'' Since then, however, numerous studies and projects have been launched to look at ways in which alternative land use futures might affect the quality of the human and natural environments. Implicitly, these projects create the expectation of an open exploration into future development patterns that will result in effective public policies to create a more desirable future. This study was conceived to determine the degree to which the actual practice of land use-transportation scenario planning meets this expectation.

2 Data collection and methodology

The study began with an open-ended survey in 2003–2004 to gather information on current and past scenario planning practices. I sent the survey initially to the planning directors of 658 member organizations in the National Association of Regional Councils (NARC). I sent additional surveys to members of the Association of Metropolitan Planning Organizations that were not also NARC members. One-hundred fifty-two recipients responded, 45% of which indicated that they had direct information on one or more scenario planning projects, or knew of someone who might. I sent a second survey to 69 persons or organizations that had been identified by respondents of the first survey. Responses from the two surveys were supplemented by hundreds of emails, telephone calls, and Internet searches, resulting in an initial data pool of 153 projects.

This initial pool was subjected to a threshold analysis to determine whether the projects in fact utilized land use-transportation scenario planning techniques. The primary discriminating criterion was whether future land use inputs (i.e., the spatial allocation, density, heterogeneity, or design of growth) varied across scenarios. Those that held such conditions static were excluded from the data set. This left a total of 80 projects in the study.[1] Two researchers then independently used the six analysis areas outlined in Table 1 to evaluate each project, and harmonized their findings.

3 Results: Land use-transportation scenario planning practice

The geographical distribution of the 80 projects in the data set is depicted in Fig. 1. The pattern indicates interesting clusters of projects along the west coast and in the

[1] An annotated bibliography of the projects is available at http://content.lib.utah.edu/u?/ir-main,101. Many of the project reports are also available through a digital library maintained at the University of Utah J. Willard Marriott Library (http://content.lib.utah.edu/cdm4/browse.php?CISROOT = /FHWA).

Table 1 Analysis areas[a]

Topic of analysis	Associated analytical question
Impetus for the study	What issues motivated the project sponsor to engage in the study process?
The nature of the scenarios	What types of land use elements were varied between scenarios (e.g., the overall magnitude of growth; the mix between jobs and households; the location, density, heterogeneity, and/or design of the growth)?
The evaluation process	What indices were selected to evaluate/compare the scenarios and what technical tools were used to measure those indices?
Evaluation results	What were the outputs from the evaluation process?
Public involvement	At what points in the process and in what ways were members of the public involved?
Resulting actions	What follow-on actions or institutional changes were undertaken by the sponsor or other entities as a result of the study?

[a] In addition to providing the foundation for this study, the six-part analysis provided the basis for an annotated bibliography, which is available at http://content.lib.utah.edu/u?/ir-main,101

Fig. 1 Land use-transportation scenario planning projects in the U.S

Chesapeake Bay area, suggesting a connection between land use-transportation scenario planning and states that have some level of growth management legislation in place (see Johnson et al. 2002). Temporally, the rate at which scenario planning projects have been undertaken has been increasing steadily since the late 1980s (see Fig. 2).

3.1 Motivations for undertaking scenario planning

The purposes that organizations list for undertaking scenario planning projects indicate, to some extent, how those organizations view the purpose of the public

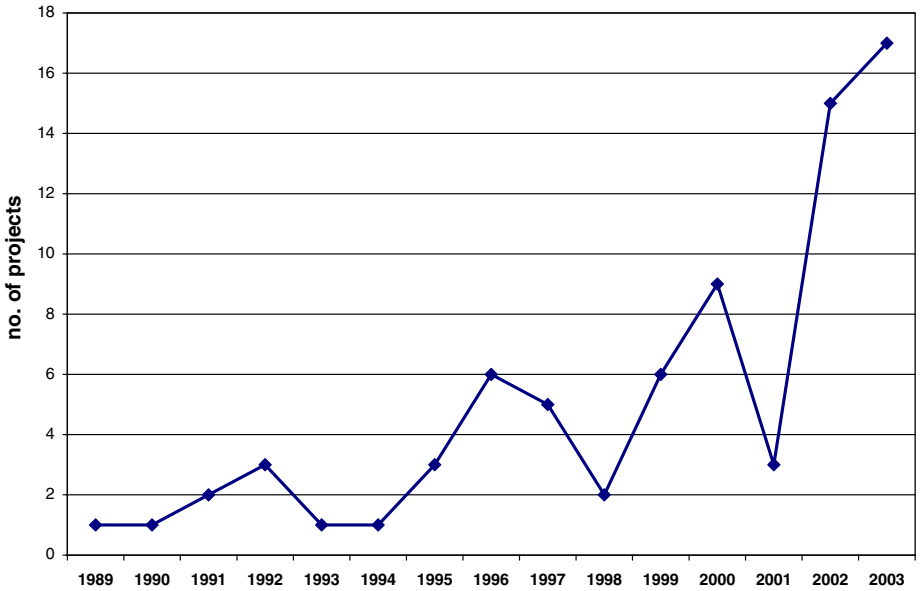

Fig. 2 Land use-transportation scenario planning project completion dates

participation process and the type and possible extent of policy changes the organization anticipates might result from the planning exercise. At a broad level, most sponsors of the scenario planning projects assessed in this study (61%) were concerned about some type of spatial pattern or urban form issue. Concerns within this category included: ensuring sufficient amounts of land for future growth; promoting modally balanced transportation systems; and avoiding sprawl and the traffic congestion, loss of open space, and air and water pollution frequently associated with sprawl.

These concerns suggest that many of the project sponsors entered into scenario planning, not to engage in a wide-ranging public dialogue on planning issues, but with an agenda to achieve some particular objective. One can infer that sponsors concerned about land capacity issues were hoping the process would lead to policy changes that would result in lower land consumption rates. Those concerned with promoting balanced transportation systems and avoiding sprawl were probably looking for policy changes that would result in less automobile use.

3.2 The nature of the scenarios

Given that urban form concerns seem to dominate scenario planning processes, establishing just how many different forms to include in a project seems fundamental. Because humans have a fairly limited ability to hold onto multiple bits of information simultaneously (Georgantzas and Acar 1995), scenario planning processes usually attempt to limit the number of scenarios under consideration (Godet 2001). Having too few scenarios, however, can also lead to problems. Having only two scenarios can suggest that one scenario is ''good'' and the other ''bad.'' Having three might imply that one of the scenarios is the normative ''forecast,'' or lead participants to choose the middle scenario as the ''Goldilocks'' compromise between

the other two more antipodal options (Ringland 1998). A consensus appears to emerge from the literature that four scenarios is the right number: not too many to confuse participants, but enough to allow for divergent thinking and coherent story telling (Godet 2001; Ringland 1998, 2002).

Only one-quarter of the projects in this study contained the recommended four scenarios. Over half of the projects contained either two or three scenarios (17% and 34%, respectively). Although only 10 projects (13%) contained six or more final scenarios, several projects with two, three, or four final scenarios actually used many more preliminary ''sketch'' scenarios in early stages of their processes (e.g., Bay Area Alliance for Sustainable Development 2002).

The labeling of elements used in public dialogue can employ metaphors that subtly suggest preferred courses of action (Stone 2002). Hence, how scenario planning project sponsors name scenarios for presentation can affect public perceptions of the scenarios and can influence processes to select a preferred scenario. Value associated names such as *Urban Sprawl* (American Farmland Trust 1995) and *Business as Usual* (Allen et al. 1995), on the negative side, or *Wise Growth* (Tri-County Regional Planning Commission 2003) and *Quality of Life* (Allen et al. 1995), on the positive side, send clear signals on how the sponsors wish the public to perceive the scenarios. Scenario titles that seem less value laden still are not without the potential for bias. Titles such as *Village/Town Centers* (Metropolitan Transportation Planning Organization 2000) or *Development* (Pacific Northwest Ecosystem Research Consortium 2002) still can have associated connotations that may artificially attract or repel participants in scenario planning processes (see Wirthlin Worldwide 1997).

The data indicate that scenario planning project sponsors tend to use the more value-laden and letter/number labels in roughly equal amounts (13 and 11 of 80, respectively). Another seven used transportation modes for scenario names (e.g., *Rail*, *Highway*) and 16 made use of miscellaneous systems. The clearly dominant method (37 of 80) was to use names associated with various land use types and forms, such as *Major Centers* (Puget Sound Council of Governments 1990), *Residential Cluster* (1000 Friends of Minnesota 2003), and *Corridor Development* (Denver Regional Council of Governments 1995).

Another method to assess the type of scenarios used is to look at the variables employed (see Table 2). With spatial patterns and urban form being the dominant concern motivating project sponsors, it is not surprising that *location of growth* and *density of growth* were the two leading variables used to distinguish scenarios (73 and 76 of 80 projects, respectively). *Land use diversity* (homo/heterogeneity) was also a popular variable (50). With the focus on density and diversity, one would expect there to be greater interest in using land use design—the third ''D'' in the

Table 2 Variables between scenarios ($N = 80$)

Variable	Number of projects[a]
Rate or amount of growth	20
Location of growth	73
Density of growth	76
Design of growth	25
Homo/heterogeneity of growth	50
Transportation system elements	40
Pricing/policy elements	12

[a] Because many projects used multiple variables, the sum of the right-hand column exceeds the total number of projects in the study

triumvirate of density, diversity, and design (Cervero and Kockelman 1997)—than the 25 projects indicated in the data. The lower than expected number, however, may be more the result of limitations in the ability of the transportation models to estimate design influences (see Beimborn et al. n.d.) than in a lack of interest on the part of sponsors.

The widespread use of land use density as a variable raises obvious questions about the degree to which sponsors varied that attribute across scenarios within a given project. In other words, how dense, or dispersed, were sponsors willing to go in their scenarios? Although density was a variable in 76 of the 80 projects in the study, the data were sufficient to make comparisons across only 22 projects. These projects presented data indicating the expected average development density for each scenario in the planning horizon year over the entire study area. Figure 3 shows the maximum range, both positive and negative, of scenario densities for each of these projects, compared to the identified trend or baseline scenario. Because study horizon years varied across projects, the data in Fig. 3 have been normalized to 20 years, the most common study horizon.

The first thing to note about the figure is how few projects include scenarios that are less dense than the trend. This is consistent with the widespread concern of possible future sprawl as a strong motivation to engage in scenario planning, as noted above. The second notable feature of Fig. 3 is the narrowness of the density ranges. All but four of the projects have a range below 27%, and the median value of the group is 11%. Since the density ranges measured in Fig. 3 are averages based on total development—both old development, as well as new—one would expect the degree of density change possible during the planning window to be somewhat limited, particularly over a time period as short as 20 years. Most observers of urban

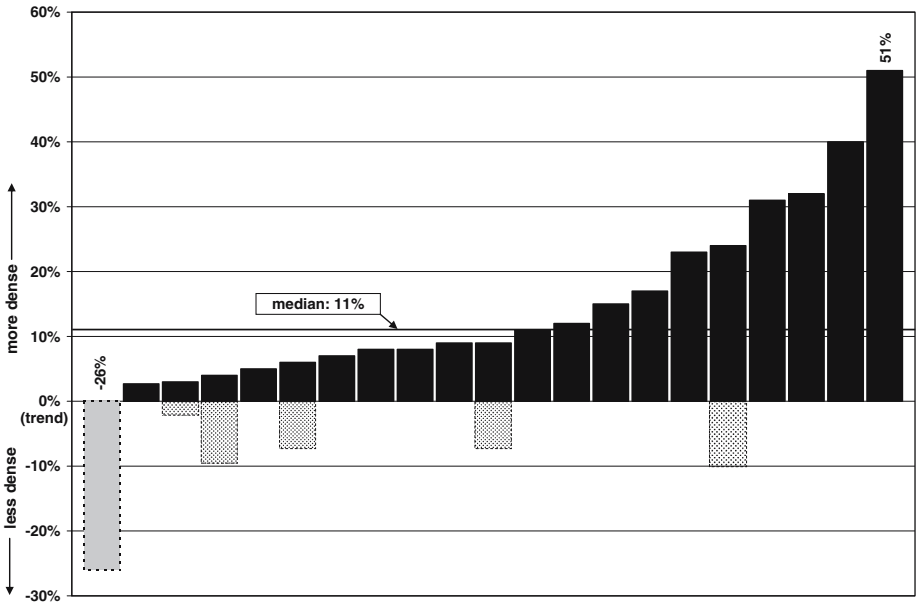

Fig. 3 Range of maximum density variation per project compared to trend scenario (planning horizons standardized to 20 years)

form believe that substantial change in metropolitan-level development patterns requires a significantly longer timeframe (e.g., Downs 2004). It is also possible that the narrow range reflects a common political conservatism that permits consideration of only incremental change (Anderson 2006).

3.3 The evaluation process

Most of the scenario planning projects in this study were sponsored, at least in part, by some regional entity, often by a Metropolitan Planning Organization (MPO). Given the traditional MPO focus on transportation, it is not surprising that over half of the projects (47 of 80) relied to some degree on the travel forecasting models normally used to develop federally required long-range transportation plans (see Table 3). Only nine projects reported using a method to improve the model's ability to evaluate the features frequently emphasized in pedestrian- or transit-oriented development patterns (e.g., use-mixing and pedestrian-oriented design), a rather low number considering the apparent objective of many projects to explore more pedestrian/transit based development options.

3.4 Evaluation results

The projects reported data on the relative impacts of scenarios in a wide range of formats, making comparisons between projects difficult. Because of these challenges, just two indices are presented here: vehicle miles traveled (VMT) and emissions of oxides of nitrogen (NO*x*). Figure 4 shows the maximum range of variation in VMT, compared to the trend scenario, for 31 projects. Although three projects indicated increased VMT, the predominant direction in VMT is downward, with a median reduction of –2.32%. Five projects included scenarios that demonstrated a 10% or greater reduction. One of these scenarios—from the LUTRAQ project—included significant pricing components, as well as land use and transportation elements. The other four projects, however, appear to have relied only on land use and transportation features. Significantly, the three scenarios with the greatest variation in VMT come from projects that reported using some method to increase modeling sensitivity to land use variations. The data on NO*x* emissions show a similar direction of change, and a comparable median (–2.07%), but a wider range than the VMT data (see Fig. 5).

Table 3 Analysis tools used in scenario planning projects ($N = 80$)

Type of tool	Number of projects
Travel forecasting model	47
With transit/pedestrian-oriented development submodel	9
With a GIS scenario building tool	20
With a land use allocation model	7
Sketch travel model	3
Sketch land use/travel model	3
Land use model only	4
GIS model only	10
Economic model/analysis	6
Other/no data	13

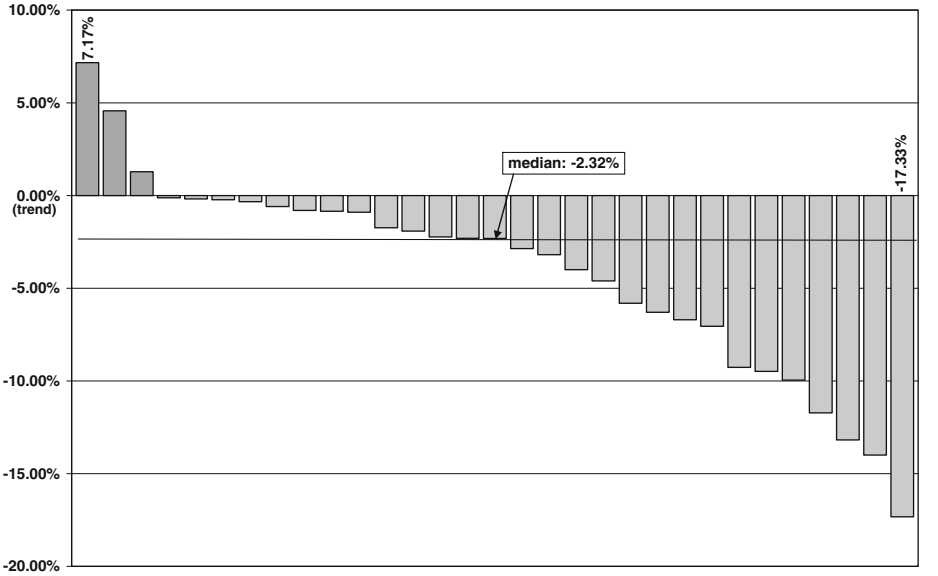

Fig. 4 Range of maximum variation in VMT compared to trend scenario (planning horizons standardized to 20 years)

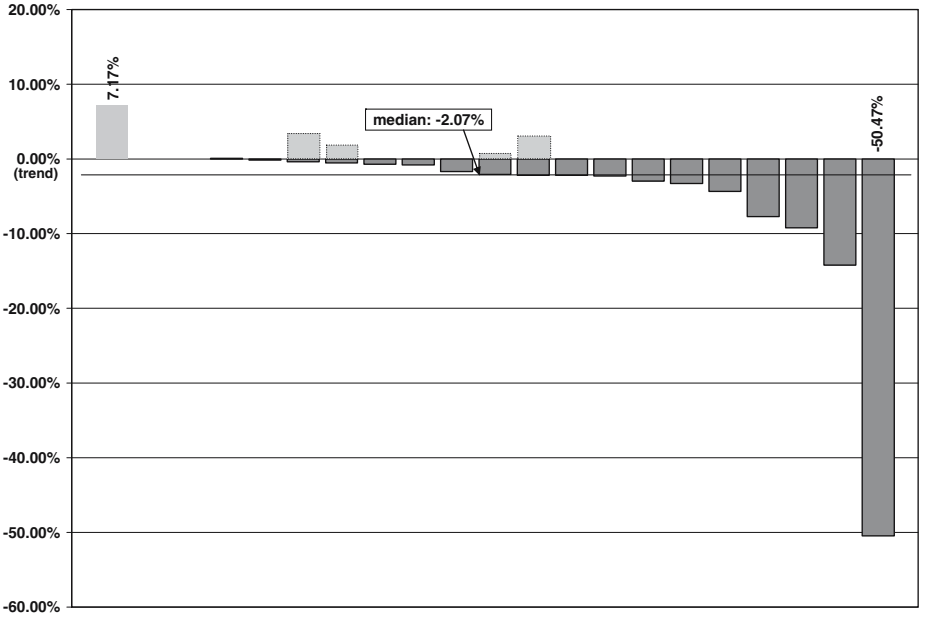

Fig. 5 Range of maximum variation in NO*x* emissions compared to trend scenario (planning horizons standardized to 20 years)

3.5 Public participation

It would seem that a primary reason for undertaking a scenario planning project would be to engage the public in some meaningful interaction on growth and development issues (Burbank and Ways 2005). While most of the projects analyzed as part of this study had some public hearings or presentations on the scenario planning process, only a minority involved citizens or stakeholders in some active way. Twenty-two projects (28%) directly involved citizens in the crafting and development of scenarios, compared to 70 projects that involved sponsor staff and 26 that involved consultants. Of the 49 projects that concluded with the selection of a preferred scenario, only 19 (39%) involved citizens in that selection process.

3.6 Resulting actions

Given the level of effort required by most of these projects, one would anticipate that some concrete result would be forthcoming at the end of each process. The leading result from this group of projects was the adoption of some type of transportation plan (27 projects). With the high degree of MPO involvement, already noted, this is not a surprise. Twenty projects resulted in the adoption of a general or comprehensive plan, and another 14 ended with some other type of policy plan. Twenty other projects, however, ended with no action being reported, and in 14 of those cases project documentation indicated that no future action was anticipated.

4 Discussion

According to business-based scenario planning theory and practice, the objective of scenario planning is to engage the members of some group in an interactive, open-ended process that will lead to a strategic decision about the future (Ogilvy 2002). With a handful of notable exceptions, the land use-transportation scenario planning projects reviewed in this study substantially failed to fulfill these expectations. The evidence suggests that planning agencies frequently entered the study process with a predetermined agenda, engaged the public only cursorily, used inadequate assessment methods, and failed to conclude the process with a strategic action or plan.

4.1 The ''planners' agenda'' and public (non)participation

Many project sponsors began their respective scenario planning projects with at least a general agenda already in mind. Nearly two-thirds (61%) of project sponsors indicated concern about reduced land supplies, increased auto reliance, and continued sprawl as motivations for initiating scenario planning, suggesting that most sponsors engaged in the planning process to forward policy objectives that will result in more compact and less auto-oriented futures. This evidence stands in contrast to the business-oriented scenario planning model, where pre-conceived notions of project results are consciously avoided (Godet 2001).

The undercurrent of this ''planners'agenda'' is also suggested in the naming, number, and content of the scenarios. Sixteen percent of the projects used value-associated scenario names (e.g., *Urban Sprawl*, *Quality of Life*). More than half of the projects contained only two or three scenarios, introducing the potential biases

associated with having too few scenarios, outlined above (Ringland 1998). As to content, only six projects contained scenarios less dense than the trend scenario, with the remainder containing only scenarios more dense. Although this could be the result of public input, it is at odds with general public preferences for less dense development patterns, particularly for housing (Downs 2004).

The presence of a planners' agenda is also apparent from the relative lack of interactive public engagement in most of the projects. In almost three-quarters of the projects, the public had no or only a very limited role in the development and crafting of the scenarios used. Sixty percent of the projects that concluded with the selection of a preferred scenario failed to involve the public in that seemingly important public decision.

Problem definition is a highly political function that usually has a decisive influence on subsequent steps in decision-making processes (March 1994). The evidence suggests that, for the projects studied in this analysis, the target problems had already been articulated by the time the public became involved. While public education may have been an underlying objective of some of these projects, most promoted themselves as forums for open interaction. To that extent, these projects largely failed to provide what they seemed to offer.

4.2 Methodology

To the degree that scenario planning projects are undertaken to promote a less auto-reliant future, the overall results of project analyses are rather disappointing. With a median density increase of 11% over trend conditions (see Fig. 3), the median reduction in VMT is only –2.32%—less than one-quarter the change in density. Median reductions in NO*x* emissions—at –2.07%—seem similarly meager. Two methodological factors appear to be at the root of these results.

The first is the type of transportation forecasting tool used to analyze the scenarios. Traditional four-step travel demand models are notoriously insensitive to variations in land use patterns, especially those more fine-grained design features intended to facilitate non-automotive travel (Beimborn et al. n.d.). Yet, only 11% of the projects in this study reported using some method to compensate for this lack of sensitivity. It seems likely there are additional projects in the data that used similar modeling features but did not report that fact in project documentation. Nevertheless, the low reported number highlights a serious disconnect between a common motivation behind land use-transportation scenario planning—reducing sprawl and associated auto reliance—and the tools used in scenario planning processes.

A second possible factor behind the seemingly low VMT and NO*x* numbers is the over-reliance by project sponsors on land use density as a variable, to the exclusion of other factors known to influence travel patterns. The literature indicates that, in addition to density, land use diversity (heterogeneity) and design can all significantly influence travel patterns (Cervero 1998; Downs 2004). While 95% of the projects in this study used density as a variable, less than two-thirds used land use diversity along with density, and only 30% used all three Ds (density, diversity, and design). Perhaps more importantly, many researchers have pointed to transportation pricing as a strong, if not the strongest, available method to alter travel choices (Giuliano 1995). Yet, only 15% of the projects studied used some form of transportation pricing.

Density, indeed, can be an important factor in influencing travel (Downs 2004). However, it may not be the most influential factor (Kockelman 1997), and it is not nearly as effective standing alone as it is in combination with other strategies (Cambridge Systematics 1994; Cervero 1998).

4.3 Institutional structure

Participants in public planning processes generally expect a conclusion that includes concrete action. Given the obvious parallels between scenario planning and the rational-comprehensive decision-making model (problem articulation; goal setting; alternative development, assessment, and comparison; decision/implementation), it would seem that participants in scenario planning processes, in particular, would expect some result that includes assertive action. Yet, more than three-fifths of the projects in this study failed to achieve the important step of crafting or selecting a preferred scenario. For 25% of the projects, no decision or implementing steps were apparent; nearly three-quarters of these projects indicated that no action was anticipated.

Ready explanations for these failures are not apparent. However, possible reasons include a lack of political investment in the planning process or a lack of authority or will to carry out the logical implementation steps. Over half the projects in this study were sponsored by MPOs, councils of governments (COGs), or some other multi-jurisdictional body. Most of these institutions lack zoning and planning authority, a key component to implementing many of the regional strategies tested in scenario planning projects. However, even in the areas where these institutions have authority—principally in transportation planning and funding—concrete action did not always occur. For example, several of the MPO sponsors did not connect the outcome of their scenario planning project to their regular regional transportation planning process (e.g., San Diego Association of Governments 1998). These instances suggest two institutional failures: first, a general mismatch between the scale of analysis of growth related issues (regional) and the level of authority over the mechanisms needed to effectively intervene (local); and second, a failure to connect one governmental function (visioning/scenario planning) with another (transportation planning and funding).

5 Conclusion

Land use-transportation scenario planning is an important planning tool whose popularity and use is increasing. Among its strengths, it offers important opportunities for citizens to engage in constructive dialogue about the future of their communities, and provides a basis for assertive action to direct the course of that future. As outlined here, the actual practice of scenario planning has fallen short of realizing the technique's potential, revealing several structural obstacles in the areas of public participation, methodology, and institutional structure. To more fully realize the promise offered by scenario planning, three things need to occur.

First, public involvement processes need to be revamped. As with many facets of land use and transportation planning, citizens involved in scenario planning projects are frequently in the position of merely rubber-stamping decisions already made by

consultants, planners, and other insiders. Involving the public only to review and comment on draft interim products puts citizens in a passive role where only strongly articulated positions can influence the trajectory begun behind closed doors. Instead, the public should be incorporated in study processes before a single line has been drawn or a single word written. Citizens then can and should be given a central role in the crafting, development, and assessment of the key components in the study process, including but not limited to the articulation of study goals, the drafting of study scenarios, the selection of a preferred scenario, and the development of implementation tools. This level of involvement would go a long way toward overcoming many of the planners' agenda effects noted above. The recent use of open-ended charrettes (e.g., Envision Utah n.d.) and GIS-aided "just in time" scenario analyses (e.g., Sacramento Area Council of Governments and Valley Vision 2004) are steps in the right direction.

Second, the methodologies used in scenario planning need to be reassessed. The bulk of the projects studied here used standard four-step travel demand models as the chief assessment tool. As the progeny of the interstate highway construction era, these tools are structurally deficient in analyzing the small-scale land use features frequently tested in scenario planning. Although innovative techniques were employed in several of the projects to overcome modeling limitations (e.g., Contra Costa Future 2003), assessment tools more appropriate to the demands being placed upon scenario planning will need to be crafted.

Last, the institutional structures behind regional land use-transportation scenario planning need to be bolstered. While wholesale adoption of regional land use zoning systems seems unlikely (Downs 2004), federal institutional and regulatory support can assist in providing an important link between the vision behind most scenario planning analyses and concrete action. The Federal Highway Administration (FHWA) has taken some initial steps in this direction with its recent programs highlighting scenario planning as a "best practices" planning tool (FHWA 2005). A fundamental next step would be to create institutional structures that routinize the connection between scenario analyses and the state and metropolitan transportation systems planning regimens required by federal statute (23 U.S.C. §§ 134, 135). Although a handful of the projects assessed in this study attempted to make these connections (e.g., Bay Area Alliance for Sustainable Development 2002), a more systematic structure would likely require the development of federal regulations that expressly support and guide that integration.

Implementing these recommendations would likely move the practice of scenario planning forward; there is, however, still much that is unknown about the technique. Important areas for additional inquiry include the various theoretical constructs that underlie land use-transportation scenario planning and possible connections between scenario planning practices and federally mandated environmental analyses. Additional explorations could also occur in areas touched on, only briefly, in this study. For example, more in-depth analysis of project sponsor motivations, expectations, methodologies, and outcomes could bring additional light to planning and decision-making processes, and a more detailed understanding of how study methodologies affect project outcomes.

This study has attempted to chart of the growth of scenario planning in the past decade and a half, and to observe challenges and changes in the technique. While other important analyses have relied on a single case study (Zegras et al. 2004) or a small group of projects (Avin and Dembner 2000), this study was designed to

capture as broad a sample as possible. Although 80 projects were ultimately identified, the sample was most certainly incomplete. This is true, in part, because the increased use of GIS software—and the ''just in time'' scenario planning capacity that it provides—is making scenario planning projects too numerous to count. The breadth of this study, while a strength in some ways, also led to several limitations. Chief among them was a lack of detail on the methodologies and outcomes of individual projects. Resource limitations meant that researchers had to rely almost entirely on information contained in sponsor-created documents. This is likely to have resulted in incomplete information and a pro-sponsor bias. A case study approach involving a smaller sample would likely shed additional light on these and other subjects.

Fifteen years ago, land use-transportation scenario planning projects such as the *Puget Sound 2020* project in Washington and the *LUTRAQ* study in Oregon were considered ground breaking efforts (Delaware Valley Regional Planning Commission 2003, pp. 1–2). In less than a generation, the concept has become common enough to enter the state-of-the-practice. Although the rapid growth of the technique has come with the process, technical, and structural challenges outlined here, we are already seeing changes to address some of those issues. Given this rapid pace of change, it is reasonable to expect that in the near future the promise of land use-transportation scenario planning can more fully become a reality.

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References

1000 Friends of Minnesota and Eureka Township Envisioning Task Force: *Eureka Township Envisioning Task Force: Summary Report.* (Eureka Township, Eureka, MN, 2003). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

1000 Friends of Oregon: *Making the Connections: A Summary of the LUTRAQ Project.* (Author, Portland, OR, 1997). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Allen, E., McKeever, M., Mitchum, J.: The Energy Yardstick: Using PLACE^{3}S to Create More Sustainable Communities. California Energy Commission, Sacramento, CA, (1995). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

American Farmland Trust: *Alternatives for Future Urban Growth in California's Central Valley.* (Author, Washington, DC, 1995)

Anderson, J.E. Public Policymaking, 6th ed. Houghton Mifflin, New York (2006)

Avin, U.P., Dembner, J.L.: Using scenarios to improve plan-making. Paper presented at the annual meeting of the Association of Collegiate Schools of Planning (2000)

Bartholomew, K.: Land-use based scenario planning: theory, practice, implications. Paper presented at the Transportation Research Board Annual Meeting, Washington, DC (2005)

Bay Area Alliance for Sustainable Development: *Smart Growth Strategy/Regional Livability Footprint Project: Final Report* (Association of Bay Area Governments, Oakland, CA, 2002). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Beimborn, E., Kennedy, R., Schaefer, W.: Inside the Blackbox: Making Transportation Models Work for Livable Communities, Environmental Defense Fund, New York (n.d.). Available via Environmental Defense Fund. Retrieved 24 September 2006 from http://www.environmentaldefense.org/documents/1859_InsideBlackBox.pdf

Burbank, C., Ways, S.: Scenario planning: a new paradigm in transportation decision making. The Public Manager **33**(3), 7–11 (2005)

Cambridge Systematics: *The Effects of Land Use and Travel Demand Strategies on Commuting Behavior*. (Federal Highway Administration, Washington, DC, 1994)

Cervero, R.: The Transit Metropolis: A Global Inquiry. Island Press, Washington, DC (1998)

Cervero, R., Kockelman, K.: Travel demand and the 3Ds: density, diversity, and design. Transport. Res. Part D **2**, 199–219 (1997)

Contra Cost County, California: *Shaping Our Future*. (Author, Walnut Creek, CA , 2003). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Delaware Valley Regional Planning Commission: *Regional Analysis of What-If Transportation Scenarios: Final Report*. (Author, Philadelphia, PA, 2003). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Denver Regional Council of Governments: *Metro Vision 2020 Urban Form Alternative and Evaluation Criteria*. (Author, Denver, CO, 1995). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Downs, A.: Still Stuck in Traffic. The Brookings Institution, Washington, DC (2004)

Edwards, J.L., Schofer, J.L.: Relationships between transportation energy consumption and urban structure: results of simulation studies. Transportation Research Record 599 (1976)

Envision Utah: *The History of Envision Utah*. (Coalition for Utah's Future, Salt Lake City, UT, n.d.). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Federal Highway Administration: *Scenario Planning* (2005). Retrieved 24 September 2006 from http://www.fhwa.dot.gov/Planning/scenplan/index.htm

Georgantzas, N.C., Acar, W.: Scenario-Driven Planning: Learning to Manage Strategic Uncertainty. Quorum Books, Westport, CT (1995)

Giuliano, G.: The weakening transportation-land use connection. Access **6**, 3–11 (1995)

Godet, M.: Creating Futures: Scenario Planning as a Strategic Management Tool. Economica, London (2001)

Johnson, D., Salkin, P.E., Jordan, J., Finucan, K.: Planning for Smart Growth: 2002 State of the States. American Planning Association, Washington, DC (2002). Retrieved 24 September 2006 from http://www.planning.org/growingsmart/states2002.htm

Kockelman, K.M.: Travel behavior as a function of accessibility, land use mixing, and land use balance—evidence from the San Francisco Bay Area. Transportation Research Record 1607 (1997)

Lockwood, S.: Participation: its influence on planning methodology. In Highway Research Board Special Report No. 142. Transportation Research Board, Washington, DC (1973)

March, J.: A Primer on Decision Making. The Free Press, New York (1994)

Mazziotti, D.F., Hemphill, M., Churchill, L., Hamilton, J., Gies, M.: Energy Conservation Choices for the City of Portland. Oregon. U.S. Department of Energy, Washington, DC (1977)

Middlesex Somerset Mercer Regional Council: *The Impact of Various Land Use Strategies on Suburban Mobility*. (Author, Princeton, NJ, 1988). Retrieved 24 September 2006 from http://ntl.bts.gov/DOCS/470.html

Ogilvy, J.: Creating Better Futures. Oxford, New York (2002)

Pacific Northwest Ecosystem Research Consortium: *Willamette Basin Alternative Futures Analysis*. (U.S. Environmental Protection Agency, Washington, DC, 2002). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Peskin, R.L., Schofer, J.L.: The Impacts of Urban Transportation and Land Use Policies on Transportation Energy Consumption (Report No. DOT-05–50118), Department of Transportation, Washington, DC (1977)

Porter, M.: Competitive Advantage: Creating and Sustaining Superior Performance. Free Press, London (1985)

Puget Sound Council of Governments: *Vision 220: Growth Strategy and Transportation Plan for the Central Puget Sound Region*. (Puget Sound Regional Council, Seattle, WA, 1990). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Replogle, M.: Land use/transportation scenario testing: a tool for the 1990s. Paper presented at the Transportation Research Board Annual Meeting, Washington, DC (1993). Retrieved 25 September 2006 from http://tmip.fhwa.dot.gov/clearinghouse/docs/landuse/luts/

Ringland, G.: Scenario Planning: Managing for the Future. John Wiley, New York (1998)

Sacramento Area Council of Governments and Valley Vision: *Tall Order Forum 2004: Regional Choices for Our Future*. (Authors, Sacramento, CA, 2004). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

San Diego Association of Governments: *Region 2020: 2020 Cities/County Forecast Land Use Alternatives*. (Author, San Diego, CA, 1998). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

SEWRPC : *Land Use-Transportation Study, Forecasts and Alternative Plans*. (Author, Milwaukee, WI, 1966)

Stone, D.: Policy Paradox: The Art of Political Decision Making. W. W. Norton, New York (2002)

Tri-County Regional Planning Commission: *Regional 225 Transportation Plan*. (Author, Lansing, MI, 2003). Available via the J. Marriott Library, University of Utah. Retrieved 25 September 2006 from http://content.lib.utah.edu/cdm4/browse.php?CISOROOT = /FHWA

Wirthlin Worldwide: Envision Utah: 1997 Values Research, Envision Utah. Salt Lake City, UT (1997). Retrieved 25 September 2006 from http://www.envisionutah.org/resourcesfiles/36/Wirthlin%20Worldwide%20Values%20Research%20Summary.pdf

Zegras, C., Sussman, J., Conklin, C.: Scenario planning for strategic regional transportation planning. J. Urban Planning Develop. **130**, 2–13 (2004)

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