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Performance Measures and the Uncertainties of
Planning: Current Practice at Transportation
Planning Organizations

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**PERFORMANCE MEASURES AND THE UNCERTAINTIES OF PLANNING:
CURRENT PRACTICE AT TRANSPORTATION PLANNING ORGANIZATIONS**

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ABSTRACT

Transportation planning in the United States is moving to widespread use of performance-based planning methods as new federal requirements for Metropolitan Planning Organizations (MPOs) are implemented. In addition to requirements for measures of safety and infrastructure, many MPOs are adopting performance measures for other issues. This study explores current planning practice in using a performance-based approach to tackle a complex planning issue: location affordability, defined as the combined household cost burdens of housing and transportation. A review of long-range transportation plans at 20 large MPOs provides information on how location affordability is represented in regional transportation plans, how it is defined and measured, and how it is integrated into the planning process. Using Christensen's (1985) matrix of planning and policy problems as a theoretical framework, appropriate application of performance measures in connection with location affordability is identified. For challenging planning issues where solutions are uncertain or infeasible, performance measures are more appropriate if used in project or program evaluation, supporting a search for more effective solutions rather than holding MPOs accountable for outcomes.

1 INTRODUCTION

Regional transportation planning agencies in the U.S. are called upon to address an array of social equity issues. Among these is an issue of economic equity: location affordability, or the combined cost burdens of housing and transportation for households. Location affordability is a policy concept that first garnered national attention in 2006 when the Center for Neighborhood Technology, a non-profit research and advocacy organization, published their influential Housing + Transportation (H+T) Index (Center for Neighborhood Technology 2016). CNT developed a method to use Census data to model household transportation cost burdens, and then combined these with data on housing costs to produce the Housing + Transportation (H+T) Index. The Index has captured the attention of planning practitioners, stakeholders, and advocacy groups and is an emerging topic in planning efforts.

Resolving unaffordability, however, presents serious challenges, requiring coordination between land development processes, affordable housing programs, transportation policy, and the routine operation of the transportation system. It requires agencies develop a relevant definition of what constitutes an acceptable level of cost burdens. Further, agencies must anticipate and grapple with wider economic forces and demographic trends that can overwhelm any transportation-related interventions. The convening and confounding influences are often far outside the purview of a transportation planning agency. Still, regional transportation planning agencies, or Metropolitan Planning Organizations (MPOs), are responding to their stakeholders and including location affordability in their plans.

In parallel to location affordability gaining prominence on the planning agenda in many regions, the processes of transportation planning are transitioning to greater use of performance-based frameworks and methods. Although various performance management methods have been used by transportation agencies for some time, federal legislation now requires MPOs to adopt a performance-based approach to planning. These requirements were first established in 2012 with the passage of Moving Ahead for Progress in the 21st Century Act (MAP-21) and were largely continued under the 2015 Fixing America's Surface Transportation (FAST) Act (FHWA 2016). Through the subsequent federal rule-making process, guidance has been developed on national transportation goals, performance targets, data, and reporting requirements (FHWA 2016). Substantively, these performance requirements focus on safety and on infrastructure condition; however, MPOs are also applying performance management methods to other planning issues as they restructure their processes to comply with the new requirements. In a recent survey, two-thirds of MPOs indicated interest in going beyond the federally required measures (Transportation for America 2017).

With the changes and new requirements, it is worthwhile to consider some of the implications of this shift. In particular, it is useful to investigate whether performance-based

approaches to planning improves MPO capacity to address difficult, socio-economic issues like location affordability. This study explores current practice at 20 large MPOs using information from a review of their long-range transportation plans (LRTPs). The review documents whether these MPOs include location affordability in plan goals, objectives, and performance measures; how location affordability is defined and measured; and how it is integrated into the planning process. This information is then interpreted using a theoretical framework to identify constructive applications of performance measures for effective planning for location affordability. Thus the framework moves beyond technical questions of data and definitions to include an exploration of the characteristics of the planning situation that make the use of performance measures appropriate or inappropriate. The findings are of interest for those seeking to improve planning practice with the use of performance measurement in addressing challenging planning issues.

The paper is organized as follows. Section 2 provides an overview of performance-focused transportation planning. Challenges to using performance management methods in transportation planning, especially to address difficult issues, are discussed in Section 3. Section 4 introduces a theoretical framework for understanding such planning issues. The method used for the plan review is described in Section 5, while Section 6 presents results of the review. Section 7 interprets the results using the theoretical framework. Section 8 summarizes the findings.

2 PERFORMANCE MANAGEMENT IN THE TRANSPORTATION SECTOR

Performance management is defined as the 'process of defining, monitoring, and using objective indicators of the performance of organizations and programs to inform management and decision making on a regular basis' (Poister, Aristigueta, and Hall 2015, p 1). Performance management is a collection of mechanisms that are adopted to improve the performance of an organization. More than just published data, a performance measure is a variable, or combination of variables, selected to represent a characteristic or issue of interest, applied in a goal-setting context (Gudmundsson et al. 2015). Performance monitoring, the practice of using performance measures in a reporting program, is a prominent, if not defining, feature of performance management (Triantafillou 2013).

In the transportation context, performance-based planning and programming (PBPP) is 'the application of performance management within the planning and programming processes of transportation agencies to achieve desired performance outcomes' (Grant et al. 2013, p 1). In addition to supporting performance monitoring and target setting, other benefits of PBPP include clarifying goals by converting them to measurable objectives; supporting policy and investment decisions by allowing for systematic comparison of alternative options; and

assessing the effectiveness of projects and strategies in furthering progress towards goals (Grant et al. 2013)

Any use of performance measures incorporates an element of accountability. This is done through the reporting mechanisms and feedback relationship between an implementing agency and the entities that empower it, either directly or indirectly, to do its work. The strength of accountability can vary; weak accountability is characterized by simply reporting on activity and outputs, while strong accountability will link results to incentives (or sanctions), such as funding levels. In this way, performance management is method of 'governing the government' by regulating the available options for decision makers and steering their activities (Triantafyllou 2013). Lewis (2015) describes performance measurement as a control mechanism used by higher level governments to regulate the behavior of lower levels of government, with a main goal of reducing or avoiding inefficiencies.

For an MPO, the accountability environment includes the MPO policy board, local governments, state DOTs, state legislatures, federal regulators, and the public. MAP-21 and the related federal rules formalize the accountability relationship between MPOs and the federal government by requiring PMs, targets, and reporting on progress towards federal objectives in exchange for the use of federal funds (United States General Accounting Office 2015).

Although formal articulation of the PBPP requirements in MAP-21 have only recently been released, the adoption of performance management practices in the U.S. transportation sector has been underway for some time. This turn to performance management is part of a broader response to demands for greater accountability in government. Increasingly, public agencies are called to prove their legitimacy by documenting their efficacy in fulfilling their organizational missions through decisions that, a priori, can be convincingly linked to particular outcomes. This can be understood as a strategy to demonstrate agencies' continued validity in response to challenges from privatization, outsourcing, other agencies, or even other levels of government that may threaten reduced political support or funding (Kassof 2000).

Still, the use of data and indicators in the planning and management of transportation systems is not new. Examples of long-standing programs include transportation conformity programs for air quality compliance (U.S.DOT Office of Planning Environment & Realty 2017), the Congestion Management Process (U.S.DOT Office of Planning Environment & Realty 2014), and asset management programs (FHWA 2015). Outside these programs, many transportation agencies were also adopting other performance-oriented approaches, including benchmarking, target-setting, performance dashboards, and quantified criteria for selecting or prioritizing specific projects. The mandates for PBPP will mainstream performance-based methods.

In addition to complying with the new federal requirements, MPOs must continually adjust to any state requirements, as well as changes in the interests of their oversight boards or

executive management, as well as in the priorities of citizens and stakeholders. These forces create a dynamic environment that is unique for each MPO. Thus, the specifics of MPO performance measurement programs will vary even as MAP-21 requirements will establish some consistency among MPOs.

3 CHALLENGES TO EFFECTIVE PBPP

The performance measures to be used in PBPP emphasize safety, traffic, and infrastructure condition, and are connected to national transportation goals in these topic areas. Yet MPOs are tasked to include a much wider array of social and economic factors in their work. Longstanding U.S. law on environmental protection is explicit in requiring that impacts to communities (the human environment) be a consideration in the transportation decision-making process. The mission statement of the U.S.DOT specifically states that the agency is to ensure the transportation system 'meets our vital national interests and enhances the quality of life of the American people, today and into the future' (U.S.DOT 2015). Regulations on Environmental Justice also require MPOs to assess the equity effects of their plans (FHWA Office of Planning Environment 2017). Thus in addition to issues of mobility and infrastructure, transportation agencies may be interested in an expanded performance measurement program that includes social and economic factors. This raises several questions for MPOs.

First, transportation agencies are hesitant to adopt performance measures—and the accountability this entails—of phenomena over which they have little, limited, or only indirect control (Meyer 2000). At the same time, many of the benefits of transport projects are realized as the combined effect of the transport project and other factors, such as land use development, which is controlled by local governments and private developers.

Second, choosing what to measure in order to evaluate progress toward what goal(s) assumes there is a link between what agencies can do and the expected outcomes from those actions. This link is supported by accepted knowledge, or evidence, of relationships between means and ends (Davoudi 2006). Generally, evidence comes from scientific research, but can also be drawn from experiential or tacit knowledge. With lack of clarity about the links between transportation interventions and socio-economic or quality of life outcomes and sometimes extended time lags between implementation and results, it can be difficult to connect specific interventions with specific outcomes. Further, any measure of the effectiveness of an intervention needs to have a compelling and relevant connection to transportation (Gudmundsson et al. 2015).

Third, numerous benefits flowing from transport systems are qualitative or subjective factors of quality of life which do not lend themselves to tidy quantification. Neighborhood quality, for example, is an expression of a complex set of factors and interacting processes that

are difficult to isolate into causal mechanisms and to measure changes in outcomes. This presents a serious challenge to developing clear and valid measures that can be combined with traditional traffic or infrastructure measures in a performance measurement system (Meyer 2000). Additional technical issues include defining thresholds of effect and categories of population groups for socio-economic impacts and benefits (Karner 2016).

Although social and economic factors present challenges in a quantitative, performance-focused planning environment, these factors are important considerations for the economic and social well-being of individuals, households, communities, and regions. Thus, even in PBPP, these factors need to continue to be priorities for planning agencies.

The Case of Location Affordability

One such challenging planning issue is location affordability. The issue has several characteristics that make it difficult to address using a performance management approach. Among the technical challenges are identifying a meaningful threshold for affordability. Although CNT proposes a threshold of 45% of household income, this is a normative view that combines the existing policy standard of 30% of income for housing affordability and the so-called 'attainable goal' of 15% of income on transportation (Center for Neighborhood Technology 2015, p 3). Further measurement issues include appropriate geographic scale to measure outcomes (region, neighborhood, etc.) or whether affordability is only relevant for certain socio-economic groups (lower-income, minority, etc.). These definitional issues arise when an overarching goal of affordability or social equity needs to be translated to a performance measure, and agreement on specific objectives and desired outcomes is needed in order to arrive at a valid measure for assessing progress.

Even with consensus on a location affordability goal, it may not be clear what actions will deliver the desired results. The forces that affect housing and transportation cost burdens are the result of many actions by governments, developers, households; wider economic forces that affect employment and income; and historic processes that create and sustain social inequities. Designing planning interventions that will improve affordability requires finding solutions that simultaneously shape the supply and spatial distribution of housing units, housing choices by households, transportation options, and travel behavior, while controlling counter-productive processes such as gentrification and residential displacement. Few of these processes are under the direct control of an MPO. Solutions may seem theoretically feasible, but lack of funding or limitations in what a planning agency can do make them unrealistic. The complexity of inter-governmental relationships also introduces uncertainty, as different levels of government (local, regional, state, federal) may pursue different policies and programs for different sectors that create tensions and conflicts in planning and implementation.

Affordability solutions can also be prone to unintended consequences or disappointing or even surprising results because of differences in local conditions.

The uncertainty surrounding what constitutes location affordability and what interventions will increase affordability makes effective planning and plan implementation a challenge. Yet uncertainty is inherent in any endeavor that seeks to predict let alone shape the future. The reduction of uncertainty is thus one of the core tasks of any planning effort.

Governments frequently respond to uncertainty by adopting rules to ensure predictability in processes and outcomes. The implementation of performance measures in transportation planning constitutes the adoption of a type of rule, a mechanism to reduce uncertainty in planning processes and in transportation outcomes. For example, interpreting goals as measurable targets reduces goal uncertainty through clarification and quantification (Grant et al. 2013). Tracking outcomes of implemented projects and programs reduces uncertainty about what works by measuring the degree of effectiveness of those solutions. Performance measures can also reduce uncertainty or inconsistency in an agency's strategic direction by maintaining focus on measurable and reported targets and outcomes. For those outside the agency, performance measures reduce uncertainty about how decisions are made by making the decision-making process more transparent. Performance measures also reduce uncertainty in the accountability environment, allowing regulating and legislating entities to exert more control through mandated measures or mechanisms of accountability (e.g. reducing funding for missed targets). When performance measures are used as part of performance reporting, communicating information about the efficacy of the agency, they can become a strategy for reducing uncertainty of ongoing support from decision-makers, funders, and the public.

These rationales for performance measures rely on assumptions of certainty: goals can be focused without loss of consensus and the projects and programs in the plan constitute proven solutions. However, adopting performance measures does not eliminate underlying uncertainty. In fact, performance measures can be inappropriate or counter-productive in some conditions. Thus it is important to consider the use of performance measures under conditions of uncertainty.

4 A THEORY OF UNCERTAINTY IN PLANNING

Christensen (1985) developed a matrix to classify planning situations according to conditions of uncertainty. Christensen argues that failing to recognize uncertainty and behaving as though issues and solutions are clear will lead planners to produce ineffective plans or even implement projects with harmful unintended effects. The central idea of the matrix is that by clarifying the

nature of uncertainty in a given situation, planners can improve their effectiveness with methods and processes that are aligned with the conditions of the task at hand.

Christensen’s matrix plots uncertainty along two axes: goals and solutions (see Figure 1). Goals are uncertain in the sense that there can be less than full consensus for a goal, or there may be multiple goals that each have strong support but which conflict with one another. Solutions are those interventions that advance the goals. In transportation planning, solutions can be policies, programs, or projects.

In this conceptualization, the most effective approach to a planning issue depends on whether the uncertainty lies in the dimension of solutions or of goals. When there is consensus on goals and solutions are known (the upper left quadrant), the issue can be tackled with routinized processes of government, through bureaucratic operations that deliver replicable, dependable results. Issues in this part of the matrix have causal relationships that are understood and can be shaped by the agency.

In the upper right quadrant, there is disagreement or conflict among stakeholders on the goals. For each position in the debate, advocates can point to a known technology and how that technology would support their preferred goal. However, until the lack of agreement on what goals are to be addressed is resolved, selecting a solution is expected to lead to conflicts among

Figure 1: Christensen’s Matrix

Goals → Solutions ↓	Consensus	No Consensus
Known	Consensus on goal Replicable solution(s) Dependable results Bureaucracy and routine implementation	Conflict over goal(s) Proven technologies available for various potential goals Bargaining and trade-offs
Unknown	Shared commitment to a problem/goal No proven solution(s) Pilots, experimentation	Conflicted or unclear goals Unproven solutions Zone of chaos and 'wicked problems'

Adapted from Christensen, 1985.

stakeholder groups. Thus in this quadrant, the appropriate approach is a bargaining process through which the goals themselves are clarified, or compensatory arrangements or trade-offs are worked out among stakeholder groups. Notably, because the context of the bargaining process is unique—the individuals, groups, and constellation of interests are particular to any planning process—outcomes of the process will also be unique.

Similar to goals, solutions and technologies can be certain or uncertain. Thus the lower left quadrant represents situations where there is consensus on goals, but the means to address the issue are unknown or unproven. Such situations are common in connection with broad and complex problems such as crime or accessibility. In these situations, resolving the uncertainty requires searching for more information through pilot programs, phased implementation, experimentation, and innovation as a method to search for solutions.

The lower right quadrant represents those situations where there is uncertainty about solutions *and* lack of agreement on goals. This is a zone of chaos and of ‘wicked problems’ (Rittel and Webber 1973), where agencies become reactive and undirected in their planning and implementation. The only resolution is to find a pathway to another area of the matrix, either by securing consensus on goals or by focusing on workable solutions. In some cases, this is done by re-framing the problem to reduce disagreement of goals, perhaps partitioning the problem into several smaller issue areas, thus shifting the problem to the left where a search for solutions can begin. Alternatively, agencies can leave the conflicts over goals unresolved and identify a menu of potential solutions, moving the situation upwards. The choice of solutions then becomes the object of a bargaining process over which problems to solve with the solutions available.

Although the matrix is described as having only four boxes, Christensen emphasizes that the boundaries in the matrix are not bright lines. She notes that many planning situations may straddle a boundary, reflecting the dynamic nature of public debate. Issues can also make multiple moves across the matrix over a planning process as coalitions form and reform or intergovernmental relationships adjust.

In *Cities and Complexity*, Christensen (1999) describes the hazards of government agencies’ predisposition to certainty. ‘Delusions of certainty’ in the solutions dimension encourage adoption of policies that incorrectly assume an understanding of the connection between means and ends. Here, expert knowledge may be overestimated and disciplinary biases may pre-suppose a particular solution set. When uncertain solutions are applied, the results are often surprising, uneven, or disappointing. Failing to diagnose uncertainty on the goal dimension may lead to an artificial narrowing of issues so that they match the preferred solutions of an agency or of a particular sector. Or agencies may be surprised when they meet resistance to implementing a plan that is based incomplete consensus. According to Christensen, the interplay between diverse preferences and perspectives in a region coupled

with sector-specific planning encourages premature programming of solutions and premature assumptions of consensus on goals (Christensen 1999, p 108).

In this study, using location affordability as the issue of analysis is an opportunity to examine how MPOs are addressing a challenging issue that presents planners with a high degree of uncertainty. Examining how MPOs define, operationalize, and plan for location affordability offers insights into the potential for improved planning using performance-focused methods.

5 PLAN REVIEW METHOD

There are a number of methods for studying plans to document planning practice. For transportation plans, the most common approach is what Baer terms 'plan critiques' (1997). This method can be appropriate for creating descriptions of notable or 'best practice' examples; however, they are unsystematic and make cross-comparisons and generalization of findings difficult. Examples of plan critiques include reports for the FHWA such as *Integration of Context Sensitive Solutions in the Transportation Planning Process* (Center for Transportation and the Environment 2007) and *Metropolitan Area Transportation Planning for Healthy Communities* (Lyons et al. 2012). One of the weaknesses of this approach is the lack of a systemic method and sampling frame; thus these studies tend to reflect the idiosyncratic interests of the researcher and/or the project sponsor. More systematic approaches are less common, but there are a few examples in the transportation literature. Examples include a review of accessibility measures in metropolitan plans (Proffitt et al. 2015), of the quality of state department of transportation sustainability plans (Mansfield and Hartell 2012), and of safety in North Carolina pedestrian master plans (Jones et al. 2010). The overall goal of these comparative studies is to identify patterns, that will, over time improve the quality of plans and increase plan efficacy in addressing real-world issues.

There are a few published studies of how the shift to performance-focused methods is affecting transportation planning practice. For example, Boisjoly and El-Geneidy (2017) used a qualitative assessment of 32 metropolitan plans to focus on definitional and measurement issues of accessibility in plan objectives and performance measures. Other researchers have focused on the methods and metrics used to assess the equity impacts of transportation plans (Karner 2016; Bills and Walker 2017). Most studies have emphasized the technical dimensions of performance measures (e.g. validity, reliability, and existence of a conceptual linkage to plan goals) with somewhat less focus on the how the measures are applied in the planning process. This study contributes to this literature but goes beyond technical aspects of measurement design and analysis technique to explore institutional issues.

Several planning scholars have applied Christensen's matrix in analyses of planning initiatives. Balducci et al. (2011) used Christensen's matrix in describing the high level of uncertainty and disequilibrium in spatial planning and thus the need for post-structuralist planning theory based on contingency, fluidity, and experimentation. Khisty (1992) adopted the matrix to critique the rational planning model in transportation planning, especially when connections between solutions and goals are not well defined.

For this study, the review collects information about whether location affordability is included in the plan narrative, goals, and objectives. If the plan includes a performance measure of location affordability, information about the data sources, thresholds defining unaffordability, and performance targets is collected. The review also documents how location affordability measures are used in the planning process or in related planning efforts.

Sample

This review includes the current LRTP documents of MPOs with populations over 2.5 million in their planning jurisdictions in 2010, as of December 2016 (U.S. Department of Transportation 2016). These 20 MPOs represent some of the longest established MPOs in the country including the Chicago Metropolitan Agency for Planning (designated in 1962) and the National Capital Region MPO (1965). Regions with more recent histories of urbanization and growth are also represented by MPOs centered in Atlanta, Phoenix, San Diego, and Seattle. (Note that the Puerto Rico MPO is excluded from the analysis although it ranks 13th by population because a current LRTP was not available online at the time of this analysis.) Altogether, these 20 MPOs are tasked with transportation planning for nearly 113 million residents, just over 36% of the total U.S. population in 2010.

Eighteen plans were accessed in July 2016. Two additional plans (Denver and St. Louis) were added in December 2016 when adjustments to jurisdictional boundaries increased their regions' population to over 2.5 million. The list of MPOs along with the primary plan document included in the review is provided in Appendix A.

The plans represent a mix of full length (so-called 'major update') LRTPs and shorter ('minor update') plans, depending on where an MPO was in their 4-year update cycle for each MPO. All the plans were developed before the Final Rule on federally required performance measures was in effect. Even so, interest in and preparation for implementing PBPP practices are very much in evidence as MPOs anticipate new requirements or continue performance-oriented approaches they had previously adopted. The oldest plan was adopted in June 2013 (Detroit) and the most recent plan was adopted in April 2016 (Los Angeles). The plan horizon is 2040 for all plans except Phoenix and Denver which have a 2035 horizon. In some cases, the plans refer to additional analyses or related planning documents, such as plan appendices or

stand-alone reports on their performance management program. Some plans are integrated with or draw heavily from a separate policy document, vision plan, or regional comprehensive plan (land use, transportation, housing, and other public services). In such cases, these additional documents were also reviewed to gain as full a picture as possible. For example, the current LRTP for Chicago represents a minor update of the 2010 plan that carries forward the goals, objectives, and performance measures of the 2010 plan; accordingly the relevant sections of the 2010 plan were reviewed. The current LRTP for Washington, D.C. is a brief document that is primarily designed to update the Transportation Improvement Program (TIP), while retaining the goals, objectives and priorities of the previous, full-length plan; thus the previous LRTP is also used for the review, along with the 2014 Regional Transportation Priorities Plan that sets forth long-term policies and objectives for regional transportation planning work.

Plan Review Process

I reviewed the plans in several steps. First, I read through the plans to gain an overall understanding of the main issues for the region and of the MPO's planning methods. Particular attention was given to plan sections on social equity, economic prosperity, livability, and similar, where the issue of location affordability was likely to appear. Goals, objectives, and strategies for location affordability were noted along with how any location affordability performance measures were applied in the planning process. Next, I examined relevant references to other documents, with any further information from these documents added to the review. Finally, I searched each plan document for the terms 'afford', 'affordability', 'affordable', 'equity' and 'equitable' to check that all sections where location affordability was discussed had been reviewed.

It is important to note that a number of plans gave considerable attention to affordable *housing*, and a few discuss *transportation* affordability, but do not consider these cost categories a combined cost burdens. These approaches address important aspects of social equity and may represent a strategic move to align categories of cost burdens with sectors and planning organizations (i.e. transportation affordability in a transportation plan, housing affordability in a regional comprehensive plan). This segmenting of cost burdens, however, can obscure the economic challenges faced by households, perhaps even leading to counterproductive policies and projects such as remote siting of affordable housing or failing to plan for low-cost transportation services in neighborhoods with low-cost housing (Ewing and Hamidi 2016). In the review, information about how plans cover segmented cost burdens is noted; nevertheless only plans that explicitly linked cost burdens for housing *and* transportation are considered to be taking up location affordability.

This method has some potential drawbacks that may impose limitations on the results. Areas of concern include potential reviewer bias (unreliable reading of the plans) or instrumental bias (the review method is unreliable across plans), or the review is incomplete due to missing information from related documents or other sources. These potential sources of bias are somewhat reduced by focusing the review narrowly and making a second round of reviews of those plans that did include an location affordability indicator. For completeness, when an LRTP was linked to other planning documents, those related documents (such as a regional comprehensive plan) were retrieved and added to the review. Note that the absence of location affordability in the LRTP is not necessarily evidence that a region does not have an affordability issue or is not making efforts to address affordability through some alternative pathway. Nevertheless, since an LRTP is intended to provide major documentation of current regional conditions, goals for the future, a strategy for progress, and constitutes the justification for the major investments, it is reasonable to expect that if location affordability is an issue in a region, it will be evident in some fashion in the LRTP.

A further drawback may be including only large MPOs. Large MPOs may face greater complexity in their planning work as a result of a more complex intergovernmental environment, with more sectors and of governmental units in their planning jurisdictions compared to smaller MPOs. At the same time, large MPOs may have increased capacity for taking on new or emerging methods because of greater staff capacity and other resources (e.g. data, models). As a result, they may be better positioned and more likely to take up emerging issues or innovative approaches (Karner 2016). Still, similarity in size does not preclude considerable diversity in their regional characteristics and in the historic, economic, and political contexts that are relevant for transportation planning. Thus the analysis is expected to yield insights with broader relevance to the transportation planning and policy community, including for smaller MPOs.

6 PLAN REVIEW RESULTS

The 20 regions take a range of approaches to addressing affordability. Some MPOs limit the issue a discussion in the plan narrative, others address housing affordability and transportation affordability as separate issues, but not combined into location affordability. In some regions, location affordability is a prominent topic of a related plan, such as a regional comprehensive plan or regional sustainability plan, but is given less attention in the LRTP. A few plans include discussion of location affordability in connection with their upcoming transition to PBPP, signaling that while location affordability may not be part of a performance-based planning process in the current plan, the MPO anticipates doing so in the future. A summary of information from the plan review is provided in Appendix B.

For some MPOs, location affordability is not portrayed as an important issue. This may be because not all regions have a location affordability problem. Alternatively, some regions face other, perhaps more pressing, priorities. For example, the Detroit plan mentions a need for accessibility to jobs for residents in affordable housing, but the major focus of the plan's solutions is system preservation and transportation funding. Similarly, the plan for the New York region discusses affordability, mostly in connection with housing affordability, while giving greater emphasis on infrastructure and system resiliency.

Other regions are addressing location affordability through alternative planning mechanisms. For example, although location affordability is not an issue discussed in Baltimore's LRTP, this region developed a Regional Plan for Sustainable Development (RPSD), a category of plan supported by the HUD Sustainable Communities Planning Grant program (U.S. Department of Housing and Urban Development 2017). The Baltimore RPSD has strong emphasis on strategies to reduce location cost burdens and the LRTP supports that plan by setting aside \$100 M for funding RPSD projects. Another HUD planning grant recipient, Newark, emphasizes affordable transportation in their LRTP and at the same time, their RPSD emphasizes housing affordability, especially for renters.

The majority of plans do not implement a location affordability performance measure in their current LRTPs, despite affordability getting at least passing mention in 13 of the 20 plans. Five MPOs include a performance measure that measures location affordability in the current LRTP: Chicago, Los Angeles, San Francisco, St. Louis, and Washington, D.C. Los Angeles and a sixth MPO, San Diego, also include an indicator for transportation cost burdens in equity assessments of their plan. The way location affordability is defined, measured, and integrated into the transportation planning process in these 6 plans is discussed in following subsections. (Note: further discussion of the 6 plans is available in Appendix C.)

Defining and Measuring Location Affordability

Many plans cite CNT's H+T Index as a benchmark, indicator, or target. The H+T Index approach may be more or less accurate in different parts of the country, depending on other costs of living (food, education, health care, taxes, etc.). It also ignores differences in household life cycle or type, which may shape demographic differences among regions. Still, the impact of the Index is substantial. The regional indicator report for Washington DC refers to the H + T Index as the 'national standard for assessing basic community affordability' (Metropolitan Washington Council of Governments, n.d., p 23. However, simply adopting the H+T Index as a performance measure for transportation planning purposes presents MPOs with some methodological dilemmas.

For example, the Chicago region adopted the H+T Index as part of a regional monitoring program in 2010, with annual reporting using updated data and exemplary projects. The indicators used in this program are presented in various regional planning documents and linked with planning goals, including those of the current LRTP. As part of the LRTP update process (ongoing as of this writing), the regional indicators are being revisited to consider adjustments to improve their validity and comprehensibility to nontechnical audiences, and to evaluate the quality, reliability, and timeliness of the underlying data. Specific improvements include changes to use 'actual measured values and not be reliant upon modeled or estimated figures' (Chicago Metropolitan Agency for Planning 2015a, p 2). Accordingly, the review identified two major issues with the use of the H+T Index. First, the Index uses estimates of transportation costs. Second, the estimates are based on data collected from multiple years by the American Community Survey and thus are poorly aligned with annual reporting (Chicago Metropolitan Agency for Planning 2015a). Therefore, the MPO elected to change to using Consumer Expenditure Survey data to calculate a location affordability indicator. These data are empirical and are released annually. However, the switch to Consumer Expenditure Survey data will have an important disadvantage for use in PBPP: geographic scale. These data are reported at the metro level while transportation and housing interventions are most often site- or corridor-specific. This raises the question of whether implementing a regional transportation plan could have a large enough effect to move the indicator in the desired direction. As a result, an effective, but small-scale intervention could be undervalued by the regional indicator.

The scale of measurement can also mask considerable disparities among socio-economic groups. Several of the plans tackle this issue in equity assessments. Although some analysis of equity of an LRTP is required under Federal Environmental Justice regulations (FHWA Office of Planning Environment 2017), there is considerable variation on definitions of equity and assessment methods. For example, the MPO for the St Louis region models subregional variation of cost burdens, finding a different picture than the relative affordability for the region as a whole. The analysis focuses on differences in transportation cost burdens, which can be projected using the MPO's models (East-West Gateway Council of Governments 2015b). For Environmental Justice populations, the location affordability indicator is 52% of income at current gas prices, rising to 56% if gas cost \$5/gallon, the latter cost burden comparable to Los Angeles. Comparing these populations, modest cost burdens for the region as a whole are masking high vulnerability for Environmental Justice populations, largely as a result of a significant gap in median income (\$35K vs \$62K). The disparity in income is coupled with relatively low transit use in the region which might offer a lower cost option for lower income households (East-West Gateway Council of Governments 2015b, p 49; East-West Gateway Council of Governments 2015a, p 16). Although the disparities do not rise to a formal standard

of a 'disproportionate impact', they demonstrate how disaggregated data can reveal considerable differences within a region.

The Washington DC plan limits its measurement of location affordability only to 'Activity Centers', areas of employment concentration, rather than for the overall region. Activity Centers are also a key concept in the region's vision document and policy plans and serves as a common concept across sectors and jurisdictions to support a coordinated strategy of focusing growth. Monitoring affordability in these areas reflects an interest in sustained and focused planning for these zones. The baseline indicator report states that the location affordability indicator was below the target level of 45% of income. However, this same report notes that the overall level of affluence in the region 'masks entrenched inequities in communities with high concentrations of poverty and unemployment' (Metropolitan Washington Council of Governments, n.d.) p 2. Similarly, using area median income to assess location affordability may mask high cost burdens for low-income households, especially if these households reside outside Activity Centers. Of note, the Washington DC MPO intends to adopt a new method for their equity assessments in 2017 (Metropolitan Washington Council of Governments 2017). This method will consider benefits and impacts to 'Equity Emphasis Areas', designated areas with concentrated low-income and minority populations anywhere in the planning jurisdiction.

The MPO for the Los Angeles region uses two cost burden indicators their plan. The first is the percent of income spent on both housing and transportation, calculated using BLS and ACS data. This indicator is part of a regional monitoring program and an overall plan coordination effort, but is not directly used to measure the benefits of the LRTP because of the difficulty of projecting housing costs (Southern California Association of Governments 2016b) p 23). The second is annual household costs for transportation only, using the same method as used to calculate the transportation cost component of the H + T Index. Here, the preference for modelled data is in order to project potential benefits of the plan, not in reporting on observed outcomes. The San Diego region MPO similarly uses modelled transportation cost burdens in its equity assessment. Although this latter plan includes affordable housing and affordable transportation in its goal framework, the two concepts are not linked.

Although most of the plans that discuss location affordability or include it in their planning goals and objectives reference the H+T Index, several MPOs use alternative methods of measurement. Some MPOs prefer to focus on high-level, regional indicators; others assess subregional differences in affordability using disaggregate data. A further difference is whether an MPO uses modeled or observed data. Observed data may have greater reliability, but are limited to use in ongoing monitoring applications. On the other hand, projecting future conditions involves modeling data. The choices reflect important differences in institutional arrangements and in planning context. The Chicago experience provides an example of internal

critique and review to maintain a performance measurement program, also pointing out a potential drawback to adopting an indicator that is readily available but is not well-aligned with agency needs.

Accountability Environment

Looking across the plans there is a general characteristic of using a measure of location affordability in a weak accountability framework. That is, while a location affordability indicator is implemented, if an agency fails to adequately 'perform', there are no particular ramifications, such as a reduction in funding. This is demonstrated by use of the indicator as a performance reporting or communication mechanism.

In the Washington DC, and Chicago regions, location affordability is included in a regional monitoring program. These programs provide updates on regional changes on the indicators over time. While the indicators have some link to LRTP goals and objectives, this does not yet rise to a performance-based approach to planning. Instead, these examples are better described as a form of performance communication.

The St Louis region also has a regional monitoring program, but the LRTP builds on this by including location affordability in its equity assessment, thus accepting a degree of accountability for affordability effects of the plan for Environmental Justice populations. The plans for San Diego and Los Angeles are similar; cost burdens are included in their equity assessments, but these are limited to transportation cost burdens.

The San Francisco region plan goes somewhat further in this regard. The plan includes a location affordability measure in its equity assessment as well as in an assessment of the overall impacts of the plan. These assessments, however, do not find that the plan is expected to reduce housing and transportation cost burdens. In fact, projections of the adopted plan scenario move in the wrong direction, driven by projected increases in gas prices, a housing market recovery that will increase housing prices, and population growth. Although there are no apparent consequences for this expected shortfall in progress towards a regional affordability goal, the results are not glossed over. Rather the shortfall is used as an opportunity for performance communication. In a frank discussion, the difficulty of the region's affordability dilemma is described along with the limits of the ability of the MPO to resolve the issue and some explanations as to why that is the case. At minimum, retaining the location affordability measure may signal commitment to an important issue for stakeholders. As the plan notes, 'while not unexpected given the Bay Area's historically high housing costs, this represents one of the greatest regional challenges to tackle over the coming years' (Metropolitan Transportation Commission 2013c, p 24); greater affordability remains 'vexingly out of reach' (Metropolitan Transportation Commission 2013c, p 61).

Location Affordability in the Planning Process

In PBPP, performance measures are used as part of the plan development process. They provide a mechanism that supports planning decisions to maintain an alignment between solutions and goals. In the planning process, they can be applied as criteria for selecting or prioritizing projects, for comparing plan scenarios, or for evaluating the expected benefits of an adopted plan (either for the whole region or for smaller geographies or selected demographic groups in an equity assessment). According to published guidance, performance measures can also serve as a tool for evaluating results over time (Grant et al. 2013). This, in turn creates a feedback loop to inform future plans with information about the effectiveness of implemented solutions. Given that PPBPP is not yet fully implemented by MPOs, it is not surprising that the plans show limited implementation of the location affordability performance measure in their LRTP process.

In the Chicago region, affordability is incorporated into a project-level assessment with an evaluation of how specific projects are expected to change the number of affordable housing units in transit-oriented developments and overall increases in density (Dean 2009; Chicago Metropolitan Agency for Planning 2009). This assumes causal links between increased density and reduced household cost burdens and between proximity to transit and reduced transportation cost burdens for residents in affordable housing units. An expectation of improved regional location affordability assumes substantial shifts in travel behavior patterns and of the ability to effectively link development density, transit system expansions, and affordable housing in a complex urban environment.

The Washington DC MPO carried out an assessment of the full plan which included measures of households located near transit and of accessibility to jobs, but the latter is a time-based variable, not a cost burden variable, a disconnect from the regional monitoring program which uses a location affordability indicator (Swanson 2016). The project-level assessment of major projects in the adopted plan used a qualitative approach to location affordability that charts which transportation goals from the policy plan are supported for each project (Austin 2016, p 6).

In the St Louis plan, the location affordability measure is used in the plan analysis. The projected effects of the plan for location affordability are calculated for smaller geographies (Traffic Analysis Zones) and for demographic subgroups in an equity analysis (East-West Gateway Council of Governments 2015b). However, there is no evidence that this information was used to test alternative plan scenarios or the potential benefits of proposed projects. The project level assessment, described in the Transportation Improvement Program (TIP; essentially the work plan for the LRTP), is a qualitative assessment of how well a project

supports two 'priority areas' of the overarching goal of access to opportunity: (1) the degree to which a project addresses the mobility needs of low-income communities and of people with disabilities and (2) the project's support for other regional goals including those for sustainable development, land use plans, economic development, and environmental quality (East-West Gateway Council of Governments 2016). The scoring process used is not described in detail, but the TIP suggests an ordinal scale measured the degree of need for each project's expected improvements.

Similar to the St Louis plan, the Los Angeles region plan also uses a transportation cost burden measure in its equity assessment of the effects of the full plan. The assessment is presented alongside projections of conditions without the plan (a 'no-build' scenario), providing a comparison with a base year. Again, the plan does not describe using the cost burden measure to develop the plan scenario. Similar to the Chicago plan the Los Angeles plan includes solutions for affordability focused on ways for local jurisdictions to increase the supply of affordable housing in the region, especially near transit. The plan notes that the Los Angeles MPO and its partners are collecting information about gentrification and displacement with the intent to further study this phenomenon; this may provide more detailed information about effective solutions. As noted previously, the Los Angeles region includes a location affordability in a regional monitoring program; however this indicator is not used in the plan assessment because of the difficulty of projecting housing costs (Southern California Association of Governments 2016b, p 23).

In the San Diego plan, a regional comprehensive plan, housing affordability and transportation affordability are represented separately in the goal structure. Two indicators are used in a plan assessment, but separately, as measures of how transportation cost burdens change and how housing development provides access to jobs and other key destinations over the life of the plan (San Diego Association of Governments 2015c, p 94). The plan's performance on these indicators is driven by increasing high-frequency transit in low-income communities, which create an equitable distribution of benefits by socio-economic class. Similar to the Los Angeles plan, the transportation cost burden indicator is used to compare differences between 'no build' and implementing the plan for the base year and modelled costs in 2035 and 2050 in an equity assessment (San Diego Association of Governments 2015a, p 27). A further, project-level assessment of the plan uses different and weighted criteria, with the closest parallel to the transportation cost burden indicator a criterion for the change in transit trips by people of disadvantaged populations (San Diego Association of Governments 2015b, p 12).

The San Francisco region's plan represents a higher degree of integration of a location affordability indicator into the planning process. Like the other California plans, this plan is a comprehensive regional plan linking transportation planning to other sectors in the region

including housing. A set of performance targets were adopted, many of them cross-cutting in nature, that reflect the integrated transportation-land use approach of the plan. These targets are used to evaluate the potential pairings of land use scenarios and transportation system scenarios in an iterative fashion as the scenarios evolved through the planning process. Repeated assessments of the equity effects of the plan scenarios were made during the plan development process (Metropolitan Transportation Commission 2013a).

The preferred plan scenario is assessed with respect to goals and targets for the plan. The location affordability target is a 10% reduction in housing and transportation cost burdens for low- and lower-middle income households, a level that would bring the region in line with the national average (Metropolitan Transportation Commission 2013c). The equity assessment of the plan compares changes in these cost burdens for vulnerable populations compared with the rest of the region. A measure of the share of renter households with high housing cost burdens in areas where high growth is anticipated, an indicator for displacement risk (e.g. gentrification), is also reported. The results of the plan assessments show the plan is not expected to reduce housing and transportation cost burdens. In fact, projections for the adopted plan scenario move in the wrong direction for the overall location affordability target and for the two measures in the equity assessment. These results are explained by projected increases in gas prices, a housing market recovery that will increase housing prices, and population growth in areas where lower-income households and minority households are concentrated. Growth is also expected to increase housing price pressures, which the plan proposes be offset with affordable housing strategies in those areas. Although the plan is unable to reduce cost burdens, projections do at least stabilize the length of commutes for lower-income workers.

Project-level assessment results are similar. Notably, in the project-level assessment, no projects were projected to have an adverse effect on the location affordability target, reflecting the influence of housing market and other influences outside the control of the MPO. As the plan notes, 'while not unexpected given the Bay Area's historically high housing costs, this represents one of the greatest regional challenges to tackle over the coming years' (Metropolitan Transportation Commission 2013c) p 24); greater affordability remains 'vexingly out of reach' (Metropolitan Transportation Commission 2013c) p 61).

The San Francisco plan reveals a difficult dilemma for the region and for MPO capacity to address location affordability. As for the other two California plans, the San Francisco plan was produced under California SB 375 which creates new requirements for reductions in GHG emissions and for planning for adequate housing to accommodate future growth. The GHG reduction targets require planning that will trigger shifts to lower-carbon travel modes and shorter commutes. The state mandate for fully accommodating future housing demand requires planning for increasing density and infill development. The plan responds to these

requirements with an overall strategy of concentrating growth, increasing the housing supply in existing communities, and upgrading and expanding transit service. These planned interventions are not, however, projected to be able to offset high cost burdens for lower-income households. In fact these plan strategies may exacerbate the problem: improved transit service may make housing units close to transit even more costly; geographically constraining new housing construction may increase housing market pressures. The results of the plan assessment seem to bear this out, despite the adopted plan allocating much of the new housing growth to areas with high numbers of jobs and high transit potential. Thus while the plan offers a plausible pathway to meeting state environmental and housing targets, it is unable to simultaneously improve on the important social equity issue of affordability. Although location affordability is integrated into a performance-focused approach, other goals, outside factors, and mandated targets had greater influence over the plan. The San Francisco experience offers a cautionary note to regions that assume increases in density and more transit-oriented development are solutions for unaffordability.

From the plan review it is unclear that using location affordability performance measures helps planning agencies produce plans that are expected to improve affordable outcomes. Admittedly, the current generation of LRTPs were developed before MPOs had full clarity about new federal requirements for PBPP, so future plans may look quite different. Still, the review provides some insights into emerging practice and early patterns in the use of performance measures. First, the weak accountability of regional monitoring programs, where location affordability is frequently included, does not create a strong feedback loop for the transportation planning process. Further, because regional monitoring programs focus on aggregate measures, they do not provide data at a level of spatial detail to measure the effectiveness of projects in improving affordability. Fine-grained data are needed to track project-level outcomes and strengthen understanding of what solutions work and where. Second, implementing a PBPP approach to the LRTP process does not resolve internal tensions between different goals and objectives. Nor does it simplify the search for feasible solutions to a difficult challenge. Here, the San Francisco plan is particularly relevant. Rather than abandoning performance-focused planning in resolving location affordability, there may be useful ways to adjust the use of performance measures. The next section returns to Christensen's matrix as a framework for identifying potentially more effective uses of performance measures, even when goals are conflicted and solutions uncertain.

7 PERFORMANCE MEASURES AND UNCERTAINTY

Figure 2 presents a revised version of Christensen's matrix, adding information to the matrix about the use of performance measures in each of the four quadrants. Although quantified

Figure 2: Performance Measures and Christensen’s Matrix

Goals  Solutions 	Consensus	No Consensus
Known	<i>Bureaucracy & Stable Rules</i> <ul style="list-style-type: none"> ▪ Measure efficacy in program delivery ▪ Measure value of program benefits 	<i>Pluralist Politics & Agreed Rules of the Game</i> <ul style="list-style-type: none"> ▪ Measure efficacy in following procedural rules ▪ Measure enforcement of terms of bargaining agreements
Unknown	<i>Change & Expansion & Rules of Experimentation</i> <ul style="list-style-type: none"> ▪ Measure effects of programs including differences by context ▪ Measure agency support of innovation and experimentation 	<i>Wicked Problems & Problem Finding</i> <ul style="list-style-type: none"> ▪ Measures of leadership ▪ Measures of solution identification ▪ Measures effectiveness in restructuring and formation of multiple goal positions.

Adapted from Christensen (1999).

measures can be used in any circumstance, their purpose, design and interpretation must vary if they are to foster and support effective planning.

In the upper left quadrant, the relationship between means and ends is known. Results are predictable and replicable. This is a zone of certainty for an agency, with clear objectives and well-defined solutions. Therefore, agencies can be held accountable for results. In these circumstances, performance measures work well as measures of organization efficacy in delivering projects and programs that will lead to desired outcomes. Yet, such situations are unlikely to be permanent; technological change can make traditional solutions ineffective or unfeasible and changes in social values can call goals into question.

In the lower left quadrant, solutions are uncertain. This is an area where experimentation, pilots, phased implementation, and innovation are needed to develop and test solutions. Because there is no proven solution, it is inappropriate to hold agencies accountable for results (Christensen 1999). However, agencies should be accountable for collecting and assessing information about outcomes from any candidate solutions that are implemented. Here, performance measures are appropriate if used as program evaluation mechanisms, to evaluate and compare solutions and understand any differences in results that are attributable

to differences in the implementation context. Christensen notes that government agencies tend toward premature programming of unproven solutions, leading to unintended, institutionally constrained searches for effective solutions. Thus, the drive for certainty binds the prospects for change to established agencies and their powerful supporters, and so limits the very innovation essential to resolving the uncertainty. This systemic contradiction results in costly, distorted, and unresponsive programs' (Christensen 1999, p 106).

When there is lack of consensus on goals, yet for any position taken in the debate there is a feasible solution, the situation is in the upper right quadrant. The challenge for the agency is to support a successful political bargaining process to work out the accommodation of the various preferences (Christensen 1999). Because outcomes of bargaining process are unpredictable, it is inappropriate to expect consistent, replicable outcomes. However, agencies can be held accountable for the quality and diversity of debate over goals and for their role in building inclusiveness in the debate. Thus, appropriate performance measures relate to the enforcement of procedural rules that foster productive debate and broaden access to the decision-making process. Also appropriate are performance measures that measure agencies' effectiveness in enforcing any agreed-upon bargaining arrangement, such as a compensatory program for accepting negative impacts (Christensen 1999, p 134). Situations of bargaining can be destabilized with technological change that make some solutions unfeasible. Alternatively, if the issue is fragmented across agencies and addressed through narrowly focused programming areas, this can create an artificial consensus if goals are 'pre-specified' so as to fit with the programming (Christensen 1985).

Situations where solutions are unproven and there is no agreement on goals are, unfortunately, fairly common in public policy and planning. In the lower right quadrant, goals are vague or conflicted, facts are debated, competing positions offer no proposals for solutions, and there may be inadequate levels of trust to support a bargaining process. Planning tends to become reactive and undirected (Christensen 1985). The situation is also characterized by pluralism in interests and values, institutional complexity, and uncertain knowledge (Head and Alford 2015). Resolving the situation requires shifting it to another quadrant. This can be done by restructuring or redefining the problem to one that participants agree can be worked on, which moves the situation to the lower left quadrant. Or restructuring the debate to focus on problems that can be solved with existing solutions, which moves the situation to the upper right quadrant. Here, Christensen emphasizes the importance of social learning and of leadership (Christensen 1985). The application of performance measures or even evaluation frameworks to situations in this chaotic quadrant is limited (Head and Alford 2015). An organization may be able to identify ways to measures of organizational effectiveness in connection with processes and forums that improve the stability of the situation. Measures of

individual leadership may be appropriate as well, although the qualities of leadership needed for resolving ‘wicked problems’ are unique. Instead of the ability to communicate a clear vision and set an organizational direction requiring, here, critical skills are mobilizing ‘adaptive work’ among stakeholders and partners (Head and Alford 2015)

8 DISCUSSION AND CONCLUSION

The review of plan documents for 20 large MPOs finds 6 plans (35%) include location affordability in the goals, objectives, or strategies of their LRTPs. Four regions (20%) include an indicator of location affordability in their regional monitoring programs (Chicago, Los Angeles, St. Louis, Washington D.C.). Two regions include a location affordability indicator in a list of indicators for potential adoption in the future. In 4 regions, San Francisco, San Diego, Los Angeles, and St. Louis, MPOs include an indicator of transportation costs in the equity assessment of their LRTPs. Only one plan, for the San Francisco region, is found to use a location affordability performance measure as part of a performance-based planning effort.

The plans in this review draw heavily from the H+T Index for defining and measuring location affordability (Center for Neighborhood Technology 2016). Plan narratives frequently mention the Index, and the 45% affordability threshold proposed by CNT is adopted by some MPOs as a target or benchmark. The plans for the Washington DC and Newark regions even refer to the H+T Index as the ‘standard’ (Metropolitan Washington Council of Governments, n.d.; North Jersey Transportation Planning Authority 2013). The H+T Index has clearly had an impact on the work of MPO planners.

Overall, indicators for location affordability are applied in a weak accountability environment. Regional monitoring programs focus on communicating information about affordability and do not link progress (or lack thereof) to incentives (or penalties). Nevertheless, there is an element of accountability in including affordability indicators in an equity assessment. Equity (or EJ) assessments are federal requirements; under Title VI of the Civil Rights Act, an MPO must demonstrate that its plan will not disproportionately burden or deny benefits to low income or minority populations (FHWA Office of Planning Environment & Realty 2016). This accountability is diluted somewhat by the flexibility MPOs are allowed in the equity assessment methods.

There are several potential explanations for why MPOs address location affordability in a weak accountability framework. It is likely that MPOs are reluctant to accept responsibility for location affordability outcomes because they have little power and only indirect influence over many of the actors and elements that shape affordability, including most of the economic costs of transportation. Understandably, MPOs are reluctant to accept strong accountability for outcomes in such an environment. At the same time, simply reporting indicators without some

link to decision-making or planning processes means agencies are setting aside a potentially useful tool.

It is clear that with respect to location affordability, MPOs are not in the upper left quadrant of Christensen's matrix where unaffordability can be resolved by administering a bureaucratic program. Thus, the application of performance measures in their traditional sense, as measures of organizational effectiveness in delivering programs, is inappropriate.

Uncertainty in the goals dimension can exist because the goals are vague. Vague goals are often 'charter' goals, which serve the function of creating a common ground and a community, and are not really targets for attainment (Landau 1973). These goals are 'more like receding horizons than fixed targets' (Catron cited in Landau 1973, p 536). Catron explains that agencies establish their success by demonstrating their efficacy in their *programming* activity, not in their ability to attain charter goals. In such cases, regional monitoring and weak accountability may be appropriate. At the same time, communicating a regional monitoring program as though it is a performance measurement framework with strong accountability can create unrealistic expectations and even create negative perceptions of agency efficacy when problems persist.

In situations in which goals are conflicted, developing consensus requires planners enable resolution through processes of debate, bargaining, and tradeoffs. Appropriate use of performance measures to evaluate MPO efficacy in this work could include measures of MPO performance in accommodating diverse preferences, such as the diversity of plan scenarios considered in the planning process. Measures of how well MPO processes follow procedural rules that support debate are also appropriate (e.g. measures of the diversity of stakeholder views, the depth of engagement, stakeholder influence on the plan). Performance measures could also be used to track the enforcement of conditions of bargains and agreements. In cases of goal uncertainty, s that create accountability for outcomes are inappropriate; the emphasis should be on effectiveness in supporting pluralist politics and following procedural rules.

If there is uncertainty in both goals and solutions, with stakeholders voicing vague concerns but no clear proposals for regional affordability, the situation is likely in the lower right quadrant, along with other 'wicked problems'. To make any real progress, an MPO or an individual needs to assume a leadership role and guide the situation towards greater certainty. In this situation, it is counterproductive to hold MPOs accountable for particular outcomes (Christensen, 1985).

An additional area of uncertainty is in what solutions are effective in reducing unaffordability. The plans reviewed suggest this is the most likely circumstance for location affordability. Links between means and ends are described without specificity and in qualitative terms, and even carefully crafted plans are unable to make much headway on the issue. Unintended consequences of proposed solutions (e.g. gentrification and displacement) are

acknowledged. In the plans reviewed, there is a general pattern of recommending transit, transit-oriented development, and sustained affordable housing policy for dwelling units near transit as ways to improve location affordability. These are not particularly new or innovative ideas, and yet despite being included in plans for many years and in many regions, they are apparently inadequate in resolving regional affordability challenges. Perhaps this is because they are insufficiently scaled, infeasible, or subject to confounding forces. Whatever the source of the shortfall, this suggests there is considerable uncertainty in solutions for unaffordability even if there is consensus on location affordability goal.

If location affordability is an issue that can be sited in the lower left quadrant of Christensen's matrix, where goals are agreed but solutions unproven, performance measures should focus on holding the MPO accountable for *information* about outcomes, but not for the outcomes themselves. This involves mobilizing performance measurements as information-gathering, evaluative mechanisms to learn more about results from various implementation activities which treat projects and programs as experiments or pilots. The findings of these evaluations can improve understanding of what solutions work and in what contexts. Therefore, measuring the effectiveness of a location affordability intervention such as a transit investment or TOD project requires not regional-level monitoring, but rather fine-grained data, localized analyses, pre- and post-project evaluations, and investigation of disappointing or surprising outcomes. The indicators of gentrification and displacement risk, which may provide important information about unintended effects on affordability from transit investments, that are under development for the Los Angeles and San Francisco regions are potential examples of such practice.

In situations of solution uncertainty, focusing on evaluation and information gathering tests assumptions about the effectiveness of conventional solutions and mitigates the tendency toward premature programming. In this quadrant, planning 'works through trial and error, trying something, receiving feedback from the environment, and then making further modification in response' (Christensen 1985, p 67). Accountability for collecting and interpreting information could be created with measures related to how an MPO supports incremental adjustments; collects and uses information from test solutions; the quality of its evaluation work; and its encouragement of innovative solutions to problems (Christensen 1999). In plan assessments this could mean using multiple methods to analyze the sensitivity of plan effects to different thresholds of affordability or definitions of vulnerable neighborhoods. In line with this, Bills and Walker (2017) suggest harnessing the ability of activity based models (implemented by the majority of MPOs in this study) to make detailed demographic analyses and compare plan effects for particular types of households with effects for the region overall.

In recent years, there has been considerable research into the technical aspects of performance measures: identifying data, setting targets, and improving performance reporting. These are and will continue to be important aspects of developing a performance-focused approach to planning. However, the institutional aspects that shape implementation are also key topics. Potential extensions of the current study include expanding the sample of MPOs to include those in smaller regions and broaden the perspective of current practice beyond the largest metro regions. Examining how MPOs are addressing issues other than location affordability in PBPP would produce further insights in emerging patterns in planning practice. Augmenting a plan review with information from other sources, such as interviews with MPO staff and stakeholders, and working group documents and discussions could enrich the analysis.

The way that MPOs interpret and use the information from performance measurement programs will largely determine whether PBPP actually strengthens plans and planning practices or becomes a bureaucratic exercise with little connection to real world outcomes. The degree to which performance measurement programs contribute to reducing uncertainty is an important factor for their success, especially in connection with difficult issues where consensus may be weak and solutions unproven. Thus, a performance measurement program should be designed with the conditions of uncertainty in mind to keep the focus on how to better solve problems, not simply on how to better measure them. This perspective on PBPP can better equip MPOs to tackle the challenging issues in their regions.

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APPENDIX A: MPOS INCLUDED IN ANALYSIS

MPO (and major city)	Population (2010)	Year Designated	Primary Plan Document (date plan adopted)
Atlanta Regional Commission	4,818,052	1971	The Atlanta Region's Plan. Transportation Element (Atlanta Regional Commission 2016) (February 2016)
Baltimore Regional Transportation Board	2,684,661	1992	Maximize 2040 (Baltimore Regional Transportation Board 2015) (November 2015)
Boston Regional Transportation Board	3,159,512	1973	Charting Progress to 2040 (Boston Region Metropolitan Planning Organization 2015) (July 2015)
Chicago Metropolitan Agency for Planning	8,453,793	1962	Go To 2040 (Chicago Metropolitan Agency for Planning 2010; Chicago Metropolitan Agency for Planning 2015b) (October 2014)
Delaware Valley Regional Planning Commission (Philadelphia)	5,626,318	1965	Connections 2040 Plan for Greater Philadelphia (Delaware Valley Regional Planning Commission 2013a; Delaware Valley Regional Planning Commission 2013b; Delaware Valley Regional Planning Commission 2013c) (July 2013)
Denver Regional COG	2,827,082	1977	2035 Metro Vision Regional Transportation Plan (Denver Regional Council of Governments 2011) (February 2011)
East-West Gateway Council of Governments (St. Louis)	2,571,327	1973	Connected2045 (East-West Gateway Council of Governments 2015a; East-West Gateway Council of Governments 2013) (June 2015)
Houston-Galveston Area Council	5,892,002	1974	Bridging Communities 2040 RTP (Houston-Galveston Area Council 2016) (March 2016)
Maricopa Council of Governments (Phoenix)	4,055,281	1973	2035 Regional Transportation Plan (Maricopa Association of Governments 2014) (January 2014)
Metropolitan Council (Minneapolis-St. Paul)	4,055,281	1973	Thrive MSP Transportation Policy Plan (Metropolitan Council 2015) (January 2015)

Metropolitan Transportation Commission (San Francisco)	2,849,557	1970	Plan Bay Area (Metropolitan Transportation Commission 2013a; Metropolitan Transportation Commission 2013c; Metropolitan Transportation Commission 2013b) (July 2013)
National Capital Region Transportation Planning Board (Washington, D.C.)	4,586,770	1965	2014 Constrained LRTP (Sonenklar et al. 2015; National Capital Region Transportation Planning Board 2014; Greater Washington 2050 Coalition 2010) (October 2014)
New York Metropolitan Transportation Commission	12,367,508	1982	Plan 2040 (New York Metropolitan Transportation Council 2013) (April 2016)
North Jersey Transportation Planning Authority (Newark)	6,579,801	1982	Plan 2040 (North Jersey Transportation Planning Authority 2013) (September 2013)
North Central Texas COG (Dallas-Fort Worth)	6,417,630	1974	Mobility 2040 (North Central Texas Council of Governments 2016) (March 2016)
Puget Sound Regional Council (Seattle)	3,690,866	1991	Transportation 2040 (Puget Sound Regional Council 2014) (May 2014)
San Diego Association of Governments	18,051,203	1975	San Diego Forward (San Diego Association of Governments 2015c) (October 2015)
Southeast Michigan Council of Governments (Detroit)	4,703,593	1974	Creating Success with Our Transportation Assets (Southeast Michigan Council of Governments 2013) (June 2013)
Southern California Association of Governments (Los Angeles)	3,095,271	1972	The 2016-2040 Regional Transportation Plan/ Sustainable Communities Strategy (Southern California Association of Governments 2016c; Southern California Association of Governments 2016b; Southern California Association of Governments 2016a) (April 2016)
Southwest Pennsylvania Commission (Pittsburgh)	2,574,953	1974	Mapping the Future: A Southern PA Plan (Southwestern Pennsylvania Commission 2015) (June 2015)

APPENDIX B: SUMMARY OF PLAN REVIEW

Note: Plans grouped by use of location affordability (LA) performance measure (PM).

MPO or Main City	LA in goals	LA a strategy or objective	LA in PMs	LA PM	How LA PM is used	Data used for LA PM	Comments
San Francisco		✓	✓	"Decrease by 10 percentage points (to 56 from 66%) the share of low-income and lower-middle income residents' household income consumed by transportation and housing."	Scenario evaluation, project prioritization, equity analysis	Regional model outputs; vehicle costs include costs of owning and operating.	In addition to the LA PM, the equity assessment of the plan has a measure of displacement risk: '% of rent-burdened households (50% or more of income) in high-growth areas'; preferred plan scenario does not improve on these 2 indicators; plan narrative calls LA 'one of the greatest regional challenges to tackle over the coming years'. Housing affordability tracked in regional monitoring program.
St. Louis		✓	✓	"Average proportion of household income spent on housing and transportation costs in the St. Louis region"	Regional monitoring + PM for transportation system	American Community Survey (after the H+T Index)	Use a measure of accessibility for project prioritization that is linked in narrative to LA, but method not reported in plan.
Chicago	✓		✓	"Percentage of income spent on housing and transportation by moderate-income and low-income residents: 53% by 2015, 45% by 2040"	Regional monitoring	Consumer Expenditure Survey, BLS	Targets referred to as 'aspirational goals'.

Los Angeles				"Percent of income spent on housing and transportation."	Regional monitoring	BLS; ACS	LA indicator not applied to current plan but will be used for monitoring going forward. Out of pocket transportation costs included in equity assessment.
Washington DC				"By 2020, the housing and transportation costs in Regional Activity Centers will not exceed 45% of area median income"	Regional monitoring	H+T Index	Minor update plan. General note that the MPO will revisit their PM program and may use different data sources or PMs in the future and as MAP-21 requirements are finalized; suggest PMs will be used to select plan scenarios and/prioritize projects in future plans.
San Diego							Housing affordability and transportation affordability are in the goal structure, but not linked. Out of pocket transportation costs included in equity assessment.
Dallas-Fort Worth				"Relative change in Housing + Transportation Affordability Index"	Potential use in future	H+T Index	LA PM catalogued for potential future implementation in PBPP or regional monitoring.
Minneapolis-St. Paul					Potential use in future		Plan catalogs an extensive list of possible measures including an LA PM; note interest in developing a work plan with more robust methods that will support using equity for prioritization and evaluation.

Philadelphia	✓						Minor update plan; previous plan included measure of household energy and auto costs for scenario analysis; use a housing affordability PM in a regional monitoring program.
Boston		✓					Link between objective to minimize cost burdens for households and project evaluation and scenario analysis not evident.
Seattle		✓					Update plan largely focused on revising the financial element and revenue estimates to regain fiscal constraint compliance; minor discussion of housing affordability; indicate interest in adopting new PM practices, esp. use of more quantitative measures.
Atlanta							Not a priority issue in plan.
Baltimore							Affordable transportation and affordable housing/accessibility are separate strategies elements.
Denver							Closely linked with the regional development and growth plan, which lists cost of living as a challenge for the region, primarily LA costs. LA is not included in regional goals, baselines, and measurable outcomes.

Detroit						Several recommendations and strategies related to TOD, rental unit preservation, and linking housing and jobs, but not discussed in connection with potential PBPP.
Houston						PMs focus on system performance (infrastructure condition and reliability), crash rates, mode split, and air quality.
New York						Discussion of housing affordability in connection with a Sustainable Communities Planning Grant.
Newark						Housing affordability, esp for renters, emphasized in regional sustainability plan; transportation affordability a goal of LRTP and use in prioritization in unspecified, qualitative way; plan notes project prioritization model under development.
Phoenix						Some discussion of transportation affordability in plan narrative.
Pittsburgh						The MPO carried out a PM development project to identify potential measures including cost of living, and shares of housing units that are occupied/vacant.

APPENDIX C: FURTHER DISCUSSION OF PLANS

Chicago

Planning in the Chicago region is led by the Chicago Metropolitan Agency for Planning (CMAP). CMAP is responsible for comprehensive planning and, as the designated MPO for the region, also for transportation planning.

In 2010, CMAP partnered with the Chicago Community Trust on the Regional Indicators Project. The project began with the development of 'Common Grounds Goals'. The goals were cross-walked to sectors that represent government and non-profit areas of responsibility. Twenty-eight goals are noted as relevant for the transportation sector, the highest number across all sectors. Relevant indicators were developed that link goals with various program activities and outcomes. These indicators are presented in regional planning documents, including the LRTP. Each year, the Regional Indicators Project has produced a 'Implementation Report' that presents updated data and examples of regional projects that support the goals and affect the indicators. It is noteworthy that in the annual progress reports, not all indicators are reported. Instead the emphasis is on qualitative descriptions, example projects, and infographics suggesting the primary intent is performance communication without a strong accountability framework.

As part of the LRTP update process (ongoing as of this writing), the regional indicators are being revisited to consider adjustments to improve their validity, comprehensibility to nontechnical audiences, and to evaluate the quality, reliability, and timeliness of the underlying data. Improvements to indicators were guided by an interest in using 'actual measured values and not be reliant upon modeled or estimated figures' (Chicago Metropolitan Agency for Planning 2015a) p 2. The indicator update effort will feed into the current LRTP planning cycle, with the new measures and targets applied in the next CMAP plan.

CMAP's indicator review offers some insights into the development of indicators for use in planning. The review identified two major issues with the use of the H+T Index as a location affordability indicator (Chicago Metropolitan Agency for Planning 2015a). First, the Index uses estimates of transportation costs. Second, the estimates are based on data collected from multiple years by the American Community Survey. Therefore, CMAP elected to change to using Consumer Expenditure Survey data to calculate a location affordability indicator because they are empirical data and are released annually, aligning with the annual performance reporting schedule. However, the switch to Consumer Expenditure Survey data has an important disadvantage: geographic scale. CES data are reported at the MSA level only while transportation and housing interventions are most often site- or corridor-specific. This raises the question of whether implementing a regional

transportation plan could have a large enough effect to move the indicator in the desired direction. This mismatch between the scale of indicator and scale of plan interventions greatly reduces the ability to evaluate the effectiveness of a plan or project.

Still the indicator review effort reveals a generalized, ongoing commitment to the issue of LA. Although changing the underlying data, CMAP elected not to adjust the target for this measure (Chicago Metropolitan Agency for Planning 2015a). This commitment, however, is perhaps possible because of weak accountability: the review notes the targets are aspirational only. The adjustments adopted following the indicator review are an example of using internal critique and organizational learning to maintain a meaningful PM program. It also points out a potential drawback to adopting an indicator that is readily available but is not well-aligned with agency needs.

The CMAP plan places location affordability as a benefit of 'livable communities', the latter defined as places that 'offer transportation choices providing timely access to schools, jobs, services, health care, and basic needs . . . opportunities for recreation, participation in the arts, and involvement in the governance of their communities . . . imbued with strength and vitality' (Chicago Metropolitan Agency for Planning 2010) p. 14. The quality of livability is to result from the strategy of linking land use development and housing, increasing transit options and reducing driving. As a result, household costs for transportation are expected to decline. As mentioned, the location affordability indicator is deployed in the regional monitoring program and is reported for 284 municipalities and the region as a whole.

The adopted portfolio of capital projects included in the CMAP plan was selected through a staff analysis coupled with public engagement to collect feedback from residents (Chicago Metropolitan Agency for Planning 2009). The location affordability indicator was not applied to the scenario development/selection process. Instead projected effects on housing affordability, driven primarily by affordable housing units in transit-oriented developments, and overall increases in density, serve as the project evaluation metrics for affordability (Dean 2009; Chicago Metropolitan Agency for Planning 2009). This approach assumes causal links between increased density and reduced household cost burdens and between proximity to transit and reduced transportation cost burdens for residents in affordable housing units. These assumptions rely on substantial shifts in travel behavior patterns and of the ability to effectively link development density, transit system expansions, and affordable housing in a complex urban environment.

St. Louis

East West Gateway Council of Governments (EWG) is the comprehensive planning organization and MPO for the greater St. Louis, Missouri, region. This region straddles the Illinois-Missouri border and includes 200 cities. The current LRTP was developed to align with the MAP-21 national transportation goals and includes indicators related to those goals (East-West Gateway Council of Governments 2015a). EWG also sponsors a regional monitoring program, OneSTL, that tracks a wide range of indicators, including measures of location affordability (East-West Gateway Council of Governments 2013). The alignment between the indicators used in the LRTP and the goals of OneSTL, the Missouri and Illinois Departments of Transportation, and MAP-21 are presented in the plan (East-West Gateway Council of Governments 2015a), p 11).

In the LRTP, the location affordability PM falls under an overarching goal of supporting communities by connecting them to opportunities and resources across the region. As the region has comparatively modest housing costs, the primary thrust of the strategies for attaining this goal do not focus on cost burdens. Instead they include planning assistance to local governments for multimodal planning, coordinating land use and transportation planning, and equity in accessing the decision-making process. OneSLT uses CNT's H+T Index, describing this indicator as a measure of the efficiency of the transportation network and of the degree of locational choice for residents. Interestingly, EWG presents regional indicators along with values for 34 'peer regions' and a peer average, contextualizing the indicators by comparing St. Louis to regions of similar population size (East-West Gateway Council of Governments 2013).

The technical appendix to the LRTP expands on the OneSTL indicator by calculating the location affordability indicator for smaller geographies (Traffic Analysis Zones or TAZs) and for Environmental Justice populations (high shares of poverty, minority, people with disabilities, zero-car households, or seniors) (East-West Gateway Council of Governments 2015b). Further, the indicator is calculated using the 'current' price for gasoline (\$2.438/gallon) and with a gasoline price of \$5/gallon, adding an element of price vulnerability. This vulnerability assessment acknowledges future price uncertainty and evaluates how negative developments could play out for the region. However, there is no evidence that this information was used to test plan scenarios or the potential benefits of proposed projects.

The location affordability indicator appears not to be applied in the project prioritization process. Instead, the prioritization is described in the EWG Transportation Improvement Program (TIP) as a qualitative assessment of how well a project supports two 'priority areas' of the overarching goal of access to opportunity: (1) the degree to which a project addresses the mobility

needs of low-income communities and of people with disabilities and (2) the project's support for other regional goals including those for sustainable development, land use plans, economic development, and environmental quality (East-West Gateway Council of Governments 2016). The details of the scoring process used are not described in detail, but the TIP suggests an ordinal scale measured the degree of need for each project's expected improvements.

EWG brings their MPO modeling tools to bear on the issue of location affordability, using their regional travel demand model to calculate driving (and thus driving costs) at the TAZ level. This calculation of regional variation in cost burdens can then be linked to demographic or geographic characteristics. The results of this more detailed analysis reveal some substantial differences from the overall regional picture. For Environmental Justice populations, the location affordability indicator is 52% of income at current gas prices, rising to 56% if gas cost \$5/gallon, the latter comparable to Los Angeles. Comparing these populations, modest cost burdens for non-Environmental Justice populations are masking high vulnerability for Environmental Justice populations, largely as a result of a significant gap in median income (\$35K vs \$62K). The disparity in income is coupled with relatively low transit use in the region which might offer a lower cost option for lower income households (East-West Gateway Council of Governments 2015b, p 49; East-West Gateway Council of Governments 2015a, p 16). Although the disparities do not rise to a formal standard of a 'disproportionate impact' for an Environmental Justice assessment, they demonstrate how disaggregated data and the choice of comparison group can reveal considerable differences within a region.

Washington DC Region

The National Capital Region Transportation Planning Board (TPB) is responsible for regional transportation planning within the Metropolitan Washington Council of Governments. The planning jurisdiction includes portions of Virginia and Maryland as well as the District of Columbia. The plan included in this study is a minor update plan that emphasizes an updated list of projects to fit with financial projections. This plan draws from a 2014 priority and policy plan and a 1998 vision document for its goals and strategies (National Capital Region Transportation Planning Board 2014; National Capital Region Transportation Planning Board 1998). The COG also supports Region Forward, a regional monitoring program. Region Forward produced a set of indicators and targets in 2010, including an indicator for location affordability (Greater Washington 2050 Coalition 2010).

Region Forward adopts the H + T Index for their location affordability indicator, calling it the 'national standard for assessing basic community affordability' (Metropolitan Washington Council of Governments, n.d.), p 23. The indicator is applied to 'activity centers', areas of

employment concentration, rather than for the overall region. Activity centers are also a key concept in the TPB vision and policy plans and serve as a common concept across sectors and jurisdictions to support a coordinated strategy of focusing growth. The baseline report for Region Forward indicators reported the location affordability indicator was below the target level of 45%, a value suggested by CNT as an appropriate threshold for affordability. However, this same report notes that the overall level of affluence in the region ‘masks entrenched inequities in communities with high concentrations of poverty and unemployment’ (Metropolitan Washington Council of Governments, n.d.) p 2. Similarly, using area median income to assess location affordability may mask high cost burdens within the region for low-income households, especially if these households reside outside Activity Centers. Of note, the TPB intends to adopt a new method for their equity assessments in 2017 (Metropolitan Washington Council of Governments 2017). This method will consider benefits and impacts to ‘Equity Emphasis Areas’, designated areas with concentrated low-income and minority populations. It may be that this demographically disaggregated approach will also be considered for the Region Forward monitoring program.

Although there is a performance analysis report for the current plan, the Region Forward indicators are not applied. Changes in jobs accessibility are assessed, but this measure is a time-based variable, not a cost burden variable. The location affordability indicator may have set aside because it is already below the target level. The performance analysis includes a chart noting which transportation goals from the policy plan are supported for each funded project; however, it is not clear how projects were prioritized or if the adopted plan as a whole was developed using a PBPP approach.

Los Angeles

The Southern California Association of Governments (SCAG) is the COG and MPO for the region comprised of Ventura, Los Angeles, Orange, San Bernardino, Riverside, and Imperial counties. The current SCAG LRTP combines a regional transportation plan and a regional sustainable communities plan into a single coordinated plan, as required by state mandate. Under SB 375, California’s urban regions must develop plans that are aligned with GHG reduction targets and requires agencies to plan for providing adequate housing for the projected future population. Although developed prior the release of federal rules under MAP-21, the plan notes that SCAG has been using PMS in their planning processes since 1998, with sustainability-related measures added in 2004 (Southern California Association of Governments 2016b) p 3.

The SCAG plan gives considerable attention to affordable housing and to the link between housing and transportation. The plan describes the need for affordable housing as one of the region's most pressing challenges. Further, the plan states, 'For many households in the region, minimizing transportation and housing costs remains a priority' (Southern California Association of Governments 2016d) p 14. The plan narrative goes on to describe the difficulty of addressing the issue. The state mandates contribute to this difficulty: although building compact neighborhoods with high-capacity transit reduces GHG emissions and provides more mobility choices to more people, low-income households, which are most likely to rely on transit, may face displacement if they live near new transit infrastructure (Southern California Association of Governments 2016c) page 55). Plan strategies focus on ways for local jurisdictions to increase the supply of affordable housing in the region, especially near transit. The plan notes that SCAG and its partners are collecting information about gentrification and displacement with the intent of further study of this phenomenon. SCAG's cost burden indicators are measured at the regional level. This approach is likely to mask differences within the region. Sub-regional information on location affordability would be important to interpret information about gentrification and displacement in the region.

SCAG describes two cost burden indicators their plan. The first is the percent of income spent on both housing and transportation, calculated using BLS and ACS data. The second is annual household costs for transportation only, as calculated by CNT in their H + T Index. This second indicator is used to assess plan performance by comparing a continuation of recent conditions (a 'no-build' scenario) against projected conditions with the implementation of the current plan. Both these 2040 projections are then compared to the base year 2012. The first indicator, however, is not used in the plan assessment because of the difficulty of projecting housing costs (Southern California Association of Governments 2016b) p 23). Emphasis on using transportation costs as a measure of plan benefits likely reflects an interest in using indicators that are more directly influenced by the MPO and the LRTP. The use of the transportation cost indicator focuses on assessing the plan to report its expected benefits; there is no evidence they were used to develop the plan scenario or to prioritize projects in the plan. Although SCAG creates a closer link between cost burden indicators and the LRTP, the application of the indicators is characterized by weak accountability.

San Diego

San Diego Area Governments is the MPO and COG for San Diego County. This region is adjacent to the Los Angeles MPO, SCAG, and borders with Mexico. The San Diego plan describes the 'binational'

character of the region as a result of the maquiladora program that supports cross-border manufacturing, creating large flows of workers and freight across the border. As for SCAG, the current SANDAG plan is a combined plan for transportation and regional development (San Diego Association of Governments 2015c). The plan was developed before the final rules for implementing MAP-21 were established, and prior to the passage of the FAST Act. Still, the plan uses a performance measurement framework to evaluate the selected plan scenario for the overall network and a PM approach to the equity assessment of the plan.

The SANDAG plan includes indicators for both housing and transportation cost burdens, but these are measured separately, as measures for equity. That is, the indicators measure regional differences in how transportation cost burdens change and how housing development provides access to jobs and other key destinations over the life of the plan (San Diego Association of Governments 2015c), p 94. The two indicators are not, however linked as a measure of LA. The plan's performance on these indicators is driven by increasing high-frequency transit in low-income communities, which create an equitable distribution of benefits by socio-economic class. Both indicators are measured at the regional level.

Transportation costs are discussed in connection with social equity and the access to opportunity: 'It is difficult to overstate the importance of transportation options for people who are economically disadvantaged . . . For many low-income individuals, the costs of owning and operating a car are prohibitive, and having one is simply not an option' (San Diego Association of Governments 2015c) p 128). The solution to this dilemma is alternatives to driving, chiefly transit. The plan assessment finds the plan does provide equitable benefits in this regard, although this result is based on the realization of the land use development outcomes included in the plan (San Diego Association of Governments 2015c) p 129. SANDAG limits the assessment of plan performance for affordability measures to the focused category of out-of-pocket transportation costs: automobile operating costs, tolls, parking charges, and transit fares. This emphasizes those elements of the system that the agency can most directly affect and which require fewer assumptions about future developments in additional cost categories such as vehicle prices, insurance, and similar. This likely improves the ability of the model to predict future conditions that are expected to result from implementation of the plan. Because the indicator is designed to measure differential effects of the plan among populations, those items most likely to change as a result of the plan are appropriate. The indicator does, however underestimate the total transportation cost burden for those who own an auto as it does not include purchase, depreciation, insurance, and other fixed costs which are substantial shares of the total costs of automobility. As a

result, the indicator may under represent changes in the share of income expended by driving, and more acutely so for lower-income households for whom these outlays likely take a greater proportion of income than for wealthier households.

The transportation cost burden indicator is used in the equity assessment of the plan. The indicator is reported as the change in the percent of household income consumed by out-of-pocket transportation costs, comparing the differences between 'no build' and implementing the plan for the base year 2012 and modelled costs in 2035 and 2050. It is measured for minority households, low-income households, and seniors, with a threshold of disproportionality of 20 percentage points difference from the complementary population for each group (San Diego Association of Governments 2015a), p 17. This threshold is based on a principle in Title VI of the Civil Rights Act that a difference of 20 percentage points is unlikely to be random. The equity assessment finds very small differences for these groups, although in absolute terms, lower-income households are projected to continue to expend a greater share of income on transportation than the rest of the region (San Diego Association of Governments 2015a), p 27. Results for changes in accessibility for these groups are similarly equitable. The SANDAG equity assessment takes advantage of the region's activity-based model, which allows for modeling projected costs and travel behavior by household instead of by TAZ (San Diego Association of Governments 2015a) p 10. This finer-grained approach avoids many issues of aggregation including the potential of masking effects on clustered demographic groups within the TAZ geography.

The equity assessment also compares each equity group to its complement for the region. That is, low-income households are compared to non-low income households instead of comparing low-income households to the entire region. This approach allows for clear comparisons of differences than the more common method of comparing low-income populations to the overall region including the low-income population. Still, the indicator is still reported at the aggregate, regional level. This may continue to mask disparities that occur in sub-areas. Although not discussed in the plan, the potential for gentrification and displacement may offset some of the gains from transit investments that produce the equitable results of the plan assessment if households currently in areas slated for transit investment move elsewhere. Over subsequent plan cycles, the information from the current assessment can be compared with outcomes from the plan, creating the information feedback needed to strengthen understanding between the proposed solutions to improving transportation affordability.

The plan reports on further, project-level assessment of the individual projects included in the plan. The project-level criteria differ from the plan scenario indicators and by broad project

type (highway, railroad crossings, transit, etc.). The closest parallel to the transportation cost burden indicator is a criterion for the change in transit trips by people of disadvantaged populations (San Diego Association of Governments 2015b) p 12. The criteria are weighted and used to rank projects for prioritization in the plan.

Notably, SANDAG launched a regional indicators effort in 2006 to track progress in implementing the regional comprehensive plan. Transportation-related indicators include travel delay, travel times and volumes on key corridors (auto and transit), transit ridership, and mode shares for commuting. Housing affordability indicators are also used, but again, the two cost categories are not linked. A regional monitoring report is issued every two years, with the most recent report for 2012-2013, prior to the development of activity-based travel model (San Diego Association of Governments 2017).

San Francisco

Plan Bay Area is the regional plan for the nine-county San Francisco Bay Area, a planning effort led by the Metropolitan Transportation Council (MTC). Similar to SCAG, the MTC plan was produced under SB 375. In addition to mandated targets for GHG reductions and adequate housing, Plan Bay Area includes 8 voluntary, targets, for which quantitative metrics were developed, plus 5 additional metrics specifically for an equity assessment of the plan.

MTC used PBPP to develop the Plan Bay Area. The performance targets were adopted from among approximately 100 proposed targets which were reviewed and the list narrowed to those that could be modelled using MTC's modeling tools and which could be influenced by the agency. Many of the targets are cross-cutting in nature, reflecting the integrated transportation-land use approach of the plan. The selected targets were used to evaluate the potential pairings of land use scenarios and transportation system scenarios in an iterative fashion as these scenarios evolved through the planning process. Repeated assessments of the equity effects of the plan scenarios were also carried out.

As the San Francisco region is one of the costliest housing markets in the U.S., it is not surprising that location affordability is a prominent issue in the MTC plan. The location affordability target of a 10% reduction in housing and transportation cost burdens for low- and lower-middle income households is set to bring the region in line with the national average for these cost burdens. The equity assessment also assesses the plan's effects for location affordability for the region's vulnerable populations, plus a measure of the share of renter households with high

housing cost burdens in areas of high growth, considered an indicator for displacement risk (e.g. gentrification).

Based on the plan assessment, however, Plan Bay Area is not expected to reduce housing and transportation cost burdens. In fact, projections of the adopted plan scenario move in the wrong direction for the overall location affordability target and for the two measures in the equity assessment. These results are explained by projected increases in gas prices, a housing market recovery that will increase housing prices, and population growth in areas where lower-income households and minority households are concentrated. Growth is also expected to increase housing price pressures, which the plan proposes be offset with affordable housing strategies in those areas. In comparison, the 'No Project' scenario, in which no investments are made for transportation and land use is sprawl-oriented has the greatest increases in housing and transportation cost burdens. Although the plan is unable to reduce cost burdens, projections do at least stabilize the length of commutes for lower-income workers.

Project-level assessment results are similar. Notably, in the project-level assessment, no projects were projected to have an adverse effect on the location affordability target, reflecting the influence of housing market and other influences outside the control of the MTC. As the plan notes, 'while not unexpected given the Bay Area's historically high housing costs, this represents one of the greatest regional challenges to tackle over the coming years' (Metropolitan Transportation Commission 2013c) p 24); greater affordability remains 'vexingly out of reach' (Metropolitan Transportation Commission 2013c) p 61).

Because the MTC plan must prioritize compliance with legislatively mandated targets, indicators for location affordability (and the other voluntary targets) are essentially used in a plan assessment, not as part of the performance-based plan development. In this highly constrained intergovernmental system with ambitious targets for GHG emissions and housing, the plan assessment serves as a mechanism to communicate likely outcomes, including its limitations in effecting progress towards some goals.

Plan Bay Area plan reveals a difficult dilemma for the region and for MPO capacity to address LA. The state mandates for GHG reductions require planning that will trigger shifts to lower-carbon travel modes and shorter commutes. The state mandate for fully accommodating future housing demand requires planning for increasing density and infill development. The plan responds to these requirements with an overall strategy of concentrating growth, increasing the housing supply in existing communities, and upgrading and expanding transit service. These planned interventions are not, however, projected to be able to offset high cost burdens for lower-

income households. In fact these plan strategies may exacerbate the problem: improved transit service may make housing units close to transit even more costly; geographically constraining new housing construction may increase housing market pressures. The results of the plan assessment seem to bear this out, despite the adopted plan allocating much of the new housing growth to areas with high numbers of jobs and high transit potential. Thus while the plan offers a plausible pathway to meeting state environmental and housing targets, it is unable to simultaneously improve on an important social equity issue. Plan Bay Area offers a cautionary note to regions who assume increases in density and more transit-oriented development are certain solutions for unaffordability. It also suggests adding legislative mandates also adds additional constraints to the solution set available to planners and may 'harden' scenarios against potential trade-offs among goals.

Rather than glossing over this dilemma, the plan uses the shortfall as an opportunity for performance communication. The plan includes a frank discussion of the plan's failure to meet the desired targets for LA, describing the difficulty of the region's affordability dilemma, the limits of the ability of the MPO to resolve the issue, and some explanations as to why that is the case. At the same time, location affordability retains a degree of integration into the planning process, as opposed to being relegated to an isolated monitoring program. Despite the negative results, the potential for serving as a feedback mechanism remains intact, with the potential for future learning about the realized effects of the plan. The negative results may also motivate greater urgency in developing local affordable housing policy and programs. At minimum, continuing to measure and report on the issue despite making little headway in meeting the target may signal commitment to an ongoing search for more effective solutions. Interestingly, the overview section of the plan closes with a paragraph noting the plan cannot guarantee the projected outcomes it describes (Metropolitan Transportation Commission 2013a)p 16. In a clear nod to uncertainty, the plan is characterized as a way to structure investments and policies so as to improve the chances of attaining the desired future for the region.

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