PERFORMANCE MANAGEMENT SYSTEMS OF CONGESTION MANAGEMENT NETWORKS

Evidence from Four Cases

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ABSTRACT: *The central research question in this article asks how performance management systems are employed in interorganizational governance networks designed to mitigate traffic congestion. Congestion management networks (CMNs) adopt performance management systems across regionally bound networks of state, regional, and local actors; and within these networks, performance data are often assumed to be directing policy strategy and tool selection. Drawing on existing frameworks for categorizing performance measures and policy strategies used within congestion management networks, the authors present data from case studies of four regional networks. The CMNs studied here were indelibly shaped by the funded mandates of the U.S. Department of Transportation with guidance from the major transportation reauthorization bills since the early 1990s. No uniform performance management system exists in the regional CMSs that were studied. Rather, the CMNs' performance management systems are a construct of discrete and overlapping performance management subsystems. Making comparisons more difficult, CMN performance measures are tied to multiple policy domains (including economic, environmental health, and quality of life). Left unanswered are questions relating to the collection and analysis of performance data in terms of administrative and political drivers and the extent to which congestion management is ultimately the policy frame that drives action in these networks. Some suggestions are offered that may eventually lead to answering some of these questions through further empirical inquiry and modeling.*

KEYWORDS: *communities of practice, governance networks, performance management, traffic congestion, transportation planning*

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> Ask anyone what's the biggest problem in San Diego, and you'll probably hear "traffic." However, if we have learned anything in the last decade, it's that we can't build our way out of congestion.
>
> —2030 San Diego Regional Transportation Plan

As public problems are increasingly understood to be persistent and "wicked," the existence of robust performance management systems operating within governance networks takes on even greater importance. This has been widely noted in the literature concerning policy networks (Rhodes, 1997), policy subsystems (Baumgartner & Jones, 1993), public sector networks (Agranoff, 2005), public management networks (Agranoff, 2007; Milward & Provan, 2006), and governance networks (Koliba, Meek, & Zia, 2010; Sorensen & Torfing, 2005). A body of research has begun to emerge that assesses the performance of interorganizational networks within the policy domains of social service agencies, emergency management, education, and community economic development (Agranoff & McGuire, 2003; Comfort, 2007; Meier, O'Toole, & Lu, 2006; Milward & Provan, 1998). Fewer studies, however, have looked at the role of performance management systems imbedded within interorganizational networks (see Frederickson & Frederickson, 2006). This article contributes to the latter body of literature that looks at the role of performance management systems operating within governance networks by studying these systems as they are embedded within congestion management efforts undertaken at the regional level.

"Performance management," and the universal and particular performance measurement theories that shape performance management practices, may be viewed as the application of systematic and standardized criteria to assess the success of some action undertaken at an individual, group, organization, or interorganizational level (Moynihan, 2008). Donald Moynihan observes: "Performance management systems are designed to take information from the environment, through consultation with the public, stakeholders, public representatives, and [other relevant actors]." Performance management systems provide a means by which critical actors "engage in coding, interpreting and refining information from the external environment and internal stakeholders into a series of information categories such as strategic goals, objectives, performance measures, and targets" (Moynihan, 2008, p. 6). To be an effective performance management system, this analysis must be used by policymakers and other key decision-makers to guide collective action.

David Frederickson and George Frederickson (2006) describe the role that performance measurement processes play within governance networks aligned around the delivery of healthcare services and regulation. They pay particular attention to the ways in which performance measures are defined and valued by actors across these networks and conclude that the successful use of performance management to guide network actions is hampered by some of the same factors that have an impact on the use of performance measures in individual organizations or institutions. They identify the costs of information, the access to adequate information, and the politics that surface when data is categorized and used to ascribe causality. Frederickson and Frederickson conclude that these challenges are accentuated when actors across multiple scales of government, business, and voluntary associations operate within a governance network.

In writing about the challenges of performance measurement in networked contexts, Beryl Radin observes, "The construct of the American political system calls for an assumption that the multiple actors within the system have different agendas and hence different strategies for change. Performance measurement should thus begin with the assumption of these multiple expectations and look to the different perspectives found [across the spectrum of network actors]" (2006, pp. 239–240). Thus, in complex, networked contexts, not only do the costs of data and the challenges posed by access to data pervade, but questions concerning what performance data are to be collected, which data matter, and how these data are used to inform decisions are embedded into ever more complex multi-institutional arrangements. These challenges may be particularly visible in the processes that networks undertake to define, collect, analyze, and use performance data to guide decision-making and collective action.

The present study examines the extent to which these challenges persist across interorganizational governance networks that attempt to manage traffic congestion. The integration of performance management systems into congestion management networks (CMNs) has been supported through the major transportation reauthorization bills beginning with the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and extending to the 2005 SAFETEA-LU. As a result, the U.S. Department of Transportation (USDOT) has played an extensive role in the developments of CMNs at the regional level and the use of performance management systems by these networks as a part of their core planning and operational functions. The study was intended to answer several questions: "Does a common framework for interpreting network performance exist across a congestion management network?" and "Do congestion management networks possess tangible performance management systems?"

The unit of analysis of this study is the regional CMN, an interorganizational governance network comprising a range of federal, state, regional, and local organizations and institutions, including the USDOT, state agencies, regional metropolitan planning organizations (MPOs), public transit agencies, county and local governments, private contractors, employers, and "travelers" across a region, among others. CMNs exist to plan for and implement a variety of congestion management strategies. In part as a result of federal mandates and technical assistance programs, many CMNs have consciously integrated performance management systems into their planning and operating functions. The discussion that follows will describe how the causes of traffic congestion are delineated within the field of congestion management as well as how the field understands the consequences of congestion management for other areas of public concern, including environmental, economic, and quality-of-life issues.

There are some case studies of congestion management networks within the public administration literature. Recent cases include Dolly's case study of Seattle Metro's "Commute Partnerships" (2002), which is used as a teaching case of Electronic Hallway that tracks the 20-year evolution of the region's congestion management network. Agranoff has studied the Des Moines Metropolitan Planning Organization and the extent of its partnerships with regional actors (2005). Goetz, Dempsey, and Larson (2002) undertook a comparative case study analysis of metropolitan planning organizations in an effort to discern what distinguishes effective MPOs from noneffective MPOs. Vogel and Nezelkewicz (2002) conducted a case study of the MPO for the Louisville metropolitan area, concluding that substantial pressures were affecting the region's capacity to coordinate across local jurisdictional lines. The present study adds to this body of literature by drawing on a series of case studies of four congestion management networks completed by one of the authors.

The article begins by defining the role of a performance management system within an interorganizational network, drawing on Moynihan's (2008) Interactive Dialogue Model and then considers the types of performance measures that are commonly employed across the congestion management arena. It is argued that a certain set of assumptions regarding the relationship between the causes and effects of traffic congestion guide the selection of strategies pursued by congestion management networks. These assumptions inform the framing of performance goals and, ultimately, the uses of particular performance measures. Drawing extensively on existing models, we reconstruct the performance measurement framework that has emerged within congestion management based on standards for measuring congestion rates, the causes of congestion, the impacts of congestion management strategies, and the impact of congestion on the environment, land-use patterns, quality of life, and local economic development (Porter, Suhrbier, Plumeau, & Campbell, 2008; Weisbrod, Vary, & Treyz, 2001). Following this is a discussion of the range of congestion management strategies employed by congestion management networks under the auspices of one of five different kinds of policy strategies commonly adopted across the field and an examination of the range of actors mobilized within congestion management networks. A composite map, or conceptual model, of an ideal type of congestion management network is introduced.

Case studies are drawn from four CMNs noted for their robust congestion management efforts. We pay particular attention to the role of the MPO, the existence of critical governing communities of practice, and the existence of visible performance management systems. Based on the case study data, it is concluded that the performance management systems in each of these regions are manifested through one (or more) of four possible formats: the use of real-time data; episodic data collection and dissemination; modeling and forecasting; and program/project evaluations. Some consideration is given to the extent to which the prescriptions regarding performance management systems directed by the USDOT have been implemented. We conclude with some considerations for future research pertaining to performance measurement processes in governance networks

Performance Management Systems in Governance Networks

Viewed through the lens of organizational behavior (Mintzberg, 1983), complex systems dynamics (Boland & Fowler, 2000; Holloway, 1999), and organizational learning (Moynihan, 2008), performance management systems operating across organizational and interorganizational contexts are interlocking processes that are intentionally designed to manage the flow of feedback within or across units. Effective performance management systems will provide ongoing support to the implementation of collective actions derived from the analysis of performance data. Theodore Poister describes performance management in terms of a continuous cycle of inquiry that encompasses the collection and processing of data, the analysis of the data, and the utilization of the analysis to adjust actions and behaviors. Poister posits that the analysis of data is carried out through the act of rendering comparisons over time, across units, and against internal targets and external benchmarks (2003, p. 16). The analysis of data should lead to decisions regarding strategy, program delivery, service delivery, day-to-day operations, resource allocation, goals and objectives, and performance targets, standards, and indicators (p. 16). Moynihan (2008) describes the processes needed to link data evaluation, decision-making, and action as centering on the role of formal and informal "interactive dialogue" about performance data.

Dialogue around performance data "will not necessarily engender consensus and agreement," Moynihan asserts, for "this depends greatly on the homogeneity of the actors involved, their interpretation of the data, their ability to persuade others, and their power in the decision process" (2008, p. 112). He asserts that effective performance management systems facilitate the use of "dialogue routines" that "require a commitment of time by staff and a setting where performance data that might otherwise be ignored is considered. . . . Such routines provide an opportunity to access information, make sense of this information, and persuade others" (p. 110). In effective performance management systems, actions and strategies are collectively agreed upon, and "those made responsible are not only given the task but also the rationale, thus, enabling them to understand the 'what' and 'why.' Through understanding this, there [comes] an increased likelihood of implementation" (Savas, 2005, p. 136). Within performance management systems, "Dialogue forms a basis of social cooperation" through which commitments around common agreements are reached. Moynihan concludes that "interactive dialogue therefore acts as a social process that helps to create shared mental models, has a unifying effect, and helps to develop credible commitment for the execution phase" (2008, p. 111).

Performance *management* systems are guided by the performance *measurement* theories that inform the mental models and decision heuristics of critical actors. These mental models are often shaped by certain assumptions regarding the ascription of causality and assumptions regarding the relationship between inputs, processes, outputs, and outcomes. It has been suggested that the greater the consensus around the relationship between causes and effects, the more robust the performance management system (Moynihan, 2008).

Moynihan asserts that the rationale for advancing performance management systems is "based on the logic that the creation, diffusion, and use of performance information will foster better decision making in government, leading to dividends in terms of political and public accountability, efficiency and budget decisions" (2008, p. 10). In short, it is assumed that "performance measurement is a stimulus to strategic behavior" (De Bruijn, 2001, p. 21) that, in theory, should ultimately lead to effective outcomes.

The USDOT offers a set of very clear suggestions for how regional CMNs should integrate performance management into their network governance. Meeting these criteria qualifies regions to apply for several large grant programs, including Congestion Mitigation and Air Quality (CMAQ) and Urban Partnership Agreements. Given the emphasis the USDOT places on performance management, and the level of specificity it provides around the construction of a performance management system (*see Figure 1*), one may conclude that CMNs are a particularly useful venue for studying the role of such systems in interorganizational networks.

Congestion Management Performance Measurement Theory, Strategy, and Structure

Traffic congestion emerged as a public policy problem during a time of increasing awareness of the causes and consequences of environmental pollution and the increased demands that traffic congestion makes on the quality of life and economic vitality of regions. Traffic congestion is defined as simply "too many travelers on roads and highways at the same time" (Porter et al., 2008, pp. 2–6). Over the course of the past four decades, traffic congestion has been singled out as a contributor to air and noise pollution, global climate change, and economic and time inefficiencies, a threat to travelers' safety, and a negative influence on

1. *Create an MPO committee that addresses performance measurement*
   The process of developing and implementing performance measures requires a commitment of time and resources. One way to acknowledge this reality from the outset is to plan for a sustained group of practitioners devoted to the complex tasks of selecting measures, identifying data sources and tools, and deciding the best frequency of analysis and distribution of performance findings.
2. *Discuss what measures are ideal and use them to motivate data and tool development*
   Given the rapid evolution of automated travel data collection technology, it is helpful to discuss performance measures beyond those that are supported by current capabilities. As one element of a performance measurement effort, transportation agencies within a region may jointly wish to define the most appropriate measures and associated data needs.
3. *Build performance measurement into traveler information programs*
   A number of regions have developed systems to provide the public with real-time information on the condition of the transportation system (e.g., location and severity of delays, location and status of accidents, status of the transit network, weather-related traffic problems, disruptions from special events).
4. *Develop a regular performance report*
   Many transportation agencies are reporting transportation performance measures on a regular basis. Even a very simple report providing one or two performance measures can have a positive effect in broadening the discussion over investment priorities.
5. *Involve managers with day-to-day responsibility for operations in the process of developing performance measures*
   Agencies responsible for major investment decisions often take the lead in developing performance measures. However, it is critical that this process involve practitioners who are concerned primarily with day-to-day operation of the transportation system.

Figure 1. Federal Highway Administration Performance Measurement System Guidelines

Source: USDOT, 2009.

regional quality of life. Congestion is estimated to waste 4.2 billion hours of time nationwide, at an annual cost (including time and wasted fuel) of $78 billion. The cost of delay and wasted fuel was $710 per traveler in 2005. These costs reflect only the direct travel-time costs (based on value of time), not secondary impacts on the economy (Porter et al., 2008, pp. 2–9). Traffic congestion is also a major contributor to air pollution and the emission of greenhouse gases due to the increased vehicular emissions from excess idling and acceleration associated with persistent traffic congestion (Colvile, Warren, Mindell, & Hutchinson, 2001; Delucchi, 2000).

The causes of high traffic density are often understood in terms of infrastructure or capacity limits, population growth, and sprawl. Traffic congestion on highways is caused "when traffic demand approaches or exceeds the available capacity of the highway system. Traffic demands vary significantly depending on the season of the year, the day of the week, and the time of day. Also, capacity can change because of weather, work zones, traffic incidents, or the mix of drivers and vehicles on the road" (Porter et al., 2008, p. 2-6). Some factors may be predictable, such as the normal fluctuation of traffic during rush hour. Some causes yield predictable traffic patterns, such as work zones and the timing of traffic control devices. Other causes of congestion are less predictable, such as weather, traffic accidents, and special events. The causes listed above are decidedly episodic and may be managed through coordinated action and planning. Large or growing populations are often cited as the root cause of traffic congestion. Ultimately, congestion stems from a lack of capacity to accommodate all of the travelers opting to be on the roads on any given time. Episodic and unpredictable factors temporarily constrain this capacity.

Table 1 provides an overview of the range of possible congestion measures employed within the transportation planning field. In addition to measuring the causes of congestion, several measures are used to gauge the rates of congestion, with volume/capacity being the most widely used. Another set of performance measures concerns the consequences of congestion. These consequences have been widely understood as falling into one of five categories: environmental impacts, atmospheric impacts (pertaining to greenhouse gas emissions in particular), impacts on land use patterns, economic impact, and overall quality-of-life indicators. A final set of performance measures pertains to the assessment of strategies pursued to mitigate traffic congestion.

Performance measurement implies certain assumptions regarding causality—namely, that inputs into the system (however defined) shape the processes undertaken, which in turn produce certain outputs leading to short, intermediate, and long-term outcomes (Poister, 2003). Claims regarding the validity of particular couplings of causes and effects, and, ultimately, problems and solutions, are made by and through certain combinations of policy actors operating within and across governance networks (Koliba, Meek, & Zia, 2010). In a sense, the building of a performance management system around a set of assumptions regarding a relationship between causes and effects, inputs and outputs, and outputs and eventual outcomes is grounded in validity claims made by certain combinations of stakeholders and network actors. While a common appreciation of the relationship between causes and the consequences is clearly shared by congestion management professionals, the challenge lies in providing more uniformity across systems and ensuring that data will provide policymakers with actionable information.

Since it was first recognized as a public problem, congestion has been viewed as a matter of regional scope, extending "beyond one jurisdiction's boundaries and [requiring] collaboration with many different organizations; in border areas, even with other nations" (Porter et al., 2008, p. 5-14). Over the course of the past four decades, new institutional arrangements have evolved to form the basis of regional governance and implementation structures that increasingly rely on

Table 1. Congestion Measures Used in Congestion Management Networks

Category of measure	*Subcategory*	*Representative measures*
Cause of congestion	Limited capacity: bottlenecks	Number of lanes, width of lanes, number of mergers
	Traffic incidents	Number of incidents, length of time to clear debris, etc.
	Work zones	Reduction in number of lanes, number of temporary closures
	Weather	Correlation between weather and congestion rate
	Traffic control devices	Degree of backup at traffic signals/signs
	Special events	Correlation between special events and congestion rate
	Rush hour/commute time	Correlation between commuting patterns and congestion rate
	Too many vehicle miles traveled	Public transit ridership
Rate of congestion	Highway capacity manual measures, queuing-related measures, travel time-based measures, reliability measures	Volume/capacity, roadway congestion index (RCI), travel time index (TTI), level of service, buffer index, total congestion delay
Impact of congestion	Environmental: air quality	Smog level, reduction in vehicle miles traveled (VMT)
	Environmental: noise level	Decibel level
	Environmental: water quality	Water runoff pattern/content
	Climate change: carbon emissions	Fossil fuel consumption level, comprehensive modal emissions model
	Land use	Land use metrics
	Economic: trucking	Costs of congestion: value of added transit time, changes in reliability, buffer index
	Economic: individual business	Costs of congestion: cost of remaining open for longer hours to process late deliveries, penalties or lost business revenue associated with missed schedules, cost of spoilage for time-sensitive, perishable deliveries, cost of maintaining greater inventory to cover undependability of deliveries, cost of reverting to less efficient production scheduling processes, additional costs incurred because of reduced access to markets for labor, customers, and delivery areas, changes in reliability, buffer index

	Economic: households	Costs of congestion: cost of commute in terms of time (opportunity costs) and money (fuel costs, car maintenance costs), travel time reliability, buffer index
	Economic: regional economy	Costs of congestion: diminished cost competitiveness and market growth opportunities, redistribution of business to outlying areas.
	Quality of life	Changes in reliability
Impacts of congestion management strategies	Expand capacity	Rates of congestion, length of new roadway, new lanes, shoulders constructed, primary measures of benefit examined are traveler delay, travel time and/or travel speed, depending upon specific measures examined in study.
	Reduce/cap capacity	Rates of congestion
	Manage existing capacity	Rates of congestion, high-occupancy vehicle (HOV) lane usage, changes in traffic patterns, primary measures of benefit examined are traveler delay, travel times, and/or travel speeds, depending upon specific measures examined in study, changes in reliability
	Manage demand	Percentage reductions in VMT, number of telecommuters, number of alternative work schedules, changes in traveler perceptions/attitudes
	Promote multimodality	Maximum load factors (e.g., ratio of passenger-miles to seat-miles), public transit ridership, bike path and pedestrian walkway usage, park & ride usage, changes in reliability

Sources: Banks, 1998, Boarnet, Kim, & Parkany, 1995, FHWA 2004, Meyer, 1994, 1999, OECD, 2007, Porter et al., 2008, USDOT, 2009, Weisbrod et al. 2001.

real-time performance data to develop models and plans around which traffic congestion may be mitigated.

The development of congestion management networks has been fueled, in part, by federal mandates calling for the development of regional transportation plans, the ongoing monitoring of congestion rates, and the implementation of policies and programs designed to mitigate congestion. "The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and the resulting planning regulations incorporated [travel] demand management actions in several components of [a] mandated urban transportation planning process (US DOT, 1993)" (Meyer, 1999, pp. 586).

The strategies pursued to mitigate the causes of congestion extend across a wide range of policy tools pursued alone or as suites of policy tools organized around a concerted congestion management effort. Congestion management specialists categorize these strategies in terms of the places within the transportation system through which the intervention is to take place. The categories include the development of new highway infrastructure; placing limits on the expansion of new infrastructure; more efficient use and design of existing infrastructure; initiatives designed to limit the demand for roadways and reduce vehicle miles traveled (known as travel demand management); and improvement of transit systems through expanding and improving mass transit systems and promoting multimodality (traveling by means other than single-occupancy motor vehicles, thus reducing vehicle miles traveled) (Cambridge Systematics, 1996; Federal Highway Administration [FHWA], 2004; Meyer, 1999; Porter et al., 2008). Table 2 lists the range of congestion control strategies currently being undertaken by CMNs. "Given the regional impact on congestion resulting from the region's unique combination of commuters and visitors, collaboration of agencies and organizations within the region is critical to improving transportation system performance (Porter et al., 2008, p. 5-14).

The USDOT (2009) describes the networks that have evolved to implement these strategies as "institutional arrangements" devised through "agreements and organizational structures both within transportation agencies and between agencies." These arrangements may take the form of "forums that regularly bring together transportation planners and operations practitioners as well as agreements that promote involvement of management and operations practitioners in planning processes, or that promote a regional planning perspective within an operations environment." In other words, CMNs are structured around the planning for, and implementation of, a range of congestion management strategies. Figure 2 represents the range of possible network actors implicated in regional CMNs. This map was devised through a combination of literature review and the coding of network actors in the four case studies discussed further on. Lines and arrows are used to signify the flow of financial, human, and knowledge capital. Institutional actors

Table 2. Classification of Transportation Control Initiatives

Type of strategy	*Congestion control initiative*
Expand capacity (supply of roadway)	Expand highway infrastructure
Limit growth of capacity	Land use and growth management
Management & operations: Use existing capacity more efficiently	Integrated corridor management strategies Episodic controls ATMS-type traffic signalization improvements (ITS) High-occupancy vehicle (HOV) priority lanes/facilities Right turn on red, flashing yellow Traffic engineering improvements Incident-management systems Ramp metering systems at highway entrances
Travel demand management	Mandatory employer trip-reduction programs (ECO) Voluntary employer trip-reduction programs Trip-reduction ordinances On-street parking restrictions Maximum parking ratios Carpool and vanpool programs Telecommuting Alternative work schedules/compressed workweeks Marketing, advertising & education Road and congestion pricing VMT and emissions fees Fuel and other at-the-pump charges Parking charges Transit service improvements
Multimodality	Multimodal Transportation Corridor Investment Bicycle and pedestrian facilities/programs

Source: Cambridge Systematics, 1996.

are presented in rectangles. Contracted actors are represented in the dotted ovals. The various groups, committees, and teams that are critical to the functioning of the network are represented in the circle. Figure 2 provides a very preliminary display of a flow chart configuration of an "ideal type" of CMN.

Some critical actors operating within a CMN include metropolitan planning organizations (MPOs), state transportation agencies, the range of contract agents, regional, county, and local governments, and the travelers themselves. Regional MPOs serve as a central actor within each of these cases. Some regions already had regional government organizations (councils of governments that were already focusing on urban development and land use) or a regional planning agency (focused on rural/suburban development and land use). In total, there are 381 MPOs in the United States (Bureau of Transportation Statistics, 2009; GAO, 2009).

The organizational structure of MPOs across the CMN cases studied here

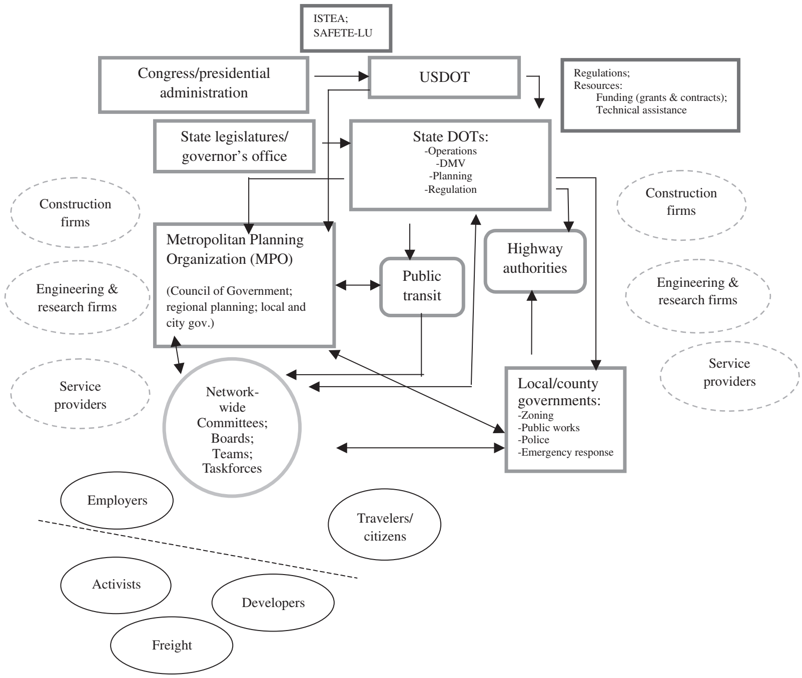

Figure 2. Prototypical Congestion Management Network: Actors and Ties

takes one of two forms: either situated in a department or division of a regional governance body or a stand-alone transportation planning and programming organization. Regional governance bodies are often referred to as councils of governments (COGs) that are governed through regional advisory boards made up of local government officials. COGs often coordinate a region's land use, natural resource, and transportation strategies. MPOs housed in COGs are generally staffed by a COG's transportation division. Stand-alone MPOs, such as the one in Orlando, exist to provide plans that satisfy the conditions necessary for the receipt of federal transportation funding for capital, operating, and planning assistance. MPOs are also housed in local or regional planning organizations. Depending on the context, MPOs may be either the lead organization or the network administrative organization for the congestion management network (Provan & Kenis, 2007).

State governments and agencies can also play a significant role in CMNs. Some state transportation departments develop statewide and corridor-level congestion management plans and also provide technical, logistical, and operational support to regional MPOs. State DOTs often contract with engineering and construction firms to build or maintain state highways. In instances in which metropolitan regions span more than one state boundary, a number of state DOTs and other state government entities will be involved.

Metro-area public transit systems that are not run by COGs may operate as nonprofit, for-profit, or government-run entities. They may be structured as government corporations or regional transit authorities as well. Some regions may have multiple public transit systems that are differentiated by mode (public, light rail, subway, etc.) or geographic scope. Public transit systems are often critical to regional congestion management strategies. Highway authorities and private toll-road operators are common in highly urbanized areas and serve as actors within CMNs.

Local and county governments play a critical yet oftentimes ambiguous role in CMNs (Dolly, 2002). In regions with regional governance structures, local governments will often have an official role in the governance of the COG through regional advisory boards. Local governments are often chiefly responsible for the maintenance of local roadways as well as local land use decisions through zoning. Their public works staff surveys and maybe repairs local bridges, shoulders, culverts, and roadways. Their zoning and planning commissions and boards usually must weigh in on critical transportation designs considerations. Local law enforcement and emergency responders are critical in enforcing congestion management strategies that involve incident management and the enforcement of laws and rules designed to decrease congestion.

With the rise in the use of indirect policy tools like grants and contracts to deliver public goods and services, much of the project and program implementation used by CMNs are delivered by third-party contractors or grantees. Road construction and engineering firms are hired to build new roads, modify existing infrastructure, implement traffic monitoring systems, and other strategies designed to expand capacity and improve the efficiency and effectiveness of existing capacity. Universities are asked to assist in the development of new engineering, performance measurements, forecasting, and modeling projects. Nonprofit and for-profit service providers may be involved in public information campaigns, employer trip-reduction programs, car and van pooling, and other demand-management strategies.

Employers in a region are often targeted as critical actors. In some regions, traffic-reduction ordinances mandate that employers of a certain size implement measures to reduce the vehicle miles traveled (VMT) by their employees. Development fees may be levied for new facilities that are forecasted to increase traffic volumes. In other instances, employers may be offered incentives, such as vouchers or discounted public transit passes, to obtain voluntary compliance with certain kinds of demand management strategies.

Individual travelers play a key role in CMNs. The number of travelers on regional roads and highways is often used to inform critical congestion measures, such as VMT. Individual travelers are often the targets of public education and incentive programs designed to reduce the number of vehicles on the roads at any one time. Travelers are also subject to regulations enforced through fees, tolls, and law enforcement measures. Ultimately, public officials responsible for highway infrastructure are accountable to the citizenry. MPOs are looking to provide the public with real-time data about the performance of the region's congestion management system.

The Role of Performance Management Systems in Selected Congestion Management Networks

The configuration of performance management systems in CMNs is illustrated below with reference to a series of case studies of regional networks undertaken by one of the coauthors in collaboration with other associates at Cambridge Systematics and Resource Systems Group. The full results of these case studies appear in a final report that is cited throughout (Porter et al., 2008). The case studies were developed from a variety of data sources. Particular attention was paid to how and to what extent these networks defined and used performance measures to monitor progress and, in many cases, to make decisions regarding future actions. Key informants within each network were interviewed (Miles & Huberman, 1994); public documents, Web sites, and internal documents were examined (Woodrum, 1984). All of these data sources were used to create case studies using a standardized outline format that permitted comparison across cases (Yin, 2009). The sections of each case study report included relevant background information, details pertaining to the planning process, congestion management strategies, the uses of performance measurement data, specifics about the structure of the network, and funding issues.

The four cases studies deal, respectively, with the CMNs in Dallas–Fort Worth, Texas; Minneapolis–St. Paul, Minnesota; Orlando, Florida; and San Diego, California. These areas were selected because of the level of innovation they have undertaken in recent years to mitigate congestion (Porter et al., 2008, p. 1-2). They were identified through an informal Delphi survey of industry experts. Table 3 presents an overview of some of the pertinent congestion measures, and population sizes and growth patterns in each region. Several commonalities may be found across these cases. All have sizable metropolitan populations, and each metropolitan area has seen a substantial growth in congestion rates as measured by delays in traveler hours over the course of the past 20 years.

Each of the four regional CMNs places emphasis on a different combination of congestion mitigation strategies. Orlando, for instance, emphasizes improving incident response to alleviate congestion caused by traffic accidents. Dallas–Fort Worth tends to emphasize traffic signal improvements and the promotion of alternative modes of travel. Minneapolis–St. Paul has focused on extensive freeway ramp metering systems that regulate the number of vehicles entering the highway and also

Table 3. Congestion and Population Data of Selected CMN Case Studies

	Measures & (rank)			
Metro area	*Annual delay per traveler hours (rank)*	*Travel time index (rank)*	*2005 population, millions (rank)*	*2000–2005 population change (rank)*
Dallas–Fort Worth, TX	58 (5)	1.35 (9)	5.8 (4)	+11.7% (68)
Minneapolis–St. Paul, MN	43 (23)	1.26 (26)	3.1 (16)	+5.2% (250)
Orlando, FL	54 (8)	1.30 (17)	1.9 (27)	+17.1% (22)
San Diego, CA	57 (6)	1.40 (4)	2.9 (17)	+4.1% (325)

allows buses and carpools to have travel-time advantages over single-occupancy vehicles. San Diego has undertaken travel-demand management and operational strategies, including vanpool programs and high-occupancy toll lanes.

In each of these instances, networkwide programs, initiatives, and projects have been created that are governed through interorganizational project teams, program staff, groups, or committees comprising a range of professional administrators, engineers, elected officials, industry representatives, and the citizenry at large. Table 4 outlines the place of the regional MPOs relative to regional governance structures. It also lists the governing groups, committees, and task forces employed across each region to manage networkwide activities. Funding sources that fund congestion management planning, performance monitoring, and strategy implementation are listed.

The governing bodies of each of these regional networks may be described as "communities of practice" (CoPs) (Agranoff, 2005; Koliba & Gajda, 2009; Snyder, Wenger, & de Sousa Briggs, 2003). To a certain degree, CoPs operate as "social learning systems" where practitioners connect to "solve problems, share ideas, set standards, build tools, and develop relationships with peers and stakeholders" (Snyder et al. 2003, p. 17). Of particular interest here is that the CoPs are a critical locus of regional performance management systems, serving as the place where performance data are discussed, decisions are made through these discussions, and implementable actions are subsequently followed. Although the case study methodology did not extend into an exanimation of the dynamics of these groups, teams, committees, and taskforces, one would anticipate that they are spaces where the "interactive dialogue" about performance measures takes place (Moynihan, 2008).

In all four of the regions under study here, there is clear evidence of the adoption of all five FHWA practices for integrating performance management into CMNs (*see Figure 1*). In some cases, more than one "MPO committee" is responsible for performance measurement. These groups are listed in Table 4. The full extent to which these groups effectively carry this out cannot be determined through the present study. All four regions have developed traveler information programs using real-time data-collection systems (*see Table 5*). All four regions develop regular performance reports, sometimes with separate reports issued by MPOs and state DOTs. As a result of these groups and performance management systems in place, it is evident that managers, engineers, and planners are involved in the day-to-day responsibility for operations in the process of developing—and using—performance measures (USDOT, 2009).

In each of the four cases, performance management systems were identified, with the results presented in Table 5. All the regional CMNs relied on some combination of real-time performance data, episodic compilations of statistics, congestion management strategy evaluations, and modeling and

Table 4. Metropolitan Planning Organizations of Selected Cases

Region	*Regional governance (COG)*	*Metropolitan planning organization administrative structure*	*Governing committee, board, etc.*	*Notes*	*Funding sources*
Dallas–Fort Worth	North Central Texas Council of Governments (NCTCOG)	Transportation division of NCTOG	Regional Transportation Council (RTC) Technical committees	TxDOT has district offices, North Texas Tollway Authority plays a role	Federal Congestion Mitigation and Air Quality Improvement Program (CMAQ), Surface Transportation Fund (STP), DART congestion fund, NTTA tolls
San Diego	Sand Diego Association of Governments (SANDAG)	Transportation division of SANDAG	Board of directors of SANDAG Transportation Committee Regional Planning Committee Technical working groups	Transportation planning extends to land use	Corridor Mobility Improvement Account, local sales tax, state TIP, federally backed bonds, traffic congestion relief program
Minneapolis–St. Paul	Met Council (Regional Planning Agency, also operates public transit system)	Transportation division of Met Counsel (Designated MPO)	Transportation Advisory Board Team Transit Technical advisory committee	Team Transit comprised of Met Transit, Mn/DOT, Center for Transportation Studies–UMN, state patrol, local government	CMAQ, Urban Partnership Agreement (UPA), USDOT ICM Pilot Program, state gas tax, DMV fees, MV sales tax
Orlando	None	Metropolitan Orlando	Traffic Incident Management Teams MPO policy board M&O subcommittee	Orlando–Orange County Expressway Authority plays role Florida Turnpike Enterprise plays role	STP funds, tolls, state gas tax, car rental surcharge, local infrastructure sales tax

Table 5. Performance Management Systems in Four CMNs

Region	*Performance management system*	*Data-collection format*	*Notes*
San Diego	Freeway Management System	Real-time	Cameras, signal status, vehicle sensors
	Freeway Performance Monitoring System	Real-time	State wide data collection developed by PATH and UC Berkeley
	Arterial Traffic Management Systems	Real-time	Signal timing
	Transit Management Systems	Real-time Compilation of statistics	PM related to transit system
	Traveler Information Management System	Real-time	Real-time transit data
	Trip Reduction Ordinance	Compilation of statistics	Provides local governments with standard measures/tools
	Integrated Corridor Management	Compilation of statistics	Shared across transit systems, Caltrans, highway patrol
	SANDAG annual reports	Compilation of statistics Modeling and forecasts	
	Caltrans	Real-time modeling and forecasts	Loop detectors Traffic counts
Dallas–Fort Worth	Transportation Improvement Program (TIP)	Compilation of statistics	Monitors overall congestion rates, Early scoping phases
	Thoroughfare Assessment Program	Real-time Modeling and forecasts	Signal integration and monitoring
	National ITS: used by Texas DOT and DART (transit) Traffic Management Centers	Real- time modeling and forecasts	Uses satellite data, closed-circuit TV, highway sensors
	Transportation: "State of the Region" reports	Compilation of statistics	
	Dallas–Fort Worth Regional Travel Model	Modeling and forecasts	Facilitated by NCTCOG
	Regional Arterial System	Real-time Compilation of statistics	
	Intermodal/Freight System	Forecasts	
	Texas DOT data collection	Real-time	Pneumatic tubes

	NCTCOG data collection	Compilation of statistics Modeling and forecasts	Aerial photography Project-specific evaluations
Minneapolis–St. Paul	Arterial Management System	Real-time	Cameras, Signal optimization systems
	Regional Transportation Audit	Compilation of statistics	Performed by Met Council
	MN/DOT data collection Met Council data collection	Compilation of statistics Real-time	Standardized congestion measure—MN/DOT and Met Council: Traffic flow per hour
	Metropolitan Freeway System Congestion Report	Compilation of statistics	Written by MN/DOT
Orlando	Traffic Operations Group—out of FDOT—Traffic Incident Management teams	Real-time After-action reports	Response actions, after-action reports
	Expressway Management System	Real-time	Uses cameras, travel times
	Traffic Signal Report Card	Compilation of statistics	Uses data to demonstrate success of signal timing
	Surface Transportation Security and Reliability Information System Model Deployment	Modeling and forecasts	
	Texas Transportation Institute report	Compilation of statistics	Discussed by Metroplan staff and policy board
	Central Florida Consortium	Central data hub	12 local and regional partner agencies
	iFlorida	Real-time Modeling and forecasts	Expressway Authority collects data
	Tracking the Trends report	Compilation of statistics	Done annually by Metroplan
	M&O subcommittee	Compilation of statistics Modeling and forecasts	Uses incident indicators—used to use LOS Asks: Are we making the right investments?
	Metroplan initiates	Citizen surveys	Metroplan

forecasts. Real-time performance data systems are most often used in congestion management strategies that focus on the management of existing capacity. Real-time data are used to regulate the coordination of traffic signals and signs, incident management programs, and traveler information systems. Oftentimes, more than one agency in the region compiles congestion management statistics into episodic, annual reports. These reports are used in making planning and other strategic congestion management decisions. The evaluation of individual congestion management strategies is often undertaken in terms of grant and contract reporting. These data may, or may not, be included in regional data compilation reports.

Computer model simulations and forecasting are used by those responsible for planning in the CMNs studied here. The sophistication of MPO technical forecasting abilities varies widely. Some MPOs only have the data and technical expertise to conduct traditional "four-step" models, while others are able to develop forecasts using more advanced "activity-based" models (GAO, 2009). The traditional four-step model forecasts trip outcomes as individual events and rarely considers behavioral processes (Domenich & McFadden, 1975; Goodwin & Hensher, 1978; McNally, 2000). In contrast, the activity-based framework attempts to improve the understanding and prediction of travel behavior by recognizing the complexity of activities and travel decisions (Goodwin & Hensher, 1978; McNally, 2000). Activity-based models are needed to model more complex transportation-related policy problems, such as air quality and climate change (GAO, 2009). The San Diego region has been using activity-based models since 2004, Dallas–Fort Worth began using these models in 2009, but Orlando and the Minneapolis–St. Paul do not yet appear to use activity-based planning.

There is no uniform performance management system in the four cases under study here; rather, multiple performance management subsystems are at work in each of the four regional CMNs. A CMN's performance management system is a construct of both discrete and overlapping performance measurement processes. Some regions have attempted to provide an overarching umbrella that includes all performance measurement activities, most notably San Diego's Integrated Performance Management framework and Orlando's Central Florida Consortium.

All the regions studied here have at least one, and often two, annual or biannual compilations of performance data. These reports draw on national congestion data, such as the Texas Transportation Institute's Urban Mobility Report, to provide both time series data and comparative data. They also synthesize real-time data and other measures of congestion causes, congestion rate, and congestion impact that have been adopted within a region. These reports are often written either by state DOT planning divisions or regional MPOs. In some cases, as in Minneapolis–St. Paul, these two entities generate separate reports. In San Diego, each agency develops its own reports, and certain combinations of actors are primarily bound together through the sharing of real-time performance data and standard performance measures.

Some regional adoption of standards for measuring congestion rates may be observed. In addition, some regions have adopted common indicators to convey congestion measures to the public. For example, Orlando's Tracking the Trends and the annual State of the Region reports of Dallas–Fort Worth's North Central Texas Council of Governments provide the public with indicators of congestion from year to year for the entire region.

Real-time performance measurement is being adapted to both operational- and planning-level functions of CMNs. These cases underscore how the real-time data systems typically used in operations are now cycling back into planning through the incorporation of real-time data into computer simulation modeling and forecasting. The CMNs studied here use extensive modeling and forecasting to predict the consequences of design interventions. These models and forecasts are then compared to real-time data, with conclusions drawn from these triangulations.

Discussion

This study of performance management systems in four CMNs leads to several conclusions pertaining to the nature of performance management systems in these types of networks. The first three points center on the general conclusions drawn from the study. Areas in need of further research are also suggested. Points 4, 5, and 6 pertain to some areas that call for more empirical inquiry or theoretical development.

1. The Measurability of Traffic Congestion and the Relative Homogeneity of Shared Mental Models of Its Causes and Consequences

This study of four CMNs suggests that the pervasive use of performance data to guide planning and operations in CMNs is anchored in a common framework and language for measuring congestion levels and impacts. Conceptually, traffic congestion is a social problem that is extremely amenable to scientific explanation. Congestion management is, in turn, guided by a set of industry standards and metrics that have evolved through engineering studies, computer modeling, systems planning, and economic and environmental impact assessments. As a result, it is necessary to consider the extent to which a "performance measurement culture" (Frederickson & Frederickson, 2006) has been promulgated by the coupling of federal prescriptions and a commonly shared set of professional standards and measures. These professional standards are largely determined by transportation, civil, and in some cases, environmental engineers, planners, and modelers employing the most current research methods and data-collection technologies. The professional engineers, planners, and, public administrators who work in DOTs, MPOs, public transit organizations, highway authorities, engineering and construction firms, and some divisions of local government have established a common language for defining congestion rates, congestion causes, and some of the consequences of congestion, and thus may be said to be united through a common mental model.

2. The Federal Government as a Driver of Performance Management Development

The USDOT, particularly through the Federal Highway Administration, has contributed to the development of the performance management systems of the CMNs in the four cases studied here. At the programmatic or project level, performance data are often collected and even mandated to be collected through the range of federal grants and regulations initiated by the USDOT. The apparent role of the FHWA performance management guidelines (*see Figure 1*) in shaping regional network practices points to the kind of roles that federal-level agencies can play in shaping network practices. Although the kind of data that flowed through the performance management systems of the ones under study here varied, the existence of multiple forums through which performance data are collected and utilized to inform decision-making is noteworthy. The major role that federal resource flows and regulations played in building this capacity speaks to the possible benefits that federal influence can play within governance networks that undertake other policy functions.

3. The Heterogeneity of Intranetwork Performance Management Systems

The range of performance management systems within the CMNs under study here employed performance data in different ways: as real-time data systems, in annual reports, through models and forecasting, and for the evaluation of specific programs and projects. Each of the regions studied here drew on all of these strategies, leading to the conclusion that CMN will likely possess multiple performance management subsystems that are a construct of discrete and overlapping forms. Network actors with particular stakes in specific policy and programmatic strategies often collected and analyzed data based on their own sets of metrics. This finding leads to the conclusion that despite the role of the USDOT in building performance management capacity in these regions, the nature of this capacity will probably vary. It is very likely that the variation may eventually be shown to be the result of differences in the existing modeling capacity, the organizational cultures of key institutions, or the degree of collaborative capacity that persists across the network (Zia et al., under review).

4. Persistent Questions About Cultures of Performance

The extent to which a “culture of performance” (Frederickson & Frederickson, 2006) is evident in these cases needs to be explored in greater detail. Although the studied networks employed similar mental models concerning the causes and consequences of traffic congestion, just how and to what extent congestion data were used to inform actual policy, programmatic, and project decision-making remain to be seen. Frederickson and Frederickson (2006) observe that when performance data are used for political purposes to undergird an argument for or against continued support of a given initiative, administrators are likely to approach performance management systems with caution. Deborah Stone's (2002) examination of the role of measurability and numeracy in framing policy problems and solutions is worth noting in this context. The selection of performance standards in the CMNs studied here was probably undertaken through an extensive web of highly political dynamics. Program advocates, environmental and land-use advocates, regional developers, local governments, and area landowners are often able to access and comment on the range of performance data collected in each region. Given these factors, the depth and breadth of performance management systems across each of these cases suggest that the common commitment to performance measurement, at least on the part of those most directly associated with the core planning and operations of the CMN, are noteworthy. The "science" of congestion management is clearly evident in the kinds of performance measurement frameworks adopted across the transportation field. The extent to which the culture of performance that appears to persist across the CMNs studied is actually isolated from the sites of real power and decision-making authority needs to be studied.

5. The Need for Deeper Study and Modeling of Communities of Practice Responsible for Collecting, Discussing, and Using Performance Data

A more focused study of the dynamics occurring within the range of groups, teams, committees, and councils dotting the networked landscape of each case is needed. These groups serve as spaces in which actors from a variety of organizational and institutional interests engage in some kind of collective decision-making process around matters of networkwide interest. The use of interactive dialogue processes (Moynihan, 2008) undertaken by communities of practice to evaluate performance data might be a central focus of such a study.

The noted systems theorist R.L. Ackoff observes that "system performance depends critically on how the parts fit and work together, not merely on how well each performs independently; it depends on interactions rather than on actions. Furthermore, a system's performance depends on how it relates to its environment—the larger system of which it is a part—and to other systems in that environment" (1980, p. 27). This point is echoed in other studies of network performance (Frederickson & Frederickson, 2006; Meier, O'Toole, & Lu, 2006). It is likely that some CMNs are more tightly coupled than others. The multiscale, multijurisdictional settings in which regional networks operate mean that a definitive assessment of how and to what extent a network is "performing" is very difficult to determine. The interview subjects for the case studies noted how a host of independent factors, such as gas prices, shifts in the state of the regional economy, the proclivities of local government jurisdictions, and the influence of interest groups all play a role in shaping outcomes over and above the range of factors found in traditional congestion management practices.

More detailed case studies focusing on the role of national, regional, and local politics in regions are needed. There is need for agent-based models of these governing dynamics in which the performance metrics most prominent to each agent's decision heuristic are blended with the decision heuristics of other agents. The extent to which conflicts arise over which performance measures to count needs to be documented and eventually modeled.

6. The Need for Understanding How Congestion Goals Compete or Align with Other Policy Goals

Although it is commonly understood, and often appreciated, that professional engineers steer the day-to-day operations and programs of CMNs, strategic direction is generally provided through a variety of formal and informal planning processes that extend beyond congestion management, into the realms of land use, environmental and economic development, and other dimensions of regional and urban planning. Moreover, MPOs are increasingly choosing congestion management strategies that also aim at improving multiple outcomes, including air quality, mobility, accessibility, quality of life, and mitigating greenhouse gas emissions (Cambridge Systematics, 2010). A sole focus on congestion management outside the context of broader community goals and policy domains may result in the adoption of strategies that are contrary to an integrated regional vision of all these policy domains (Reinke & Malarkey, 1996).

In addition, little is known about how congestion management indicators and measures combine, commingle, or compete with other planning and operating systems (Moynihan, 2008; Radin, 2006). Further complicating matters is the relationship between congestion management and policy and administrative considerations of different policy foci, like transportation planning more broadly, environmental management, land-use planning, and economic development initiatives. It may turn out that the congestion management network is not the appropriate unit of analysis at all, given the promulgation of regional planning processes that occur across different regions and integrated across multiple policy domains.

The four case studies do not enable a determination of the extent to which a commitment to performance has actually led to effective outcomes. The regions studied here suffered from persistent congestion problems that spurned innovation. The data flowing through their performance management systems demonstrated that traffic congestion was a growing problem in the region (*see Table 3*). The extent to which these data fueled successful mitigation efforts needs to be explored.

Conclusion

When performance is understood within a network context, questions inevitably must be raised concerning whose measures count and who decides whose measures count (Frederickson & Frederickson, 2006; Radin, 2006). Ultimately, performance assessment is as a central feature in the governance of networks, underscoring the important role of accountability regimes in these contexts. Moynihan concludes that "there is likely to be no single definitive approach to a.) interpreting what performance information means and b.) how performance information directs decisions" (2008, p. 102). Although this assertion seems reasonable, the continued study of CMNs may provide an extremely compelling site for further exploring such matters.

References

Ackoff, R.L. (1980). The systems revolution. In M. Lockett and R. Spear (Eds.), *Organizations as systems* (pp. 26–33). Milton Keynes, UK: Open University Press.

Agranoff, R. (2005). Enhancing performance through public sector networks: Mobilizing human capital in communities of practice. *Public Performance & Management Review, 31*(3), 320–347.

Agranoff, R. (2007). *Managing within networks: Adding value to public organizations.* Washington, DC: Georgetown University Press.

Agranoff, R., & McGuire, M. (2003). *Collaborative public management: New strategies for local governments.* Washington, DC: Georgetown University Press.

Banks, J. (1998). Performance measurement for traffic management systems. *Transportation Research Record, 1634,* 39–45.

Baumgartner, F.R., & Jones, B.D. (1993). *Agendas and instability in American politics.* Chicago: University of Chicago Press.

Boarnet, M., Kim, E.J., & Parkany, E. (1995). Measuring traffic congestion. *Transportation Research Record, 1634,* 93–99.

Boland, T., & Fowler, A. (2000). A systems perspective of performance management in public sector organizations. *International Journal of Public Sector Management, 13*(5), 417–446.

Bureau of Transportation Statistics. (2009). Metropolitan planning organizations. www.bts.gov/external_links/government/metropolitan_planning_organizations.html, accessed March 10, 2009.

Cambridge Systematics. (1996). Quantifying air quality and other benefits and costs of transportation control measures. Task 1 Report. Project 8-33. Washington, DC: National Cooperative Highway Research, Transportation Research Board.

Cambridge Systematics. (2010). *Measuring transportation network performance.* National Cooperative Highway Research Report 664, www.trb.org/publications/public/, accessed October 12, 2010.

Colvile, R.N., Warren, R., Mindell, J., & Hutchinson, E. (2001) The transport sector as a source of air pollution. *Atmospheric Environment, 35*(9), 1537–1565.

Comfort, L. (2007). Crisis management in hindsight: Cognition, communication, coordination, and control. *Public Administration Review, 67*(Supplement), 189–197.

De Bruijn, H. (2001). *Managing performance in the public sector.* London: Routledge.

Delucchi, M.A. (2000). Environmental externalities of motor-vehicle use in the U.S. *Journal of Transport Economics and Policy, 34*(2), 135–168.

Dolly, S. (2002). Commute partnerships. Electronic Hallway. https://hallway.org/cases/display_PDF.php?pdfFile=commu_a/, accessed June 1, 2009.
Domencich, T. A., & McFadden, D. (1975). *Urban travel demand: A behavioral analysis*. Amsterdam: North-Holland.
Federal Highway Administration (FHWA). (2004). Mitigating traffic congestion with demand-side strategies. http://ops.fhwa.dot.gov/publications/mitig_traf_cong/mitig_traf_cong.pdf, accessed May 28, 2009.
Frederickson, D., & Frederickson, H.G. (2006). *Measuring the performance of the hollow state.* Washington, DC: Georgetown University Press.
Goetz, A.R., Dempsey, P.S., and Larson, C. (2002). Metropolitan planning organizations: Findings and recommendations for improving transportation planning. *Publius, 32*(1), 87–105.
Goodwin, P.B., & Hensher D.A. (1978). The transport determinants of travel choices: An overview. In D. Hensher and Q. Dalvi (Eds.), *Determinants of travel choice* (pp. 1–65). Westmead, UK: Saxon House.
Government Accountability Office (GAO). (2009). *Metropolitan transportation planning organizations: Options exist to enhance transportation planning capacity and federal Oversight.* GAO-09-868. Washington, DC.
Holloway, J. (1999). Managing performance. In A. Rose and A. Lawton (Eds.), *Public services management* (pp. 238–259). Harlow, UK: Prentice-Hall.
Koliba, C., & Gajda, R. (2009). Communities of practice as an analytical construct: Implications for theory and practice. *International Journal of Public Administration, 32*(2), 97–135.
Koliba, C., Meek, J., & Zia, A. (2010). *Governance networks: Public administration and policy in the midst of complexity.* New York: Taylor & Francis.
McNally, M. (2000). The four-step model and the activity-based approach. In D. Hensher and K. Button (Eds.), *Handbook of transport modeling* (pp. 35–52; 53–69). Amsterdam: Pergamon.
Meier, K., O'Toole, J., & Lu, Y. (2006). All that glitters is not gold: Disaggregating networks and the impact on performance. In G. Boyne, K. Meier, L. O'Toole, and R. Walker (Eds.), *Public service performance: Perspectives on measurement and management* (pp. 152–170). Cambridge: Cambridge University Press.
Meyer, M. (1994). Alternative methods for measuring congestion levels. In *Curbing gridlock: Peak-period fees to relieve traffic congestion. Special Report 242* (pp. 32–61). Washington, DC: Transportation Research Board, National Research Council.
Meyer, M. (1999). Demand management as an element of transportation policy: Using carrots and sticks to influence travel behavior. *Transportation Research Part A, 33*(7–8), 575–599.
Miles, M.B., & Huberman, A.M. (1994). *Qualitative data analysis: An expanded sourcebook,* 2nd ed. Thousand Oaks, CA: Sage.
Milward, H., & Provan, K. (1998). Principles for controlling agents: The political economy of network structure. *Journal of Public Administration Research and Theory, 8*(2), 203–222.
Milward, H., & Provan, K. (2006). A manager's guide to choosing and using collaborative networks. IBM Center for the Business of Government, Washington, DC.
Mintzberg, H. (1983). *Power in and around organizations.* Englewood Cliffs, NJ: Prentice-Hall.
Moynihan, D.P. (2008). *The dynamics of performance management: Constructing information and reform.* Washington, DC: Georgetown University Press.
Organization for Economic Cooperation and Development (OECD) and European Confer-

ence of Ministers of Transport (ECMT). (2007). *Managing urban traffic congestion: Summary document.* www.sourceoecd.org, accessed May 25, 2009.

Poister, T. (2003). *Measuring performance in public and nonprofit organizations.* San Francisco: Jossey-Bass.

Porter, C., Suhrbier, J., Plumeau, P., & Campbell, E. (2008). *Effective practices for congestion management: Final report.* Prepared for the American Association of State Highway and Transportation Officials. NCHRP 20-24A, Task 63.

Provan, K.G., & Kenis, P. (2007). Modes of network governance: Structure, management, and effectives. *Journal of Public Administration Research and Theory, 18*(2), 229–252.

Radin, B. (2006). *Challenging the performance movement: Accountability, complexity and democratic values.* Washington, DC: Georgetown University Press.

Reinke, D., & Malarkey, D. (1996). Implementing integrated transportation planning in metropolitan planning organization: Procedural and analytical issues. *Transportation Research Record, 1552*: 71–78.

Rhodes, R.A.W. (1997). *Understanding governance: Policy networks, governance, reflexivity and accountability.* Buckingham, UK: Open University Press.

Savas, E.S. (2005). *Privatization in the city: Successes, failures, lessons.* Washington, DC: Congressional Quarterly.

Snyder, W.M., Wenger, E., & de Sousa Briggs, X. (2003). Communities of practice in government: Leveraging knowledge for performance. Learn how this evolving tool for cross-organizational collaboration currently is being used in a variety of public sector settings and how it can help you cultivate improved performance outcomes in your backyard. *Public Manager, 32*(4), 17–22.

Sorensen, E., & Torfing, J. (2005). The democratic anchorage of governance networks. *Scandinavian Political Studies, 28*(3), 195–218.

Stone, D. (2002). *Policy paradox: The art of political decision making.* New York: Norton.

U.S. Department of Transportation (USDOT). (1993). Management and monitoring systems: Interim final rule. 23 CFR Parts 500 and 626. *Federal Register,* Washington, DC.

U.S. Department of Transportation (USDOT). (2009). Planning for operation: Performance measurement. http://plan40perations.dot.gov/performance.htm, accessed May 27, 2009.

Vogel, R.K., & Nezelkewicz, N. (2002). Metropolitan planning organizations and the new regionalism: The case of Louisville. *Publius, 32*(1), 107–129.

Weisbrod, G., Vary, D. & Treyz, G. (2001). Economic implications of congestion. National Cooperation Highway Research Program (NCHRP) Report 463, Transportation Research Board.

Woodrum, E. (1984). "Mainstreaming" content analysis in social science: Methodological advantages, obstacles, and solutions. *Social Science Research, 13*(1), 1–19.

Yin, R.K. (2009). *Case study research: Design and methods.* Los Angeles: Sage.

Zia, A., Koliba, C., Meek, J., Campbell, E., Lee, B.H.Y., & Colangelo, D. (under review). Performance management of inter-organizational governance networks: Understanding the effects of contextual complexity and collaborative capacity on the prioritization of performance measures for MPOs.

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