

# Evaluating Potential Performance Measures for Congestion and System Performance



June 20, 2013

In a joint effort with the Bipartisan Policy Center and the State Smart Transportation Initiative, the Eno Center for Transportation held a daylong meeting on June 20 in Washington, DC, to discuss federal performance measures for highways. Under the recently passed federal transportation bill, *Moving Ahead for Progress in the 21st Century*, the U.S. Department of Transportation was required to create and implement a number of performance measures to help guide and monitor federal transportation spending. The workshop brought together a number of experienced experts as well as officials directly involved in and affected by the upcoming rulemaking.

## EXECUTIVE SUMMARY

The Eno Center for Transportation (Eno) and the Bipartisan Policy Center (BPC), in cooperation with the State Smart Transportation Initiative (SSTI), hosted a workshop on June 20, 2013, to discuss the pending federal rulemaking on performance measures under the nation's surface transportation bill *Moving Ahead for Progress in the 21st Century* (MAP-21). The workshop brought together stakeholders and thought leaders to exchange information and determine areas of consensus around performance measures for congestion and system performance.

Workshop participants included:

- Senate staff involved in writing the MAP-21 provisions;
- Leaders from the U.S. Department of Transportation (U.S. DOT) tasked with developing MAP-21 performance measures and implementation guidelines and;
- Representatives from state departments of transportation (DOTs), metropolitan planning organizations (MPOs), and other public and private groups with an interest in MAP-21 implementation.

This report summarizes the recommendations of Eno, BPC, and SSTI based on the workshop discussion and previous research,<sup>1</sup> and includes recommended measures of congestion and system performance as well as ad-

ditional considerations for their successful implementation. These recommendations integrate the performance measures currently in development or in use by workshop participants as well as the perspectives of participants related to these measures and their value to national, state, and regional interests.

Eno, BPC and SSTI recommend average trip time and system reliability as effective measures for congestion and system performance under MAP-21's National Highway Performance Pro-

## Passenger travel time data are available from private and non-traditional sources but not currently utilized in practice.

gram (NHPP) and Congestion Mitigation and Air Quality Improvement Program (CMAQ). These measures meet basic criteria for measuring congestion and system performance, are useful to both practitioners and travelers, and are easily communicated to stakeholders and the public.

Successful implementation of these measures requires additional focus on

data collection centered on passenger travel times for all modes rather than data that support standard highway-centric measures of delay. Passenger travel time data are available from private and non-traditional sources but not currently utilized in practice. Measures of trip times and travel time reliability will effectively push the industry to utilize new and "big data" sources along with traditional transportation data.

Additionally, making progress in reducing passenger trip times and increasing travel time reliability will establish a basis by which states and MPOs can implement performance-based planning and programming processes, where investments and strategies are evaluated, selected, and programmed to achieve these and other transportation goals.

## WORKSHOP BACKGROUND AND PURPOSE

Transportation system performance measurement is not new; state DOTs and MPOs use performance information to manage state and regional systems, to evaluate project-level investment alternatives, to assess transportation-land use issues, and for many other purposes. However, performance-based planning and programming, where investments and strategies are evaluated, selected, and programmed to achieve goals and performance targets across multimodal transportation assets is exceedingly rare.

States and MPOs are only beginning to develop performance-based plans that incorporate performance management concepts for all modes, for operations, and for achieving broad economic, environmental and community development goals. Additionally, until MAP-21 set the process in motion, national transportation policy did not provide a clear sense of purpose for investments in America's transportation system.

Recognizing the need for a new vision for federal transportation policy, BPC's National Transportation Policy Project (NTPP) was formed in 2008 to bring fresh thinking to these issues. NTPP published *Performance Driven: A New Vision for U.S. Transportation Policy*<sup>2</sup> in 2009 as the result of an intensive effort to develop consensus among diverse stakeholders and recommendations for a forward-looking American transportation policy. The work of NTPP echoed and built upon the work of two congressionally mandated commissions on national transportation policy reform, both of which emphasized the need to define a specific purpose for the federal program.

Prior to MAP-21, other notable interest groups of stakeholders and practitioners including the Brookings Institution, Transportation for America, the U.S. Government Accountability Office, Building America's Future, and American Association of State Highway and Transportation Officials' (AASHTO's) Standing Committee on Performance Management, among others, also developed proposals on national transportation policy. The nuances of these proposals varied; however, they were all largely focused on the application and use of performance measures in the federal-aid surface transportation program. NTPP took performance measurement beyond the concept of reporting with an additional focus on using outcome-based performance measures to evaluate the effectiveness

**TABLE 1: Measures of Congestion and System Performance**

MAP-21 Goal Area	Performance Measure
<b>Congestion Reduction</b>	Annual Hours of Delay (AHD)
	Annual Hours of Truck Delay (AHTD)
	Duration of Congestion
	Percent of Urban Roadways Congested
	Vehicle Miles Traveled
	Vehicle Occupancy
	Travel Time Index
	Population and Jobs with Access to Transit
	Unlinked Transit Passenger Trips
	Motor Vehicles per Household
<b>System Performance</b>	Reliability Index
	Travel Time
	Planning Time Index
	Annual Hours of Delay
	Avg. Travel Speed on Highways
	Percent of Work Trips using Alternative Modes
	Percent of People Driving Alone to Work
	Transit Total Revenue Service Hours
	Transit Avg. Boardings
	Transit On-time Performance
	Transit Delay
	Number of Bunched Bus Intervals
	TIP Projects with Bike/Ped Elements
	Truck Reliability Index
	Motorists Satisfaction

and transparency of transportation investments.

While MAP-21 is not directly focused on the use of performance measures to guide investment decisions, it does identify national goals for safety, system condition, congestion reduction, system efficiency, freight movement, environment, and project delivery. MAP-21 requires the USDOT to define performance measures under each national goal area within 18-months of bill enactment, or by April 1, 2014, in consultation with states, metropolitan areas, and other transportation stakeholders. Measures for congestion and

system performance are also required for projects funded under four of the core program areas.

### WORKSHOP DISCUSSION Performance Measures

Consistent with the national goals noted above, MAP-21's NHPP – which consolidates the SAFETEA-LU Interstate Maintenance, National Highway System (NHS), and the Highway Bridge Programs – requires the implementation of measures to assess system condition and performance. MAP-21 also continues the CMAQ Program and requires states to implement measures

that assess traffic congestion and on-road mobile source emissions.

Participants attending the workshop were asked to provide sample metrics currently being developed or implemented by their agency in an effort to comply with MAP-21 for these core program areas, i.e. measures of congestion and system performance. Table 1 shows the measures of congestion and system performance provided by participants and includes the measures recommended by AASHTO for MAP-21 implementation.

As shown in Table 1, measures of congestion are most commonly focused on the highway-specific measures of system delay and duration of congested conditions; system performance measures include measures of reliability as well as delay, and; both categories include a variety of ways to express delay and system reliability.

### Participant Perspectives

The workshop began with introductions of all participants and a welcome from the BPC/ Eno/ SSII hosts. Opening remarks focused on the im-

portance of finding common ground for recommending measures under the congestion reduction and system performance reporting requirements of MAP-21, which establish a foundation for national policy with significant implementation requirements for the USDOT and FHWA. FHWA leadership echoed this comment, noting that the USDOT faces several challenges in implementing MAP-21's statutory provisions on performance management.

The FHWA's approach to selecting and developing performance measures in the MAP-21 rulemaking process (as articulated in the workshop) can be defined as "realistic and rational," with a focus on what can be achieved in practice and in the short-term using data that are readily available.

Workshop participants were then invited to comment on and/or ask questions about the legislation itself, the intent of the congestion/system performance measures provisions in the bill, the rulemaking process, and/or the MAP-21 implementation process. In terms of development and implementation of measures for congestion

and system performance, participants expressed differing opinions on what might be considered practical given the challenges associated with the congestion reduction goal area as well as those associated with measuring system performance. The distinctions noted by workshop participants in defining measures of congestion and system performance are summarized below.

### Measures of congestion are largely highway-focused and provide at best a partial indication of mobility.

Common measures used by transportation agencies to track congestion and delay include volume-to-capacity ratios, vehicle hours of delay, and mean roadway speed.<sup>3</sup> Both state DOT and MPO participants offered that non-recurring delay is more important than recurring delay (i.e., it is less bothersome to travelers because they learn to expect it), and that traveler-focused measures, such as actual trip times, provide a more direct measure of how congestion affects users than highway-focused measures of delay. Travel time is also well understood by decision-makers and the public as noted by several participants.

**There is a fundamental challenge in understanding the economic costs, benefits, and tradeoffs of the congestion "problem."** Congestion and delay increase the costs of economic transactions and social interactions; however, congestion is also a product of those same economic and social forces. Thus, congestion is simultaneously a product of, and "drag on," economic activity. MPO participants noted that transportation and land use plans that encourage high-density residential and commercial developments and enhanced transit may, in fact, increase localized congestion.

However, accessibility to services, jobs, and recreational activities may also increase while door-to-door travel trip times actually decrease. In this way,



Brian Taylor (far right), a professor at the University of California, Los Angeles, led the daylong group discussion.

measures used to track congestion are best when based on the actual trip times experienced by users of the multimodal system. One state DOT participant noted that “congestion reduction” is not a state-adopted transportation goal.

**Reliability measures can be used as measures of congestion as well as system performance.** Workshop participants provided both types of measures for these areas (Table 1). In general, reliability is used to measure how travel times vary over time. Calculating the average trip time and the size of the “buffer” – the extra time needed by travelers to ensure a high rate of on-time arrival – helps to develop the reliability measures, which are often defined by the 90<sup>th</sup> or 95<sup>th</sup> percentile travel time. While the empirical definition can be standardized, appropriate targets must be considered based on the scale of the system evaluated, for example, project-level versus network-level. Normalized metrics like the travel time index can be used to compare reliability performance across systems and regions.

## Findings

There was substantial agreement among participants that measures of delay can be useful as highway operations planning tools for identifying system bottlenecks, but do not capture what matters most to travelers: how long it takes them to reach a desired destination. Additionally, business and personal travelers value travel time reliability because it allows them to make the best use of their time, and freight shippers and carriers require just-in-time predictability for industry competitiveness.

Several workshop participants emphasized that traditional measures of congestion do not address local and regional desires for different patterns of urban development. In some areas, high-density residential and commer-



*The daylong workshop brought together a number of experienced experts as well as officials directly involved in and affected by the upcoming rulemaking.*

cial developments, improved pedestrian and bicycling facilities, and enhanced public transit to encourage shorter trips and multi-modal travel may achieve regional goals but fare poorly under many traditional road system performance metrics. This is because such planning interventions and investments may actually increase localized congestion while decreasing door-to-door travel times.

Comprehensive transportation and land use planning can increase accessibility to services, jobs, and recreational activities, which ultimately increases regional economic health. As detailed in NTPP’s 2009 report, accessibility measures are critical measures of economic activity and robustness. Today’s demands for global trade and information access require connections that are both “fast and direct” and more than just physical. Measures of travel time are better indicators of regional accessibility, including access to jobs and access to labor. Future work is needed to formally develop and implement measures of accessibility; the use of average trip times

would be a constructive move in that direction.

At present, there are limited traditional data available to practitioners to develop robust measures based on the actual travel times for a full trip from trip origin to destination. Highway speed data are available in many locations and can be used to calculate highway travel times but, obviously, cannot be used to measure a complete door-to-door trip. MPOs collect additional data needed to understand total travel times using regional household travel survey; however, these surveys are expensive to conduct and therefore not updated often. The U.S. Census<sup>4</sup> provides some of the data required to understand passenger travel times, but only for work trips.

New and emerging data sources and “big data” – including probe data from cell phones and other sources - provide opportunities to develop trip times and origin-destination data that will support both measures and should continue to be evaluated by the FHWA accordingly.<sup>5</sup> These data provide opportunities

to move beyond highway-centric measures while meeting MAP-21 requirements and advancing the state-of-the-practice. These data are available and in some cases already in use; however, non-traditional data are not currently advocated at a national level for transportation analysis, and their use for transportation system applications, including travel time and origin-destination data collection and analysis, is not yet broadly understood by the industry.

### Additional Considerations

Workshop participants noted that the criteria and rules for this new planning and project selection process are likely as important as the measures selected. Additionally, the timeframe for realizing outcomes is a key component of the process, where transportation improvements that change land use and travel patterns will likely take longer to “perform” as compared to those that focus on expanding the existing network. In both the short and long terms, measures of access likely provide better information on the benefits of transportation investments. In metropolitan contexts, participants identified accessibility measures as more policy-relevant

than conventional mobility measures. Accessibility addresses how long it takes to reach chosen destination and the costs and modes associated with these trips.

While not a direct objective of MAP-21, workshop participants noted that any selected measures, as well as the process by which they are implemented, should be clear, non-technical, and understandable to a broad audience. Relating all measures back to their broader benefits and costs provides a useful tool for informing project selection decisions at the agency and political levels and will help advance the conversation of investing in our nation’s transportation future, including the development of realistic needs to meet long-range transportation goals.

### Recommendations

BPC, Eno, and SSTI recommend average trip time and system reliability as appropriate measures of congestion and system performance under MAP-21. Based on the discussions at this workshop between relevant stakeholders and public-sector leaders, these measures fit the legislative framework

for performance measurement, can be measured with existing data sets, and would be effective for state and local practitioners as they attempt to achieve transportation investment goals.

However, MAP-21 is the beginning of a larger and longer transformation towards a more performance-based federal transportation program. To continue this process, the next transportation authorization bill will need to add new measures and potentially improve existing ones. Based on the discussions at this workshop, Eno, BPC and SSTI recommend the following:

- To advance the state-of-the-practice and to best reflect how we travel today and will likely continue to travel in the future, additional focus must be placed on developing data sets that more accurately depict the full trip times of travelers using all modes.
- Congestion does not appear to be an effective goal or measure for the federal program. Congress should reconsider the attempt to measure congestion and consider whether other performance measures might be better for evaluating desired outcomes.
- Accessibility measures are critical measures of economic activity and robustness and could serve as effective substitutes for congestion. The next surface transportation bill should work to better develop metrics of accessibility.
- For any of these measures to have a substantial impact on transportation investment decisions, they will ultimately need to be meaningfully tied to funding. Congress should attempt to outline how this transition will be made in the next bill.



*The group concentrated on the more challenging areas of system performance and congestion and agreed measures should be able to target national goals and easily understandable to the general public.*

## End Notes

<sup>1</sup> BPC and Eno continue to bring new voices to the transportation debate to create a dynamic and enduring vision for the future of federal surface transportation policy. Recent high-profile reports and workshop proceedings include: *The Consequences of Reduced Federal Transportation Investment*, 2012; *Performance Driven: Achieving Wiser Investment in Transportation*, 2011; and *Performance Driven: A New Vision for U.S. Transportation Policy*, 2009. These reports can be accessed via the National Transportation Policy Project's website, <http://bipartisanpolicy.org/projects/national-transportation-policy-project>.

<sup>2</sup> NTPP was formally launched in February 2008, with the aim of bringing new approaches and fresh thinking to today's transportation issues. The first phase of the project's work resulted in the report, *Performance Driven: A New Vision for U.S. Transportation Policy*, which proposed a variety of ideas and recommendations for reforming transportation policy. The report addresses both a long-term vision for transportation policy as well as a number of ideas and reforms that can be incorporated in a future authorization bill. The report and additional information on the NTPP can be accessed on NTPP's homepage <http://bipartisanpolicy.org/content/about-national-transportation-policy-project>.

<sup>3</sup> *The Strategic Intermodal System Bottleneck Study, Technical Memorandum 2, Methodology to Identify Bottlenecks*, Florida DOT, 2011, notes these examples of traditional data used historically for tracking delay; however, the study focuses on the use of vehicle probe data to collect travel speed on roadways.

<sup>4</sup> The U.S. Census Bureau collects annual data on the journey to work trip at the census tract level via the American Community Survey.

<sup>5</sup> The FHWA Office of Operations provides methodologies for understanding highway travel times in the report, *Travel Time on Arterials and Rural Highways: State-of-the-Practice Synthesis on Arterial Data Collection*, 2013, as well as other publications available on its website, <http://www.ops.fhwa.dot.gov/>. For understanding complete end-to-end trips, INRIX provides real-time, predictive, and historic travel time data, and AirSage provides cellular probe data for travel time and origin-destination analysis. These are provided as examples of big data sources currently available to understand complete end-to-end travel times.

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