Using Real Time Transportation System Performance Measures to Fuel a Regional Congestion Management System

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ABSTRACT
All urbanized areas with population greater than 200,000 are required to develop a Congestion Management System (CMS) and implement it as part of the metropolitan transportation planning process. A CMS is defined as a systematic process for managing congestion that provides information on transportation system performance and on alternative strategies for alleviating congestion and enhancing mobility. In the Portland, Oregon metropolitan region, Metro (the regional government and metropolitan planning organization) has adopted a CMS to “efficiently manage and modernize the transportation system to meet urban demands.” Through a unique partnership with local, regional, state and federal transportation agencies and Portland State University, Metro is embarking on a five-year Portland Region CMS Roadmap toward improving the CMS in concert with the region’s regional transportation plan update. The objective of this paper is to describe how the CMS Roadmap is helping Metro to achieve the region’s vision for a sustainable transportation system. This will include new efforts to extract data from multiple sources, including a new freeway traffic data archiving system for measuring travel times in key corridors as well as describing congestion trends. Freight and transit data will also be included. In addition, the paper will describe Metro’s efforts to create a congestion management toolbox/guidebook that will aid local jurisdictions to identify and evaluate appropriate mitigation strategies. These products should also have applicability outside of the Portland region. Finally some conclusions will be drawn regarding the region’s collective efforts to improve the management of the transportation system using performance metrics.

INTRODUCTION
Portland, Oregon is proud of being known for its lush environment, its diverse selection of quality microbreweries and a progressive form of regional transportation planning (though not necessarily in that order). It is not proud of its mounting congestion. Furthermore, rain wasn’t the only dark cloud over the city when Portland’s metropolitan planning organization, Metro, was admonished by the Oregon Division of the Federal Highway Administration for inadequately addressing the federal congestion management requirement.

In recent months, however, three things have occurred that suggest a new day for Portland and its congestion situation. First, Portland State University was designated as a regional University Transportation Research Center when Congress passed the Safe, Accountable, Flexible and Efficient Transportation Equity Act: a Legacy for Users (SAFETEA-LU) in August 2005. Second, Metro, the Port of Portland and the Portland Business Alliance released a study entitled, The Cost of Congestion, that significant raised the awareness of the issue among decision-makers and the general public. Third, Metro completed and submitted a “congestion management roadmap” to FHWA
describing a new approach to satisfying the federal requirement, utilizing best practices identified from throughout the country.

The purpose of this paper is to provide the highlights of these three developments. It is, undoubtedly, an incomplete picture of congestion management in Portland, much less the broader picture of transportation planning in the region. Metro is presently embarking on the next update of its long-range Regional Transportation Plan as well as the development of the “New Look,” a follow-up to the well-known 2040 Growth Concept that was developed over a decade ago. The region is witnessing a significant expansion of its rail transit network, with light rail transit and streetcar tracks being laid all over the city. A reader interested in these developments is encouraged to contact either author or to look at web pages of Metro and its various partners.

SAFETEA-LU AND OREGON’S UNIVERSITY TRANSPORTATION CENTER

On August 10, 2005 the nation’s new transportation bill, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) was signed. This created 60 University Transportation Centers (UTCs) to “advance significant transportation research on critical national transportation issues and to expand the workforce of transportation professionals.” Research should be aimed at solving current problems as well as “advanced research,” and the education component is aimed at addressing the transportation workforce crisis in the U.S.

The act created several categories of UTCs, and the 10 largest ones are called National University Transportation Centers (other types include Regional, Tier I, Tier II and Transit). One of these is located at “Portland State University, in partnership with the University of Oregon, Oregon State University, and the Oregon Institute of Technology.” The total amount awarded will be $16 million with a dollar for dollar match requirement. To achieve the UTC goals, funds are used for Research, Education and Technology Transfer (in this context tech transfer means making transportation research results available to potential users in a form that can be implemented, utilized or otherwise applied). The bill also states that research and education must support the national strategy for surface transportation research identified in a document “Highway Research and Technology” and by the Federal Transit Administration’s research and technology programs.

The Oregon UTC is dedicated to: “stimulating and conducting collaborative multi-disciplinary research on multimodal surface transportation issues across all of Oregon and beyond; educating a diverse array of current practitioners and future leaders in the transportation field; and encouraging implementation of relevant research results through technology transfer.” Through collaboration and partnerships with transportation and industry, we focus on three themes: advanced technology, integration of transportation systems with land use planning, and healthy communities. So far we have identified nearly 100 faculty from about 24 departments at the four campuses who are interested in transportation research. We expect projects to be multidisciplinary and multi-campus. We envision our UTC to be student centered, and faculty driven, based on project initiation by faculty principal investigators and expansion of educational
programs by educators. The key thread that is woven through all of our activities is collaboration—we are statewide and plan for cross-discipline, cross-campus and cross-institutional collaborations with agency and industry partners. Portland State University, in partnership with the University of Oregon, Oregon State University and the Oregon Institute of Technology is committed to:

- Providing relevant research to assist local, state, and regional agencies in their work;
- Expanding the pool of highly talented students who choose to work in the area of transportation planning and engineering;
- Building upon our collective efforts to make Oregon a place where innovation, creativity, and collaboration lead to sustainable communities.

We are looking forward to working together to create a vibrant, multimodal, multidisciplinary university transportation center that is an exciting place for students to learn and be enriched by an active faculty and compelling research program.

THE COST OF CONGESTION

In December 2005, Metro, the Port of Portland and the Portland Business Alliance released a study, entitled “The Cost of Congestion,” (see http://www.metro-region.org/article.cfm?articleid=16673) to provide baseline information about the relationship between investments in transportation and the economy. The study was intended to serve as a springboard for discussions about planning for, and investing in, the region’s transportation system.

The study, which made extensive use of specific examples to illustrate the impact of congestion on businesses’ bottom lines, received widespread media coverage. For example:

- Intel has missed deliveries, which affects production lines across the globe.
- Providence Health Systems’ increased medical delivery times are resulting in a $1 million-to-$1.5 million relocation of warehousing and support operations.
- Portland General Electric is spending $500,000 a year for additional travel time for maintenance crews.

The Cost of Congestion report deliberately did not identify, much less endorse, specific projects. Nonetheless, in just a few months the report has stimulated extensive discourse, including a recent forum at the City Club, a prominent civic organization in Portland. In a city that is known for passionate debates about planning issues and transportation planning in particular, elevating the discussion is an important part of the planning process, especially when projections suggest that the current population of 1.3 million could swell by an additional million over the next 20 years.

MANAGING CONGESTION

As a designated Metropolitan Planning Organization in a region with at least 200,000 people (see Figure 1), Portland is required under federal transportation law, starting with ISTEA, to fulfill the requirements of the Congestion Management Process (CMP),
known prior to SAFETEA-LU as Congestion Management System (CMS). A CMS is “a systematic process for managing congestion that provides information on transportation system performance and on alternative strategies for alleviating congestion and enhancing mobility.” A CMS must have the following elements:

1. An ongoing method to monitor and evaluate the transportation system, identify the causes of congestion, identify and evaluate alternative actions, and evaluate the efficiency and effectiveness of implemented actions;
2. Defining parameters for measuring the extent of congestion and for supporting the evaluation of the effectiveness of congestion reduction and mobility enhancing strategies;
3. Establishing a program for data collection and system performance monitoring;
4. Identifying and evaluating the anticipated benefits of both traditional and non-traditional congestion management strategies;
5. Identifying an implementation schedule, implementation responsibilities, and possible funding sources for each strategy; and
6. Implementing a process for periodic assessment of the efficiency and effectiveness of implemented strategies, in terms of the area’s established performance measures.

Figure 1: Portland Regional Congestion Management Network
In Spring 2006, Metro completed a process of revamping its approach to meeting the CMP requirement. The “roadmap” product of this endeavor reflects recent trends and certain approaches or methods that have recently been promoted by FHWA and in the literature. One is a shift to planning-oriented performance measures and to the concept of reliability in particular. Another is the notion of “planning for operations,” which in this case means building closer ties between planning agencies such as the MPO and operating agencies such as the Oregon DOT and TriMet, the transit agency. The five specific areas comprising the roadmap include:

1. Measure transportation system performance
2. Identify the causes of congestion
3. Identify and evaluate alternative actions
4. Implement cost-effective solutions
5. Evaluate the efficiency and effectiveness of implemented actions

**Reliability and Other Communication-Friendly Performance Measures**

Recent transportation trends have revealed a nationwide shift towards understandable user-centric performance measures, such as reliability and travel time delay. Portland’s congestion management approach is focused on educating policy-makers in the MPO committee structure about congestion so that they can weigh it, among other major planning factors, during planning and programming decisions. This depends on quantitatively demonstrating the difference between recurrent and non-recurrent delay so that the MPO can prioritize the appropriate type of investment in each context.

PSU is the Portland region’s official ITS data archiving center. The PSU Intelligent Transportation Systems Lab has developed the Portland Oregon Regional Transportation Archive Listing (PORTAL, http://portal.its.pdx.edu) that archives the region’s freeway sensor data at a 20-second level. Several useful automated performance reports have been created that Metro will use in pursuit of the CMS roadmap. For example, Figure 2 shows a sample Portland Congestion Report produced for January 2006 that contains several standard performance measures such as the travel time index and the buffer index.

![Figure 2: Portland Congestion Report](attachment:image)
As another measure of regional freeway performance, travel times can also be tracked at particular points and over longer freeway segments. Using a user-oriented set of pull-down menus, specific locations, time periods and levels of aggregation can be selected. As an example, Figure 3 shows a sample for a segment of Interstate 5, covering a two month period in 2006 and showing the average travel time and +/- one standard deviation. This clearly shows that travel time not only increases during the peak period but its variability also increases.

![Travel Time Reliability Example](image)

**Figure 3: Travel Time Reliability Example**

![Travel Time and Congestion for Interstate 5](image)

**Figure 4: Travel Time and Congestion for Interstate 5**
At a larger scale, it is also possible to analyze congestion and travel time reliability of a much longer distance. Figure 4 shows a sample monthly travel time report for a 21-mile segment of northbound Interstate 5 during weekdays in April 2006. The figure shows the average travel time for the entire segment (green line) as well as the 95th percentile travel time (red line), as well as the frequency that a particular time interval was congested (blue vertical bars). As shown, during the morning and afternoon peak periods there is a sizable difference between the mean and the 95th percentile travel times, indicating that shippers or travelers must allow a large “buffer time” during these periods in order to arrive on time. Using a slightly different graphical format, Figure 5 illustrates the difference in travel time reliability for northbound Interstate 5 for an off peak time (10-11 am) and a peak time (5-6 pm).

Figure 5: Sample Travel Time Reliability Plot

The data archiving and analysis being done at PSU is integral to Metro’s approach to diagnosing congestion in the region. In turn, much of the ITS lab’s work is made possible by the investments that have been made in data collection technologies and communications infrastructure, namely the fiber optic network that connects PSU with the Oregon DOT, Portland DOT, TriMet and others.

Talking “TSMO” at the MPO

Diagnosing congestion and communicating with decision-makers about it is a fundamental element of the CMP. It is complemented by the duty of the MPO to develop transportation plans and capital programs that address the identified problems and opportunities. Because of fiscal limitations and, in Portland’s case, a land-use driven
planning philosophy, transportation agencies are turning increasingly to transportation system management and operations (TSMO) to solve congestion problems, especially in the near-term.

TSMO strategies, many of which are enhanced by advanced technologies (a.k.a., intelligent transportation systems or ITS), seek to optimize the performance of existing infrastructure. In Portland, familiar examples of current TSMO activities include incident response vehicles (ODOT), signal prioritization for transit vehicles (PDOT/TriMet), and real-time traveler information (i.e., www.tripcheck.com, www.trimet.org/arrivals/).

However, while MPOs are responsible for developing long-range plans and shorter-range capital programs, they rarely have authority to operating any aspect of the transportation system. Metro, as an example, can promote policies and programs in its Regional Transportation Plan and can prioritize certain capital investments in its Transportation Improvement Program (TIP) but it cannot change signal timing, dispatch motorist assistance trucks or reschedule bus routes.

Implementing the CMP roadmap, therefore, depends on the ability of Metro staff to work with counterparts at partner agencies such as Portland and Oregon departments of transportation to develop common goals. Fortunately, this culture of collaboration is particularly strong in Portland. In 2005, a consortium of ITS staff from various regional operating agencies was codified as a subcommittee of Metro’s Transportation Policy Alternatives Committee (TPAC), which occupies the role at the MPO often known in other regions as the technical advisory or planning committee. This committee, called TransPort, has been helping agencies in the region coordinate their ITS projects for over a decade.

TransPort received an infusion of support when Portland was awarded a grant from FHWA in 2005 to be one of three cities, along with Detroit and Tucson, to demonstrate the use of a Regional Concept of Transportation Operations, or RCTO. Another example of planning for operations, an RCTO involves developing a shared regional vision of transportation operations for a topic such as incident management as well as an implementation plan to help the region achieve that vision. In Portland, the first RCTO being developed covers traveler information: how to generate it and how to share it. As an example of the “culture of collaboration,” the grant was applied for collaboratively by PDOT, ODOT, TriMet and Metro; the position it funds is with the city and the person who occupies it works at Metro’s offices.

CONCLUSION

The transportation agencies in the Portland metropolitan area are embarking on an innovative process to improve congestion management through collaboration and benefiting from the use of real performance measures that inform the decision-making process. Through this transparent process lessons learned will be documented that we hope can be used as “best practice” examples for local jurisdictions and for other regions.