Saxton Transportation Operations Laboratory

Use of Archived Operations Data in Transportation Planning

Revised Scan of Current Practice

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Table of Contents

Introduction

This report documents the research team's scan of current uses of archived operations data in transportation planning at metropolitan planning organizations (MPOs) and State departments of transportation (DOTs). During this scan, the team focused on speaking to staff members at MPOs and State DOTs and reviewing online agency planning documentation to identify:

- the types of archived operations data available to planners,
- the extent to which that data was used in a variety of planning activities,
- the challenges they encountered with using archived operations data, and
- agencies' future directions regarding this practice.

This scan serves as the foundational step in the Federal Highway Administration's (FHWA) Saxton Transportation Operations Lab task, *Creation of Desk Reference and Workshops on How to Use Archived Operations Data for Metropolitan, Statewide, and Non-Metropolitan Transportation Planning*. The information gained from this scan will be used to enhance the research team's understanding of archived operations data in planning and motivate and inspire ideas for innovative uses of archived operations data in planning.

We spoke to staff from the following agencies regarding the use of archived operations data:

MPOs

- Baltimore Metropolitan Council (BMC)
- Capital District Transportation Committee (CDTC)
- Delaware Valley Regional Planning Commission (DVRPC)
- Houston-Galveston Area Council (H-GAC)
- Maricopa Association of Governments (MAG)
- Metropolitan Washington Council of Governments (MWCOG)
- Mid-America Regional Council (MARC)
- San Diego Association of Governments (SANDAG)

State DOTs

- Maryland State Highway Administration (MD SHA)
- New Jersey Department of Transportation (NJDOT)
- Oregon Department of Transportation (ODOT)
- Washington State Department of Transportation (WSDOT)

Cross-Cutting Findings

Archived Operations Data Used for Planning

The archived operations data available to the organizations interviewed includes volume and speed data on freeways in major metropolitan areas. The data is generally obtained through freeway loop detectors owned and operated by the State DOT and private sector probe data such as INRIX. Several organizations mentioned that they are shifting from INRIX to the FHWA National Performance Management Research Data Set (NPMRDS) containing HERE data. Organizations such as the Baltimore

Metropolitan Council (BMC), Maryland State Highway Administration (MD SHA), Delaware Valley Regional Planning Commission (DVRPC), Oregon DOT, and Washington State DOT have access to incident data through responder or TMC operator manual data entry. Many of the agencies do not feel that they have adequate arterial volume and speed data. MWCOG, MAG, MARC, and NJDOT have purchased speed data for their arterials. The use of archived transit operations data is rare among the agencies interviewed. DVRPC is one planning organization that uses operations data from several transit agencies. Several of the States on the East Coast participate in the I-95 Corridor Coalition's Vehicle Probe Project and access travel time data through that tool.

Planning Applications for Archived Operations Data

Setting outcome-based objectives or performance targets

Agencies that we spoke to typically indicated that they have not yet begun using archived operations data in the process of identifying reasonable performance targets and objectives. A couple of exceptions include, NJDOT and WSDOT. NJDOT used archived operations data to baseline performance measures related to delay and duration of congestion and then set targets. WSDOT has been using archived operations data for over a decade to set goals and targets as part of programs such as the Government Management Accountability and Performance (GMAP), Joint Operations Policy Statement (JOPS) and Moving Washington initiative. Another agency reported that it is working on setting targets but reported that it has only used modeled data thus far.

Identifying transportation needs and problems, e.g., safety, congestion, air quality

This is one of the most common uses of archived operations data among the agencies interviewed, particularly as part of the congestion management process (CMP) for MPOs. For example, BMC uses archived speed and travel time data from the Vehicle Probe Project Suite of analysis tools to identify bottlenecks in the region. This information is then mapped using GIS and layered with truck volumes and other data to provide a comprehensive view of high priority areas for projects or other investments. MWCOG uses archived operations data to identify the top 10 most unreliable highway segments as part of its CMP report. WSDOT uses a *Highway Segment Analysis Program* to identify locations on state highways where travel speeds fall below 70 percent of posted speed during peak periods.

Validation or calibration of existing analysis tools or models

Many of the MPOs interviewed reported that they use archived operations data to calibrate and/or validate their regional travel demand model. There was one or two instances in which the agencies reported that this data is used for another type of model or tool, including IDAS and microscopic and mesoscopic simulation models. Typically, a modeler was not part of the interview and so, the interviews did not go into detail on this topic.

Prioritization and selection of programs and projects

There are several more formal processes or tools that are in use among agencies interviewed that incorporate archived operations data in the prioritization of projects. We found examples at the WSDOT, MAG, and Maryland SHA. WSDOT developed in 2000 and updated in 2009 its Mobility Project Prioritization Process with a spreadsheet tool that uses archived operations data inputs to help estimate the benefits and costs of a project element. Additionally, MAG uses archived operations data and model

data to perform benefit-cost analysis that focus on congestion impacts when rebalancing or re-prioritizing the projects that have been planned for implementation in its regional transportation plan. MAG also uses a sketch-level CMP tool to prioritize projects for CMAQ funds. Maryland SHA uses archived operations data in simulation models to analyze and select bottleneck improvement alternatives.

Evaluating the impacts of implemented programs and projects

There were several examples of archived operations data used to assess the effects of a project or program particularly congestion mitigation activities. This practice appeared to be most common among the State DOTS. WSDOT regularly conducts before and after studies of congestion mitigation projects or programs typically with loop detector data and then provides the results either quarterly as part of the Gray Notebook or in the Annual Congestion Reports. They also use data collected through automatic license plate recognition (ALPR) technology, Bluetooth, and BlueToad to perform before-after analysis. WSDOT recently reported on the effects of tolling operations, active traffic management, its incident response program, and the I-405 Corridor Improvement Program. MD SHA completed a comprehensive before-after study to understand the regional mobility and reliability impacts of the InterCounty Connector (ICC), an 18-mile, six-lane tolled highway that connects the I-270 and I-95 corridors.

Planning to handle non-recurring events, e.g., evacuations, planned special events, TIM

The interviews uncovered few examples of the use of archived operations data in planning for non-recurring events such as game day events, presidential visit, processions, evacuations, etc. BMC's incident management committee reviews incident response data and performance measures to identify areas for improvement. WSDOT looks at traffic and safety data to identify areas for improvement and uses incident response data to manage the efficient operations of its incident response program. DVRPC used probe data to calibrate a microsimulation model for evacuation planning with the City of Philadelphia.

Monitoring and reporting on transportation system performance

As anticipated, the most common use of archived operations data among the agencies interviewed was to report out measures on the performance of the transportation system. The performance measures that relied on archived operations data included travel time, delay, travel time index, planning time index, percent of arterials/freeways congested, and incident clearance time. MAG and Kansas City Scout, a joint highway operations program of the Missouri and Kansas DOTs, have performance dashboards that show historical operational performance of the transportation system using color-coded maps, graphs, and tables. The reporting of system performance was an important part of each MPOs' congestion management process typically displayed in a CMP report or in the MTP. MD SHA publishes the annual *Maryland State Highway Mobility Report*, which summarizes the state of transportation and the outcomes of policies, programs, and projects on congestion and reliability.

Tools to Support Use of Archived Operations Data in Planning

Nearly all the organizations interviewed were using or developing a tool to assist them in analyzing and visualizing the archived operations data they accessed.

Several of the agencies interviewed used the I-95 Corridor Coalition's Vehicle Probe Project (VPP) Suite, tools that agencies can use to develop summary reports and graphics based on the VPP data. The VPP, a collaborative effort between the Coalition and the University of Maryland, provides participating agencies access to archived operations data, with a contract to use data from INRIX for the first phase. The VPP provides travel speed and congestion data throughout the states along the I-95 corridor, from New Jersey to Florida. Agencies who participate in the VPP have access to a monitoring site, real-time data feed, a data archive, and the VPP Suite.[1]

Another archived data tool that several agencies use is the Regional Integrated Transportation Information System (RITIS), provided through the University of Maryland's Center for Advanced Transportation Technology (CATT) Laboratory. RITIS is "an automated data sharing, dissemination, and archiving system" that fuses operations data from multiple agencies. RITIS is composed of three main components: real-time data feeds, real-time situational awareness tools, and archived data analysis tools. The archived data analysis tools allow participating agencies to "query, analyze, and derive performance measures from the RITIS archive." Archived data can also be downloaded as raw data for agencies to analyze using in-house tools.[2]

SANDAG and other California MPOs use the California Freeway Performance Measurement System (PeMS) which has an extensive network of over 25,000 traffic detectors across the state highway network that is used in regional planning efforts. The data SANDAG can obtain from PeMS includes traffic volumes and speeds. PeMS data is displayed on maps and available through an interactive website. SANDAG has worked with Caltrans to expand PeMS to include an arterial and corridor module.

The New Jersey DOT uses its own congestion management system in combination with the VPP Suite. The Oregon DOT uses Portland State University's "Portal," an ITS Archived Data User Service for the Portland-Vancouver metropolitan region. This provides ODOT access to traffic counts, speed, occupancy, incident, weather, transit and freight data. WSDOT and CDTC are each developing their own versions of tools to store and/or analyze data.

MD SHA uses the VPP Suite along with its traffic count databases and maps congestion, reliability, and incident information with projects, programs, and asset information in an enterprise GIS framework. This helps the agency understand gaps and identify opportunities for more informed performance-based planning.

Barriers

While the MPOs and State DOTs in this scan made use of archived operations data in planning, they still reported several challenges or barriers that they faced in this effort. Below is a list of the primary barriers mentioned by the organizations:

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[1] I-95 Corridor Coalition Vehicle Probe Project. Oct 2013. Accessible at: http://www.i95coalition.org/i95/Portals/0/Public_Files/uploaded/Vehicle-Probe/One%20Pager-VPP-VPP%20Suite-10jan2013-Final.pdf.

[2] University of Maryland CATT Lab, "RITIS." Accessible at: http://www.cattlab.umd.edu/?portfolio=ritis

Staff time and technical expertise to analyze the very large sets of raw data. There is often more data than is needed for planning and distilling the data down into information that can inform investment decisions is a time-intensive process. Some agencies have begun using tools to summarize the data.

Integrating the available data sets which are in various formats and differing temporal and spatial resolutions. Agencies need help in the integration of these datasets into a meaningful analysis platform that ties the data together when and where appropriate—helping to correlate the cause and effect of various things. One agency mentioned that it was a challenge to integrate INRIX data with its other data because of the difficulty in shifting from the "traffic message channel" (TMC) format into a GIS layer.

Comparing performance results based on data from different data providers or sources. There are systematic differences in data collection methods between data providers and this can lead to a loss of confidence in comparisons between performance measures over time if data providers or collection methodology changes. At the Metropolitan Washington Council of Governments (MWCOG), the CMP report for 2012 has two distinct lists of top 10 bottlenecks based on INRIX probe data and Skycomp aerial photo surveys. MWCOG was also unsure how the new FHWA data from HERE.com would compare with their previously purchased INRIX data. This is echoed by other State DOTs as well. A related challenge is related to understanding how to interpret changes in performance results in the context of many outside influences including the economy, gas prices, land development, and other factors. This is particularly difficult when making before and after comparisons for project evaluations.

Obtaining fine-grained arterial data that supports arterial strategies such as signal timing. In general, MPOs and State DOTs did not have adequate coverage of arterials in their systems. In addition, at least one MPO noted that it was not able to use INRIX data on arterials for examining signal timing changes because it was not specific enough. Operations strategies are often implemented on a scale that is smaller than what archived operations data can support.

NJDOT has purchased INRIX data for arterials but there are unresolved issues related to decisionmaking with arterial data, for example, determining which of the multiple speed curves to use (high, low, or average).

Shifting the Role of Archived Operations Data from Informing to Influencing Investment Decisions. The use of archived operations data in actually supporting or leading to investment decisions was often indirect although WSDOT uses archived operations data along with other information in making key investment decisions. At MWCOG, there is a cross-check that occurs between highly congested locations and proposed project locations to ensure that it is addressing the areas of most need. The notion of using archived operations to justify investments in not uncommon, but it is unclear whether investment decisions would actually change as a result of this information. The agencies interviewed did not appear to use performance data to develop concepts for projects. In some instances, location of congestion was a factor in evaluating or assigning scores for projects. Many agencies reported that they looked to more closely connect archived operations data with planning and programming decisions in the near future. Changing this process appears to be a challenge for several agencies.

Future Directions

Based on our conversations with several MPOs and State DOTs who are some of the leaders in the U.S. in the use of archived operations data for planning, we identified the following directions for future advancements in this area:

- Advancing tools to store, integrate, analyze, and visualize multiple sets of archived operations data. Planners increasingly have access to large volumes of operations data that need to be processed, quality-checked, and analyzed in order to be of value in the planning process. MPOs and State DOTs are now building, acquiring, or enhancing tools that will allow them to make sense of this data. For example, the Washington State DOT is in the process of developing Digital Roadway Interactive Visualization and Evaluation Network Applications (DRIVE Net), an online data storage, analysis, and visualization tool that will provide the planners with the information that they need for their analysis. The Capital District Transportation Commission (CDTC) in New York is currently using a consultant to develop a tool to assist in the analysis of archived data that will allow the users to specify certain conditions (e.g., traffic speed below 50 miles per hour) and receive instances of those conditions.

- Expanding access and analysis of multi-modal data to overlay bike and pedestrian counts and transit operational performance data. Many of the MPOs and State DOTs we spoke with mentioned that they see archived operations data moving into alternative modes. Having access to archived bike or pedestrian counts and transit speeds, would enable agencies to advance in several important aspects of planning. It would support SANDAG's planning for integrated corridor management and MD SHA's development of person throughput policies and evaluation tools. The Mid-America Regional Council (MARC) noted that the Kansas City region is not primarily focused on congestion issues and has begun bike and pedestrian counts to support its multimodal goals. The Delaware Valley Regional Planning Commission (DVRPC) overlays multimodal data on its CMP analysis maps. WSDOT reports on the bike and pedestrian safety through it quarterly performance report called Gray Notebook. WSDOT is now expanding through its DRIVE Net platform to collect and process pedestrian data using the mobile devices' Media Access Control (MAC) addresses and re-identifying them to trace the pedestrian trajectory. This work is in a beta phase.

- Near-term integrated corridor management (ICM) planning. The interviewees at MWCOG saw a lot of potential for the use of archived operations data in the more short-term planning for ICM. In addition, SANDAG is working with Caltrans to develop C-PeMS, a new module for PeMS, the state's archived operations data source and analysis tool, which focuses on corridor-level planning.
- Use of archived operations data to baseline activity-based models and calibrate mesoscopic and microscopic models. SANDAG plans to use its archived operations data to baseline its upcoming activity-based model and other organizations mentioned the use of data to support mesoscopic and microscopic modeling.
- Increased use of origin-destination data to produce reliability performance measures.

- Tracking data at the lane level to evaluate/analyze lane-based management strategies such as HOV/HOT lanes.

Case Studies

Baltimore Metropolitan Council

Overview

The Baltimore Metropolitan Council (BMC) represents Baltimore City and five surrounding counties in Maryland: Anne Arundel, Baltimore, Carroll, Harford, and Howard. The region is home to a population of over 2.5 million and is the 19th largest market in the U.S.[3] In addition, Baltimore is among the top 20 most congested regions in the country in terms of total delay, planning time index, and total truck delay.[4]

Like many other MPO and DOT planners interviewed, the staff of the BMC did not seem to have many concerns with data quality from operations data sources. There were concerns with some agencies being less willing to provide data for various reasons, but overall there was trust in the data and/or an appreciation for what the data enabled the MPO to do. BMC was particularly interested in finding better ways to acquire signal systems data and transit information. They were noted that their use of operations data has grown with the advent of new tools that afford easier access and advanced reporting functionality.

Archived Operations Data

BMC relies on two primary sources for archived travel time and speed data – INRIX data, provided through the VPP Suite, and data from travel time runs. Acquiring the more ubiquitous INRIX data has saved BMC approximately 4,000 miles of driving time spent performing the travel time runs, although they do still collect data both ways. BMC also conducts aerial surveys through SkyComp, and collects traffic counts from various sources, including the Maryland State Highway Administration (MD SHA), to support their Congestion Management Process (CMP). Other archived operations data BMC uses to support planning include incident data collected by CHART and made available through RITIS, Maryland statewide police accident records provided through the MAARS database, and signal re-timing information from MD SHA.

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[3] Baltimore Metropolitan Council, "About the Region." Feb 2013. Accessible at: http://www.baltometro.org/about-the-region/about-the-region.

[4] Texas Transportation Institute, *2012 Urban Mobility Report.* Dec 2012. Accessible at: http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/mobility-report-2012.pdf.

Table 1. Highlights of operations data available to BMC.

Data Type	Data Source	Who Collects the Data	Format (and issues with data format or quality)	Planning Activity Supported
Volume	Traffic Counts	BMC, MD SHA		• Populate travel demand model • Calibration for evacuation model
	BMC travel demand model			• Calibration for evacuation model
Speed	Travel times, Private sector (INRIX)	I-95 Corridor Coalition/ University of Maryland	Would like higher temporal and spatial resolution from sensors and probe data	• Bottleneck reports • CMP • Project programming
	Travel times and speeds. GPS travel time runs	BMC		• Planning studies • Project prioritization • Model calibration • CMP[5]
Incidents	RITIS			• Performance tracking
	Responder statistics	CHART		• Performance tracking
Signals	Number of re-timed signals and resulting air quality benefits	MD SHA		• Attainment Report

Planning Activities Using Archived Operations Data

Identifying transportation needs and problems, e.g., safety, congestion, air quality

BMC uses archived speed and travel time data from the VPP Suite along with travel time runs to identify bottlenecks in the region. They use GIS to overlay this information with locations where projects are being programmed for funds in order to justify the projects to elected officials. They can also overlay data on truck volumes, and other information to create a comprehensive view of high priority locations in the region. Recently, the agency has looked into overlaying information on pedestrian safety campaign corridors, where resources have been deployed in high pedestrian crash locations, as well as identifying local activity corridors with heavy truck volumes and commodity flows.

[5] Baltimore Regional Transportation Board, *Congestion Management Process for the Baltimore Region*. Accessible at: http://www.baltometro.org/downloadables/CMP/CMP_BaltimoreRegion.pdf.

Validation or calibration of existing analysis tools or models
Travel times, speed data, and traffic counts are used to calibrate and validate their travel demand model. Volume data derived from this model is also used to drive a regional evacuation model developed by the University of Maryland.

Prioritization and selection of programs and projects
BMC uses travel time and speed data to evaluate and rank projects for incorporation into the long range plan. This is accomplished through a combination of analysis performed using the VPP Suite's bottleneck ranking and user delay cost tools.

Planning to handle non-recurring events, e.g., evacuations, planned special events, TIM
BMC uses incident data available through RITIS to analyze TIM-related performance measures such as incident clearance time and roadway clearance time. They also analyze responder statistics, though these data only include incidents for which a CHART team has responded. They work with their regional TIM committee to identify ways to improve TIM Operations through post-incident discussions and analysis of archived operations data. For example, the committee discovered the fatal incidents take the longest to clear, and therefore the region could have the most to gain from finding ways to improve response to these incidents in particular. This does not yet directly feed into the planning process, though it does shed light on which TIM strategies may be most valuable to program into future plans.

Monitoring and reporting on transportation system performance
BMC uses archived operations data to develop Quarterly Congestion Analysis Reports identifying the top ten bottleneck locations in the region. Probe data from the VPP Suite is used to generate these reports, with contiguous segments flagged as a potential bottleneck if reported speeds fall below 60 percent of the reference speed for longer than 5-minutes.[6]

Use of Tools to Analyze and/or Visualize Archived Operations Data
BMC gets visualizes and analyzes operations data from tools embedded within RITIS, including the VPP Suite, the Incident Cluster Explorer, etc. Additional tools, like in-house GIS, are also used to summarize and visualize data.

Challenges or Barriers to Use of Archived Operations Data

One of the challenges BMC faces is collecting operations data from some agencies or operations groups. Traffic signal data has been elusive for a variety of technical and institutional reasons. They noted that it may be helpful for an upper-level manager to stress the importance of archiving and sharing operations data so that staff can more clearly see the value.

BMC – as well as other agencies in the region – are also limited in terms of staff resources. Staff does not necessarily have the time or technical expertise to process raw data. RITIS and the VPP Suite have been

[6] Baltimore Metropolitan Council, *Quarterly Congestion Analysis Report for the Baltimore Region – Top 10 Bottleneck Locations, 3rd Quarter 2013.* Accessible at: http://www.baltometro.org/downloadables/CMP/CMP_Congestion_2013Q3.pdf.

extremely helpful in streamlining this process as opposed to requiring each agency in the region to have specialized staff to process the data.

Lastly, BMC's travel demand model staff currently relies on traffic counts for populating the travel demand model, both those collected by BMC and by MD SHA. While ITS detectors collect continuous data, these sensors are usually only on major freeways and are not necessarily maintained well. Other, more trustworthy counts are performed only once every couple of years. Interviewees noted that it would be helpful to have more up-to-date operations data for incorporation into the model.

Ideas for Future Advancement of this Practice

The BMC interviewees noted several additional types of archived operations data they would like to access for planning purposes:

- Incident Data – It would be helpful to have an incident database that reflects all incidents that occur in the region, not just those for which a CHART team has responded. In addition, a more automated way to record and store information about activity at an incident would improve the robustness and reliability of the incident data.
- Volume Data – BMC has been looking into acquiring more volume data from signal controllers and private sector providers for use in their evacuation model.
- Signal System Data – Several partner agencies have sophisticated traffic signal controllers that could provide data through cameras, advanced detection systems, and other equipment. There is a huge opportunity to tap into this data resource to analyze the effectiveness of signal timing plans in the region, as well as to be used in other planning activities.
- Origin-Destination Data – Information on the trips travelers are making at specific times of day would be valuable, especially for calibrating the travel demand model. It would also be useful to gather origin-destination information from truck owner/operators for the purposes of freight planning, as the Baltimore region experiences significant truck travel. It was noted that the I-95 Corridor Coalition is in the process of procuring real-time origin-destination data for use by operations staff and planners. BMC is excited about the possibilities that this dataset may provide.
- Transit Data – Passenger counts, ridership, and other transit data would be useful for informing the travel demand model as well as for analyzing how many travelers shift modes during major incidents, weather events, etc., and how that impacts congestion. This data would also be helpful for meeting impending MAP-21 reporting requirements for multimodal performance measures.

As they expand their access to as much archived operations data as possible, BMC sees an opportunity to link these data together – freight, safety, transit, etc. – in order to more comprehensively analyze the system rather than focusing on only single modes or automobiles. In addition, having more data in place would allow the agency to better incorporate nonrecurring congestion into their planning process. This would allow them to more accurately identify projects targeted to address key issues in the region.

Additional References:

Interview, Baltimore Metropolitan Council, Eileen Singleton, Ed Stylc, Bala Akundi, November 22, 2013.

Capital District Transportation Committee

Overview

The Capital District Transportation Committee (CDTC) is the MPO for New York's Capital Region operating out of Albany, NY and representing four New York counties: Albany, Rensselaer, Saratoga, and Schenectady. The MPO's region has a population of approximately 840,000 people. CDTC's Policy Board of local elected officials and transportation agency representatives manage an annual staff budget of about $2,000,000.[7]

Archived Operations Data

CDTC maintains a summary of traffic volume data for Capital District roadways entitled the *Traffic Volume Report*. The *Traffic Volume Report* includes data for all state roadways and non-state roadways with functional classifications greater than local. CDTC collects data for this report through different mechanisms, including information on traffic counts from the MPO's member agencies and the New York State Department of Transportation's (NYSDOT) Management Information System for Transportation (MIST) dataset.[8]

Table 2. Highlights of operations data available to CDTC.

Data Type	Data Source	Who Collects the Data	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Volume	Traffic counts, Loop detectors	Local agencies		Performance measurement
	MIST, Loop detectors	New York State DOT	Limited to two major routes	Performance measurement, model improvement
Speed	MIST, HERE.com. GPS vehicle probes	HERE.com (provided by FHWA)		
Incidents	MIST, Crash reports, Crash report forms	New York State Department of Transportation		Identifying high-incident locations

Planning Activities Using Archived Operations Data

CDTC has found value in using archived operations data for identifying transportation needs and problems. Specifically, CDTC has access to the MIST dataset that provides volume, speed, and incident data along I-87 and I-90. CDTC has used the travel demand model to identify and quantify congestion problems. The model is focused on AM and PM peak hour traffic on a typical weekday. The MIST data provides a more comprehensive and accurate understanding of weekday congestion patterns on the Interstate system. For example, MIST data demonstrated that average operating speeds on the

[7] CDTC. *A Reference Guide to the Capital District Transportation Committee (CDTC)*, January 2013. Available at: http://www.cdtcmpo.org/guide.pdf

[8] CDTC. *CDTC Traffic Volume Report Data*, September 2011. Available at: http://www.cdtcmpo.org/tvr/tvrdes.htm

Interstate system, in the absence of incidents, were generally higher than predicted by the model. The Northway (I-87) had a similar amount of delay as I-90, but the MIST data indicated that reliability was worse on the Northway, consistent with a popular perception that the Northway has worse congestion. The MIST data also highlighted that congestion was especially bad on Fridays in the summer, when vacation travel mixes with commuter travel. This perspective was overlooked by focusing on typical PM peak hour data. MIST data allows the MPO to understand and weigh the costs and benefits of investments to address non-recurring and recurring delay. It contributed to CDTC establishing a strong priority for operations and incident management and a strong policy in the congestion management process and RTP that expressways in the region will not be widened to address congestion except in the context of managed lanes.

CDTC has used archived operations data to better understand their travel demand model. Comparing the outputs from their model with the archived data, CDTC learned that their models were not as accurate in predicting delay as they had believed. CDTC intends to use archived data to improve these models.

The significant performance measures tracked by CDTC are: hours of delay, excess delay (number of hours at a level of service of E or less), and planning time index. The planning time index was developed by the Texas Transportation Institute and represents a ratio of driving time on one of the slowest traffic days to driving at 55 miles per hour. To monitor and track performance, CDTC supplements its own data with data from the New York State DOT's MIST. The table below highlights performance measures that are tracked by CDTC:

Table 3: Transportation Service Core Measures[9]

Access	• Percent of PM Peak Hour Trips Transit Accessible • Percent of PM Peak Hour Trips with Transit Advantage • Percent of PM Peak Hour Trips Accessible by Bicycle • Percent of PM Peak Hour Trips Accessible by Walking
Accessibility	• Travel Time between Representative Locations by Quickest Mode
Congestion	• PM Peak Hour Recurring Excess Person Hours of Delay • Excess Person Hours of Peak Hour Delay per PMT x 1,000 • Excess Person Hours of Peak Hour Delay per Person x 1,000
Flexibility	• Reserve capacity on the Urban Expressway and Arterial System (PM Peak Hour Vehicle Miles of Capacity)
Community Quality of Life	• Subjective measure evaluated at regional, corridor and project level scales

[9] FHWA. *Placing the Congestion Management Process in the Context of Metropolitan Transportation Planning Goals and Objectives: CDTC*, April 2009. Available at: http://www.ops.fhwa.dot.gov/publications/fhwahop09043/fhwahop09043.pdf

Use of Tools to Analyze and/or Visualize Archived Operations Data

The CDTC MPO has contracted with a consultant to develop a tool to assist in the analysis of archived operations data. A previous challenge to analyzing the data was that the MIST dataset was large and consisted of many unlinked tables within the database. Conducting analysis was a labor-intensive process requiring coordination between many of these different tables to understand the data. The new tool facilitates the analysis by allowing the users to specify certain conditions (e.g., traffic speed less than 50 miles per hours on a specific section of roadway), and the tool will be able to output the instances of the conditions. The MPO does not have specific tools that visualize the archived operations data.

Challenges or Barriers to Use of Archived Operations Data

As noted above, CDTC's main challenge in using archived operations data for transportation planning was the combination of lack of staff and labor-intensive nature of the analysis. The completion of the analysis tool should help alleviate some of this challenge.

Ideas for Future Advancement of this Practice

CDTC staff indicated that they do have access to granular data (e.g., the HERE.com probe data), but a significant challenge for the MPO is to find time for staff to analyze the data. Any tools or methods to facilitate the analysis of archived operations data would be very useful to the MPO.

Further, analysis that CDTC currently completes using archived operations data is mostly limited to the major highways in the region. Historically, this limitation is due in part to the availability of data, but the MPO would like to expand their use of archived operations data to the principal arterials.

Finally, the CDTC staff believe that archived operations data has the potential to strengthen the relationship between planning and operations. A challenge is the lack of a feedback loop between planner or designers and those in operations. For example, if a facility is built and is not functioning the way the planners or designer had anticipated, it would be useful to have data to understand any potential issues and resolve future, similar issues in the design or planning phases. Planners and designers will discuss anecdotal stories highlighting the operation of different facilities when reviewing long term strategies and activities, but these stories are not necessarily supported by data and rather based on field experience. CDTC believes it would be beneficial to integrate the data more into the planning process to support longer term planning.

Additional References:

Interview, CDTC, Chris O'Neill and Sreekumar Nampoothiri, November 18, 2013.

FHWA. *Toolbox for Regional Policy Analysis Report. Case Study: Albany, New York,* 2000. Available at: http://www.fhwa.dot.gov/planning/processes/tools/toolbox/albany/.

Delaware Valley Regional Planning Commission

Overview

The Delaware Valley Regional Planning Commission (DVRPC) is the metropolitan planning organization for the greater Philadelphia region. The region is home to over 5 million people and is the 5th largest region in the U.S., according to the 2010 U.S. Census.[10] It covers five counties in Pennsylvania (Bucks, Chester, Delaware, Montgomery, and Philadelphia), four counties in New Jersey (Burlington, Camden, Gloucester, and Mercer), and 352 municipalities. The DVRPC region is the ninth most congested in terms of yearly delay per auto commuter (48 hours of delay per commuter, per year), and the seventh most congested in terms of overall travel delay.[11] The most congested freeway miles in the region are along the major routes into and out of the City of Philadelphia.[12]

DVRPC utilizes multiple types of archived operations data and overlays it to create a comprehensive view of multi-modal issues in the region for the purposes of identifying high priority locations for projects. The MPO also employs several tools for managing, visualizing and publishing the data to share their regional perspective with agency partners and to better communicate to decisionmakers the need for transportations investments in specific areas.

Archived Operations Data

DVRPC has access to the following archived operations data:

- For speed data, the MPO uses the I-95 Corridor Coalition VPP Suite, which contains INRIX vehicle probe data and additional data sets.
- DVRPC collects transit schedules and ridership information from regional transit agencies such as New Jersey Transit, Southeastern Pennsylvania Transportation Authority (SEPTA), and the Port Authority Transit Corporation.
- For incident data, DVRPC can access both New Jersey and Pennsylvania incident databases through their RIMIS (Regional Integrated Multimodal Information Sharing) System. Pennsylvania's database, which is fed into RIMIS through a data interface, includes the Road Condition Reporting System (RCRS), an incident database managed by PennDOT. Other incident data included in RIMIS is entered manually by traffic operations center (TOC) staff at NJDOT or other city or county staff.[13]

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[10] U.S. Census Bureau, "Metropolitan Statistical Areas With More Than 750,000 Persons in 2010 – Population by Age: 2010," *Population, Estimates and Projections—States, Metropolitan Areas, Cities*. 2012. Accessible at: http://www.census.gov/compendia/statab/cats/population/estimates_and_projections--states_metropolitan_areas_cities.html.

[11] Texas Transportation Institute, *2012 Urban Mobility Report.* Dec 2012. Accessible at: http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/mobility-report-2012.pdf.

[12] Delaware Valley Regional Planning Commission, *Is Congestion Getting Worse?* Accessible at: http://www.dvrpc.org/TrackingProgress/pdf/TR_Congestion.pdf.

[13] Delaware Valley Regional Planning Commission, *Using Operations Data for Planning in the Delaware Valley: First Steps*. Aug 2011. Accessible at: http://www.dvrpc.org/reports/11049.pdf.

Table 4. Highlights of operations data available to DVRPC.

Data Type	Data Source	Who Collects the Data	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Volume	DVRPC	DVRPC collects counts at over 5,000 locations per year		
	ITS sensors (RIMIS)	DVRPC, Traffic.com, NJDOT, and others		
Speed	VPP	INRIX, though I-95 Corridor Coalition		
	ITS sensors (RIMIS)	DVRPC, Traffic.com, NJDOT, and others		
	BlueTOAD, Bluetooth Sensors, and tube classification counts	DVRPC		
	Dynac, ITS sensors	PennDOT	Only accessible for previous 3 months	
Incidents	NJDOT incident data entered manually, PennDOT incident data available through a data interface to RIMIS	NJDOT, PennDOT, DVRPC, County and Municipal TOCs and Emergency Management Agencies (EMA)		
	Data entered manually by municipal and county TOC and EMA staff into RIMIS	NJDOT, PennDOT, DVRPC, County and Municipal TOC's and Emergency Management Agencies (EMA)		
Construction Activity and Special Events	NJDOT construction data entered manually, PennDOT construction data available through a data interface to RIMIS	NJDOT, PennDOT, DVRPC, County and Municipal TOC's and Emergency Management Agencies (EMA)		
	Data entered manually by municipal and county TOC and EMA staff into RIMIS	NJDOT, PennDOT, DVRPC, County and Municipal TOC's and Emergency Management Agencies (EMA)		
Transit	Vehicle counts, passenger counts	NJ Transit, SEPTA, PATCO		• Transit signal priority

				project • Signal re-timing • CMP
Bike/ Pedestrian	Counts	DVRPC		

Planning Activities Using Archived Operations Data

DVRPC uses archived operations data to understand and evaluate conditions in the short, medium-, and long-term. For example, DVRPC uses archived data to plan for signal re-timing (short-term planning), identify the worst bottlenecks in the region (medium-term planning), and identify and track performance measures (long-term planning).[14]

Identifying transportation needs and problems, e.g., safety, congestion, air quality

Both INRIX data and incident data are used to help identify heavily congested and/or high accident locations. Tools like RIMIS and the VPP Suite are sometimes leveraged for this type of analysis. In-house GIS and graphics staff are also heavily utilized to help produce web-based interactive maps and infographics to communicate transportation issues and problems.

Prioritization and selection of programs and projects

DVPRC uses archived operations data as a basis for corridor studies. They would like to formalize the processes by which the data are used for project prioritization and selection, especially for regional signal re-timing and transit signal priority projects.

DVRPC is currently using archived transit data to identify areas to improve transit service, such as by providing more stops through signal optimization for transit. They are using speed and travel time data as well as transit operations data to evaluate alternatives to improve bus service along a corridor in Philadelphia.

The MPO also uses the results of the CMP, which is developed using archived operations data, as a basis for picking corridors for investment in ITS infrastructure through the Transportation Operations Master Plan. DVRPC uses the CMP as criteria for projects to be programmed in the Long Range Plan and has just begun to update their Transportation Improvement Plan (TIP) criteria to include the CMP as well.

Evaluating the impacts of implemented programs and projects

DVRPC staff have the ability to leverage archived INRIX data and accident, construction, and special event information through RIMIS or through GIS to analyze changes to traffic and safety conditions after projects are implemented.

Planning to handle non-recurring events, e.g., evacuations, planned special events, TIM

DVRPC was a sub-consultant on an evacuation planning effort for the City of Philadelphia. The project involved extracting a microsimulation model of the city center from DVRPC's travel demand model, and

[14] Neaderland, Zoe. *Use of Archived Operations Data by Regional Partners & DVRPC.* 2012.

then calibrating the model with the MPO's VPP data on arterials in the city. The model was used to analyze how to best evacuate buildings, which routes all modes would likely take, which intersections would cause major bottlenecks, and other factors that may impact efficient evacuation of the city during a major event.

Monitoring and reporting on transportation system performance

DVRPC uses archived operations data to track performance measures, which in turn allows them to justify funding different operations-related projects. In their current CMP they use one measure based on archived operations data: duration of congestion. For their next CMP, they plan to use data from the VPP Suite to generate three performance measures they anticipate are likely to become part of the MAP-21 reporting requirements: planning time index, duration of congestion, and annual hours of delay.

Use of Tools to Analyze and/or Visualize Archived Operations Data

DVRPC uses multiple tools to visualize and publish data so that they can better communicate high priority corridors in terms of congestion, crashes, and other factors, especially when coordinating with local partners. The MPO uses the tools available through the VPP Suite to conduct analysis and generate reports. DVRPC noted that though there are an increasing variety of sources of archived operations data available, the data from the VPP Suite is made available in an approachable format for planners. Much of the archived operations data from different agencies in the region originates in Excel tables. DVRPC merges this data with sensor data and VPP data and exports it into GIS to conduct analysis and generate graphics and reports. Unlike many other MPOs and agencies interviewed, DVRPC had a substantial GIS staff on site to help with more sophisticated analysis and visualization.

DVRPC also has Interactive Detour Route Mapping (IDRuM) through their website, which publishes via a web-based application all Pennsylvania and New Jersey DOT emergency detour routes in the region, and most New Jersey DOT routes outside of the region, into a single interface (www.idrum.us). In addition, the MPO has an in-house graphic design staff who develops infographics and other visuals and crash and congestion statistics to share with partner agencies, decision-makers, and the public.

Challenges or Barriers to Use of Archived Operations Data

DVRPC has experienced several challenges associated with archived operations data. For incident data, incident management task forces are corridor-based, so when the MPO wants to report incident data on a regional basis, they have to go through the non-standardized geospatial referencing of data and expend significant resources fusing data between the two states and cleaning up inconsistencies. It would be beneficial to be able to standardize how incident data is reported and geo-referenced across all corridors and agencies in order to gain an accurate regional picture.

In addition, incident data can be difficult to analyze due to issues with standardization of terminology. For example, incident duration, clearance times, and other data may be entered differently depending on the agency, and NJDOT and PennDOT – DVRPC's two primary resources for incident data – do not necessarily capture these data in the same way. DVRPC has considered crosschecking their incident data

against the police crash database, though this data lags by 6 months or more and does not contain municipality crash reports.

Because the DVRPC covers two states, inconsistent data reporting methods and formats is an issue DVRPC faces with other types of archived operations data as well. For example, some transit agencies have different data available than others, making it difficult to perform an analysis for the entire region. In addition, 3rd party probe data is complex to manage due to its size and also do to the fact that it is georeferenced using proprietary methods—called traffic message channel (TMC) codes, which can be challenging to overlay on agency GIS layers.

Another barrier to using archived operations data is the sheer amount of data that needs to be processed. The probe data for the DVRPC region amasses to nearly 3.4 billion records per year. Working with this data is extremely difficult without a series of powerful tools and hardware. This is a big reason why DVRPC puts a high value on the VPP Suite as it pre-processes, aggregates, and presents the information in a more digestible format for the agency. An example of how it aggregates data is by allowing a user to choose the time period (e.g. five-minute or one-hour interval) of data appropriate to the use.

Ideas for Future Advancement of this Practice

DVRPC felt that any movement towards standardization of performance measure definitions would be beneficial for encouraging agencies to collect and report operations data consistent manner. The MPO felt that additional areas that could help expand the use of archived operations data include:

- finding solutions to mapping TMC-based code data into agency GIS and resolving other problems with TMC codes such as changes in direction,
- continuing to refine how to summarize data at a corridor and regional level, and
- continuing to have improvements in analysis of arterial operations data.

In addition, one area that DVRPC would like to see as the focus of future research is how to model the impacts of changes in travel time, speed, or planning time on the future conditions.

Additional References:

Interview, DVRPC, Jesse Buerk, Sean Lawrence, Zoe Neaderland, and Laurie Matkowski, November 25, 2013.

Houston-Galveston Area Council (H-GAC)

Overview

The Houston-Galveston Area Council (H-GAC) houses the MPO for an eight-county region surrounding the City of Houston and serves more than six million people across 7,800 square miles.[15] H-GAC has access to various sources of real-time and archived operations data and is updating its congestion management process (CMP) to incorporate this data to support better long-term planning activities.

Archived Operations Data

H-GAC is moving forward in using the operational performance data available in the region. It has access to fairly extensive freeway data collected and used in real-time by TranStar, a multi-agency coalition and traffic management center (TMC) focused on the management and operation of the region's transportation system. The region has a network of toll tag readers that collect speed and travel time data on freeways and toll roads. The Texas Department of Transportation (TxDOT) is in the process of replacing the toll-tag readers on its freeways with Bluetooth readers because they provide comparable data collection capabilities at a significantly lower cost.

H-GAC has faced more challenges in measuring arterial performance than freeway performance. The City of Houston has implemented Bluetooth readers on a 60-square-mile test section on its arterial system to capture arterial speeds. The City has been approved for funding through H-GAC to deploy Bluetooth readers across the remainder of its arterial network. Several other communities have also implemented Bluetooth readers on several arterials in the region, but not to the extent of the City of Houston.

H-GAC has also purchased 2009 travel time and speed data from INRIX to help assess system performance. H-GAC has been working with the Texas A&M Transportation Institute (TTI) to conflate the INRIX data with H-GAC's modeling network, which would assist in validation of travel speed for the model. However, discrepancies in both networks have needed to be overcome in order to properly merge the two datasets. TTI is nearing completion of this merging effort and will be integrating 2012 data as well. This will allow for a before-after review of how specific projects implemented between 2009 and 2012 may have impacted travel times and speeds.

H-GAC has access to traffic count data that mostly comes from TxDOT. TxDOT usually collects 5-year saturation counts with tubes. This is the primary count source for H-GAC's travel demand model, and it is provided to H-GAC at no cost. However, a location's count is only registered for a single 24-hour period. Any construction, incident, or counter malfunction will not result in a second attempt to collect a count. It would be cost-prohibitive to conduct a continual, comprehensive count program with a road network as extensive as the Houston-Galveston area, with over 36,000 network links. The City of Houston has restarted its traffic count collection efforts, but even with a city of 650 square miles, count collections on streets cannot be conducted annually.

[15] H-GAC Website. December 2013, accessible at: http://www.h-gac.com/home/default.aspx

Table 5. Highlights of operations data available to H-GAC.

Data Type	Data Source	Who Collects the Data	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Speed	Automatic Vehicle Identification (AVI) – toll tag readers on freeways	TxDOT/TTI/TranStar	Toll tag readers are much more expensive than Bluetooth	
	Bluetooth	TxDOT/City of Houston/Other Cities/TTI/Houston TranStar	Bluetooth predominantly being researched for arterial implementation. Certain times of day may have limited reads on arterials.	
	INRIX (Includes arterials)	INRIX	Segmentation of the INRIX network does not necessarily align with the travel demand model.	
Volume	5-year saturation counts with tubes; arterial counts	TxDOT, local agencies	Accuracy issues with loops and tubes. High cost of count collection due to region's size.	
Transit		Regional Transit Authorities		

Planning Activities Using Archived Operations Data

Validation or calibration of existing analysis tools or models

H-GAC has assessed archived data to investigate travel time reliability and has discovered higher variability in afternoon travel than the concentrated morning peak period. The agency attributes this finding to greater flexibility in afternoon departure times and to the fact that travelers equipped with traffic information may be adjusting their departure time to account for current conditions.

The modeling group at H-GAC has used the data from TranStar (toll-tag readers and other detectors) to and INRIX to validate the speed data in its models for freeways and arterials, respectively.

Prioritization and selection of programs and projects

The use of data in evaluating management and operations strategies in the planning process has been limited thus far. In early 2012, H-GAC made its first attempt to quantitatively evaluate some of its ITS project submissions to the transportation improvement program through the ITS Deployment Analysis System (IDAS). H-GAC worked to evaluate several ITS components in IDAS, including traffic signal system improvements, CCTVs, and dynamic message board installations, among others, but had difficulty with the process and obtained some results that were not plausible. H-GAC staff had to be somewhat creative in incorporating updated technologies and strategic in entering these inputs into the IDAS model for more plausible results.

Evaluating the impacts of implemented programs and projects

H-GAC is not currently using archived operations data to prioritize congested locations or projects. Existing plans to update the CMP will focus more on utilizing system performance data as part of the prioritization process. As mentioned, H-GAC will be looking at the INRIX data to potentially identify before-after impacts of project implementations. While some pertinent information may be gathered from this exercise, results could be impacted by variables that may not be project-related. For example, the economic downturn and recovery fall within the 2009-2012 period may have influenced both safety and mobility metrics. Better post-implementation evaluation is a key target of the current modifications planned for the CMP.

Planning to handle non-recurring events, e.g., evacuations, planned special events, TIM

H-GAC has not used archived operations data to handle non-recurring events as part of regular planning activities. However, local entities, such as the City of Houston, Harris County, TxDOT, and the METRO Transit Authority utilize the data for their own incident management operations. H-GAC has been involved in developing a regional incident management program for the Houston-Galveston region, which has involved utilizing this dataset and deriving potential programming based on the information available. If a regional incident management program is to be implemented, these incident-related data will be used for program monitoring and assessment to determine future needs.

H-GAC has worked with operations data to learn about how the timing of evacuation decisions affects traffic patterns. Evacuations are difficult to model because destinations are often unknown and may change en-route. In addition, other factors can play into an evacuation, such as the impact Hurricane Katrina had on Hurricane Rita's evacuation over a month later. Archived operations data was used to identify issues related to the both the Hurricane Rita and Hurricane Ike evacuations. It was found that government evacuation announcements were not coordinated with employer early dismissals, which appeared to have created a dual-wave of overlapping evacuation traffic. A potential planning solution would be to arrange for only essential personnel to come to work during anticipated regional evacuation events.

Monitoring and reporting on transportation system performance

Much of the data collected on the performance of the transportation system is used for real-time management and operation of the system by TranStar at the TMC and for providing traveler information on the public website. This data is archived and used to a lesser extent for monitoring performance measures and objectives. H-GAC is reviewing options for conducting performance reporting through the

now-available datasets. Houston TranStar produces an annual report that documents measures of annual average incident clearance time, changes in measured congestion, and traveler use of information.

Use of Tools to Analyze and/or Visualize Archived Operations Data

TTI calculates the travel time index and planning time index for the region using the toll tag reader and Bluetooth data. This data is calculated and fed into a color-coded speed map (see Figure 1) that displays system performance. This map is used for real-time monitoring and incident management at the Houston TranStar Control Room and for public dissemination on the Houston TranStar website.

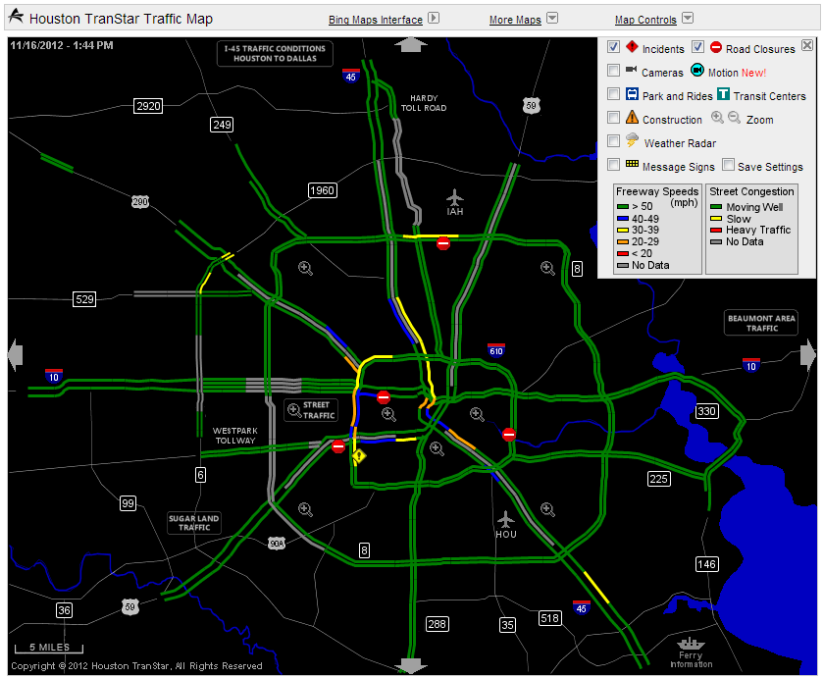


Figure 1. Houston TranStar Color-Coded Traffic Map. [16]

Challenges or Barriers to Use of Archived Operations Data

H-GAC has encountered several barriers when trying to use data for planning for operations. H-GAC's travel time and speed data are predominantly generated by toll tag readers on the freeway and toll road system, which are too expensive to implement throughout their region of about 8,000 square miles. H-GAC is looking to replace this infrastructure with Bluetooth readers, which are much more affordable.

Furthermore, traffic count data provided by 5-year saturation counts conducted by TxDOT is not accurate enough for operations and planning activities. The City of Houston is investing in a WiMAX network to provide a communication link to its 2,500 intersections that might supplement this data, but expanding this region-wide could prove too expensive to be feasible.

[16] Houston TranStar, Real-Time Traffic Map. Available at: http://traffic.houstontranstar.org/layers/.

Finally, H-GAC does not have an arterial data collection system and currently relies on INRIX data that does not always line up with modeling needs, although it can be interpolated well enough for model validation.

Ideas for Future Advancement of this Practice

Upon completion of the CMP update and installation of a large network of Bluetooth readers, H-GAC anticipates that it will be better able to incorporate both real-time and archived operations data into its planning process.

Additional References:

Interview, H-GAC, Jeff Kaufman, November 21, 2013

Maricopa Association of Governments

Overview

The Maricopa Association of Governments (MAG) uses archived operations data in at least three significant aspects of planning: prioritization of projects and scenarios for programming; calibration and validation of MAG's travel demand model and microsimulation tools; and monitoring and reporting on system and corridor performance to the public. The primary sources of archived operations data for MAG are the Arizona Department of Transportation's Freeway Management System (FMS) data and private sector probe data purchased from INRIX and Nokia. Of note is MAG's Congestion Management Process Tool which is a spreadsheet-based sketch tool that uses archived operations data to inform the selection of projects for CMAQ funds. A performance-based spreadsheet evaluative tool has also been developed and has applied to project selection for the Transportation Alternatives (TA) funding program.

MAG has gone through an evolution in its use of archived operations data over the past decade. Initially, it focused on using archived operations data to validate and calibrate its travel demand model and generally inform investments. It has moved to a much stronger linkage between data and investment decisions. This has been driven at least partially by their unique regional transportation plan, an associated half-cent sales tax that funds much of the plan, and a legislatively-mandated audit every 5 years. The existing RTP was first developed in 2003/2004 at the same time as the ½ cent sales tax was approved for the region. As part of the sales tax proposition, the RTP needed to clearly lay out what expenditures and programs were planned for a 20-year cycle. The subsequent rebalancing of the RTP programs has been supported by the use of archived operations data. The audits have also moved MAG toward a more data-driven prioritization process, and the public's expectations to be kept informed on the outcomes of their investments have led to the development of a web-based performance dashboard that uses archived operations data.

Archived Operations Data

The primary sources of archived data used at MAG come from the Arizona DOT's (AZDOT) Freeway Management System (FMS) and private sector probe data. The AZDOT FMS data provides volume, speeds, and vehicle classification, but only for approximately 40 percent of the freeway system. The private sector-purchased data provides speeds for the entire system of freeways and arterials, but does not provide volumes. MAG has purchased data for the last 3 years.

Table 6. Highlights of operations data available to MAG.

Data Type	Data Source	Who Collects the Data	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Classification	AZDOT FMS – loop detectors	AZDOT	Covers only 40% of freeway lane miles	Model Calibration, Validation, Baseline ABM, Scenario Planning, Program Rebalancing, Project Evaluation and Ranking
Volume	AZDOT FMS Counts	AZDOT	Covers only 40% of freeway lane miles	Performance Management, Model Calibration, Scenario Planning, Program rebalancing, CMP, Project Evaluation and Ranking.
	Counts	Local Agencies		Same as above.
Speed	AZDOT FMS	AZDOT	Covers only 40% of freeway lane miles	Same as above.
	Private Sector Purchased Probe Data	INRIX, Nokia	Supplements data on freeways from AZDOT FMS and covers arterials. Only provides speed and not volume.	Same as above.

Planning Activities Using Archived Operations Data

Setting outcome-based objectives or performance targets

One of the early uses of archived operations data for planning at MAG was to serve as a framework for identifying the goals and objectives of the RTP. In anticipation of MAP-21 rulemaking, MAG is exploring a set of proposed performance targets linked to RTP goals and objectives. MAG has initiated working sessions with AZDOT representatives to develop targets that meet state level expectations while reflecting unique MPO-level goals and objectives. Reliability and mobility measures are being considered, with targets being defined as maximum values expected in proportion to increases in supply and demand measures on the transportation system.

Validation or calibration of existing analysis tools or models

The archived operations data from the private sector probes and the AZDOT FMS is used to support modeling at MAG. There are thirteen modelers on staff at MAG with two staff members focused on microsimulation modeling. Archived operations data is used in an extensive process to calibrate and

validate the region's travel demand model. Additionally, archived operations data is being used to develop baselines for MAG's forthcoming Activity Based Model (ABM). MAG began using microsimulation models approximately 2 years ago, primarily for studies in the region. Archived operations data is also used to support MAG's microsimulation modeling.

Prioritization and selection of programs and projects

Archived operations data is used at MAG for rebalancing the lifecycle programs in the RTP and funded through the ½ cent sales tax. Additionally, MAG uses the data through a sketch-level CMP tool to prioritize projects for Federal funding such as through the CMAQ program. A performance-based spreadsheet evaluative tool has also been developed and has been applied to project selection for the Transportation Alternatives (TA) funding program.

When MAG has a need to rebalance or reprioritize the projects that have already been allocated to the multiple phases of the RTP's lifecycle programs, MAG uses archived operations data as well as model data to support quantitative performance measures, which are used for analysis of multiple rebalancing scenarios. The scenarios include different prioritizations of projects to be implemented up to the RTP original horizon year, 2026. Rebalancing was performed in 2010 and 2012 for the freeway program. MAG used the AZDOT FMS data for the first rebalancing and supplemented the data with private sector probe data for the second rebalancing effort. The analysis focused mainly on congestion, travel time, and cost-benefit, and was intended to give policymakers relevant information to select a scenario that would provide for the most optimal use of funds for the remainder of the plan.

MAG also uses archived operations data to support the prioritization of congestion management strategies and projects through its CMP sketch-planning tool. The spreadsheet-based tool guides users in applying both quantitative and qualitative criteria to assess strategy and project effectiveness and rank projects. This is primarily done for projects funded through the CMAQ program at MAG. The tool was developed to link a framework of performance measures that was collaboratively developed by member agencies to project selection. MAG had to rely primarily on qualitative information for bike and pedestrian projects, but it is now starting to collect bike counts so that it can use more quantitative data in the next selection cycle.

Monitoring and reporting on transportation system performance

See Use of Tools to Analyze and/or Visualize Archived Operations Data.

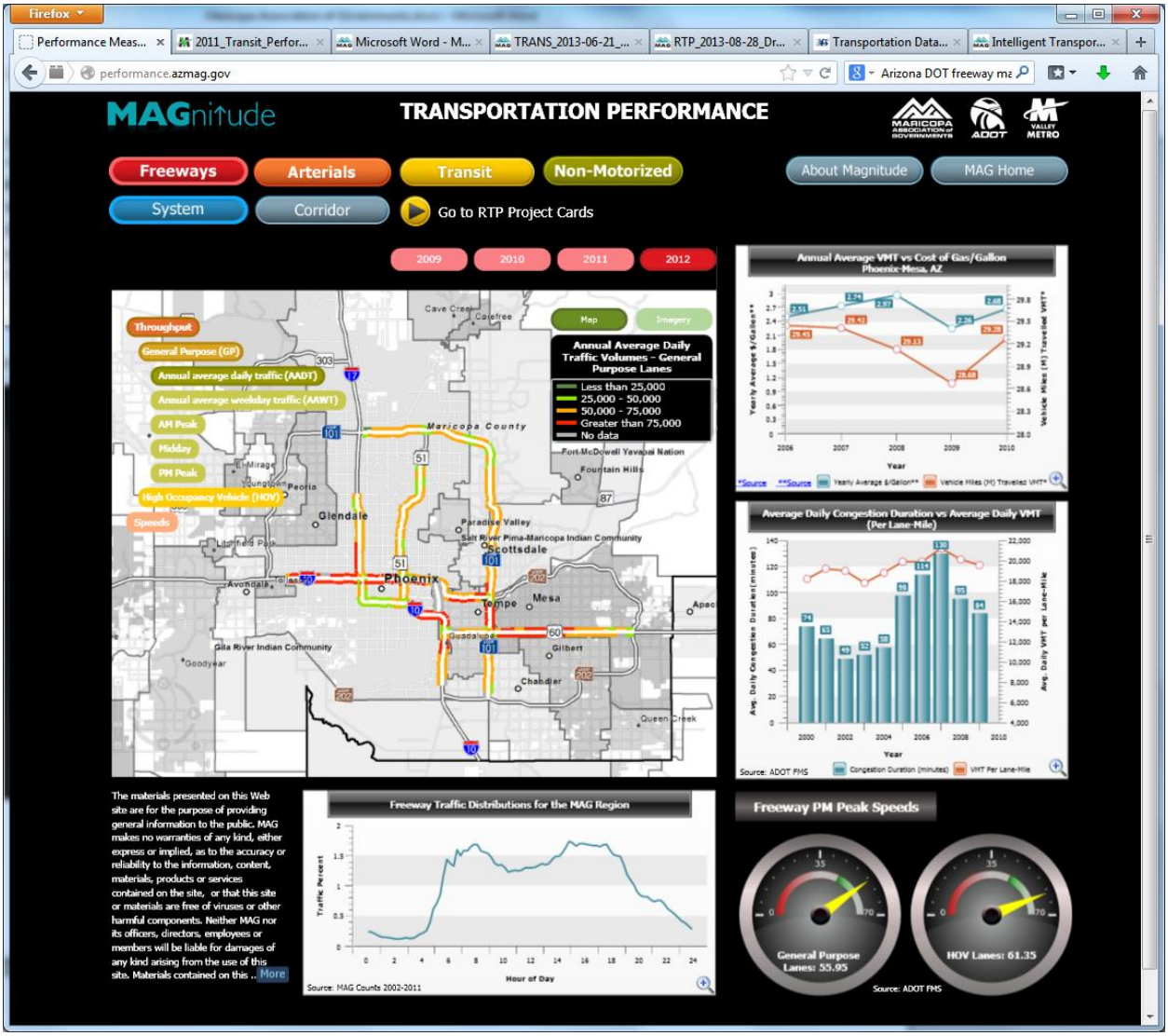


Figure 2. MAG's interactive performance dashboard developed in partnership with AZDTO and Valley Metro.

Use of Tools to Analyze and/or Visualize Archived Operations Data

One of the recommendations from the State-mandated 2011 RTP Performance Audit was to create tools that would allow policy makers, agency officials and the general public to understand the performance outcomes on the transportation system. In 2012, MAG developed an interactive performance dashboard that easily allows the public to see the various multi-modal performance outcomes at the system and corridor levels. The dashboard, called MAGnitude, is supported through a partnership between AZDOT, MAG, and Valley Metro. It provides delay, congestion, volume, speed, and other measures on a map-based interface that can be tailored to specific corridors or system-wide. Users can look at data each year from 2009 to 2012 on maps, bar charts, and line graphs. Archived AZDOT FMS data, MAG counts, and private sector probe data fuel the website.

Challenges or Barriers to Use of Archived Operations Data

One of the challenges sited by MAG in using archived operations data is the extensive quality control process that is necessary to ensure a high degree of confidence in the data. To handle errors or quality

issues in the data due to loop detector and counter inconsistencies, blackout periods, and other malfunctions, MAG has developed data reduction, fusion and summary methodologies that include five degrees of quality assurance, including graphics and visual checks to get optimized quality results. The largest barrier to this process is the limited staff resources to handle the large quantities of data.

Ideas for Future Advancement of this Practice

MAG looks forward to continuing and advancing its practice in using archived operations data for programming and anticipates further applications to formulate programs and policies. MAG is also interested in adding real-time data to its dashboard, including non-recurring congestion, incidents, events and bottleneck analysis as well as the integration of weather data.

Additional References:

Interview, MAG, Monique de los Rios-Urban, December 3, 2013.

Maryland State Highway Administration

Overview

The Maryland State Highway Administration (MD SHA) is the division of the Maryland DOT that maintains the State's highways outside of Baltimore City. The population of Maryland is almost 5.9 million, and it is the fifth most densely populated state in the U.S.[17] In 2012, motorists travelling on MD SHA-maintained freeways and expressways on weekdays experience 35 million hours of total delay and consumed 29 million gallons of extra fuel due to congestion, which equates to approximately $1.27 billion of congestion-related costs.[18]

MD SHA's data collection program is comprised of both private sector and public sector data to evaluate existing projects and programs and identify short-term and long-term improvements. It applies multiple analysis and visualization tools to "tell a story" with archived operations data that clearly communicates the need for projects and outcomes of implementation in high priority locations.

Archived Operations Data

MD SHA gathers archived operations data from multiple sources:

- The state's ATMS platform, called CHART, collects detailed incident and event data in real-time. This same system also collects speed and volume data from deployed ITS sensors; road weather information systems data; construction and lane closure information; Virtual Weigh Station data; and other ITS-related information
- In addition to ATMS-collected data, MD SHA collects other vehicle classification, volume, and speed data from traffic counts, floating car runs, and automatic traffic recorders. These data are housed in the agency servers and publically accessible through the MD SHA Internet-Traffic Monitoring System (I-TMS) website. Data housed in the traffic count databases is collected through a uniform process for the whole network for FHWA HPMS requirements. Traffic data is also collected on a project by project basis.
- Probe-based speed and travel time data is purchased from INRIX and accessed through the UMD VPP Suite.
- For arterials and lower functional class roadways, MD SHA also obtains volume data and truck classification data.
- There is also Bluetooth coverage for speed data along certain segments of the MD SHA network, including I-270, which has high-occupancy vehicle (HOV) lanes.

All of the above mentioned incident, volume, speed, and ITS device data is fused and archived through RITIS and MD SHA systems.

[17] U.S. Census Bureau

[18] Maryland State Highway Administration, *2013 Maryland State Highway Mobility Report.* Sep 2013. Accessible at: http://www.roads.maryland.gov/OPPEN/2013_Maryland__Mobility.pdf.

Table 7. Highlights of operations data available to Maryland SHA.

Data Type	Data Source	Who Collects the Data	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Classification	I-TMS; Traffic counts, automatic traffic recorders	MD SHA		
Volume	CHART; Traffic counts, automatic traffic recorders	MD SHA		• Monitor/report congestion on arterials
Speed	INRIX - Probe	UMD-CATT Lab		• Calibrate models • Evaluate programs or projects
	Floating car runs	MD SHA		• Calibrate models
	Bluetooth	MD SHA		• Evaluate programs or projects
	I-TMS - Traffic counts, automatic traffic recorders	MD SHA		
Incidents	RITIS	UMD		• Identify transportation needs and problems

Planning Activities Using Archived Operations Data

Identifying transportation needs and problems, e.g., safety, congestion, air quality

MD SHA produces the *Maryland State Highway Annual Mobility Report* that relies heavily on archived operations data for reporting on the state of the MD SHA-maintained roadway network in terms of mobility and reliability, incident management and traveler information systems, multi-modalism and smart growth, and freight.[19] The intent of the report is to identify performance issues on the system and to serve as a short-term planning document. As part of this product, MD SHA develops statewide congestion, reliability, and bottleneck maps for freeways and expressways using speed probe data. It couples these maps with congestion maps for arterials. MD SHA does not currently develop reliability maps for arterials as data coverage on arterials for producing reliability measures is still evolving.

Validation or calibration of existing analysis tools or models

MD SHA uses probe-based speed data from INRIX and accessed through VPP Suite to calibrate their traffic simulation models, which serve as the basis for analyzing future scenarios for long-term planning. It also uses speed and traffic count data to calibrate existing conditions for travel demand models including the Maryland Statewide Transportation Model (MSTM).

On a segment basis, MD SHA calibrates their models to INRIX speed data accessed through the VPP Suite, and augments those data using floating car runs. Using the INRIX data for calibration has been a

[19] Maryland State Highway Administration, *2013 Maryland State Highway Mobility Report.* Sep 2013. Accessible at: http://www.roads.maryland.gov/OPPEN/2013_Maryland__Mobility.pdf.

major improvement over using solely floating car runs because the INRIX data accounts for both recurring and nonrecurring congestion, whereas floating car runs are not performed when there is a major incident.

Prioritization and selection of programs and projects

Through the process of developing the Mobility Report, MD SHA generates a ranked list of the most congested and unreliable segments on the system. It then looks into the sources of congestion or unreliability on the segments by accessing incident logs and other archived congestion data through RITIS. This then initiates the planning process, which focuses on both short-term and long-term projects.

For short-term projects, MD SHA uses archived operations data in simulation models to analyze bottleneck improvement alternatives, such as adding an auxiliary lane, extending an acceleration/deceleration lane, etc. The idea is that MD SHA can continue to implement these short-term projects to provide temporary relief while it continues to plan for long-term improvements.

For long-term projects, MD SHA uses archived operations data for feasibility studies to explore different alternatives that could improve operations in 20-25 years. It uses their MD Statewide Transportation Model to estimate future travel demand. Existing data and future forecasts are used in a benefit-cost/ lifecycle analysis context looking at congestion, reliability, and safety savings as well as capital and operations and maintenance costs for a project over its lifecycle. MD SHA would like to further expand their use of archived operations data for long-term decision-making to use it to the same extent it does for planning short-term projects.

Evaluating the impacts of implemented programs and projects

MD SHA uses archived operations data to conduct before-after studies of projects. For example, it recently completed a comprehensive before-after study of travel time savings and reliability improvements associated with the opening of the Intercounty Connector (ICC) in November 2011, which showed that drivers using the ICC saved more than 50 percent in travel time compared to alternative routes.[20] Traffic operations on parallel facilities have also improved due to diversion of traffic to the ICC, resulting in 5-15 percent savings in travel time.

MD SHA uses archived Bluetooth data to evaluate the performance of the HOV lanes versus the general purpose lanes on I-270.

Monitoring and reporting on transportation system performance

MD SHA uses reports derived from archived operations data to communicate congestion issues to decision-makers and to the public. The congestion and reliability maps generated as part of the Mobility Report and through the VPP Suite have served as a valuable tool for communications and outreach in telling a more comprehensive story about the state of the system. MD SHA noted that people tend to relate to the reliability maps in particular because they reflect the worst travel experience that many have experienced and remember.

[20] Maryland Transportation Authority, "Intercounty Connector (ICC)/MD 200 Saving Time." Accessible at: http://www.mdta.maryland.gov/ICC/Saving_Time.html.

Use of Tools to Analyze and/or Visualize Archived Operations Data

MD SHA uses variety of tools to analyze and visualize data, including the tools available through the I-TMS, RITIS, and the VPP Suite. The latter allows them to do corridor-level congestion and reliability analysis and to generate countywide or statewide congestion maps for the Mobility Report. MD SHA also uses the MD Statewide Transportation Model and partners with BMC and MWCOG to visualize future scenarios using archived operations data. The agency applies an Enterprise GIS suite of tools to layer operations-derived mobility and reliability data with the location of projects and ITS assets, safety data, and other information to make more informed planning decisions.

MD SHA noted that having multiple tools has not been a challenge because the base data for most analysis and visualization comes from a single source: Congestion = INRIX and Incident = CHART, and data translates easily between the tools. MD SHA feels that it has a comprehensive data set to build upon, and having a suite of tools allows it to answer a wider variety of questions than it would be able to with just one tool.

Challenges or Barriers to Use of Archived Operations Data

Even though MD SHA feels that the current data it collects is thorough, it identified several ways in which it is limited. MD SHA would like to know more about how confidence scores are calculated in the probe data, as some people question its accuracy. It would also like to understand more about the different types of vehicles on the roadway and to be able to track area-wide features as opposed to just one corridor (e.g., all freeways at a specific time of day). For speed data, INRIX data does not track congestion at the lane level, which would be helpful for planning and short-term geometric improvements. Bluetooth data can sometimes reflect individual lanes, though this coverage is not nearly as broad. Lastly, arterial data is very limited compared with freeway data. Signal systems data has been nearly impossible to garner due to limited field communications and constraints of existing systems and processes

Other barriers to using archived operations data for planning are related to institutional learning processes. The shift from “building your way out” of congestion to focusing on reliability and extracting more efficiency out of the existing network is a cultural change in the industry that will take time. However, having archived data to back up analyses and support the need for this change will be helpful.

Ideas for Future Advancement of this Practice

MD SHA would like to access several additional types of archived operations data in the future to advance their planning activities:

- Transit Data – Some jurisdictions in the state are looking to develop bus rapid transit (BRT) with dedicated bus lanes in some parts of the corridor, and transit data such as person throughput measures, transit reliability, and travel time would be helpful for evaluating alternatives for the agency.

- Origin-Destination Travel Time Data – MD SHA has multiple datasets to calculate segment-level travel speeds, but data on the travel time from point A to point B, including understanding of the percentage of drivers traveling from one area to another area, would be helpful for generating trip based reliability measures, understanding the effects of traveler information, and planning for development. This would be especially helpful for conveying the impact of certain projects to both the public and decision-makers.

- Arterial Data – Currently arterial coverage is not as abundant as highway coverage. This field is still evolving, but being able to collect data on the length and times of queues at traffic signals from a loop detector or camera feed, for example, would be helpful for determining whether timing plans need to be updated. There are still significant concerns over how accurate probe data is for arterials.

In addition to expanding the types of archived operations data MD SHA can use, having guidance developed on standard operating procedures for using archived operations data for planning so it can be done more consistently across timeline and facilities is needed. MD SHA believes it needs to conduct internal education and outreach to emphasize the importance of shifting the conversation about congestion from mobility to reliability – both automobile reliability and freight reliability.

Looking ahead, MD SHA would like to develop a suite of modeling tools to identify and implement optimum signal timing plans, ATM, ATDM and ICM plans based off of recently archived data.

Additional References:

Interview, MD SHA, Subrat Mahapatra, November 27, 2013.

Mid-America Regional Council

Overview

The Mid-America Regional Council (MARC) is the metropolitan planning organization for the bi-state Kansas City region. Its member agencies include nine counties and 119 cities and is governed by a board of local elected officials. As a council of governments, its responsibilities include developing regional plans for transportation, the environment, emergency response and more.[21] The population of the region is approximately 1.9 million.[22]

MARC's most prevalent use of archived operations data has been in the development of transportation system performance reports including a periodic travel time studies and an annual performance measures progress report. MARC has primarily relied on historic traffic flow data from INRIX purchased for 2010 and 2012. MARC also has access to the operations data collected by the ITS instrumentation on the highways. MARC is now moving to use of the NPMRDS HERE data supplied by FHWA.

Archived Operations Data

The archived operations data used by MARC primary consists of the INRIX speed data purchased for the years of 2010 and 2012. MARC received the data from INRIX packaged in "time period data bins containing average speed reports in one-hour time intervals for a full week" for each road segment. Additionally, MARC received the 85th percentile of all the speeds collected for the road link during the entire year. These were used to calculate travel time index (TTI), planning time index (PTI), and buffer time index.

MARC has access to archived operations data collected by the KC Scout Vehicle Detection Stations that monitor over 100 miles of highways across the Missouri-Kansas bi-state region. MARC typically utilizes the Congestion Index Reports and other performance summaries provided by KC Scout rather than the archived operations data.

[21] MARC, What is MARC? Available at: http://marc.org/About-MARC/General-Information/What-is-MARC.aspx.
[22] 2010 U.S. Census.

Table 8. Highlights of operations data available to MARC.

Data Type	Data Source	Who Collects the Data	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Classification	Traffic Counters	Local Agencies		
Volume	KC Scout Vehicle Detection Station	KC Scout		
	Counts	Local Agencies		
Speed	INRIX – probes and existing permanent detectors	INRIX		
	HERE/NPMRDS	HERE/Nokia		
Occupancy	KC Scout Vehicle Detection Station	KC Scout		
Incidents	KC Scout TMC Operators (?)	KC Scout		

Planning Activities Using Archived Operations Data

MARC is about to begin the update to its metropolitan transportation plan and will be updating its congestion management process in the next few months. As part of this process, MARC will be looking at how to increasingly incorporate the use of operations data. MARC is also looking to shift from purchasing archived INRIX data to the use of the NPMRDS/Nokia-Here data.

Identifying transportation needs and problems, e.g., safety, congestion, air quality

MARC uses the INRIX data and local data to identify locations of congestion and bottlenecks. This is particularly evident in the Regional Travel Time Study reports produced by MARC. Congestion levels determined through archived operations data is used to determine if justification exists for increasing capacity.

MARC has also purchased bike and pedestrian counting equipment and stores bike/pedestrian counts in a data portal. These counts are used by local agencies to support bike and pedestrian planning.

Validation or calibration of existing analysis tools or models

Although the archived operations data has not been used to support MARC's regional travel demand model, the INRIX archived speed data was used by the Missouri DOT to validate the mesoscopic model used in the Kansas City region for the Interstate 70 Second Tier Environmental Impact Study. MARC would like to use archived speed data to fully validate their travel demand model but it is currently not a top priority for the MPO.

Evaluating the impacts of implemented programs and projects

MARC attempted to use INRIX data from 2010 to conduct an evaluation of Operation Green Light, but had difficulty drawing any conclusions because the INRIX data was not specific enough. When looking at changes due to signal re-timing projects, MARC is looking at very small scale changes.

Monitoring and reporting on transportation system performance

MARC uses archived speed data from INRIX on freeways and arterials to track performance measures identified in its metropolitan transportation plan. Each year, MARC provides a performance report to the public on its website to track several measures on congestion, accessibility, air quality, and other areas of importance for the region.[23] MARC reports on the following measures to track mobility:

- Average travel speed (mph) on highways
- Percent of urban roadways congested
- Annual hours of delay per auto commuter

Additionally, MARC recently released the 2013 Regional Travel Time Study that compares the two years (2010 and 2012) of archived speed data from INRIX to illustrate changes in congestion and identification of bottlenecks for the public.

Use of Tools to Analyze and/or Visualize Archived Operations Data

KC Scout, a partnership between the Missouri DOT and Kansas DOT, provides the region with an interactive dashboard which allows the user to select a date and period of time in the past and "play out" on a map the traffic volumes, speeds, travel times, incidents, roadwork, and planned events.

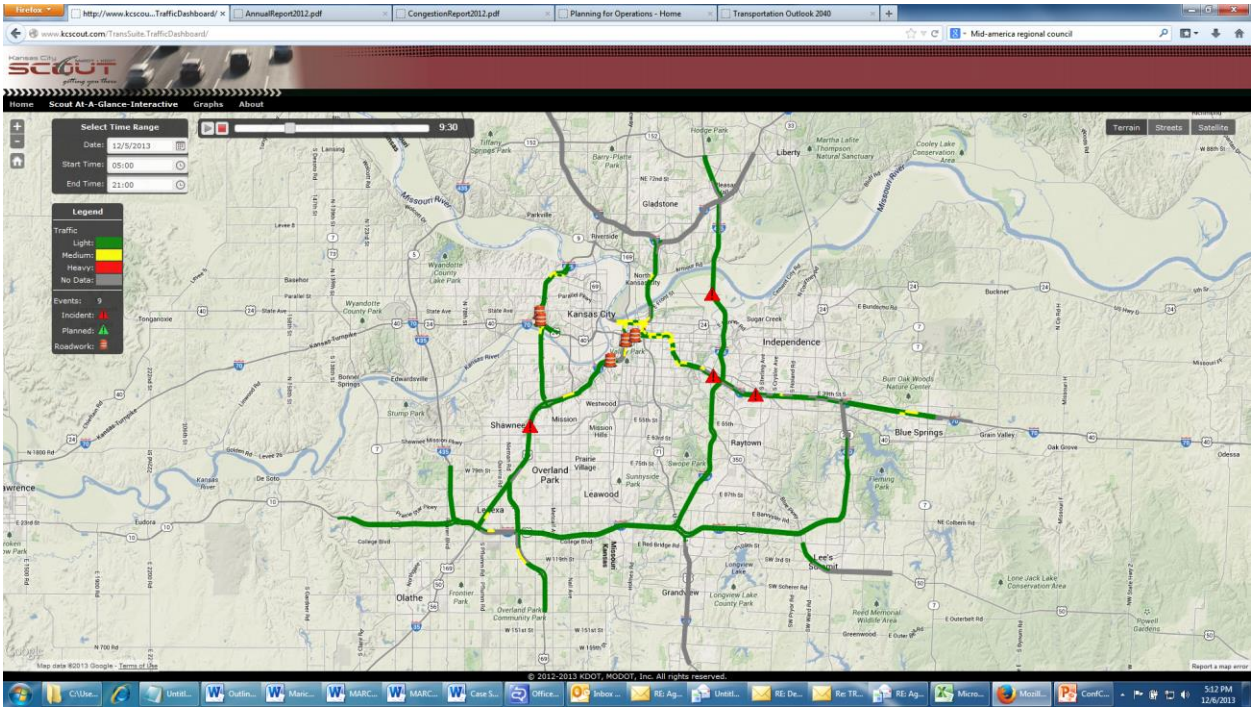


Figure 3. Kansas City Scout traffic dashboard.

[23] MARC, Transportation Outlook 2040, Performance Measures Progress Report, June 2013. Available at: http://www.to2040.org/assets/PerformanceMeasures_ProgressReport_June2013.pdf

Challenges or Barriers to Use of Archived Operations Data

MARC's challenges to using archived operations data in planning include the technical skills required for MPO staff to work with such detailed data and the ability for MARC to store and manage the data. MARC also needs more frequent data on arterials. The instrumentation for collecting data on the arterials is lacking in the region.

Ideas for Future Advancement of this Practice

Since auto congestion is not the most important performance focus in the region, MARC would like to also have more widespread count data on bicycles and pedestrians. MARC reports that the region does not experience widespread or systemic congestion and other goal areas are just as important, if not more important to the region. Transit data is collected through AVL systems by transit operators in the region, but MARC does not have that data. It would like to be able to produce a performance measure that compares auto and transit travel times.

Additional References:

Interview, MARC, Jim Hubbell, Ray Webb, Barry Viss, and Stephen Lachky, November 25, 2013.

New Jersey Department of Transportation

Overview

New Jersey, as the most densely populated state in the U.S.,[24] has a diverse transportation infrastructure that supports a significant freight industry along will businesses, housing, and recreation. The State experiences almost a million person-hours of delay every day, which translates to $2.6 billion of annual congested-related costs and $272 million in wasted fuel annually.[25]

Archived Operations Data

INRIX data provided through the VPP Suite serves as NJDOT's primary source of archived operations speed data on both freeways and arterials. Additionally, NJDOT maintains a Congestion Management System (CMS), a customized FoxPro/dBase application that has sophisticated business logic and modeling capabilities for developing various analytical data at different geographic scales. NJDOT uses the CMS as a base tool and supplements it with additional data to identify discrete congested "hot spots" and congested commuter and recreational corridors, and to analyze potential improvement strategies. The agency also uses the CMS to develop a capital investment strategy document that goes to the State legislature each year to show how and where transportation funds need to be spent to address issues on the network.

NJDOT also collects archived operations data from OpenReach, the traveler information platform for the state. OpenReach shows data on incidents, construction, and other events, and provides access to cameras, which can be used to observe traffic patterns within specific project hours. NJDOT can also access incident and construction data through RITIS, which provides more advanced visualization capabilities than OpenReach and allows for mapping of archived incident data (e.g., heat maps, clusters, event-specific).

Table 9. Highlights of operations data available to NJDOT.

Data Type	Data Source	Who Collects the Data	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Volume	Counts from permanent counting stations, temporary counts (e.g., tubes or manual intersection counts), or similar count data	MPOs		

[24] U.S. Census Bureau, 2011.

[25] Allen, John, "Using Archived Operations Data for Planning Purposes." May 18, 2012. Accessible at: http://www.njtpa.org/getattachment/43a4fd77-df21-472e-a31e-89187527e3ee/Using-Archived-Operations-Data-for-Planning-Purpos.aspx.

Speed	INRIX Probe Data	RITIS/UMD CATT Lab	Extremely large files.	• Identify high priority locations for projects • Evaluate Projects • Performance Reporting
Incidents	OpenReach - Electronic data feeds	RITIS – 511NY		Identification of recurring vs. non-recurring congestion. Understanding cause of congestion.
	OpenReach (NJDOT ATMS) – Operator input[26]	TMC	Lack of visualization capabilities	Identification of recurring vs. non-recurring congestion. Understanding cause of congestion.

Planning Activities Using Archived Operations Data

Use of Tools to Analyze and/or Visualize Archived Operations Data

NJDOT uses the visualization and analysis tools available through the VPP Suite, RITIS, and OpenReach to analyze and visualize data. They also output the data into their own GIS and export graphics from the VPP Suite, RITIS, or their own GIS into PowerPoint or other documents to develop summary reports and graphics for project-related purposes.

Identifying transportation needs and problems (e.g., safety, congestion, air quality) and prioritizing and selecting programs and projects

NJDOT uses archived operations data from the VPP Suite to identify congestion-related problems on the State highway network, which may lead to the development or problem statements. They also use the VPP Suite to evaluate projects already in concept development to help decide their priority within the project delivery process.[27]

Evaluating the impacts of implemented programs and project

The agency's current focus is on programming relatively low-cost, yet effective projects such as intersection improvements and re-striping, as well as strategies intended to maximize the efficiency of the existing network, such as integrated corridor management. NJDOT uses the VPP Suite to conduct before-after studies of the effectiveness and return on investment of implemented projects, specifically low-cost, short-term improvements. There are also efforts underway to develop standardized before-after project assessment evaluations.

Monitoring and reporting on transportation system performance

NJDOT has made very limited use of archived operations data from TRANSMIT travel time systems to report on performance through *Centerline*, a semi-annual report that tracks congestion-related measures such as incidents and travel times.[28] Performance measures are also reported in NJDOT's

[26] Confirmation needed with NJDOT traffic operations group regarding information in in this row.
[27] Allen, John, "Using Archived Operations for Planning Purposes." Feb 2012.
[28] New Jersey Department of Transportation, *Centerline*, Aug 2010. Accessible at: http://www.state.nj.us/transportation/about/asset/pdf/centerline0810.pdf.

Tactical-Level Asset Management Plan, which provides the strategic framework, context, and guidance for capital program decision-making.[29] The agency is looking to develop a protocol for system performance reporting on a regular basis, though they do not yet have a definitive path forward in this area.

Challenges or Barriers to Use of Archived Operations Data

There are several challenges to collecting and using different types of archived operations data. NJDOT's signal systems inventory is antiquated, and receiving any information on signalized intersections has been problematic. Information on intersection geometries and timing plans for New Jersey's approximately 3,000 signals is maintained on paper, not in a database that could be integrated with the CMS. NJDOT is currently focusing on potential signal system improvements such as adaptive control and system optimization, and a more thorough data on the existing systems would help them better evaluate these alternatives both before implementation and as part of before-after studies post-deployment. In addition, NJDOT would like to be able to generate regional or statewide-level visualizations of congestion, bottlenecks, high incident areas, and other archived operations data, but this cannot be done easily with the tools the agency currently uses due to limitations in the processing power of some of their existing machines and the extremely large datasets that are provided from some of these tools.

NJDOT also faces resource limitations to using archived operations data. A staff of four handles all congestion-related issues in the state, so it can be difficult for them to find time to learn how to use the various data management and visualization tools that are available. From a pure technology standpoint, the agency also faces issues such as poor wiring and Internet connectivity and outdated technology, which makes it difficult to use the more advanced tools to their full capability.

Another challenge area has been collecting traffic counts for input into the CMS. Thousands of counts come in from multiple sources (NJDOT and MPOs) and may be in different formats, which need to be reconciled. The counts also need to be added to the network and smoothed via an adaptive assignment technique, resulting in link-level data (vs. sport count data). NJDOT would like to improve traffic counting capabilities as they expand their ITS coverage. They would also like to see counts as part of the VPP Suite so that they can combine speed, traffic volume, and vehicle classification data.

Ideas for Future Advancement of this Practice

Moving forward, NJDOT would like to integrate more operations data, like agency-owned volume data, more detailed incident data, signal systems data, and other arterial data sources, with the VPP data to conduct more comprehensive analyses of high priority locations for the purposes of selecting and evaluating projects based on multiple factors, not solely operations.

NJDOT's approach for advancing the use of archived operations data in transportation planning is to develop integrated evaluation strategies for the following Congestion Relief Program categories:

[29] Allen, John, "Reliability: Data, Analytics, and Visualization." Jan 2013.

- **Problem Identification/Project Development** – Using archived operations data in conjunction with more traditional tools, like the Department's CMS, will help to better identify problem locations on the highway network for potential Problem Statement development. Bigger picture, this same identification process, combined with other Management System data (bridge, pavement, etc.), can be used to identify potential project *areas* for problem statement development that may be more efficient from a funding allocation and expenditure perspective. This Management System Integration can also be supplemented with **Key Focus Areas** to take into account State and MPO priorities from things like the Strategic Roadway Network, Smart Growth areas, and the MPOs priority corridors, sub-corridors and strategy refinement areas.

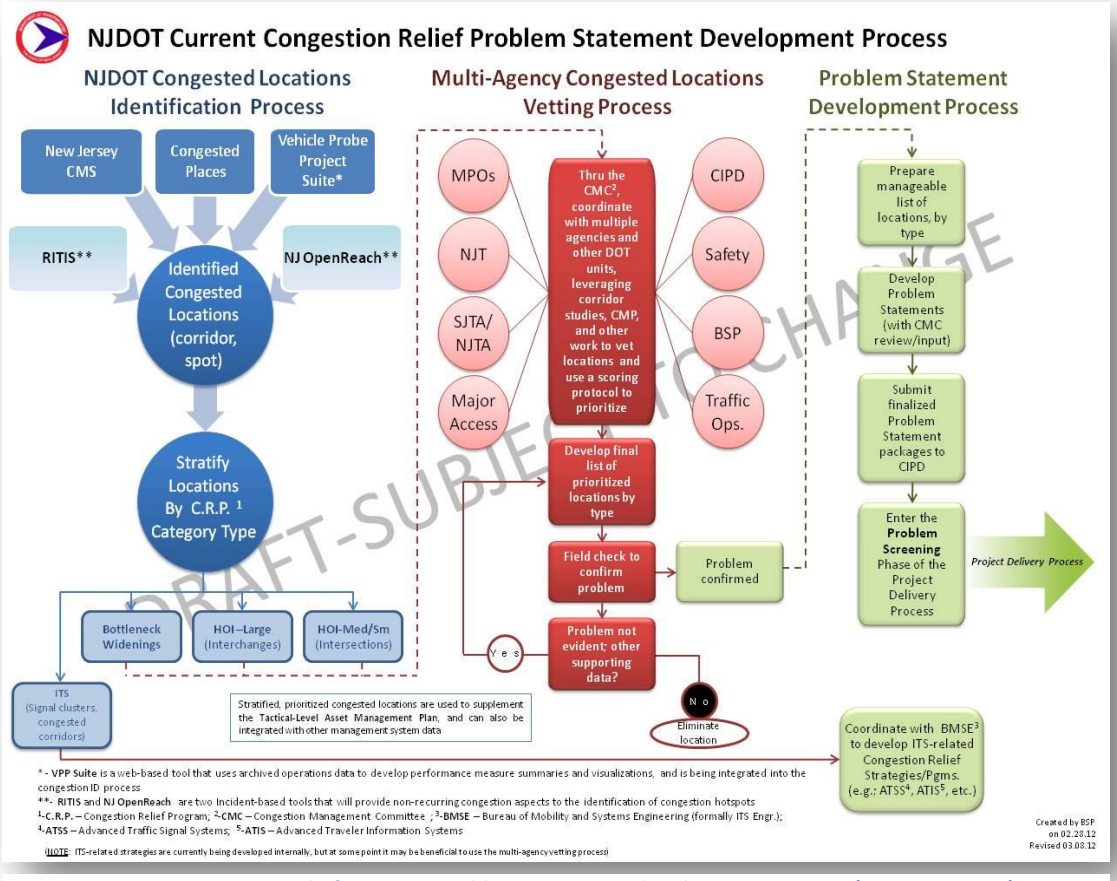


Figure 4. NJDOT Congestion Relief Program problem statement development process (Source; NJDOT).

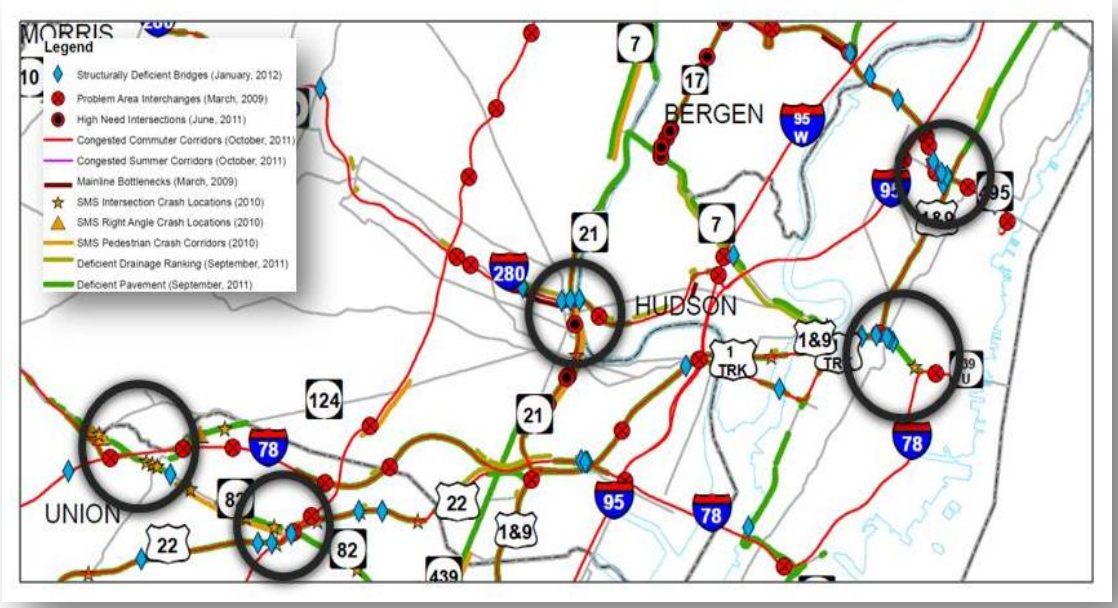


Figure 5. NJDOT Management System Integration Candidate Project Areas (Source: NJDOT).

- **Project confirmation** – The Department is in the process of revising its congestion rating process, which is used in part to confirm projects that are already in the project delivery process but were not developed through the formal problem statement process. Archived operations data will play a significant role in updating this process with better data and visualizations.

- **Before and After Studies** – Given NJDOT's asset management construct, it is vitally important to evaluate congestion relief projects to determine how effective they were in mitigating the identified problem. Archived operations data will be highly beneficial and cost-effective in helping to demonstrate project effectiveness and "tell the story" by using a tool like the VPP Suite to generate concise visualizations and performance summaries.

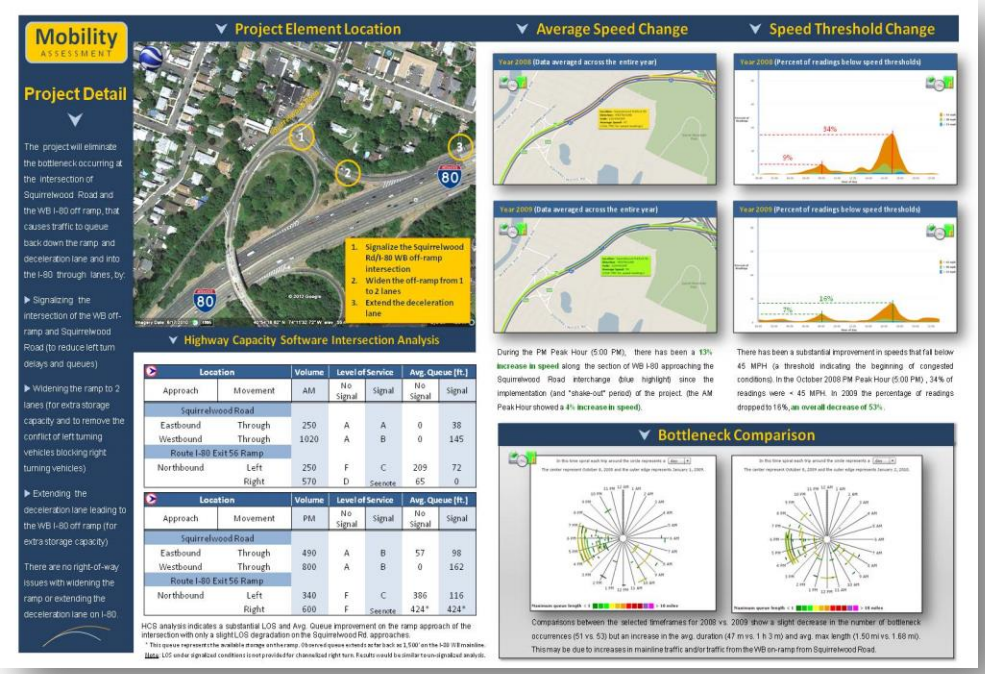


Figure 6. Performance Assessment Report Brochure Prototype – inside detail (Source: NJDOT).

- **Performance Reporting** – Archived operations data will significantly enhance the Department's ability to present system-level performance reporting for efforts such as the *Tactical-Level Asset Management Plan*, which provides the strategic framework, context and guidance for capital program decision-making via the Statewide Capital Investment Strategy (SCIS) document.

Additional References:

Interview, NJDOT, John Allen, November 25, 2013.

Oregon Department of Transportation

Overview

The Oregon Department of Transportation (ODOT) manages over 19,000 lane-miles of highway. Although traffic volumes and congestion in Oregon have remained fairly stable over the last few years, vehicle-miles traveled within the state have increased approximately 15 percent over the last 20 years, with future growth forecasted. One strategy that ODOT has implemented to mitigate congestion is the use of intelligent transportation systems (ITS). Among other ITS equipment, ODOT has deployed over 300 highway cameras, 146 freeway ramp meters, 150 portable message signs, 94 road and weather information stations, and 98 permanent variable message signs. [30] Along with the corresponding sensors and support systems, many of these deployments assist ODOT in collecting and using archived operations data.

Archived Operations Data

Portland State University (PSU) archives data from ODOT's freeways, including: volume, speed, and occupancy per lane. In addition, PSU archives all available traffic signal data, Bluetooth data, and bus data from the arterials in Oregon. PSU archives this information under their Portland Oregon Regional Transportation Archive Listing (PORTAL) effort. ODOT is actively adding new locations to install Bluetooth sensors on arterials and freeways to get a better understanding of travel times on the arterials. Once available, the intent is to archive this data in PORTAL. ODOT has also purchased INRIX data.

PSU manages and conducts all quality control and quality assurance of the archived data. This effort is funded by a regional set-aside for ITS projects provided through Metro, the MPO for the Portland region. Projects for this set-aside are selected by a committee called TransPort, which is chaired by ODOT and made up of regional transportation agency staff. ODOT has also established a steering committee to provide oversight for the PORTAL effort. While some of the ODOT data systems have built-in processes that alert ODOT to potential issues (e.g., sensor damaged or not functioning), PSU monitors the quality of the PORTAL data and sends alerts to ODOT when they detect data that may not be accurate (e.g., unrealistic travel speeds).

Table 10. Highlights of operations data available to Oregon DOT.

Data Type	Data Source	Who Collects the Data	Collection Method	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Volume	PORTAL	ODOT	Loop detectors		Ad hoc traffic studies, performance measurement
Speed	PORTAL	ODOT	Loop detectors		Ad hoc traffic studies,

[30] Oregon Department of Transportation. *Key Facts 2012*. Available at: http://www.oregon.gov/ODOT/docs/keyfacts_2012.pdf

Data Type	Data Source	Who Collects the Data	Collection Method	Issues with data format or quality (optional)	Planning Activity Supported (optional)
					performance measurement
Incidents	Crash Data System	Oregon DOT	Oregon Driver and Motor Vehicle Services crash reporting forms		

Planning Activities Using Archived Operations Data

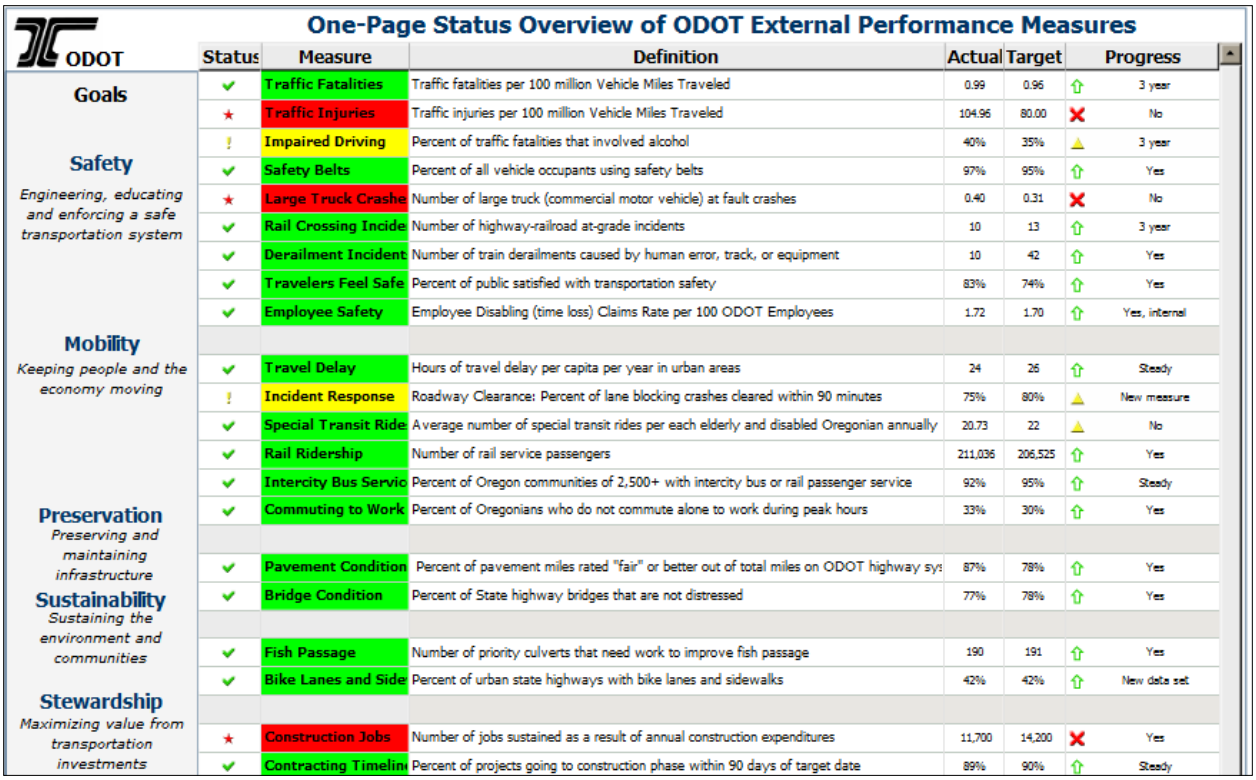
Beginning in 2009, ODOT developed a Corridor Bottleneck Operations Study (CBOS) that identified bottlenecks on five metropolitan corridors (I-5, I-205, I-84, I-405, and US 26) with a purpose of improving operations and safety. For this study, ODOT used archived data to locate areas where speeds slowed below 35 miles per hour across all lanes. ODOT developed several low-cost improvement projects as outcomes to this study.

ODOT conducts ad hoc studies to identify transportation needs. An example, if ODOT were considering a road diet on an arterial route parallel to a freeway, it would review traffic volumes from archived data on the arterial for instances when there was a recorded incident on the freeway. Along with modeling the scenario, this ad hoc study would allow ODOT to determine the volume of traffic that may divert from the freeway to the arterial and make a determination if following the completion of the road diet the reconfigured roadway would have sufficient capacity. ODOT uses historical volumes and corresponding incident data for these types of analysis.

ODOT often uses models for transportation planning, but uses the archived data to validate the model outputs. ODOT is developing software to calculate trip travel times using input from Bluetooth sensors and anticipates using INRIX data to validate the travel times developed from the Bluetooth sensor input.

ODOT uses archived data to monitor and report on transportation system performance through its Key Performance Measures (KPM) website.[31] On this web site, ODOT maintains both a single page overview that highlights the key performance measures and an interactive dashboard that allows users to view the State's performance concerning safety, mobility/economy, preservation, sustainability, and stewardship. Figures 3 and 4 below highlight these features.

[31] Oregon Department of Transportation. *Key Performance Measures*. Available at: http://www.oregon.gov/ODOT/CS/PERFORMANCE/Pages/index.aspx



ODOT

One-Page Status Overview of ODOT External Performance Measures

	Status	Measure	Definition	Actual	Target	Progress	
Goals							
Safety *Engineering, educating and enforcing a safe transportation system*	✔	Traffic Fatalities	Traffic fatalities per 100 million Vehicle Miles Traveled	0.99	0.96	⇧	3 year
	★	Traffic Injuries	Traffic injuries per 100 million Vehicle Miles Traveled	104.96	80.00	✘	No
	!	Impaired Driving	Percent of traffic fatalities that involved alcohol	40%	35%	▲	3 year
	✔	Safety Belts	Percent of all vehicle occupants using safety belts	97%	95%	⇧	Yes
	★	Large Truck Crashe	Number of large truck (commercial motor vehicle) at fault crashes	0.40	0.31	✘	No
	✔	Rail Crossing Incide	Number of highway-railroad at-grade incidents	10	13	⇧	3 year
	✔	Derailment Incident	Number of train derailments caused by human error, track, or equipment	10	42	⇧	Yes
	✔	Travelers Feel Safe	Percent of public satisfied with transportation safety	83%	74%	⇧	Yes
	✔	Employee Safety	Employee Disabling (time loss) Claims Rate per 100 ODOT Employees	1.72	1.70	⇧	Yes, internal
Mobility *Keeping people and the economy moving*							
	✔	Travel Delay	Hours of travel delay per capita per year in urban areas	24	26	⇧	Steady
	!	Incident Response	Roadway Clearance: Percent of lane blocking crashes cleared within 90 minutes	75%	80%	▲	New measure
	✔	Special Transit Ride	Average number of special transit rides per each elderly and disabled Oregonian annually	20.73	22	▲	No
	✔	Rail Ridership	Number of rail service passengers	211,036	206,525	⇧	Yes
	✔	Intercity Bus Servic	Percent of Oregon communities of 2,500+ with intercity bus or rail passenger service	92%	95%	⇧	Steady
	✔	Commuting to Work	Percent of Oregonians who do not commute alone to work during peak hours	33%	30%	⇧	Yes
Preservation *Preserving and maintaining infrastructure*							
	✔	Pavement Condition	Percent of pavement miles rated "fair" or better out of total miles on ODOT highway sys	87%	78%	⇧	Yes
	✔	Bridge Condition	Percent of State highway bridges that are not distressed	77%	78%	⇧	Yes
Sustainability *Sustaining the environment and communities*							
	✔	Fish Passage	Number of priority culverts that need work to improve fish passage	190	191	⇧	Yes
	✔	Bike Lanes and Side	Percent of urban state highways with bike lanes and sidewalks	42%	42%	⇧	New data set
Stewardship *Maximizing value from transportation investments*							
	★	Construction Jobs	Number of jobs sustained as a result of annual construction expenditures	11,700	14,200	✘	Yes
	✔	Contracting Timelin	Percent of projects going to construction phase within 90 days of target date	89%	90%	⇧	Steady

Figure 7: Screenshot of ODOT's One Page Status Report

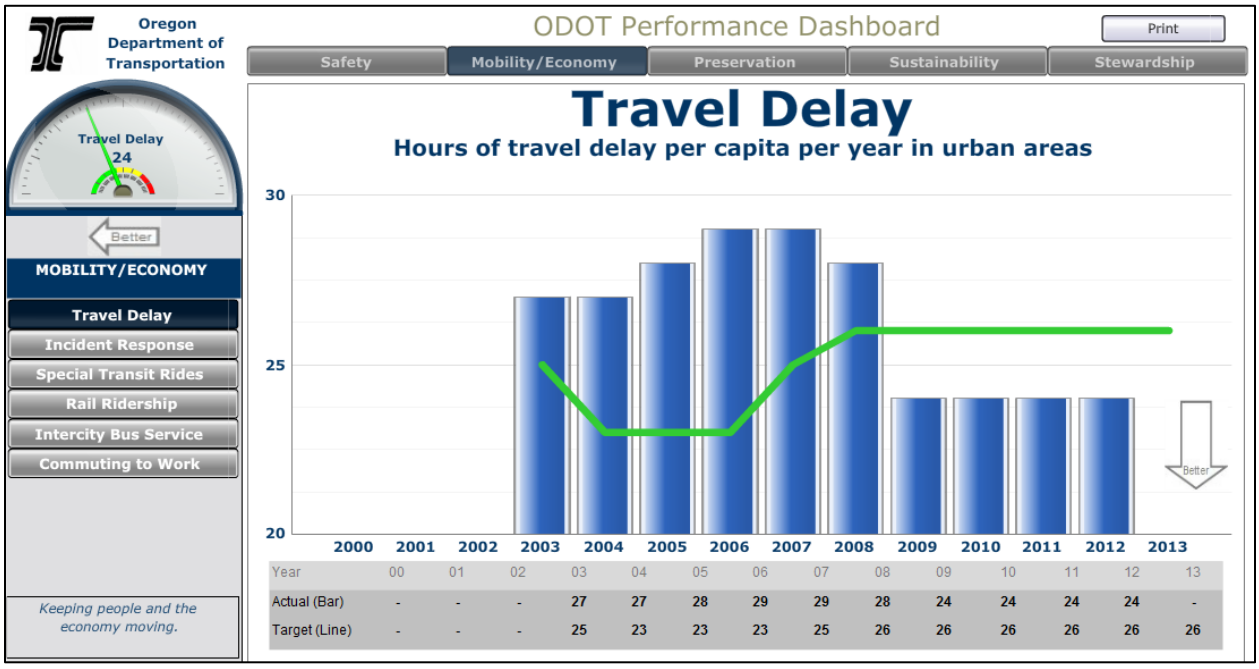


Figure 8: Screenshot of ODOT's Performance Dashboard

Use of Tools to Analyze and/or Visualize Archived Operations Data

PSU developed the PORTAL tool, a screenshot of the user interface of this tool is shown in Figure 5. PORTAL visualizes data such as: vehicle-miles traveled (VMT), vehicle-hours traveled (VHT), travel time-AM peak, and travel time-PM peak. PORTAL is the data archive system. As noted above, ODOT funds PSU to develop the PORTAL tool and ODOT what and how data can be shared. The PORTAL tool is a dashboard that, at a glance, can see how different corridors are functioning. Users can compare different days, times, and corridors to understand the archived data. PORTAL has weather and incident data integrated with the traffic data. In addition, PORTAL allows users to download data in comma separated format (.CSV files).

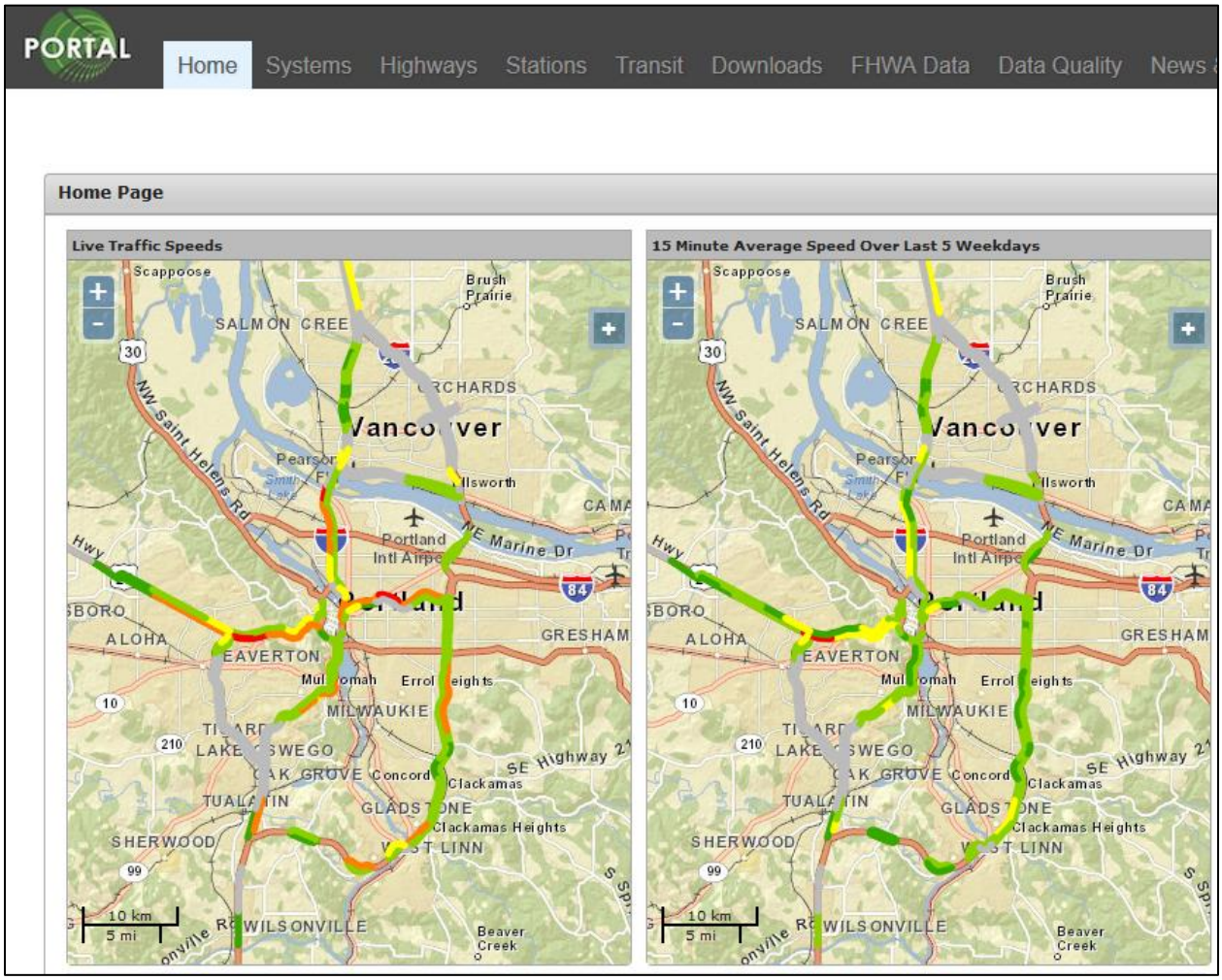


Figure 9: Screenshot from Portland State University's PORTAL web site

ODOT maintains a traveler information website entitled TripCheck[32] that provides users with information regarding work zones, weather, and incidents. ODOT plans to further enhance this system to allow users to specify their origin and destination to obtain travel times. ODOT shares information presented on this web site with PSU who archives the data.

[32] Oregon Department of Transportation. *TripCheck*. Available at http://www.tripcheck.com/.

Challenges or Barriers to Use of Archived Operations Data

ODOT's challenge to using archived operations data is having staff available to analyze the data. In an attempt to integrate more data into the planning process, ODOT has assigned traffic engineers and modelers in ODOT's planning section to that effort. ODOT typically analyzes archived data when there is a specific project in mind rather than a continuous effort to analyze the data.

Ideas for Future Advancement of this Practice

Currently, ODOT does not have a direct method to classify vehicles and analyze traffic performance by vehicle type. In the future, ODOT anticipates on updating their ramp meter system and expects that the new system will be able to capture vehicle length to assist in classifying vehicle types.

ODOT is currently planning to expand their use of travel time data through the deployment of additional Bluetooth probes on both freeway and arterials. In the past, ODOT has collected data on travel times through the use of transit buses as probe vehicles. However, to use this data, analysts must remove the bus dwell times to provide an accurate representation of travel time. ODOT has not extensively used the travel times from transit buses when planning for operations.

Additional Resources:

- Interview, Oregon Department of Transportation, Dennis Mitchell, November 25, 2013.
- Oregon Department of Transportation. *2013 Corridor Bottleneck Operations Study (CBOS)*, 2013. Available at: http://www.oregon.gov/ODOT/HWY/REGION1/pages/cbos.aspx.
- Portland State University. *PORTAL Home Page*, 2013. Available at: http://portal.its.pdx.edu/Portal/index.php/home/.

San Diego Association of Governments

Overview

The San Diego Association of Governments (SANDAG) is the metropolitan planning organization (MPO) for San Diego County, CA serving as the regional decisionmaking body for 18 cities and county government within its jurisdiction.[33] SANDAG encompasses more than 4,200 square miles with a population of more than three million people.[34]

SANDAG is the administrator of TransNet, the regional half-cent sales tax in San Diego County to fund a variety of transportation improvements and environmental conservation projects in San Diego County. Voters approved *TransNet* in 1987 *and in 2004, County voters extended the tax until 2048, which is expected to generate approximately $14 billion for highway, transit, and local road projects to reduce congestion.*[35] *Subsequent to the extension of TransNet, an "Early Action Program" was developed which established project priorities for the first ten years.*[36] *Project prioritization also takes place during every Regional Transportation Plan update cycle, and the Early Action Program serves as the priority platform network.*

Archived Operations Data

SANDAG maintains traffic count data for significant roadways and all Caltrans routes in the San Diego region. Each year, local jurisdictions and Caltrans collect traffic count data on significant roadways, State freeways, and highways. SANDAG compiles this information to present Average Weekday Traffic Counts, which are two-way, 24-hour volumes.[37] SANDAG is in the process of acquiring arterial data from a third-party vendor.

SANDAG also uses Caltrans' Freeway Performance Measurement System (PeMS) to access data. Caltrans' Freeway Performance Measurement System (PeMS) is a real-time archive data management system for transportation data in the state. It collects raw detector data in real-time, stores and processes this data, and provides a number of web pages that provide analysis of the performance of the freeway system. Caltrans requires registration to the website, with the exception of some real-time maps, and some pages that are only available to Caltrans employees (i.e., detailed TASAS Accident analysis).

Some of the information available in PeMS (plots, tabular, and/or mapped) includes:

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[33] SANDAG. *Regional Comprehensive Plan for the San Diego Region*, July 2004. Available at: http://www.sandag.org/programs/land_use_and_regional_growth/comprehensive_land_use_and_regional_growth_projects/RCP/rcp_final_complete.pdf

[34] 2010 U.S. Census.

[35] SANDAG. "About," *Keep San Diego Moving – TransNet*. Available at: http://www.keepsandiegomoving.com/transnet-about.aspx

[36] SANDAG. "Early Action Projects," *Keep San Diego Moving – TransNet.* Available at: http://www.keepsandiegomoving.com/transnet-about-early.aspx

[37] SANDAG. *Transportation* [web site]. Available at: http://www.sandag.org/index.asp?subclassid=78&fuseaction=home.subclasshome

- An inventory of the freeways and detectors that are in the geographical segment;
- Inventory of routes, corridors, managed facilities, field elements, arterials, transit agencies, and FSP beats
- Performance measures (actual and predicted) including: VMT, VHT, Delay, Lost Productivity (Congested Lane Mile Hours), Travel times, Q (VMT/VHT), Travel Time Index, Congestion Pie, Bottlenecks, AADT, Mobile 6 Modeling (measured VMT versus the measured speed), LOS, etc.;
- Detector health;
- Lane closures;
- California Highway Patrol incidents; and
- Photolog images.

Planning Activities Using Archived Operations Data

SANDAG is currently developing performance measures and targets but has only used model data thus far for that effort.

SANDAG monitors regional bottlenecks on an on-going basis. Using Caltrans' Freeway Performance Measurement System (PeMS) bottleneck algorithm, SANDAG can identify major bottlenecks. As part of the statewide "Corridor Mobility" effort[38], SANDAG collaborated with Caltrans to work on Corridor System Management Plans and used archived operations data to look at recurring and non-recurring congestion on the I-15 and I-805 corridor. The data used to look at the non-recurring and recurring congestion included speeds, volumes, incidents that SANDAG obtained from PEMS.

To monitor and report on transportation system performance, SANDAG develops its *State of the Commute* report highlighting several performance measures. As shown in Table 9, this report is divided into three categories.

Table 11. State of the Commute Performance Measure Categories[39]

CATEGORY	DESCRIPTION
Getting Around the Region	This section provides an overview of regional travel trends. It quantifies traffic flows on our freeways, as well as transit ridership levels. It also lays the groundwork for future reporting on walking, biking, and other commute modes.
How is the System Working?	This section provides performance statistics, including regional and corridor travel delay data and information on the most heavily used transit routes.

[38] Caltrans. *California Corridor Mobility*. Available at: http://www.dot.ca.gov/hq/tpp/corridor-mobility/.
[39] SANDAG. *State of the Commute 2012*. Available at: http://www.sandag.org/uploads/publicationid/publicationid_1767_16305.pdf

My Corridor Commute	This section analyzes the performance of a number of specific travel corridors in the region. It measures progress relative to benchmarks set for usage, travel times, and other key statistics, highlighting completed or planned projects designed to reduce congestion and minimize delay.

The second category, *How is the System Working?*, highlights measures such as total freeway delay during peak-hour commute, regional bottlenecks, annual freeway delay by freeway during commute periods, top transit routes by ridership, and transit ridership of TransNet-supported services. These measures use archived operational data from different sources, but draw significantly from the PeMS database and County transit organizations.

Use of Tools to Analyze and/or Visualize Archived Operations Data

SANDAG uses the PeMS tool for visualization of the data, as well as GIS mapping applications available to visualize the traffic information compiled from Caltrans sensors. SANDAG generally uses the PeMS tool for planning activities such as post-analysis, planning analysis, identifying bottlenecks, and identifying critical areas of travel time savings. Through the I-15 Integrated Corridor Management (ICM) project,[40] SANDAG is working with Caltrans to develop a PeMS module entitled Corridor-PEMS (C-PeMS) that will allow many of the planning and operations activities conducted with PeMS to be done using real-time data. SANDAG has developed a smart decision support system as part of the ICM project that will look at real-time modal performance and operational data and historical offline modal data to develop, recommend, and implement corridor-level response plans in real-time. For example, the decision support system will allow the coordination and use of freeway ramp meters with arterial signals to manage congestion levels during an incident based on real-time and archived operational data.

Challenges or Barriers to Use of Archived Operations Data

The lack of availability of arterial data has been a challenge for SANDAG when using archived operations data. To this end, SANDAG developed the initial prototype PeMS module, entitled Arterial PeMS (A-PeMS), to extend PeMS capabilities and functionalities beyond the State Highway System to collect arterial data and report performance.

Ideas for Future Advancement of this Practice

SANDAG is progressing in on several fronts in the use of archived operations data in planning. SANDAG anticipates that as its models, data collection, and data analysis efforts advance, archived operations data are more likely to influence and guide project prioritization. SANDAG currently uses archived operations data to validate its models. SANDAG plans to expand the data used to develop its models to include pedestrian and bicycle data to support and advance pedestrian and bicycle modal

[40] SANDAG. *I-15 Integrated Corridor Management*. 2013. Available at: http://www.sandag.org/index.asp?projectid=429&fuseaction=projects.detail

improvements, including the Active Transportation Grant Program[41] (funded by TransNet) and the Regional Bicycle Plan[42] (funded by a number of resources, including TransNet. Along with the County of San Diego and a local college, SANDAG developed a bike counter program to begin capturing bike data. Currently there are no archived data from this effort, but as the initiative continues the results will be useful on several fronts, including the *State of the Commute* report and advancing the two TransNet-funded bicycle initiatives noted above: the Active Transportation Grant Program and the Regional Bicycle Plan.

SANDAG is transitioning to an activity-based model and plans to use archived operations data to baseline the new model. SANDAG is also looking to advance a performance-based management approach to corridor management based on real-time and historic data.

Additional Resources:

Interview, SANDAG, Alex Estrella and Ellison Alegre, November 27, 2013.

SANDAG. *SANDAG Home Page*. Available at:
http://www.sandag.org/index.asp?subclassid=78&fuseaction=home.subclasshome

[41] SANDAG. *Active Transportation Grant Program*. Available at:
http://www.sandag.org/index.asp?classid=13&subclassid=98&projectid=418&fuseaction=projects.detail
[42] SANDAG. *Riding to 2050, the San Diego Regional Bicycle Plan*. Available at:
http://www.sandag.org/index.asp?classid=13&subclassid=98&projectid=353&fuseaction=projects.detail

Washington State Department of Transportation

Overview

The use of data for planning and demonstrating accountability to the public is a priority at the Washington State Department of Transportation. One of the management principles of WSDOT is "To preserve and enhance our resources, we will manage the WSDOT organization efficiently through the use of performance information and strategic investments."[43] WSDOT has been collecting data on congestion since 1988 to provide information to the public and decisionmakers on where congestion is occurring and what can be done about it. There are two divisions or offices within WSDOT that have significant responsibilities related to the use of archived operations data in planning and have many internal and external partners in collecting, processing, and analyzing archived operations data for planning and performance reporting. The WSDOT Division of Strategic Assessment and Performance Analysis develops a number of publications that track the performance of the transportation system and State transportation investment outcomes. Within the Multi-Modal Planning Division (Previously the Strategic Planning Division), the Statewide Travel & Collision Data Office collects, processes, analyzes, and disseminates performance information on all State roads related to travel and collisions. This office provides the archived operations data and analysis that supports much of the performance-based planning and programming at WSDOT. WSDOT reports that it uses archived operations data at several levels of planning including from concept to completion of any project that it undertakes.

Archived Operations Data

WSDOT reports that it has fairly good loop detector coverage of the urban areas of the state and has permanent traffic recorders in the rural parts of the state on WSDOT owned roads. WSDOT collects data in real-time on 82 commuter routes in urban areas of the state. The Seattle area has approximately 6,800 in-pavement loop detectors spaced every half mile and 128 data sensors on 77 centerline miles in southern Puget Sound. WSDOT has permanent traffic recorder (PTR) stations to cover gaps in the system in more rural areas. WSDOT purchased INRIX data from 2009 to 2013 to aid the agency in the planning process and is now looking to use the HERE data provided by FHWA through the NPMRDS program.

Below is a table to list the archived operations data used by the MPO or State DOT for planning purposes

Table 12. Highlights of operations data available to WSDOT.

Data Type	Data Source	Who Collects the Data	Issues with data format or quality (optional)	Planning Activity Supported (optional)
Volume	Loop Detectors	WSDOT		
	Permanent Traffic Recorders (PTR)	WSDOT		
	Short counts	WSDOT and local agencies		

[43] http://www.wsdot.wa.gov/About/ManagementPrinciples.htm

Speed	INRIX	INRIX		
	Automated License Plate Readers (rural)	WSDOT		
Incidents	Clearance times	WSDOT 's Incident Response Team		

Planning Activities Using Archived Operations Data

Identifying transportation needs and problems, e.g., safety, congestion, air quality

WSDOT uses a *Highway Segment Analysis Program* to identify those locations on State highways where mobility improvement strategies are needed. This serves as a screening tool that selects locations where travel speeds fall below 70 percent of the posted speed limit during the peak hour. WSDOT will then assess which mobility strategies will be most cost-effective for those locations.[44] Identifying locations with speeds below the 70 percent threshold requires the use of archived speed data. WSDOT considers below 60 percent of the posted speed limit to be severely congested and generally will not program a mobility improvement project for areas above the 70 percent of posted speed limit threshold unless there are other reasons to do so, such as safety concerns that require the project.

WSDOT compares current and 2-year prior travel time data on approximately 82 commute routes across the state, including the Puget Sound region, for mobility trends and reasons for performance changes to help identify what actions need to be taken to alleviate mobility issues. WSDOT has also recently begun examining transit ridership data and capacity constraints on the most traveled corridors to assess the mobility issues or chokepoints from a multi-modal corridor perspective and identify potential fixes. These results are captured in the 2013 Corridor Capacity Report.[45]

The 2013 Corridor Capacity Report is the latest version of the WSDOT Annual Congestion Report, which has been published since 2002. This document reports on performance metrics including total statewide delay, percentage of the system congested, and reliable travel times. It also includes results of before and after analyses performed on projects and programs that were intended to address congestion. These congestion-related reports are published in connection with the Gray Notebook.

Validation or calibration of existing analysis tools or models

WSDOT supplies archived operations data to MPOs in the state to calibrate their travel demand models. For example, the Southwest Regional Transportation Council (RTC), the MPO for the Vancouver metropolitan region, obtains volume data from WSDOT which is hosted on the WSDOT website and then uses that data along with household survey data to calibrate its travel demand model. Additionally, in

[44] WSDOT, GMA Planning Requirements and Resources for Statewide Transportation Planning, June 2011. Available at: http://www.wsdot.wa.gov/NR/rdonlyres/D299F5AB-2717-4353-B815-B1C7C0BDE865/0/GMAPlanningRequirementsandResourcesforStatewideTransportationPlanning.pdf.

[45] WSDOT, 2013 Corridor Capacity Report. Available at: http://www.wsdot.wa.gov/Accountability/Congestion/2013CorridorCapacityReport.htm.

the case of an intersection improvement project, observed data for the intersection is used to help post-process information from the travel demand model.

Prioritization and selection of programs and projects

Archived operations data is used in several ways for prioritizing projects in WSDOT. WSDOT uses speed, volume, and other usage data to determine when or if a project becomes programmed.

In 2000, WSDOT developed, with the help of a consultant, the Mobility Project Prioritization Process. This is a process and a spreadsheet tool that helps project sponsors estimate the benefits and costs of a project or elements of a project. This spreadsheet tool was last updated in 2009. According to WSDOT, the spreadsheet helps estimate the benefits and estimate the cost-efficiency of the following WSDOT project elements:

- "Two-Way Left Turn Lane (TWLTL)/Access Management Benefits
- Add General Purpose or Climbing Lane Benefits
- Intersection Improvement Benefits
- New Interchange Benefits
- High Occupancy Vehicle (HOV) Lane Benefits
- Park and Ride Lot Benefits
- Safety Benefits"[46]

Archived volumes, truck percentages, and HOV percentages can be entered into the tool for helping to create the cost-benefit ratio.

WSDOT uses the Highway Segment Analysis Program and the Mobility Project Prioritization Process in conjunction with travel demand models and microsimulation tools in preparing projects to be submitted to program managers for their consideration.

Evaluating the impacts of implemented programs and project

WSDOT regularly conducts before and after studies of congestion mitigation projects and programs using archived operations data and provides the results in Annual Congestion Reports. For example, the this year's edition of the congestion report*, 2013 Corridor Capacity Report*, provides a section on project results for the following WSDOT projects and programs: Tolling Operations, Active Traffic Management, Incident Response, Capacity Projects, and the I-405 Corridor Improvement Program. The I-405 corridor has significant congestion issues and WSDOT has been discussing those issues in the annual report. As projects were implemented on the corridor to improve mobility, WSDOT was able to show how travel times improved. The before-and-after analyses that are included in the report show travel time, speed, and delay measures to quantify the benefits from each project. WSDOT is able to demonstrate how much more volume it is able to serve because of the investments. The before-and-after data typically comes from the loop detectors and the processing and analysis is done by either WSDOT, the regions, or

[46] Washington State Department of Transportation, Mobility Project Prioritization Process Manual and Workbook Website, 2010. Available at: http://www.wsdot.wa.gov/mapsdata/travel/mobility.htm.

the University of Washington. The rural parts of the state use a methodology for before-and-after analysis that uses data from automated license plate readers.

WSDOT reports quarterly on the performance of its incident response (IR) program and has been able to show its success. The performance measures it reports for the program include roadway clearance times, incident clearance times, and the economic benefits the IR teams are providing to the travelers and to the state. The incident response data is collected by the response teams where the incident responder logs the incident start and end times. The incident is considered cleared once it is out of the WSDOT right-of-way or travel lanes. In the previous administration, as part of Government Management Accountability and Performance (GMAP) and Joint Operations Policy Statement (JOPS), they were required to track incidents over 90 minutes; in that case, WSDOT would collaborate with the state patrol to obtain the CAD data.

Planning to handle non-recurring events, e.g., evacuations, planned special events, TIM

The WSDOT incident response program evaluates the incident response performance data to strategize on how to better deploy the response units to get the greatest benefit.

Monitoring and reporting on transportation system performance

WSDOT reports extensively on its transportation system performance in the Gray Notebook and the related Annual Congestion Report. WSDOT has produced the Gray Notebook quarterly since 2001 and the Annual Congestion Report since 2002. The Annual Congestion Report was described previously in the *Identifying transportation needs and problems* section of this case. The report also reports on how the state is progressing towards the Moving Washington goals. Moving Washington is WSDOT's framework of principles and measurable objectives for making transportation investment decisions. The core principle of Moving Washington is "Maintain and keep safe" which is supported by three key strategies: "Operate Efficiently," "Manage Demand," and "Add Capacity Strategically." The 2013 edition of the Annual Congestion Report titled Corridor Report 2013 is the first time private sector speed data for Vancouver area commute trip analysis was used in addition to the WSDOT data.

WSDOT's Gray Notebook provides a one-page snapshot of "WSDOT's Goals, Performance and Trends" which shows for each performance measure a five-year trend line, desired direction, target, and the measure for this period and the previous period.[47] This includes the measures, "Annual (weekday) vehicle hours of delay statewide at maximum throughput speeds" and "Average clearance times for major (90+ minute) incidents on nine key western Washington corridors" which are supported by archived operations data.

Use of Tools to Analyze and/or Visualize Archived Operations Data

WSDOT is working to develop an online data storage, analysis, and visualization tool called Drive Net described in the section below, "Ideas for Future Advancement of this Practice."

[47] WSDOT, The Gray Notebook, November 22, 2013. Available at: http://www.wsdot.wa.gov/Accountability/GrayNotebook/navigateGNB.htm.

Challenges or Barriers to Use of Archived Operations Data

The primary barrier to the use of archived operations data for WSDOT is currently the amount of time it takes to produce the congestion report, a report that contains a large number of performance measures and performance analysis. It is time consuming to produce as they do it manually.

Ideas for Future Advancement of this Practice

WSDOT is currently working to address the issue of time efficiency in producing the performance measures but creating a new tool called Drive Net. WSDOT is about 25 percent done with the first phase of this effort. It is intended to be a tremendously powerful online tool that will store data, allow planners access to almost real-time data, perform data analysis, and give planners the information they need for planning analysis. WSDOT plans to fuse many datasets, including loop data, weather and incident data, and private sector data for storage, analysis, and visualization.

WSDOT uses a comprehensive set of measures and indicators in order to better interpret and understand system performance. WSDOT collects, stores, processes and analyzes huge amounts of archived operations data. However, the key is to understand the data and communicate existing conditions while taking appropriate actions to address system performance issues effectively.

WSDOT is committed to improving system productivity and travel reliability. As part of this effort, WSDOT has moved a step further by introducing a Corridor Capacity Report that incorporates multimodal performance measurement to define system performance and available capacity across all modes. Towards this end, WSDOT is introducing new performance measures with an emphasis on person-based metrics to supplement the existing transportation system analysis. This multimodal congestion performance measurement now includes:

- Corridor-based approach to systems analysis for the major urban areas.
- Metrics for each corridor that show person miles traveled, person hours of delay, and greenhouse gas emissions per person.
- Transit ridership and the percent of seats occupied during the peak period on commute trips along the corridor.
- Park and Ride capacity and utilization rates at prominent locations along urban corridors, which helps evaluate the transit ridership along commute routes.
- Extent and duration of congestion experienced on corridors, shown graphically by direction during the morning and evening peak periods.
- Cost of congestion to demonstrate the direct impact to central Puget Sound area commuters.
- Washington State Ferries' route capacity, trip travel times, and system-wide reliability.

Additional References:

Interview, WSDOT, Sreenath Gangula, November 27, 2013.

2013 Corridor Capacity Report, available at:
http://www.wsdot.wa.gov/Accountability/Congestion/2013CorridorCapacityReport.htm.