Using Performance Measures to Justify Signal Systems on Arterials
Webinar
May 4, 2017

Agenda:

#	Topic	
1	Welcome & Overview	Denise Markow, PE I-95 Corridor Coalition
2	Outcome Assessment using Probe Vehicle Data to Justify Signal Investments to Decision Makers	Dan Farley Pennsylvania DOT
3	Focused Operations: Measuring Arterial Performance Using Automated Traffic Signal Performance Measures	Alan Davis, PE, PTOE Georgia DOT
4	Polling Results	All
5	Questions & Wrap up	Denise Markow, PE I-95 Corridor Coalition

The complete presentation and audio are available at:
TSMO page:
http://i95coalition.org/transportation-systems-management-operations-tsmo/

- Presentation Link
- Audio Link

Meeting Highlights:

- **Welcome and User Group Organization:**
  - Joanna Reagle (KMJ) reviewed housekeeping items and the question and answer protocol.
  - Denise Markow welcomed all, provided a brief overview of the webinar and introduced the speakers. She noted that nearly 180 persons registered for this webinar in 36 states.
  - Denise noted the I-95 Corridor Coalition is a partnership of transportation agencies, including 16 DOTs from Maine to Florida and including the District of Columbia. It provides a forum for key decision makers to address transportation management and operations issues of common interest. More information about the Coalition may be found on their website: http://i95coalition.org/.
  - The Corridor is divided into five regions for TSMO efforts. The Coalition is currently redefining itself with a more TSMO-based theme. Arterials and arterial management is important to the Coalition as highway ramps typically junction with arterial roadways. These junctions can and will affect freeway performance.
  - The webinar focuses on three types of arterial monitoring technologies - Probe data, Re-identification data, and High resolution controller data.

- **Outcome Assessment using Probe Vehicle Data to Justify Signal Investments to Decision Makers (Dan Farley, PennDOT):**
  - Dan Farley presented on using Probe Vehicle Data to justify decisions within PennDOT. This is a collaborative effort with Purdue University.

The highlights follow:

- 40,000 miles state-owned roadway,12.8million people, 102 billion VMT annually, and 264 million annual hours of delay within Pennsylvania (PA) with an annual congestion of cost $6 trillion.
- Pennsylvania is one of the few states in which municipalities own the traffic signals. There are 1,200 municipal traffic signal owners of which 75% of the municipalities own 10 or fewer traffic signals. Contractors maintain 80% of the traffic signals. Currently, PennDOT is making strategic investments to improve arterial corridors.
- The Green Light-Go Program is a funding program (up to $40 million annually) for traffic signal management, maintenance and operations to make the Commonwealth's signalized corridors more safe and efficient. PennDOT is looking to take ownership back of several corridors, and has launched a pilot study for 160 signals in nine municipalities that parallel I-76 (Schuylkill Expressway) in the Philadelphia region.
- PennDOT is moving towards having a more performance based decision-making process.
- Three efforts currently leading the Traffic Signals Performance Measures are FHWA's EDC 4 (Everyday Counts Initiative), the Transportation Pooled Fund for Traffic Signal Systems (TPF-5(258)), and NCHRP Performance-Based Management of Traffic Signals Operations and Management study. If an agency has interest in the Pooled Fund study (PFS), reach out to Dan or one of the PFS leads.
- PennDOT is looking at where it makes sense to build relationships between corridor and intersection level metrics.
- Pennsylvania is an "all-in" State within the I-95 Corridor Coalition's Vehicle Probe Project (VPP) meaning Pennsylvania receives all of the probe data available from INRIX. PennDOT has been receiving real-time and archived data since 2011 and using the data in their 511 system and for travel times on changeable message boards. PennDOT is using INRIX XD data as it provides higher granularity.
- Dan explained the PennDOT research project in conjunction with Purdue University, in which the purpose is to develop, implement and evaluate commercial probe data to produce arterial performance measures to evaluate user costs, travel time reliability, variability and corridor prioritization. The focus of the research project is 138 "Super-Critical" corridors (AADT greater than 25,000) in the PennDOT's District 6 (Philadelphia region). Three web dashboards and a data system were developed and implemented to produce arterial performance measures.
- **Travel Time Comparison Tool** compares travel time distributions on a single corridor over different time periods using cumulative frequency diagrams (CFDs). The graphs of CDFs comparing before and after signal retiming show changes in travel time and reliability. The tool makes preparing these graphics quick and easy. Key pieces of information can be exported. (Slides 10 - 15 noted in the audio)
- **Arterial Ranking Tool** measures multiple corridors based on normalized median and interquartile travel times (TT) over the same time period. The normalized travel time is calculated by dividing the median TT by the speed limit TT for that corridor. The normalized Interquartile-Range (IQR) is calculated by dividing the difference between the 75th percentile TT and the 25th percentile TT by the speed limit TT for that corridor. Corridors can then

be compared based upon their normalized values. These two normalized values are brought together in the Reliability vs Central Tendency graph to determine the outliers illustrating where retiming changes may be needed. (Slides 16 - 26 noted in the audio)

- **Congestion Ticker** tracks speeds of corridors over time to identify time periods and locations of congestion. The graphic shows the speed ranges as percentages for a selected date and time. Cost and environmental benefit evaluations can be done with data exported to excel. (Slides 27 - 28 noted in the audio)
- A list of use applications was provided for each tool. PennDOT has used the tools for before and after evaluations of adaptive traffic signal systems and incident evaluation.
- How it works - Prior to using the tool, the corridors that PennDOT wanted to be mapped needed to laid out along with the XD segmentation in order to be prepared for the API feed from INRIX. A lot of time for this project was spent on corridor mapping. PennDOT receives a direct API feed from INRIX which goes into a minute-by-minute database created by Purdue (along with some 15-minute regression analysis to speed up the performance processes of the tools) which then goes out to the performance measures algorithms and to the tool dashboards.
- The Phase 2 of this research effort is to launch a statewide deployment, emphasizing further refining of filters and corridor identifiers, integration with real-time event data and further refine real-time metrics within regional TMCs.
- Dan provided a link to their TRB paper and will be presenting this project at ITS World Congress 2017. http://docs.trb.org/prp/17-00314.pdf

➢ During and following the presentation, the following questions were discussed:

- Jeevanjot Singh (NJDOT): Asked what is the earliest year that PennDOT has data for the Corridor Comparison Tool. *Howell Li (Purdue) noted that there is data in the PennDOT System starting from November 2014.*
- Ram Venkatanarayana(VTRC/VDOT): Asked if the comparison tools were developed and maintained on contract or are they are open source? Dan Farley noted that this work is still in process and there is not clear determination yet on how the project will move forward.
- Jeevanjot Singh: Asked what additional data is required to access these tools? *Howell Li noted that dashboards use the INRIX XD speed data at 1-minute which is downloaded from their API in real time. There are also GIS components that need to be considered, such as speed limits and signal timing information.*
- Gail Yazersky (NJDOT): Asked if any crash data was collected or available as part of other metrics. *Dan Farley (PennDOT) noted there has not been any crash data integrated into this project.*
- Eddie Curtis (FHWA): Asked if PennDOT is currently or planning to use performance measures to identify the needs for and prioritize traffic signal operational improvements that are then programmed to receive capital funding. *Dan Farley noted that yes, this is a main reason and for interjurisdiction cooperation and different strategies in different areas.*
- Diederick VanDillen: Asked if all the data generated is by INRIX or did you also use some PennDOT detection - you mentioned the anomaly with one

of the corridors due to broken loops. *Howell Li explained that only INRIX data was used in the dashboard implementation.*

- Stan Young (NREL): Asked if energy and emissions (before and after) were also calculated? *Howell Li explained that they have used the TTI/Argone metrics to calculate the before and after emissions.*
- Shayan Khoshmagham (Iteris): Asked how much smoothing/imputation was involved for INRIX data set? *Howell Li explained that they don't smooth the data geographically in terms of the XD segments but they do compute 15-minute aggregation on the data to improve dashboard performance.*
- Nick An (Manatee County, Florida): Asked how they evaluate the delay for this system? *Howell Li explained that they use the speed limit travel time as the "typical" travel time and the delay is additional travel time above that.*

- **Measuring Arterial Performance Using Automated Traffic Signal Performance Measures (Alan Davis, Georgia DOT):**
  - Alan Davis presented on GDOT is using automated traffic signal performance measures on arterials. The highlights follow:
    - The State of Georgia has seven districts, one central office and two (2) TMCs. There are 9,500 signals throughout the state. There are 6,500 signals on the state route network and GDOT Maintains 3,500 of these signals.
    - Regional Traffic Operations Program (RTOP) is the active management of regionally significant corridors coming into Atlanta. It focuses on travel time reliability with data driven decisions. Consultant program support is through Arcadis and Kimley Horn. RTOP includes 25 Corridors, 1100+ signals, spans 12 Counties, and 13 Cities in the metro Atlanta region.
    - RTOP is separated into six regions. It is currently in its 7th year with the focus being on Maintenance, Operations and Troubleshooting. Early performance measures were obtained through manual field detection, floating car travel runs and volume counts. These tasks were time consuming – using manual labor and not much technology. GDOT identified the need to improve this system and capture additional information (not only throughput).
    - They installed 230 BlueTOAD units to combat their limitations of their data collection. This information is shared with other agencies and used in their ATMS System.
    - GDOT developed specifications based upon the capabilities of Utah DOT's system. They wanted to be able to use the high-resolution controller data for to analyze how their signal systems were operating at various levels. GDOT was able to procure a new signal software system - Intelight MaxTime/MaxView for local and central software. GDOT wanted to make the new signal system the core of future operations.
    - To be able to fully utilize the high-resolution capabilities, vehicle detection, communication and a high-resolution controller is needed. Vehicle detection is not needed for all metrics.
    - GDOT maintains a 2070 architecture - 99% of the state is on a common platform - Caltrans 332/336 environment. Only needed to upgrade CPUs and didn't need to buy new cabinets. They had a turn-key deployment – conversion of the software and deployment field testing and integration.

- ATSPM is GDOT's primary tool for operations and maintenance of traffic signals. They have 3,109 signals logging high resolution data and use UDOT-produced source code.
- Twelve available metrics were noted – some run without detection while some require detection. Several were described as noted below.
- Purdue Phase Termination metric illustrates when and why a phase is being terminated so it can be analyzed and modifications can be made as needed.
- Purdue Coordination Diagram illustrates when vehicles are arriving in relation to the signal timing to help determine if the coordination along a corridor is working. Adjustments can be made in real time and viewed to determine their impact.
- Approach Volume provides volumes approaching an intersection from setback detectors. Volumes are provided for all hours and can be used to basic analyses and signal timing changes, as needed.
- Purdue Split Failure – measuring occupancy rates before and after a traffic signal turns red to determine if the demand was adequately served during the green phase.
- The metrics are not just for operational uses, GDOT showed an application not currently used by them by utilized by UDOT to measure red light running. They can determine if signal timing or coordination may be changed to help the issue or if enforcement may be needed.
- Alan explained an application of the tools through a Consultant Retiming Project. Immediately following retiming of the signals, GDOT received complaints regarding the signal timings. By looking at the date, GDOT could see that there was poor coordination of the signals. GDOT was able to assess and make improvements.
- SPM Watchdog is a tool is built into the Utah source code. It also GDOT to analyzes the data from the previous data (traits and attributes) and improve operations.
- Alan Davis explained how these tools were used during the recent collapse of I-85 in Atlanta in March 2017. I They were able to implement detours, and coordinate with engineers to redirect 250,000 vehicles. GDOT was able to normalize this closure by week two of the bridge collapse. Using the tools as well as arterial volume data, travel time data and high resolution data, they were able to see the changes in commuter patterns on major corridors and adjust signal timing plans as needed to help not only the mainline demands but also the side street movements that were seeing increased volumes. They continue to monitor and make changes as needed.
- Alan emphasized the value of ATSPMs. He recommends coordination with IT on a data management plan, since ATSPMs collect a lot of data. Lean on early adopters including: INDOT, UDOT, MNDOT, and GDOT. He emphasized using your data and also knowing what resources you have and have a plan.
- Alan thanked the pooled fund study for their work specifically the following documents: *Performance Measures for Traffic Signal Systems* and *Integrating Traffic Signal Performance Measures into Agency Business Processes* as they were very valuable to GDOT in their implementation efforts.

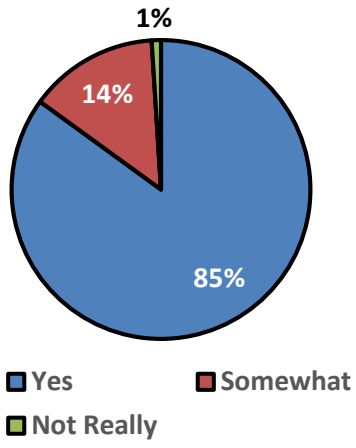
- During and following the presentation, the following questions were discussed:
  - Shayan Khoshmagham (Iteris): Asked did in GDOT implemented the ATSPM software internally. *Eddie Curtis noted that GDOT in collaboration with UDOT wrote the book on implementing the ATSPM software. The software and implementation guide is available on FWHA OSADP as well as the UDOT ATSPM website. Find links to all of the information here: https://ops.fhwa.dot.gov/arterial_mgmt/performance_measures.htm*
  - Jeevanjot Singh (NJDOT): Asked if the diagram on the UDOT's Slide is a right turn on red? Is the right turn on red allowed? *Alan Davis (GDOT) noted that this diagram was borrowed from UDOT and he believes it is on a mainline approach that did not have a right turn on red.*
  - Jeevanjot Singh: Asked what is their Central Traffic Signal Systems for Atlanta region. *Alan Davis explained that GDOT purchased Intelight MaxTime and MaxView.*
  - Rich Casmer: Asked what type of detection GDOT uses. *Alan Davis (GDOT) explained that they mostly use inductive loops across the state but they also use radar and video.*
  - Nick An (Manatee County, Florida): Asked by what means did GDOT get traffic volumes during the bridge collapse? How do you increase that throughput? *Alan Davis noted that volume data was collected through their ATSPM system, set back detection and stop bar detection to the web portal. Increase to throughput was accomplished through cycle length increases and active signal management.*
  - Jeevanjot Singh: Asked How many different types of controllers are in the region? *Alan Davis explained that they have a host of 2070 chassis however all CPUs have Intelight software as part of this deployment.*

Polling:

The audience was polled with the following questions. The responses are provided.

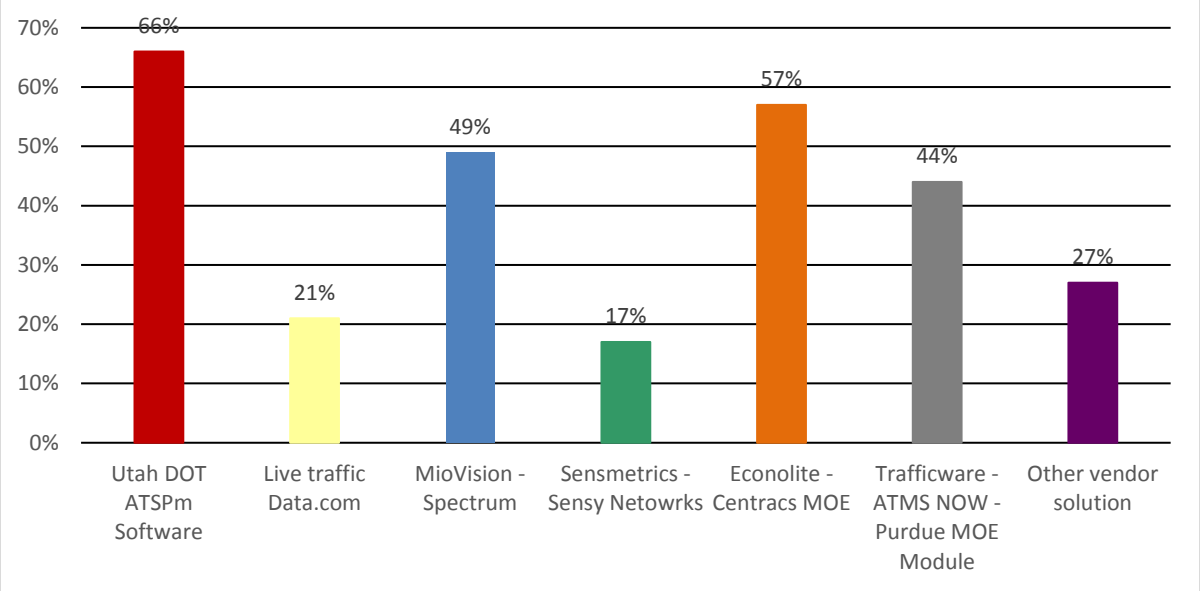
Poll 1: *Have these presentations been helpful in understanding the varying technologies involved in arterial monitoring?*

- **Yes – 85%**
- **Somewhat – 14%**
- **No – 1%**



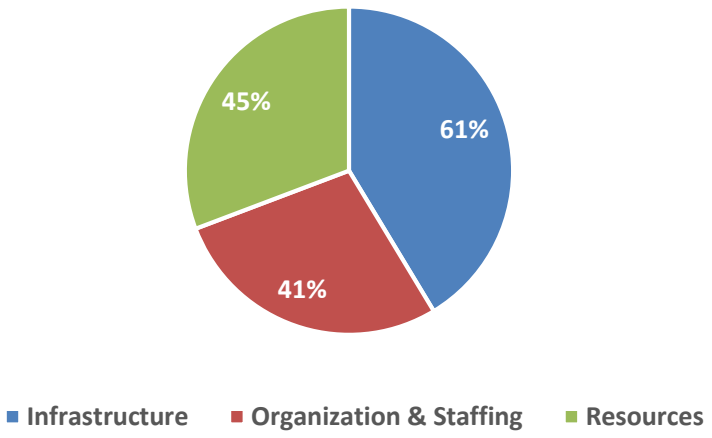
Poll 2: ***There are a number of approaches available to implement Automated Traffic Signal Performance Measures (Select all that you are familiar with)?***

- **Utah DOT ATSPM Software – 66%**
- **Live Traffic Data.com – 21%**
- **MioVision – Spectrum – 49%**
- **Sensmetrics – Sensys Networks – 17%**
- **Econolite – Centracs MOE – 57%**
- **Trafficware ATMS.NOW – Purdue MOE Module – 44%**
- **Other Vendor Solution – 27%**



Poll 3: ***What is the most prominent barrier within your organization to implementation of Automated Traffic Signal Performance Measures?***

- **Infrastructure – 61%**
- **Organization & Staffing – 41%**
- **Resources – 45%**



Wrap Up:
Denise thanked all participants and speakers for their participation.

Questions/Contacts:

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Colorado DOT	New Jersey DOT
Connecticut DOT	New Jersey Institute of Technology
DVRPC (PA)	New York City DOT
Florida DOT	New York State DOT
FHWA	North Carolina DOT
Georgia DOT	North Dakota State University
Illinois DOT	NREL
INRIX	Oklahoma County
Iteris	Oregon DOT
Jacobs Engineering	Pacific Northwest National Laboratory
Louisiana DOT	Pennsylvania DOT
Louisiana State University	Rhode Island DOT
Maine DOT	South Jersey Transportation Planning Organization
Manatee County (FL)	University of Maryland
MARC	University of Tennessee
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