NEW ENGLAND TRANSPORTATION CONSORTIUM

2019 RESEARCH PROBLEM STATEMENT SOLICITATON

I.   PROBLEM TITLE
Validate and Compare the Performance of Traveler Information from Different Sources for Recurring and Nonrecurring Traffic Conditions

II.   RESEARCH PROBLEM STATEMENT
Traveler information (TI) plays a critical role to reduce traffic crashes and travel delay. Currently, DOTs are at a critical point to decide what the next generation of traveler information system (TIS) is. DOTs have several ways to obtain TI, including (1) DOTs use inhouse data obtained directly from their own sensors/measurement, such as loop detectors and cameras; (b) DOTs purchase TI from private vendors, such as INRIX and TomTom; and (c) DOTs use crowdsourcing tools from third-party partners or simply free applications, such as Waze and Google map. These sources utilize different types of data (e.g., loop detectors, automatic vehicle location, and vehicle trajectories from crowdsourcing) and provide different types of TI, including speed map, travel time, and incident. <u>However, there is no validation or comparison of the performance of these sources in New England area. Moreover, the different TI sources are rarely integrated to fully exploit the data.</u> Therefore, research is needed to address two main issues:

(1) To validate and compare the performance of the major TI sources used by New England state DOTs for interstate and state highways in recurring and nonrecurring traffic conditions. It will conduct quantitative analysis to answer a string of questions, including what kind of TI is available, what is the accuracy and timeliness of TI for different traffic conditions, and are they capable of predicting traffic condition?

(2) To explore and exploit the potentials of integrating free crowdsourcing data with DOT sensors/measurement to enhance TI. For example, data fusion techniques could be used to integrate crowdsourcing data with loop detector data and AVL from snow plow vehicles to provide new TI (e.g., queue detection at work zones) and/or improve TI reliability. This will help DOTs to reduce the cost of TIS while significantly enhance the TIS performance.

Note: MassDOT has an on-going project[1] to evaluate the MA TIS with the primary focus on high-level overview, identifying gaps and making recommendations. This project has identified two critical gaps and recommended DOTs to conduct future research: (i) very few state DOTs (none in New England) have validated the effectiveness/accuracy of TI from different sources, and lack of performance metrics is a common issue nation-wide. And (ii) DOTs have not fully utilized the rich data sources, particularly the free crowdsourcing data. The proposed research above will fill the two important gaps identified.

III.   RESEARCH OBJECTIVES
The objectives of this research are two-fold: (1) to validate and compare the performance of the different sources of traveler information used by New England state DOTs, and (2)

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[1] Evaluation and Enhancement of MassDOT Traveler Information Programs, https://trid.trb.org/View/1575257

to explore and exploit the potentials of integrating crowdsourcing data with DOT sensors/measurement to enhance TI.

IV. COST ESTIMATE
$280,000.

V. RESEARCH PERIOD
24 months.

VI. URGENCY AND PAYOFF POTENTIAL
*State DOTs are at a critical point to decide what the next generation of TIS is. **Expected benefits** of the proposed research include: (1) DOTs will have a comprehensive and quantitative performance metrics of different TI sources. Based on that, DOTs can decide how reliable different data is, which sources are cost-effective, and whether DOTs need to collect/procure more data. (2) Integration of crowdsourcing data with DOT data can potentially satisfy the TI needs and replace or reduce TI needs from private vendors. This can significantly save the cost of DOTs.*

VII. PRELIMINARY LITERATURE SEARCH
To avoid duplicating research already published or in progress, the submitter of the Problem Statement will perform a brief literature search prior to submitting the Problem Statement. This literature search can be conducted using the Transportation Research Board's TRID database, available at https://trid.trb.org/. The TRID database contains information on completed research as well as research in progress.

Attach a brief summary (1-3 paragraphs) of the results of this literature search to the Problem Statement. The summary should describe how the subject of this Problem Statement would differ from or add to existing studies.

A search used three keywords, traveler information, performance, and highway, and limited the year between 2010 to 2019, the TRID database has identified 14 projects, and 94 publications. A brief review of these 108 records and their extended literature has resulted in 13 relevant studies; see the table for the record and the notes. The key findings are summarized below:

1. *The literature has conducted some evaluation on the performance of different traveler information (TI) sources in a few places with the focus on regular traffic patterns.*
   (1) Nebraska (reference 1) found that INRIX has reasonable performance in real-time traffic information (e.g., detecting congestion), compared to fixed location sensors.
   (2) On Ohio highways (reference 2), it was found that INRIX data usually had a delay of 6min when detecting recurrent congestion compared to loop detectors.
   (3) Florida DOT (reference 3) examined the TI from NAVTEQ, TrafficCast, and INRIX for a few road segments and found that the results were consistent with ground truth.
   (4) MassDOT (reference 4) has an on-going project that aims to evaluate and enhance MA TIS with the primary focus on high-level overview, identifying gaps and making recommendations. This project has identified two critical gaps and recommended DOTs to conduct future research: (i) very few state DOTs (none in

New England) have validated the effectiveness/accuracy of TI from different sources, and lack of performance metrics is a common issue nation-wide. And (ii) DOTs have not fully utilized the rich data sources, particularly the free crowdsourcing data. The proposed research problem will fill the two important gaps identified by this on-going project.

2. *No research has evaluated the performance of different TI sources in nonrecurrent events.*

3. *Some studies have examined TI needs and methods to provide TI, which provide methodological guidance.*

   (1) A recent FHWA project (reference 5) has conducted a synthesis on the needs of traveler information during nonrecurring events and the major dissemination methods. It found that travelers want concrete information including nature of events and the expected delay. Additionally, travelers want to know how accurate and timely the information is. It also provided a toolbox method to evaluate TI.

   (2) FHWA (reference 6) has conducted a survey on what data available in the private sector and what data the public sector used. It was found that while the public sector used a variety of data from the private sector, most private sector providers did not disclose data quality and evaluation results.

Table: Literature Search Outcome and Review Notes

	Projects/Publications	Key Findings (or objectives for on-going work)
1	PROJECT: Evaluation of Opportunities and Challenges for using INRIX Data for Real-Time Performance Monitoring and Historical Trend Assessment Nebraska Department of Roads, $62374, 2016, Completed 2016-07-01	A project funded by Nebraska that evaluated the performance of INRIX for real-time traffic information.
2	Kim, S., Coifman, B., "Comparing INRIX speed data against concurrent loop detector stations over several months," Transportation Research-Part C, Vol. 49, 2014, pp 59–72.	A studied that compared the accuracy of INRIX speed data and loop detector data. It found that INRIX data has a delay of 6min in detecting congestion.
3	Technical Memorandum, "Evaluation of NAVTEQ, TrafficCast, and INRIX® Travel Time System Data in the Tallahassee Region", Florida Department of Transportation Intelligent Transportation Systems Program, Version 2.0, March 27, 2012. Link	A report from Florida DOT that examined the information that NAVTEQ has on special events and the potential to detect and predict event clearance time, but the report was not available.
4	PROJECT: Evaluation and Enhancement of MassDOT Traveler Information Programs Massachusetts Department of Transportation, $100000, 2018, Active 2018-05-01	MassDOT's on-going project that aims to evaluate and enhance DOT traveler information program. It mainly focuses on high-level overview, identifying gaps and making recommendations.
5	State of the Practice for Traveler Information During Nonrecurring Events	A recent FHWA project that conducted a synthesis on the needs of traveler

	, 2018, 76p 2018-04	information during nonrecurring events and the major dissemination methods.
6	Private Sector Data for Performance Management: https://ops.fhwa.dot.gov/publications/fhwahop110 29/ch3.htm	A report from a FHWA that survey that conducted a survey2 on what data available in the private sector and what data the public sector used.
7	PROJECT: Analyzing Various Data Sources and Evaluating Effectiveness of Providing Travel Time for Non-Freeways Ohio Department of Transportation, $57442, 2018, Active 2018-08-17	Ohio DOT is "looking for a method to provide effective travel time information on our non-freeway system". It focuses on dissemination methods.
8	Real-Time Information Dissemination Requirements for Illinois per New Federal Rule Civil Engineering Studies, Illinois Center for Transportation Series, Issue 15-004, 2015, 126p 2015-02	Illinois has conducted a study to examine how IDOT can satisfy the real-time TI needs per Federal Rule 23 CFR 511.
9	Next Generation Performance Monitoring Data Needs for Nevada DOT , 2014, 96p 2014-12	Nevada DOT identified a list of priority routes that need real-time TI per Federal rule and the project has recommended how NDOT can procure data to satisfy the requirement.
10	PROJECT: Traffic Management Centers: Challenges, Best Practices, and Future Plans National Center for Transportation Systems Productivity and Management, $65000.00, 2012, Completed 2012-11-01	It examined the role of TMC and identified challenges as well as future plan.
11	Integrating Emerging Data Sources into Operational Practice—Opportunities for Integration of Emerging Data for Traffic Management and TMCs , 2017, 86p 2017-11	A complete study sponsored by FHWA that examined big data technology and tools that can be used to enhance TMC.
12	Evaluation of Smart-phone Performance for Real-time Traffic Prediction 17th International IEEE Conference on Intelligent Transportation Systems (ITSC14), 2014, pp 3010-3015 2014-10	A paper that used smartphone data to obtain real-time traffic prediction but there is no validation against ground truth.
13	A Comparative Study of Three Multivariate Short-Term Freeway Traffic Flow Forecasting Methods With Missing Data	A theoretical study that focused on using data analytics approach to extract traffic flow information with missing data.

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2 https://ops.fhwa.dot.gov/publications/fhwahop11029/ch3.htm

VIII. RESEARCH KEY WORDS

Provide a list of key words that can be used to conduct an additional search of the TRID database for related research. To the maximum extent possible, key words should be selected from the Transportation Research Thesaurus (http://trt.trb.org/).

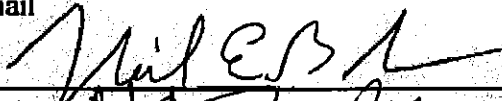*Traveler Information, Performance, Highway*

TWO DOT ENDORSEMENTS ARE REQUIRED (To be signed by separate individuals.)

IX. ENDORSEMENT BY THE SPONSORING DOT (To be signed by the DOT representative to the NETC Advisory Committee through whom the Problem Statement is submitted.)

By signing the endorsement, the DOT representative is certifying that:
1. *The Problem Statement follows the required format.*
2. *The required literature search has been conducted.*
3. *The Problem Statement addresses a transportation issue of relevance to NETC and does not duplicate another Problem Statement being submitted at this time.*

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                                                                    1/25/2019

X. ENDORSEMENT BY A SECOND EMPLOYEE OF THE SPONSORING DOT who agrees to chair the project's technical advisory committee (TAC) if the Problem Statement is selected for funding. (To be signed by a DOT staff person who has technical knowledge of the project topic and is committed to the research outcome.)

DOT Technical Endorsement: *I agree to chair the project's Technical Advisory Committee if this Problem Statement is selected for funding by NETC.*

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Signature   Date