POOLED FUND SCOPE OF WORK

DEVELOPING A STANDARD TEST PROCEDURE FOR TRAVEL TIME DATA QUALITY ASSESSMENT

Lead State: Virginia Department of Transportation

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INTRODUCTION

There is a significant and growing need for travel time data. Transportation agencies need travel time data to support system operations and performance measurement. Information service providers need travel time data to provide a more competitive product. Given this need, numerous methods and technologies have been developed to estimate travel times. In some cases, these methods allow for "in-house" deployment of sensors and computing/communication infrastructure to allow an agency/company to produce the data that they will utilize. In other cases, companies have been founded that derive travel times from various sources (in some circumstances, the company's own sensor network, or from purchased probe location information) to produce a product – a travel time data service – that is then marketed to transportation agencies and information service providers.

Given this variety of approaches, and based on recent experience, it is clear that each source of travel time data offers distinct advantages and disadvantages. It is highly unlikely that a single source of data will emerge as a clear winner that dominates all other approaches. Because of this, consumers of travel time data (transportation agencies and information service providers) are faced with a need to choose one or more travel time data services to best meet their needs. To do so effectively, there is a need for a standard test procedure to use in assessing the quality of different travel time data services. This standard test procedure will create a level playing field that will allow consumers to comprehensively and fairly consider all travel time service options.

Current Situation

In today's environment, when a consumer of travel time data attempts to compare alternatives, the agency/firm is faced with a very confusing landscape that does not support fair and balanced decision-making. Most travel time data service firms will offer "evaluations" of their products. However, the only constant among these evaluations is that they are all different. The evaluation reports use different baseline (ground truth) data – ranging from point detectors to single or multiple probe vehicle runs, different statistical comparison methodologies – from rigorous hypothesis testing to very broad graphical approaches, and have been conducted by various parties – ranging from consultants to universities. Finally, in many cases, the evaluations were commissioned and paid-for by the data service providers themselves.

The result is that consumers of travel time data are forced to make multi-million dollar decisions based on a series of incompatible evaluation reports, many of which were not produced in an objective environment.

PROJECT OBJECTIVE

The objective of this project is to develop a standard test procedure to evaluate the quality of travel time data services. The standard test procedure will produce evaluation results that are consistent and will allow for fair comparisons between travel time data services.

RESEARCH PRODUCT

The research will produce an official standard sanctioned by a Standards Development Organization (SDO), such as ATSM, that will specify a clear quality assessment procedure for travel time data. This standard will then be available for transportation agencies and information service providers to specify when comparing methods/services. In other words, the standard test procedure will allow a travel time data services consumer to compare products of multiple methods/vendors on a level playing field.

METHODOLOGY

To develop a standard test procedure for assessing travel time data quality, two parallel tracks must be coordinated at several key points (see Figure 1):

1. *Research on Test Procedures and Parameters* – Given the large number of methods that have been used for travel time quality assessment, there is a need to objectively analyze these methods, in conjunction with a full understanding of consumer needs, to arrive upon a preferred travel time quality assessment method and associated parameters.

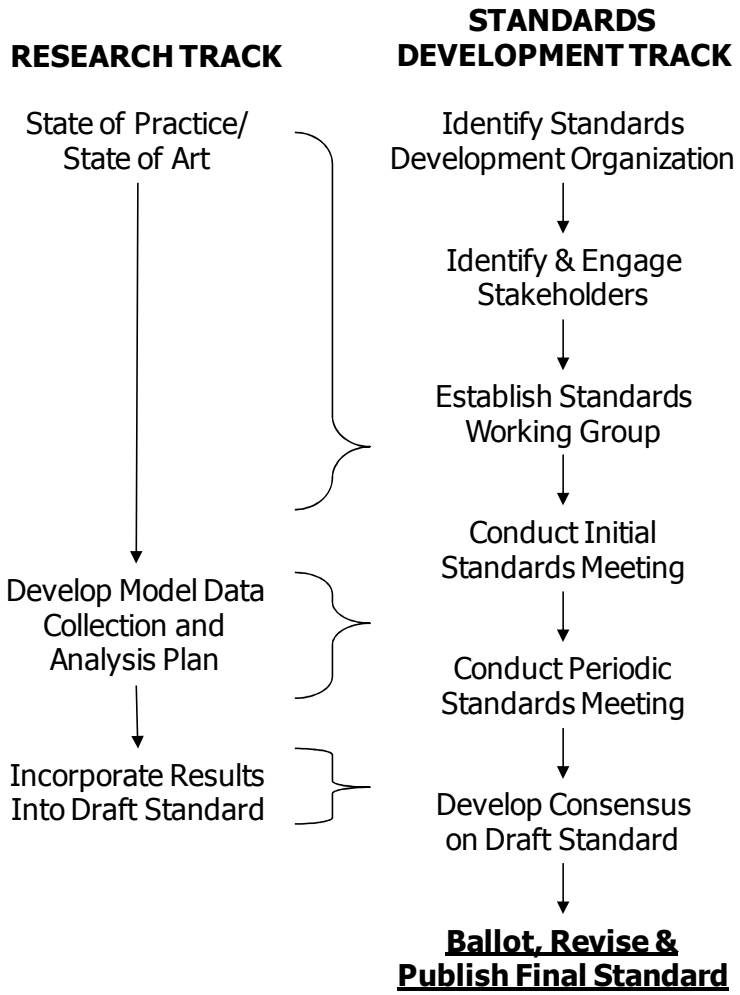
2. *Standard Procedure Development* – Once the preferred method and parameters has been identified, there is a need to identify the preferred SDO to sponsor the standard, and then a need to work through the standards adoption process.

The methodology proposed for this effort is described in more detail in the following sections

TRACK 1: RESEARCH ON PREFERRED TEST PROCEDURES AND PARAMETERS

The first track in this project involves identifying preferred procedures for evaluating the accuracy of travel time-based traveler information systems. The ultimate goal is to develop draft procedures that are statistically valid and can also be executed with a reasonable level of effort. It is anticipated that the results of this track will serve as the initial input into the standards development track. The draft procedures developed in this track would be subjected to the process shown in Track 2 to ensure that there is a consensus that the procedures satisfy the needs of all stakeholders.

Figure 1. Approach for Developing a Travel Time Accuracy Evaluation Standard



This track will review past attempts to evaluate travel time-based traveler information systems and identify critical knowledge gaps that have the potential to significantly impact evaluation results. A set of data collection and analysis procedures will be developed and evaluated to demonstrate the feasibility of the draft procedures. The draft procedures will then be forwarded to the standards committee for balloting. The specific tasks in this track are described below.

Review of the State-of-the-Practice – Past evaluations of travel time-based traveler information systems will be reviewed. The purpose of this review will be to define common methodologies used to verify the accuracy of travel time-based traveler information systems. Best practices from past evaluations will be identified, and undesirable methodologies will be noted. This task will also focus on defining any unresolved issues that have the potential to bias an evaluation.

Development of Data Collection and Analysis Plan - A draft model data collection and analysis plan will be developed based on the best practices from the first task. This model plan will develop processes to address the unresolved issues identified during the state-of-the-practice review. Some data analysis using readily available data sets (such as the Houston AVI data) may

also be used to further refine potential data collection and analysis strategies. Some unresolved issues that might be addressed may include:

- Variability in travel time measurements. One potential concern is ensuring that trained drivers doing floating car runs can adequately capture variability in the traffic stream. The data collection plan will examine this issue, including guidance for determining the minimum sample size of probe vehicles and their headways.
- Sampling plan issues. The development of a sampling plan is another area that may merit further investigation. The data collection plan will provide guidance on how to determine which routes to drive and what times of day should be examined. The number of vehicles to be used to sample each time window could also be examined.
- Calculation of ground truth. Specific processes for calculating a ground truth travel time value will be provided. Considerations may include whether instantaneous travel times or link travel times should be used.
- Accounting for error in ground truth estimates. GPS probe vehicles may be subject to positioning error, which could in turn create errors in travel time estimates. Likewise, sampling error could also impact ground truth travel times. The data collection plan will develop detailed procedures on how to account for the impact of these errors in the ground truth estimate, possibly through the construction of confidence intervals.

The stakeholders on the standards committee discussed in Track 2 will also have an opportunity to discuss important issues that should be addressed in the data collection plan. They will be used to help identify other unresolved issues as well as to define parameters to be investigated.

The draft data collection and analysis plan will be developed with two goals in mind: (1) the plan must be methodologically sound and produce an accurate ground truth travel time value for the evaluation and (2) the level of effort to execute the plan must be reasonable. The researchers will attempt to reduce the amount of manpower required to execute the plan wherever feasible.

Following the development of the draft standard, it will be forwarded to the standards committee for comment. An additional round of revision will occur based on the comments received from the committee.

Develop Final Draft of Standard – The draft data collection and analysis plan will be revised based on the results of the comments received. The revised plan will then be forwarded to the standards committee for final discussion and balloting.

TRACK 2: DEVELOPMENT OF A STANDARD

As indicated earlier, standard accuracy evaluation procedures will provide much-needed consistency in the real-time traffic information industry. The standards development tasks will be integrated into the overall project approach (see Figure 1) even though they are presented here as a separate track. The tasks envisioned in this track are as follows:

Make Preliminary Arrangements with Standards Development Organization – The first step in standards development is to identify and make arrangements with the appropriate standards development organization (SDO) which will "sponsor" the activity. The most likely candidate is ASTM International, within which there is a Committee on Vehicle-Pavement Systems (E17) and a Subcommittee on Traffic Monitoring (E17.52). The Traffic Monitoring Subcommittee has been working on a standard for evaluating fixed-point traffic monitoring devices, so a travel time accuracy evaluation standard would fall within their subcommittee scope. Additionally, the ASTM standards process is open to any interested individual. All that is required to vote on a balloted standard is annual membership (currently $75 per person).

Identify and Engage Stakeholders – For the standards development to be most effective, the stakeholders should be identified and engaged early in the process. The stakeholders include public agencies (state DOTs, FHWA, and local agencies) as well as the private sector (data providers, data aggregators, automotive and navigation companies, etc.).

Establish a Working Group and Structure within an SDO – Once it appears there is sufficient interest and the ability to move forward, a working group would be established within the selected SDO. The working group could be another subcommittee within the ASTM E17 Committee, or it could fall under the existing E17.52 Traffic Monitoring Subcommittee.

Conduct Initial Standards Meeting with Stakeholders – An initial "kickoff" meeting will be held (in accordance with SDO procedures for standards development process) with the stakeholders and will include at least these objectives:

- Identify bounds and parameters of standard
- Identify unresolved issues to feed into research project
- Identify preliminary timeline for standard development
- Review ASTM standard development process

Conduct Regular Standards Development Meetings – Once the basic parameters of the envisioned standard has been defined by the stakeholders, periodic (monthly or quarterly) meetings will be held either in person or phone to keep committee members updated on research progress and draft sections of the standard.

Develop Consensus on a Draft Standard – Based on the parallel research track, a draft standard for evaluating travel time accuracy will be developed based on the parameters agreed to by the stakeholders. The SDO's procedures will be used to develop consensus on a draft standard.

Ballot, Revise, and Publish Final Standard – This will be the final task and involves following the SDO's procedures for balloting and publishing a formal standard.

CHANGES IN REVISED SCOPE

This document represents a revised scope of work for this pooled fund project. The initial scope (dated April 2008) included a separate pilot test of the draft methodology using new field data. The pilot test has been removed in the revised scope. Instead, the draft methodology will be evaluated using existing data sets. This should help establish the feasibility of the methodology, while also producing cost savings for the project.

PROJECT BUDGET

The Virginia Department of Transportation has agreed to serve as the lead state in this effort. The Texas Transportation Institute, the University of Virginia, and the Virginia Transportation Research Council would serve as the primary researchers in this effort.

The overall project budget is estimated at approximately $322,000 total over two years. The suggested commitment is $50,000 per state from 7 states. The commitment can be paid all at once or as two payments of $25,000 per year. Table 1 shows the overall project budget broken down by VDOT fiscal year assuming a January 1, 2009 start date. The appendix shows the specific budgets provided by TTI and UVA.

Table 1. Overall Project Budget.

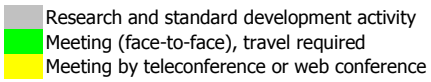
	Fiscal Year 1 (1/09 to 6/09)		Fiscal Year 2 (7/09-6/10)		Fiscal Year 2 (7/10-9/10)		All Fys
	Effort	Extension	Effort	Extension	Effort	Extension	
Labor:							
Research Scientist (Fontaine)	12%	$ 5,630	12%	$ 11,261	12%	$ 2,815	$ 19,706
Additive (40%)		$ 2,252		$ 4,504		$ 1,126	$ 7,882
Services: (Indirect Costs Shown Below)							
TTI Contract (PI: Shawn Turner)		$ 27,779		$ 67,106		$ 19,664	$ 114,549
UVA Contract (PI: Brian Smith)		$ 29,504		$ 62,939		$ 16,718	$ 109,161
Travel:							
Mileage, Lodging, Meals		$ 2,500		$ 2,500			$ 5,000
Indirect Costs: *(University contracts only)*							
TTI Contract		$ 12,725		$ 30,752		$ 9,014	$ 52,490
UVA Contract		$ 3,541		$ 7,553		$ 2,006	$ 13,099
Totals		$ 83,930		$ 186,615		$ 51,342	$ 321,887

SCHEDULE OF ACTIVITIES

The schedule of activities for this scope of work is outlined in Table 2.

Table 2. Schedule of Activities

Research Track	Standards Track	Month after Start of Project
		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Project Kickoff Meeting for Sponsors (phone/web)		
Review and document state of practice	Identify SDO	
Develop working paper with issues to be studied	Identify and engage stakeholders	
Develop draft data collection & analysis plan	Write draft standard and distribute for review	
	Discuss draft standard (phone/web)	
	Revise and distribute second draft	
	Discuss second draft (person)	
	Revise and submit ballot to SDO	
	SDO ballot open for comments	
	Revise SDO standard (meet if necessary)	
	Submit and publish final standard	



APPENDIX: UNIVERSITY OF VIRGINIA AND TTI BUDGETS

Table A-1. University of Virginia Project Budget.

DEVELOPING A STANDARD TEST PROCEDURE FOR TRAVEL TIME DATA QUALITY ASSESSMENT
DRAFT BUDGET
Brian Smith

Revised November 6, 2008

		Year 1 1/1/09 - 12/31/09	Year 2 1/1/10 - 9/30/10	Total
A.	Personnel & Benefits			
	1. B. L. Smith, Principal Investigator			
	5% effort 12 mos. @ $145,900 CY	7,295	5,471	12,766
	Allowance for salary increase	109	191	301
	Fringe Benefits - 26.9%	1,992	1,523	3,515
	2. TBD, Research Scientist			
	10% effort 12 mos. @ $58,000 CY	5,800	4,350	10,150
	Allowance for salary increase	87	152	239
	Fringe Benefits - 26.9%	1,584	1,211	2,795
	3. Graduate Research Assistant			
	88 hrs. mo. x $18.50/hr. x 12 mos./yr.	19,536	14,652	34,188
	Allowance for salary increase	5,255	3,941	9,197
	SUBTOTAL PERSONNEL & BENEFITS	**$41,658**	**$31,493**	**$73,151**
B.	Travel - Domestic	1,750	1,500	3,250
C.	Other Direct Costs			
	1. Health insurance for graduate research assistant	1,976	2,174	4,150
	2. Tuition Remission - In-state tuition remission for graduate research assistant	13,624	14,986	28,610
	TOTAL DIRECT COSTS	**$59,008**	**$50,153**	**$109,161**
D.	F&A (Indirect) Costs - 12% Total Direct Costs	7,081	6,018	13,099
	TOTAL	**$66,089**	**$56,171**	**$122,260**

Table A-2. Texas Transportation Project Budget.

ESTIMATED BUDGET DETAIL

Developing a Standard Test Procedure for Travel Time Data Quality Assessment
Pooled Fund Study with Virginia DOT and University of Virginia
Performance Period: 1/1/2009 to 9/30/2010

A. Salaries and Wages	% Effort	Year 1	Year 2	Est Hrs	Rt/hr	Est. Cost
Names of Principal Staff Members						
Principal Investigator						
Shawn Turner	24.08%	400	480	880	57.73	50802
Professional Staff						
John Wikander	4.60%	120	48	168	30.34	5097
Clerical Support						
Michelle Young	6.57%	120	120	240	17.54	4210
Subtotal		640	648	1288		60109
Summary						
Professional		26732	29167			55899
Clerical/Technical		2105	2105			4210
Subtotal salaries and wages		**28837**	**31272**			60109
Provision for estimated salary escalation each September				0.0306		
Professional		817	891			1708
Clerical/Technical		64	64			128
Total salary escalation		881	955			1836
Total Direct Labor Costs		**29718**	**32227**			**61945**
B. Borrowed Personnel		**0**	**0**			**0**
C. Consultants						
Total Consultants		**0**	**0**			**0**
D. Subcontracts						**0**
Total Subcontracts		**0**	**0**			**0**
E. Capital Equipment		**0**	**0**			**0**
F. Materials and Services						
1. computer services		828	838			1666
2. reproduction		300	750			1050
Total Materials and Services		**1128**	**1588**			**2716**
G. Communications and Shipping						
shipping reports/materials		250	250			500
Total Comm and Shipping		**250**	**250**			**500**
H. Travel						
TTI Travel		5000	5000			
Study Sponsor Travel = 4 meetings (2 each year)		12500	12500			
Total Travel		**17500**	**17500**			**35000**

Table A-2 continued

I. Employee Fringe Benefits			
Employee Fringe Benefits Estimates:			
Staff @ 17.6%	5230	5672	10902
Institutional Medical Insurance Cost			
Staff @ $471 per person/month	1732	1754	3486
Total Fringe	**6962**	**7426**	**14388**
J. Administrative costs @ 46.5% of Modified total direct costs*	**25449**	**27041**	**52490**
K. Fixed Fee	0	0	0
L. Total Cost	**81007**	**86032**	**167039**

BUDGET NOTES:

All facilities and equipment necessary to accomplish the required work are available.
The Texas A&M University System serves people of all ages, regardless of socioeconomic level, race, color, sex, religion, disability or national origin.
A. Clerical salaries are directly charged as the support required is significantly greater than the routine level of services provided by academic departments.
F1. Computer leasing and network support services is an established rate and is not charged indirect.
G. applies to shipping project reports
J. excludes D each part above $25,000, E, F1