PART I –
Candidates for Continuation Funding

PART II –
New Problems
(Statements with Evaluations and Submitter Responses)
INTRODUCTION

In formulating the fiscal year 2020 program for the National Cooperative Highway Research Program, the Special Committee on Research and Innovation will consider candidate studies in two broad categories: (1) continuations of projects initiated in earlier years and (2) new projects. Corresponding to these categories, this report is in two parts.

Part I contains write-ups for 13 continuation candidates. These write-ups were prepared by the NCHRP staff and project panels and provide the specifics of project objectives, funding, accomplishments, and recommendations for needed additional research. The continuations have been further subdivided as follows: Annual Projects (e.g., Project 20-05) and Research Projects (recommended extensions to individual objective-specific projects). You will find ‘Accountability Reports’ attached to continuation requests under the Annual Projects category.

Part II contains 114 problem statements for consideration as new projects. For each candidate problem, the problem statement write-up, which was to be submitted in a format specified by NCHRP, is presented first. The problem statement is then followed by evaluations that may be from among 3 sources: FHWA staff, NCHRP staff, and/or AASHTO committee or council. Lastly, there may be a response from the original submitter to the evaluation comments. Submitters were given the opportunity to support or rebut the evaluations or to withdraw the statement.
ACTIONS REQUIRED

This report is accompanied by a ballot for assigning priorities to both the continuation problems and the new problems. The questions to be considered in completing the ballot are:

a. Does the proposed study represent a current problem that needs researching?

b. Is the proposed study appropriate for NCHRP or should it be performed elsewhere?

c. Is the problem of interest to a majority of states?

d. Are similar efforts already underway elsewhere? If so, will this unnecessarily duplicate the efforts of others?

e. What is the probability of this research being successful?

f. If the research is successful, what is the anticipated return with respect to its cost?

By whatever means research committee members choose to employ, the evaluation of each problem by these questions is to be translated into a single rating number from 0 (no need) to 5 (absolute need) that will be used to rank the problem according to ballots returned by R&I and RAC.

The ballot is due on March 15, 2019, and a summary of the results will be distributed early in April. When R&I meets on April 9 and 10, the order in which continuation candidates and new problems will be considered will be based on the composite rankings by R&I and RAC.
Part I

CANDIDATES FOR CONTINUATION FUNDING
# FY 2020 CANDIDATES FOR CONTINUATION FUNDING

## Table of Contents

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
<th>Funding Request</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Project</strong></td>
<td><strong>Funding Request</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-05</td>
<td>Synthesis of Information Related to Highway Problems</td>
<td>$765,000</td>
<td>1</td>
</tr>
<tr>
<td>20-06</td>
<td>Legal Problems Arising Out of Highway Programs</td>
<td>$350,000</td>
<td>7</td>
</tr>
<tr>
<td>20-24</td>
<td>Administration of Highway and Transportation Agencies</td>
<td>$1,250,000</td>
<td>12</td>
</tr>
<tr>
<td>20-30</td>
<td>NCHRP IDEA Program</td>
<td>$950,000</td>
<td>20</td>
</tr>
<tr>
<td>20-44</td>
<td>Accelerating the Application of NCHRP Research Results</td>
<td>$2,000,000</td>
<td>35</td>
</tr>
<tr>
<td>20-68</td>
<td>U.S. Domestic Scan Program</td>
<td>$1,200,000</td>
<td>42</td>
</tr>
<tr>
<td>20-123</td>
<td>Support for AASHTO Committees and Councils</td>
<td>$475,000</td>
<td>47</td>
</tr>
<tr>
<td><strong>Research Projects</strong></td>
<td><strong>Funding Request</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03-112</td>
<td>Operational and Safety Considerations in Making Lane Width Decisions on Urban and Suburban Arterials</td>
<td>$150,000</td>
<td>51</td>
</tr>
<tr>
<td>15-61</td>
<td>Applying Climate Change Information to Hydrologic and Hydraulic Design of Transportation Infrastructure</td>
<td>$400,000</td>
<td>53</td>
</tr>
<tr>
<td>17-84</td>
<td>Pedestrian and Bicycle Safety Performance Functions for the Highway Safety Manual</td>
<td>$320,000</td>
<td>57</td>
</tr>
<tr>
<td>20-59(49)</td>
<td>Facilitation and Coaching Support for the 50 States Exercise</td>
<td>$450,000</td>
<td>60</td>
</tr>
<tr>
<td>20-102</td>
<td>Impacts of Connected Vehicles and Automated Vehicles on State and Local Transportation Agencies</td>
<td>$1,500,000</td>
<td>67</td>
</tr>
<tr>
<td>22-40</td>
<td>Update to AASHTO M 180-18 and Associated Highway Guardrail Specification</td>
<td>$250,000</td>
<td>72</td>
</tr>
</tbody>
</table>
Continuation Request
Project 20-05, FY 1968 & Continuing
Synthesis of Information Related to Highway Problems

Present Expiration Date: Continuing
Recommended Allocation: $765,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The purpose of NCHRP Project 20-05 is to synthesize the useful knowledge and practice on particular subjects and prepare well documented state-of-knowledge and -practice reports. This is a systematic way to bring such useful information together and to make it available to the entire highway community.

With the rapid advancements that are taking place in highway and transportation planning, location, design, construction, maintenance, and operations, and as result of the broad spectrum of information input to these fields from a multitude of sources, it is imperative that a means of synthesizing this information into usable form be maintained and augmented. This service has been provided since 1967 through NCHRP Project 20-05 under the guidance of Project Panel SP20-05 and has been highly responsive to the needs of highway and transportation organizations. The synthesis program continues to be highly rated by R&I and RAC and has consistently been ranked as a very high priority.

An appreciation of the topics that have been assigned for synthesis preparation may be gained from a reading of Research Results Digest 402 (http://www.trb.org/Publications/Blurbs/177137.aspx) or by visiting the NCHRP website. The substantial interest that the program has generated is evidenced by the number of subjects that are proposed for synthesis each year—typically between 120 and 150. As of November 30, 2018, 528 syntheses had been published, two reports are in the final editorial and publication process, and 30 others are in the research stage. A review of TRB’s web page shows that 14 NCHRP synthesis studies were published in 2018.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

For the FY2019 series, the NCHRP 20-05 project committee requested and AASHTO R&I approved a budget of $1,830,000 to execute 15 topics. The budget recommended by the NCHRP 20-05 project committee for FY 2020 is $765,000 to support 17 topics. The NCHRP 20-05 project committee recommended increasing the number of topics
from 15 to 17 during its meeting on April 30 – May 1, 2018. Note that beginning in FY 2020, funds reflect the amount for research contracts only.

3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuation allocation</td>
<td>33,860</td>
<td>1,750</td>
<td>1,750</td>
<td>1,830</td>
<td>1,830</td>
<td>1,830</td>
</tr>
<tr>
<td>Transferals to proj. 20-05</td>
<td>1,375**</td>
<td>345**</td>
<td>120**</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Less obligation</td>
<td>35,235</td>
<td>2,095</td>
<td>1,870</td>
<td>1,830</td>
<td>1,830</td>
<td>1,830</td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Total available</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Recommended addition</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>765***</td>
</tr>
</tbody>
</table>

*Annual funding allocations ranged from $1.0M to $1.5M.
**These transfers were for additional synthesis projects funded by R&I from among their regular NCHRP problem statement submissions.
***Beginning in FY 2020, funds reflect the amount for research contracts only.

4. Interpretation of AASHTO Problem Statement by Panel

Administrators, practicing engineers, and researchers are continually faced with highway problems on which much information already exists, either in documented form or in terms of undocumented experience and practice. Unfortunately, this information is often fragmented, scattered, and unevaluated. Often it is unknown to the persons normally responsible for initiating changes related to the topic (changes in specifications, procedures, etc.). As a consequence, full information on what has been learned about a problem is frequently not brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

Another type of waste occurs if a number of people who have similar problems make independent efforts to assemble the appropriate information, especially if the assemblies are incomplete and not made available to others.

Textbooks, monographs, and state-of-the-art papers represent conventional methods for maximizing the use of existing information and for minimizing the total effort expended in bringing together useful information. All such documents involve the synthesis of information from various sources and can, therefore, be looked upon as information syntheses.
In this project, particular highway problems, or sets of closely related problems will be designated as topics for information syntheses. For each topic, the project objectives are: (1) To locate and assemble all documented information on the topic; (2) To learn what the practice has been for solving or alleviating problems within the topic; (3) To identify all ongoing research on the topic; (4) To learn what problems remain largely unsolved; (5) To organize, evaluate, synthesize, and document the useful information that is acquired; and (6) To evaluate the effectiveness of the synthesis after it has been in the hands of its users for a period of time.

The document produced by attainment of the foregoing objectives will be called a synthesis of existing information on the topic. The first and third objectives imply full use of the Transportation Research Database (TRID) and other information systems for documented information. It is expected that information obtained for the second and fourth objectives will be largely undocumented and will, therefore, be obtained through interviews in federal, state, and local agencies that have had first-hand experience with problems within the topic.

5. Original AASHTO Problem Statement Number

Problem Statement is on file.

6. Research Assignment to Date

NCHRP Project 20-05, "Synthesis of Information Related to Highway Problems" (see NCHRP Research Results Digest 402 for a list of prior synthesis topics).

7. Review Dates

April 30 – May 1, 2018 (Panel/staff)
# Accountability Report for NCHRP Project 20-05

“Synthesis of Information Related to Highway Problems”

<table>
<thead>
<tr>
<th>Purpose:</th>
<th>To provide summaries of the state of highway practice and knowledge.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Started:</td>
<td>Project 20-05 began in 1968.</td>
</tr>
</tbody>
</table>
| Funding: | Allocated for FY 2019: $1,830,000  
Requested for FY 2020: $ 765,000* |
| *Beginning in FY 2020, funds reflect the amount for research contracts only. |
| Problem Solicitation: | Once each year, NCHRP specifically solicits topics from state DOTs, AASHTO and TRB committees, and FHWA. TRB staff also encourages submittals by TRB committees during the TRB annual meeting. Topics for FY 2020 are due by February 16, 2020. |
| Process for Selecting Studies: | Requests are considered at an annual meeting of the 20-05 panel, and a list of topics and alternates are selected. |
| Consultant Selection: | The synthesis program is managed by staff in TRB’s National Cooperative Highway Research Program. Each year’s new studies are announced publicly (NCHRP email list and the TRB E-Newsletter) to solicit interest in being a topic panel member or an author. Staff then forms a topic panel for each selected synthesis. The topic panel reviews expressions of interest and selects authors. |

### Last Year:

| Studies Requested | 119 topics for the FY2018 program. |
| Studies Funded | 15 studies, totaling $1,830,000 were funded in 2018 (see attachment A). |
| Studies Completed | 15 NCHRP Syntheses were completed in calendar year 2018. |
| Distribution of Findings: | NCHRP syntheses are distributed widely by TRB to sponsors, subscribers, and affiliates. All NCHRP synthesis reports are posted on the TRB website as well. |

Next Year’s Studies: FY2019 studies will be selected in May 2019 from topics submitted to the committee by February 16, 2019. FY 2020 studies will be selected in May 2020.
## NCHRP SYNTHESIS TOPICS INITIATED in 2018

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic 50-01</td>
<td>Advancements in the Use of Geophysical Methods for Transportation Projects</td>
</tr>
<tr>
<td>Topic 50-02</td>
<td>Highway Hydraulic Engineering State of Practice</td>
</tr>
<tr>
<td>Topic 50-03</td>
<td>Use of Weigh-in-Motion Data for Improving Pavement, Bridge, Weight Enforcement, and Freight Logistics Practices</td>
</tr>
<tr>
<td>Topic 50-04</td>
<td>Utility Pole Safety and Hazard Evaluation Approaches</td>
</tr>
<tr>
<td>Topic 50-05</td>
<td>Incorporating Access Management into Local Ordinances</td>
</tr>
<tr>
<td>Topic 50-06</td>
<td>Advances in Unstable Slope Instrumentation and Monitoring</td>
</tr>
<tr>
<td>Topic 50-07</td>
<td>Electronic Ticketing of Materials for Construction Management</td>
</tr>
<tr>
<td>Topic 50-08</td>
<td>Emerging Challenges to Tolling on Managed Lanes</td>
</tr>
<tr>
<td>Topic 50-09</td>
<td>Performance-Based Pavement Warranty Practices</td>
</tr>
<tr>
<td>Topic 50-10</td>
<td>Availability and use of Pedestrian Infrastructure Data to Support Active Transportation Planning</td>
</tr>
<tr>
<td>Topic 50-11</td>
<td>Alternative Intersection Design and Selection</td>
</tr>
<tr>
<td>Topic 50-12</td>
<td>Development and Use of As-Builts Plans by State DOTS</td>
</tr>
<tr>
<td>Topic 50-13</td>
<td>Estimating and Contracting Rock Slope Scaling Adjacent to Highways</td>
</tr>
<tr>
<td>Topic 50-14</td>
<td>Practices for Fabricating Asphalt Samples for Testing in Laboratories</td>
</tr>
<tr>
<td>Topic 50-15</td>
<td>Asset Management Approaches to Identifying and Evaluating Assets Damaged Due to Emergency Events</td>
</tr>
</tbody>
</table>
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

Numerous legal and right of way problems affecting the operations and the services and facilities provided by state transportation agencies have been researched since the beginning of the project. Results are made available to state transportation departments and other public and private agencies through publication of *Legal Research Digests* and *Selected Studies in Transportation Law (SSTL)*. SSTL is jointly sponsored with TRB’s Transit Cooperative Research Program and is comprised of the following volumes:

- *Volume 1 Construction Contract Law* (NCHRP)
- *Volume 2 Eminent Domain* (NCHRP)
- *Volume 3 Environmental Law and Transportation* (NCHRP)
- *Volume 4 Tort Liability* (NCHRP)
- *Volume 5 Transit Law* (TCRP)
- *Volume 6 Transit Labor 13(c) Decisions* (TCRP)
- *Volume 7 Transit Charter Bus Service: Decisions and Documents* (TCRP)
- *Volume 8 Transportation Law and Governmental Relations* (NCHRP)

The Project Committee last met on November 8 and 9, 2018. The next project panel meeting is scheduled for October 2019. At the last meeting of the panel, the status of the legal studies program was reviewed and, given the available funds, 7 new topics were chosen for study. No updates of SSTL were recommended in this cycle.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The requested $350,000 will provide resources necessary to update another volume of SSTL if necessary, select 5 to 7 new studies to reflect current and important legal problems facing state DOTs, and administer the current topics under study.

The Committee meets annually. The next meeting will be held in October of 2019.

3. Funds (in thousands)
<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Continuation Allocation</th>
<th>Less Obligation</th>
<th>Balance (earmarked)</th>
<th>Reallocation</th>
<th>Total Available</th>
<th>Recommended Addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 2003-2009</td>
<td>775</td>
<td>390*</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2010</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2011</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2012</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2013</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2014</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2015</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2016</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2017</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2018</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2019</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>FY 2020</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
</tbody>
</table>

* $90K was provided by NCHRP Project 20-59

4. Interpretation of AASHTO Problem Statement by Panel

There is a continuing need for State Highway Departments to assemble, analyze, and evaluate legal elements of special problems involving right of way control, tort liability, environmental and other aspects of highway law in general. NCHRP Project 20-06 fills a need for research in these areas which traditionally have not received adequate attention and focus elsewhere.

5. Original AASHTO Problem Statement Number

Problem No. 1969-A-01 on file

6. Research Assignment to Date

NCHRP Project 20-06, "Legal Problems Arising out of Highway Programs" (See the NCHRP website at www.trb.org/nchrp).

7. Review Date

4 December 2018
Accountability Report for NCHRP Project 20-6
“Legal Problems Arising out of Highway Programs”

Purpose: To evaluate legal issues relevant to transportation programs.
Started: Project 20-6 began in 1969.
Funding: Allocated in 2019: $350,000
Requested in 2020: $350,000

Problem Solicitation: The Committee members and TRB’s Counsel for Legal Research maintain contact with the TRB legal committees and the annual TRB Laws Conference for needed studies. Prior to Committee meetings, members are asked to submit topics of interest to them or as gathered from the various TRB legal committees.

Process for Selecting Studies: Requests are considered at an annual meeting of the 20-06 project Committee. The Committee is comprised of members of the transportation legal community.

Consultant Selection: The NCHRP Project Committee provides oversight, selects topics, reviews reports, and approves consultants and their proposals. In consultation with the Committee, depending on the size and topic area, the Program Manager recommends the type of procurement, i.e. sole-source or competitive proposals from a short list of known experts or from a general solicitation.

Current Studies: 9 topics. See Attachment A
Studies Funded Last Cycle: 7 topics. See Attachment A, In Development

Studies Completed Last Year: 1 topic. See Attachment A

Distribution of Findings: Legal studies are published in the NCHRP Legal Research Digest series and/or as contributions to Selected Studies in Transportation Law. Digests are distributed widely by TRB to sponsors, subscribers, and affiliates based on expressed interest areas. Selected Studies are provided to state DOT legal counsels and FHWA and to others on request.

Use of Findings: Results are used by transportation legal counsels and engineers as a reference and for training/educating new employees.

Next Year’s Studies: The 20-6 Committee remains open to suggested topics; primary sources will be issues discussed at the 2019 TRB Legal Conference and those developed by the NCHRP Committee at its next meeting based on personal experiences and recognition of current problems.
# ATTACHMENT A

## RECENTLY COMPLETED TOPICS

<table>
<thead>
<tr>
<th>Study Topic 22-03 (LRD 73)</th>
<th>Primer on Patentability and Use of Ideas Developed by Contractors Performing Work for State and Federal Transportation and Local Planning Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Topic 22-02 (LRD 74)</td>
<td>Liability of State Departments of Transportation for Design Errors</td>
</tr>
<tr>
<td>Study Topic 22-01 (LRD 75)</td>
<td>Legal Requirements for State Transportation Agency Participation in Conversation Plans</td>
</tr>
</tbody>
</table>

## ACTIVE TOPICS

<table>
<thead>
<tr>
<th>Study Topic 23-01</th>
<th>Condemnation Hierarchy-Competing Public Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Topic 23-04</td>
<td>The Effectiveness of State False Claims Acts in Protecting State Transportation Funding</td>
</tr>
<tr>
<td>Study Topic 23-06</td>
<td>Update of Selected Studies in Transportation Law: Volume Eight, Section 1: Transportation Agencies and Civil Rights</td>
</tr>
<tr>
<td>Study Topic 24-01</td>
<td>Buy America Requirements For Federal Highway Projects</td>
</tr>
<tr>
<td>Study Topic 24-02</td>
<td>Potential Liability Associated with Unstable Slope Management Programs</td>
</tr>
<tr>
<td>Study Topic 24-03</td>
<td>Guidelines for Drafting Liability Neutral Transportation Engineering Documents</td>
</tr>
<tr>
<td>Study Topic 24-04</td>
<td>The Legal Issues Concerning the Use of Transportation Facilities to Generate Revenue for State DOTs”</td>
</tr>
</tbody>
</table>

## COMPLETED

| Study Topic 23-05 | Update-Volume Eight, Section 3: Indian Transportation Law |

## IN DEVELOPMENT

<table>
<thead>
<tr>
<th>Study Topic 25-01</th>
<th>Public Liabilities Relating to Driveway Permits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Topic 25-02</td>
<td>Summary of Unmanned Aircraft Systems (UAS) Rules &amp; Regulations for DOTs</td>
</tr>
<tr>
<td>Study Topic 25-03</td>
<td>Managing Enhanced Risk In The “Mega Project” Era</td>
</tr>
<tr>
<td>Study Topic 25-04</td>
<td>Laws Governing Homeless Encampments in Transportation Rights of Way</td>
</tr>
<tr>
<td>Study Topic 25-05</td>
<td>Damages Limitations and Waiver Provisions in Construction Contracts</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Study Topic 25-06</td>
<td>Legal Aspects Of Best-Value Procurement For Highway Construction</td>
</tr>
<tr>
<td>Study Topic 25-07</td>
<td>A Review of Case Law on Planning and Environmental Linkages</td>
</tr>
</tbody>
</table>
Cont
inuation Request
Project 20-24, FY 1988 & Continuing
Administration of Highway and Transportation Agencies

Present Expiration Date: Continuing
Recommended Allocation: $1,250,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objectives of NCHRP Project 20-24 are to (1) identify critical problems facing top management officials in state highway and transportation agencies and AASHTO and (2) design and conduct research projects to address those problems. Fiscal year allocations are used to fund projects selected by NCHRP Panel SP20-24 in response to initiatives of interest to state DOT and AASHTO leadership.

The NCHRP Panel currently meets at least twice a year, typically in conjunction with the AASHTO Annual and Spring meetings, with teleconferences as needed to address specific matters. At the two in-person meetings, the panel considers new topics for research, reviews progress on individual studies and the 20-24 project series as a whole, and discusses current issues facing DOTs and top AASHTO leadership. Recent funding has been used to address state DOT strategic management issues, system performance measurement and management, agency capabilities and workforce, transportation funding mechanisms. Section 6 contains a comprehensive listing of project titles.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

Interest in the "20-24 series" concept remains high among top management of state DOTs and the leadership of AASHTO. State DOT leadership generally as well as the AASHTO Board of Directors and staff have a continuing need for research to produce factual information and analysis in support of their strategic planning and current decision making to address such critical issues as change and uncertainty in revenues and financing mechanisms, travel demand, balance between federal and states’ roles in system management, and workforce development. The project panel requests $1,250,000 to maintain their efforts to address these continuing research needs. As in previous years, the NCHRP 20-24 panel is expected to convene at the AASHTO Spring Meeting and again in conjunction with the Annual Meeting to select new initiatives and review the status of the 20-24 series and current and recently completed projects.

3. Funds (in thousands)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial allocation</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuation allocation</td>
<td>600</td>
<td>1,825</td>
<td>500</td>
<td>400</td>
<td>9,500</td>
<td>11,250</td>
</tr>
<tr>
<td>Less obligation</td>
<td>725</td>
<td>1,750</td>
<td>500</td>
<td>400</td>
<td>9,500</td>
<td>11,105b</td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>-0-</td>
<td>75</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>145b</td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td>75</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Total available</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Recommendation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,250</td>
<td></td>
</tr>
</tbody>
</table>

a $1M per year for FY 2002-2009, $1.5M for FY 2010; $1.25M per year for FY 2011-2019
b Obligation of funds based on panel’s 9/22/2018 meeting; strategic initiatives pending

4. Interpretation of AASHTO Problem Statement by Panel

At a special session held during the 1986 Annual Meeting of the Transportation Research Board (TRB) a number of Chief Administrative Officers (CAOs) from state departments of transportation identified areas of concern in the management of transportation agencies. Economic considerations and management of financial resources were judged to be the most important areas. Others included the management of people, information systems, public affairs, and technology transfer. In each area discussed, problems were identified that are in need of research. At the same meeting, members of the academic community reported the findings of the NSF seminar on "Transportation Research: The State of the Art and Research Opportunities." Although their recommendations called for more fundamental research, some of the problems identified were very similar to those listed by the CAOs.

As a consequence, a need was recognized for a research program specifically directed to the management, administration, and policy planning needs of senior management of state transportation agencies. Accordingly, the AASHTO Standing Committee on Research directed that a study be undertaken under the NCHRP to develop a plan for research focused on these needs.

5. Original AASHTO Problem Statement Number

Problem No. 1988-A-08

6. Research Assignments to Date

NCHRP Project 20-24 "Research Program Design -- Administration of Highway and Transportation Agencies"
NCHRP Project 20-24(01) "Using Market Research to Improve Management of Transportation Systems"
NCHRP Project 20-24(02) "Executive Management Information Systems for State Departments of Transportation"
NCHRP Project 20-24(03) "Expanding the Civil Engineering Pool"
NCHRP Project 20-24(05) "Public Outreach in Transportation Management"
NCHRP Project 20-24(06)A "Performance Measures Used by State Highway and Transportation Agencies"
NCHRP Project 20-24(06)B "Business Systems Plan for Highway Engineering Information" NCHRP NCHRP Project 20-24(06)C "Information Systems for Transportation Agencies"
NCHRP Project 20-24(07) "Alternatives to Motor Fuel Taxes for Financing Surface Transportation Improvements"
NCHRP Project 20-24(07)A "Alternative Approaches to Taxation of Heavy Vehicles"
NCHRP Project 20-24(08) "Project 20-24 Series -- Revisited" (Completed -- Agency report)
NCHRP Project 20-24(09) "State Departments of Transportation: Strategies for Change"
NCHRP Project 20-24(10) "Customer-Based Quality in Transportation"
NCHRP Project 20-24(11) "AASHTO Guide for Asset Management"
NCHRP Project 20-24(12) "Issues Involving Delays in Completing Federal-aid Highway and Bridge Projects"
NCHRP Project 20-24(13) "Innovative Financing Clearinghouse"
NCHRP Project 20-24(14) "Managing Change in State Departments of Transportation: Topic Scans"
NCHRP Project 20-24(15) "AASHTO Support Activities for Reauthorization"
NCHRP Project 20-24(16) "AASHTO Experience in Transportation Enhancements"
NCHRP Project 20-24(17) "National Conference on Historic Preservation"
NCHRP Project 20-24(18) "Outsourcing of State DOT Delivery of Capitol Programs"
NCHRP Project 20-24(19) "How State DOTs Can Learn to Thrive in an E-Business Environment"
NCHRP Project 20-24(20) "Transportation Outcomes and Other Strategic Performance Impact Measures: A Framework for State Departments of Transportation"
NCHRP Project 20-24(21) "Characteristics of the 21st Century Operations-Oriented State DOT"
NCHRP Project 20-24(22) "Best Practices in Partnering with Public Resource Agencies"
NCHRP Project 20-24(23) "Assessing the Importance of Transportation for Major Industries and Sectors of the U.S. Economy" -- A. Agriculture; B. International Trade; C. Congestion; D. Travel, Tourism, and Recreation
NCHRP Project 20-24(24) "Transportation Mobility, Access, and Safety for an Aging Population"
NCHRP Project 20-24(25) "Improving Project Costing and Incorporation of New Attributes -- Highways and Transit"
NCHRP Project 20-24(26) "Finance Trends in Non-Federal Funding and Debt
NCHRP Project 20-24(27) "Expanded State and National Investment Analysis Capability -- Highway"
NCHRP Project 20-24(28) "Rate of Return from Highway Investment" (Final report overdue)
NCHRP Project 20-24(29) "CEO Peer Exchange Workshop for Strategic Leadership"
NCHRP Project 20-24(30) "Performance Measurement in Context Sensitive Design"
NCHRP Project 20-24(31) "Financial Management for Effective Program Management"
NCHRP Project 20-24(32) "New CEO Briefings"
NCHRP Project 20-24(33)A "21st Century Freight Mobility"
NCHRP Project 20-24(33)C "Transportation Vision 2010" (Active)
NCHRP Project 20-24(34) "Commuting-in-America Reporting Base"
NCHRP Project 20-24(35) "Communicating Urban Congestion Information"
NCHRP Project 20-24(36) "Updating AASHTO's Strategic Plan in CY 2004"
NCHRP Project 20-24(37) "Five Workshop Sessions to Discuss Strategic Measures for State DOTs" Strategic Performance Measures for State DOTs)
NCHRP Project 20-24(37)A “Construction Project Cost and Schedule Performance”
NCHRP Project 20-24(37)B “Pavement Smoothness”
NCHRP Project 20-24(37)C “Safety “
NCHRP Project 20-24(37)E “Bridge Conditions”
NCHRP Project 20-24(37)F “Establishment of Comparative Performance Measures program infrastructure to support national system performance data collection and analysis”
NCHRP Project 20-24(37)G “Standards and guidance for national level performance measurements”
NCHRP Project 20-24(37)H “Workshop on transportation-system performance measures suitable for national use”
NCHRP Project 20-24(37)I “Congestion (speed-based measures)”
NCHRP Project 20-24(37)J “Pavement health (composite/structural measures)”
NCHRP Project 20-24(37)K “Safety - Serious Injuries”
NCHRP Project 20-24(38) "CEO Engagement Options for Discussing Strategic Issues and Sharing Best Practices"
NCHRP Project 20-24(39) "Alternative Organizational Designs for State Transportation Departments" NCHRP Project 20-24(40) "Analysis and Benchmarking of State DOT Human Resource Activities" NCHRP NCHRP Project 20-24(41) "Project Summaries for state DOT CEOs"
NCHRP Project 20-24(42) "Comparison of State DOT Quality Management Systems"
NCHRP Project 20-24(43) "Innovative Contracting for Major Transportation Projects"
NCHRP Project 20-24(44) "Highway Safety Leadership Organizational Issues: A Survey of States and Recommendations for Sustaining Progress"
NCHRP Project 20-24(45) "Executive Seminar, Coordinating Transportation and Land Development: Outlook, Challenges, Success"
NCHRP Project 20-24(46) "Freight Transportation: New Roles for State DOTs"
NCHRP Project 20-24(47) "Benchmarking Diversity in the Transportation Industry: A Scoping Study"
NCHRP Project 20-24(48) “Analysis and Benchmarking of State DOT Human Resource Activities (Ph. 2)"
NCHRP Project 20-24(49) “Future Financing to Meet Highway and Transit Needs”
NCHRP Project 20-24(50) “In-Service Training Needs for State DOTs”
NCHRP Project 20-24(52) “Future of the National System of Interstate and Defense Highways”
NCHRP Project 20-24(53) “Twenty-first Century Leadership and Management Techniques for State DOTs”
NCHRP Project 20-24(55) “National Summit for Funding and Finance Strategies”
NCHRP Project 20-24(56) “State and Local Officials: To Advance a Vision for the Transportation System Required to Meet Future Needs”
NCHRP Project 20-24(57) “Management and Leadership Information for a Dialogue with New State DOT CEOs”
NCHRP Project 20-24(58) “Toward Developing Performance Based Federal-Aid Highway Programs”
NCHRP Project 20-24(59) “Strategies for Reducing the Impacts of Surface Transportation on Global Climate Change”
NCHRP Project 20-24(60) “Updating AASHTO’s Strategic Plan in CY 2008”
NCHRP Project 20-24(62) “The Identification of Marketing Tools that Resonate with Lawmakers and Key Stakeholders to Support and Increase Funding and Revenue for the Nation’s Transportation System”
NCHRP Project 20-24(63) “Partnership Approaches to Identify, Promote, and Implement Congestion Management Strategies”
NCHRP Project 20-24(64) “Implications for Transportation of a Conformity-Style Approach to Reduce Greenhouse Gases, and Assessment of Alternative Policies to Integrate GHG Objectives into Transportation Decisions”
NCHRP Project 20-24(69) “Implementable Strategies for Shifting to Direct Usage-Based Charges for Transportation Funding”
NCHRP Project 20-24(75) “Development of a Performance Management Roadmap”
NCHRP Project 20-24(77) “Support for a TRB-sponsored conference on Strategies for Meeting Critical Data Needs for State and Metropolitan Transportation Agencies”
NCHRP Project 20-24(78) “Integrating Performance Measures into a Performance-Based Planning and Programming Process”
NCHRP Project 20-24(80) “Assessing the Economic Benefit of Transportation Infrastructure Investment in a Mature Surface Transportation System”
NCHRP Project 20-24(81) “Leading in Lean Times: Maximizing Resources in a Constrained Environment
NCHRP Project 20-24(82) “Increasing Consistency in the Highway Performance Monitoring System for Pavement Reporting”
NCHRP Project 20-24(83) “Alternative State DOT Organizational Models for Delivering Services”
NCHRP Project 20-24(84) “State DOT CEO Leadership Forum- Summer/Fall 2012, a Focus on State DOT Current Organizational and Management Issues”
NCHRP Project 20-24(85) “Scoping support for new NCHRP 20-24 projects”
NCHRP Project 20-24(87) “State DOT Administration of Local Road Safety Aid”
NCHRP Project 20-24(88) “Performance Measure Coordination, Engagement and Reporting”
NCHRP Project 20-24(89) “Role and Value of Transportation for U.S. Industries and Sectors”
NCHRP Project 20-24(90) “Defining and Communicating a National Vision for Transportation”
NCHRP Project 20-24(91) “State DOT CEO Safety Leadership Forum -- May 2013 (Support)”
NCHRP Project 20-24(93)B(02) “Improving Public Communication Influence and Effectiveness Through Better Understanding of Transportation Users’ Expectations and Language – Management Outreach”
NCHRP Project 20-24(95) “Next Generation Workforce Management”
NCHRP Project 20-24(96) “Improving Organizational Traffic Safety Culture in DOTs”
NCHRP Project 20-24(99) “New CEO Orientation and Peer Exchange on Teamwork Between an Agency CEO and a Transportation Board or Commission”
NCHRP Project 20-24(100) “State DOT CEO Leadership Forum – a Focus on Transportation Futures”
NCHRP Project 20-24(101) “An Introduction to Knowledge Management and Workforce Issues for CEOs: A CEO Leadership Workshop”
NCHRP Project 20-24(102) “Executive Strategies to Deliver Practical Design”
NCHRP Project 20-24(103) “Peer Exchange on Issues and Communication to Support Economic Competitiveness through Transportation Investments”
NCHRP Project 20-24(104) “State DOT Implementation of MAP21 Performance Measure Rules”
NCHRP Project 20-24(105) “Launching U.S. Transportation Enterprise Risk Management Programs”
NCHRP Project 20-24(107) “Update to Transportation Governance: A 50-State Review of State Legislatures and Departments of Transportation”
NCHRP Project 20-24(108) “CEO Leadership Peer Exchange”
NCHRP Project 20-24(109) “Research on Enhancing Transportation System Resilience”
NCHRP Project 20-24(110) “Development of Resources to Support State DOT Communications on Safety”
NCHRP Project 20-24(111) “State DOT CEO Leadership Forum on “Connected & Autonomous Vehicles and Transportation Infrastructure Readiness” in conjunction with 2017 ITSWC, Montreal, Canada”
NCHRP Project 20-24(112) “Connected Road Classification System (CRCS) Concept Development”
NCHRP Project 20-24(113) “CEO Peer Exchange 2017”
NCHRP Project 20-24(114) “Supplement to NCHRP 20-07 New project on “flexible” or “urban” design, “Green Book” update”
NCHRP Project 20-24(115) “Development of Strategic Plan for Transportation Workforce Planning and Development”
NCHRP Project 20-24(117) “TSMO Workforce Development”
NCHRP Project 20-24(118) “Strategic Planning Support for AASHTO Committees”
NCHRP Project 20-24(119) “Strategic Research in Support of the Connected and Automated Vehicle Executive Leadership Team”
NCHRP Project 20-24(121) “Road Usage Charge: Applying Lessons Learned in New Zealand to the United States”
NCHRP Project 20-24(122) “A Comprehensive Study of Future Competencies for Transportation Planners”
NCHRP Project 20-24(123) “Roadmap for Supporting Specialty Personnel Recruitment, Development, and Retention in the DOT Workforce”
NCHRP Project 20-24(125) “Scoping Study to Develop the Basis for a Highway Standard to Conduct an All-Hazards Risk and Resilience Analysis”
NCHRP Project 20-24(126) “National Automation Readiness Framework: Coast-to-Coast Automated Mobility by 2025”
NCHRP Project 20-24(127) “Performance Management Implementation Concerns, Issues and Challenges”
NCHRP Project 20-24(129) “CEO Peer Exchange 2019”

7. Review Date

22 September 2018
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

IDEA (Innovations Deserving Exploratory Analysis) is a unique concept to traditional transportation research programs. IDEA seeks out proposals from entrepreneurs, inventors, forward thinkers, and problem solvers -- anybody who has a possible solution to a vexing transportation problem. IDEA makes a general solicitation, unlike most transportation research solicitations where competitive proposals are requested on a specific topic and objective.

Two types of IDEA projects, designated Type 1 and 2, are funded. Type 1 projects address technical feasibility of the proposed concepts and Type 2 projects deal with prototyping. The maximum funding for a Type 1 project is $150,000 and for a Type 2 $100,000. Additional funding from other sources as cost sharing is encouraged but not mandatory for Type 1 projects but is required (at least a 50% match) for Type 2 projects.

The NCHRP Project SP 20-30 Panel provides oversight to the NCHRP-IDEA Program. The Panel also evaluates proposals and, based on available funding, selects those with most merit. The selected proposals are then funded, recognizing the high degree of risk but also the potential for scientifically-founded solutions that have high value to transportation practice. The Project Panel meets twice a year to make new IDEA selections and review follow-on requests. The meeting is held in June and December every year. To date, the NCHRP-IDEA Program has awarded 210 contracts, out of which 184 have been completed or closed out, 20 are currently active, and 6 are in the contracting process. Ongoing activity for the NCHRP-IDEA Program can be found on the NCHRP website under the Project SP 20-30.

The NCHRP-IDEA Program's annual report, New IDEAs for Highway Systems, is published every January for the preceding fiscal year. The report summarizes research performed on NCHRP-IDEA projects active or completed during a particular fiscal year along with one-page summaries of all previously completed projects. The report for FY 2018 is currently under preparation and will be available in January 2019. The report is now being published electronically.
The product development process encompasses many steps and may also require substantial resources. An IDEA project is only intended to help initiate this process -- give it a jump start. Before a product is implemented, it usually must go through further development and refinement, testing and evaluation, commercialization, and marketing. These phases can be quite involved and resource-intensive. Following is a sample listing of the NCHRP-IDEA projects in three categories. The first category includes products known to be available in the marketplace. The second category includes completed projects that have known follow-on activity, most likely being applied on a trial or experimental basis. The third category includes active projects that are likely to continue beyond the NCHRP-IDEA contract.

**Products in the Marketplace**

- A sacrificial anode system using sprayed zinc for protecting reinforcing steel (acting as the cathode) from corrosion in marine bridge substructures – Project #3
- A composite material layer system called, Interlayer Stress Absorbing Composite (ISAC) that helps eliminate or mitigate reflection cracking in asphalt concrete overlays – Project #6
- An organic compound-based additive that inhibits corrosion of reinforcing steel and waterproofs the concrete – Project #13
- A bridge-mounted automated de-icing system to prevent snow and ice on bridge decks – Project #27.
- A dual phase ferritic martensitic (DFM) steel with improved mechanical properties and corrosion resistance – Project #28
- Lightweight composite bridge made of fiberglass-reinforced polymer honeycomb structural panels – Projects #30 and 46
- A low-cost asphalt pavement density measuring device based on capacitance energy dissipation as a rapid, convenient, and safe alternative to the nuclear gauge – Projects #32 and 47
- A high strength and lightweight hybrid composite beam for bridge structures consisting of an outer fiber-reinforced plastic shell, a compression reinforcement and a tension reinforcement – Project #60
- The application of horizontal wick drains to stabilize slopes and landslides – Projects #57 and 76
• An automated computer controlled image analysis system for measuring aggregate shape characteristics – Projects #77 and 114

• Test methods, based on fracture mechanics, for predicting low temperature performance of asphalt binders – Projects #84 and 104

• A palm-sized video event data recorder (DriveCam) that monitors driving activity by continuously recording video of the roadway, audio, and acceleration/deceleration forces into a digital looping memory – Project ITS #84

• The adaptation of self-compacting concrete (SCC) technology for the U.S. market using domestic concrete-making materials and practice for use in highway structures – Project #89

• A system of vertical composite drains (Earthquake Drains) to dissipate pore pressure to prevent liquefaction during an earthquake – Projects #94 and 103

• A device providing a simple, reliable field-like test for determining thermal cracking temperature of asphalt (Asphalt Binder Thermal Cracking Device) – Project #99

• A hand-held impact echo scanner for non-destructive evaluation of grout /void inside post-tensioned bridge ducts for tendon – Project #102

• A new mobile geophysical method based on electromagnetic induction technology to perform surveys to detect and identify subsurface features and objects for highway-related projects – Project #107

• A real-time hand-held microwave imaging device using smart array antenna for the nondestructive condition evaluation of fiber-reinforced polymer (FRP)-wrapped concrete bridge members (GAP-CAT-110 and 1200) – Project #109

• A portable equipment using a bending plate for rapid measurement of soil modulus for compaction control both in the laboratory and the field – Project #118

• A software system based on 3-D laser scan surveys for the identification, evaluation, and management of unstable highway slopes – Project #119

• A software system consisting of new image pattern recognition algorithms for automatic processing and extraction of information on roadway signs from the roadway video logging images – Project #121

• An accelerometer system based on optical fibers and moiré phenomena to assess structural integrity of highway bridges under traffic, earthquakes, and other dynamic loads – Project #124
• A laser measurement-based technology to improve bridge fabrication quality control by rapid and accurate measurements and reduce overall production costs of steel bridge fabrication – Project #127

• A vehicle-mounted scanner system based on nondestructive evaluation methods such as impact echo, impulse response, spectral analysis of surface waves and acoustic sounding for condition evaluation of concrete bridge decks – Project #132

• Simple test methods to obtain low-temperature creep and strength parameters of asphalt binders and mixtures using small-scale specimens on bending beam rheometer and requiring no additional equipment – Projects #133, 151

• A software package (Bridge Doctor) along with a user’s manual for a baseline-free methodology for real-time structural health monitoring and post-event damage assessment of highway bridges for integrity and safety – Project #137

• A methodology based on vision-based object recognition algorithms and integrated GPS and vision technologies to recognize and warn against intruding vehicles – Project #139

• An asphalt pavement raveling detection system based on an algorithm developed using 3-D line laser imaging technology – Project #163

• A traffic sensor based on computer vision technology (TrafficVision) for use on fixed and pan-tilt-zoom cameras for detecting and tracking vehicles, including motorcycles without the need of having to install additional hardware – Project #140

• A software tool for assessing physico-mechanical properties of subgrade, subbase, and base, and lift layers based on intelligent compaction rollers data during construction – Project #145

• A mobile unit for rapid and reliable measurement of pavement marking retroreflectivity – Project #146

• A low-cost cleaning device using pneumatic power and rotary wire brushes to remove debris and chemicals from cracks and joints prior to sealing treatment – Projects #148, 159

• An advanced laser measurement system (Bridge RLS) to accelerate the bridge retrofit process, reducing the time between identifying repair needs and resuming service on a bridge – Project #153
• Drained timber piling for cost-effective liquefaction mitigation and ground improvement strategy for transportation infrastructure and for improving a structure’s seismic resilience – Project #180

• A simple performance-based indirect tensile asphalt cracking test for asphalt mix design, quality control, and quality assurance – Project #195

Completed Projects with High Implementation/Commercialization Potential

• Basalt fibers and basalt fiber composite rebars made from domestic basalt for use as an alternative to steel fibers and rebars in reinforced concrete – Projects #25, 45, 86

• A lightweight cantilevered fiber-reinforced composite sidewalk for roadway bridges – Project #67

• A geocomposite layer system placed between a base and subgrade to prevent pavement damage by controlling moisture movement in pavement subgrade and base course – Projects #68, 113.

• A mechanical system based on anvil and hammer concept for crushing and recycling concrete pavement. Kansas and Iowa DOTs assisted in testing the prototype – Projects #79, 95

• A robotic safety marker system consisting of mobile signs, cones, lighting and other safety devices to provide safety to workers in the highway work zone – Project #90

• A second generation improved detection control system (D-CS) for enhanced traffic safety at high speed signalized intersections – Project #115

• A field instrument for automated rapid measurement of air permeability of pavement base or subbase – Project #130

• A sensor system for the autonomous monitoring and reporting of highway traffic noise data – Project #131

• An “active confinement” bridge rehabilitation techniques using shape memory alloy (SMA) reinforcement to retrofit concrete columns – Project #135

• A vibration absorbing system based on magnetic dampers to reduce fatigue in traffic signal support structures exposed to excessive wind-induced vibrations – Project #141
• A shape memory polymer-based sealant for use in expansion joints in pavements and bridges capable of preventing adhesive and cohesive failures through a self-healing mechanism, eliminating the need for replacing the sealant – Project #142

• An acoustic emission-based system for rapid and reliable characterization of asphalt binder embrittlement temperatures – Projects #144, 170

• A new class of bridge expansion joints based on shape memory alloys to provide superior resistance to fatigue, dynamic loads, and corrosion – Project #147

• Breakaway posts with new design and energy absorbing capability to enhance the safety performance of W-beam guardrail in frozen soil conditions – Project #149

• An automated real-time quality control aggregate monitoring system based on laser-induced breakdown spectroscopy to characterize aggregate properties – Projects #150, 168

• A rapid and reliable non-destructive method based on long-range ultrasound for inspecting bridge cables – Project #152

• A conductive low-cost, heavy-duty, and environmentally-friendly polymer-based coating system for corrosion protection of structural steel in highway facilities – Project #157

• An ultrasonic hand-held device for measuring cumulative stress at critical highway bridge components – Project #158

• A new “super” weathering, corrosion-resistant, and cost-competitive steel for the transportation infrastructure, including highways, bridges, and buildings – Project #160

• A hand-held device for nondestructively measuring in-situ yield strength of in-service steel gusset plates for use in bridge evaluation and rating – Project #161

• Scour-preventing products (scAUR and VorGAUR) for use on scour-critical bridges – Project #162

• A technique based on laser induced breakdown spectroscopy to rapidly identify and profile the presence and severity of corrosion under layers of coatings on steel structures and the presence of heavy metals imbedded in the coatings – Project #164
• Guidelines for using waste concrete fines (and the associated wastewater) in concrete by developing methods to rapidly characterize fines samples and evaluating the performance of concrete using these recycled materials – Project #166

• A prototype system for georeferenced augmented reality visualization of buried utility geospatial data and real-time monitoring of an excavator’s proximity to buried utilities in its vicinity – Project #167

• An imaging system based on inexpensive off-the-shelf sensors for an automated detection and quantification of pavement defects, including cracks and potholes – Project #169

• Bidirectional-ductile end diaphragm in straight and skewed bridge superstructures to provide resistance to bidirectional earthquake excitations – Project #172

• Asphalt binders and mixtures reinforced with grapheme nano-platelets as a multifunctional pavement material providing enhanced durability, the creep stiffness, and low-temperature flexural strength of asphalt binders and mixtures – Project #173

• A thermal zinc diffusion coating with improved corrosion resistance for concrete reinforcing bar with better ductility and durability than commercial coatings currently in use – Project #174

• A nondestructive test procedure based on the impulse response method for rapid detection of fatigue cracking in auxiliary highway structure anchor rods for timely repair and increased service life of highway structures – Project #175

• A Kelvin Probe (KP) electrode device for a rapid and stable electrode potential mapping for early corrosion detection in concrete steel reinforcement in highway structures – Project #176

• A portable field instrument, based on ultrasonic technology, for in-situ measurement of total stress (both dead and live loads) in steel bridge members – Project #179

• A small specimen geometry for uniaxial dynamic modulus and fatigue testing in asphalt mixture performance tester (AMPT) – Project #181

• Application of biochar to highway soils to increase stormwater infiltration and reduce the quantity and improve the quality (reduced nutrients) of stormwater runoff – Projects #182, 211
• An event simulation and data fusion system for synthesizing individual travel
diaries from multiple passive data sources, including consumer and anonymous
location data – Project #184

• A prototype of CurvePortal, a web interface for extracting horizontal curve
location and geometric information automatically from GIS roadway maps with
improved curve data extraction algorithm – Project #185

• An electrical probe that measures the geometry and integrity of ground
improvement columns (jet grout, soil mixed, auger cast) during construction or
immediately after construction (within 30-60 minutes) – Project #186

• A wireless worker proximity detection and alert sensing system for proactive
safety warning at dynamic roadway work zones – Project #187

• V-connectors for bridge deck-piers and pier-footing joints to provide seismic
isolation while facilitating accelerated bridge construction and retrofit – Project
#188

• A camera-based vision sensor for highly accurate remote, multi-point
measurement of bridge displacements enabled by a robust target tracking
algorithm, an advanced image distortion filter, and a vibration cancellation
technique – Project #189

• A self-contained, portable asphalt rheology tester to monitor the consistency and
uniformity of asphalt binders in real-world product environment – Project #193

**Active Projects Showing Promise**

• A bio-asphalt based on swine manure and crumb rubber as an alternative to
petroleum-based asphalt for highway construction – Projects #171, 194

• Prototype for obtaining automated turning movement counts at signalized
intersections both for exclusive and shared lanes using vehicle trajectory data
(obtained from an existing vehicle detection system) for improved traffic safety
and operation – Projects #177, 198

• A class of renewable biopolymers for use in asphalt pavements. The developed
polymers are expected to be used turnkey in asphalt production and construction
facilities – Project #178

• An integrated remote-sensing system based on radio frequency identification
(RFID) technology for monitoring, inspection, and life estimation of hydraulic
structures for developing an effective scour countermeasure strategy – Project #183

• A new type of self-de-icing LED signals for highway and railroad intersections as replacement for existing LED signal lights that are too cool to deice or melt snow and may cause accidents in snowy conditions – Project #190

• Development of equipment and software for advanced automation of ultrasonic testing of bridge members – Project #191

• Microbial-facilitated soil stabilization to mitigate volume changes in expansive pavement subgrades – Project #192

• A sensor-based inexpensive system for monitoring tension in anchor bolts in support structures for highway signs, luminaires, and traffic signals – Project #196

• Development and evaluation of hexagonal boron nitride reinforced multifunctional concrete for transportation infrastructure applications – Project #197

• An imaging method using medical x-ray machine to measure the ion penetration of concrete material to predict the service life of a pavement or a bridge. – Project #199

• Use of native grass and weed seeded microbial induced calcite precipitation to mitigate wind and water erosion of highway slopes – Project #200

• An aerodynamic damping method to mitigate large vibrations in traffic signal structures – Project #201

• A multi-channel vertical impedance scanner with large area electrode to detect corrosion in concrete bridge decks assessment without direct rebar connection – Project #202

• An automated, self-restoring crash cushion to help enhance safety of motoring public and workers on the highways while minimizing or eliminating maintenance and reducing life cycle costs – Project #203.

• A class of low-cost, non-toxic, biodegradable antifreeze biopolymers with behavior similar to natural antifreeze proteins found in fish, plants, insects, etc. to prevent ice formation on roadway and bridge surfaces during winter – Project #204.
• An integrated technology of LiDAR and radio frequency inductive testing (RFIT) to detect and discretely locate deep defects/damage in concrete bridge components – Project #205.

• An automated safety monitoring system for work zone safety based on a rule-based software program for location tracking and new generation ultra wide bandwidth (UWB) sensing – Project #206.

• A glass fiber reinforced polymer (GFRP) strand for application in mild-prestressed concrete (MPC) elements to attain higher resiliency, sustainability, and corrosion resistance with respect to traditional steel prestressed concrete – Project #207.

Proposals Received and Selected for Funding during FY 2018

During FY 2018, a total of 90 proposals were received by the NCHRP IDEA Program for its 47th and 48th review cycles. The NCHRP Project SP 20-30 Panel, after reviewing these proposals, selected 10 projects for funding.

47th Review Cycle (December 2017)

Number of Proposals Received: 36

Number of Proposals Selected for Funding: 4 (see below)

Proposal N-2108: MILDGLASS: GFRP Strand for Resilient Mild Prestressed Concrete (University of Miami)

Proposal N-2122: A Quality Control Tool to Rapidly Determine Water-to-Cementitious Materials Ratio of Fresh Concrete using the Formation Factor (Oregon State University)

Proposal N-2124: Determining Bridge Deck Chloride Quantities with Ground Penetrating Radar (Penetradar, LLC, Niagara Falls, New York)

Proposal N-2130: From Location Tracking to Continuous Interpretation: Rule-Based Automated Safety Monitoring System for Highway Work Zone Safety (University of Houston)

48th Review Cycle (June 2018)

Number of Proposals Received: 54

Number of Proposals Selected for Funding: 6 (see below)
Proposal N-2134: Material Characteristics of Cu-Based Superelastic Alloys for Applications in Bridge Columns to Improve Seismic Performance (University of Southern California)

Proposal N-1245: An Automated System for Pedestrian Facility Data Collection from Aerial Images (University of Southern Mississippi)

Proposal N-2159: SEEHIVE – Sustainable Estuarine and Marine Revetment (University of Miami)


Proposal N-2174: Reducing Stormwater Runoff and Pollutant Loading with Biochar Addition to Highway Greenways (University of Delaware)

Proposal N-2184: An Enhanced Network-Level Curve Safety Assessment and Monitoring Using Mobile Devices (Georgia Institute of Technology)

Projects Completed during FY 2018

The following NCHRP-IDEA projects were completed during FY 2018:

NCHRP- IDEA 185: CurvePortal for Automated Identification and Extraction of Horizontal Curve Information

NCHRP- IDEA 186: Development of an Electrical Probe for Rapid Assessment of Ground Improvement

NCHRP- IDEA 187: A Low-Cost Mobile Proximity Warning System in Highway Work Zone Safety

NCHRP- IDEA 188: A Class of V-Connectors for Bridge Deck-Pier and Pier-Footing Joints with Combined Advantage of Integrated Design and Seismic Isolation while Enabling Accelerated Bridge Construction

NCHRP-IDEA 189: A Novel Vision Sensor for Remote Measurement of Bridge Displacement

NCHRP- IDEA 193: DART Field Validation and Prototype Refinement

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The NCHRP-IDEA Program continues to receive a high level of interest as evidenced by the number of proposals it receives, averaging 50-60 proposals for each of its half-yearly review, and the number of products entering or being evaluated for actual
practice. The NCHRP Project SP 20-30 Panel continues to believe that the NCHRP-IDEA Program, although a modest investment, provides a unique opportunity to innovators and entrepreneurs to pursue their innovative concepts in a variety of technological areas for highway infrastructure applications. Until 2018, the funding level of the NCHRP IDEA Program was $1.40 million. This amount included the administrative costs in addition to the cost to fund the projects. Now as a result of the integration of the NCHRP-IDEA Program into the NCHRP, the administrative costs for the program are included in the overall NCHRP administrative costs. Therefore, funds requested for FY 2020 are for research projects only. It is anticipated that a sum of $950,000 will be needed to fund 6-7 projects at $150,000 per project in the next two 6-month cycles to keep the program viable and attractive to innovators, particularly those in the private sector.

3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding from FHWA</td>
<td>1125</td>
<td>3,000</td>
<td>1,500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuation allocation</td>
<td>375</td>
<td>1,000</td>
<td>750</td>
<td>6,000</td>
<td>4,750</td>
<td>10,000</td>
<td>2,800</td>
<td></td>
</tr>
<tr>
<td>Less obligation</td>
<td>1,500</td>
<td>4,000</td>
<td>2,250</td>
<td>6,000</td>
<td>4,750</td>
<td>10,000</td>
<td>2,800</td>
<td></td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Total available</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Recommended addition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>950</td>
</tr>
</tbody>
</table>

4. Interpretation of AASHTO Problem Statement by Project Panel

This project represents a new approach under the National Cooperative Highway Research Program (NCHRP), for short-term, focused research on new and innovative concepts that have the potential to provide leapfrog technological advances. The NCHRP-IDEA Program is a continuation of the SHRP-IDEA Program which funded exploration of innovative concepts from the public and private sectors in areas in which SHRP research was concentrated. The NCHRP-IDEA projects will concentrate on innovative approaches aimed at solving problems in the highway infrastructure area. Unsolicited proposals related to any aspect of the highways or intermodal facilities will be accepted; however, the Project Panel will designate specific technological areas for emphasis.

The NCHRP-IDEA Program is being administered as a special project ((NCHRP Project SP 20-30) under the NCHRP each Fiscal Year, similar to the NCHRP Synthesis Program (Project 20-05). Until June 2017, the NCHRP contracted with TRB’s Studies
and Special Programs Division for administering the NCHRP IDEA Program. Since June 2017, the NCHRP-IDEA Program has been integrated into the NCHRP. Research investigations for the program are selected by the NRC-appointed NCHRP Project SP20-30 Panel.

5. **Original AASHTO Problem Statement Number**

Problem No. 1993-SP-23

6. **Research Assignment To-Date**

NCHRP Project SP 20-30, "NCHRP-IDEA"

7. **Last Review Date**

October 31, 2018
Accountability Report for NCHRP Project SP 20-30, **NCHRP-IDEA**

**Purpose:** To support deserving proposals from entrepreneurs, inventors, forward thinkers, and problem solvers – anybody who has a possible solution to a vexing transportation problem. The NCHRP-IDEA includes projects that address technical feasibility or prototyping.

**Started:** Project SP 20-30 began in 1992; it was co-funded by FHWA through FY 1999. The NCHRP is now the sole sponsor of the NCHRP-IDEA.

**Funding:**

- Allocated in FY2019: $1,400,000
- Requested for FY2020: $950,000

**Problem Solicitation:** An announcement is distributed to solicit submittals throughout the year. Proposals are collected twice each year (deadlines: March 1 and September 1) and reviewed. The announcement is posted on the TRB website and highlighted in the TRB E-Newsletter.

**Process for Selecting Studies:** The NCHRP Project SP 20-30 Panel meets semi-annually to select proposals for award. Proposals are evaluated using the following four criteria for a total of 100 points: (i) Quality of Innovation (50 points); (ii) Research Approach (15 points); (iii) Potential Benefits (20 points); and (iv) Implementation/Commercialization Plan (15 points). Requested funds must not exceed $150,000 for a Type 1 project and $100,000 for a Type 2. Cost sharing is encouraged but not mandatory for a Type 1 project but is required (at least a 25% match) for a Type 2 project. A high degree of risk will be assumed for scientifically-founded proposals with potentially high value to transportation practice.

**Consultant Selection:** The project is managed by the NCHRP staff in the TRB’s CRP Division under the oversight of the NCHRP Project SP 20-30 Panel that selects projects for investigation. No contract may exceed $150,000, and many are for much less.

**Studies Requested Last Year:** 90 proposals were submitted in 2 cycles in FY 2018.

**Studies Funded Last Year:** See Section 1, above.

**Studies Completed**

- 6 studies were completed between October 1, 2017 and September 30, 2018.
Last Year:

**Distribution of Findings:** A summary of all completed and active IDEA projects is published each year and made available to sponsors, subscribers, and affiliates. All project reports are posted on the TRB website and also sent to the National Technical Information Service (NTIS).

**Use of Findings:** IDEA projects are intended to help jump-start the product-development process and eventual commercialization. Some products have been commercialized, others are in the process, and some have been identified as promising. Projects/products in these categories are identified each year in the continuation request.

**Next Year's Funding is requested to support approximately 6-7 new or continuing studies each year.**
Continuation Request  
Project 20-44, FY 1996 & Continuing  
*Accelerating the Application of NCHRP Research Results*

Present Expiration Date: Continuing  
Recommended Allocation: $2,000,000

---

1. Anticipated Accomplishments When Funds Allocated Have Been Expended

Since 1996, NCHRP panels, researchers, and staff have addressed all the suggested activities listed under section 4 of this form using 20-44 funds. A much larger program was funded in FY2016, and we anticipate providing assistance to a wide range of activities split between implementation (85%) and information dissemination (15%). Candidate activities are suggested by individual panels, DOTs, and AASHTO committees. Funding requests are subject to the approval of the 20-44 Panel.

**Implementation Projects Funded FY2016 - FY2018**

<table>
<thead>
<tr>
<th>Project code</th>
<th>Project description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-44(01)</td>
<td>Workshop on Increasing WMA Implementation by Leveraging the State-Of-The-Knowledge</td>
<td>150,000</td>
</tr>
<tr>
<td>20-44(02)</td>
<td>Implementation of the AASHTO Guide for Enterprise Risk Management</td>
<td>300,000</td>
</tr>
<tr>
<td>20-44(03)</td>
<td>Intellectual Property Management Guide Workshops and Assessments</td>
<td>115,500</td>
</tr>
<tr>
<td>20-44(04)</td>
<td>Implementation of NCHRP Reports 639 and 757: Adhesive Anchors</td>
<td>100,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project code</th>
<th>Project description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-44(05)</td>
<td>Dissemination of &quot;NCHRP Domestic Scan 14-01: Leading Management Practices in Determining Funding Levels for Maintenance and Preservation&quot;</td>
<td>120,000</td>
</tr>
<tr>
<td>20-44Q</td>
<td>Communication Services for NCHRP</td>
<td>499,664</td>
</tr>
<tr>
<td>20-44TS</td>
<td>Travel Support for Implementation Activities</td>
<td>9,156</td>
</tr>
<tr>
<td>07-22</td>
<td>Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual</td>
<td>150,000</td>
</tr>
<tr>
<td>10-86A</td>
<td>Software for Bidding Alternative Drainage Pipe Systems</td>
<td>66,580</td>
</tr>
<tr>
<td>15-52</td>
<td>Developing a Context-Sensitive Functional Classification System for More Flexibility in Geometric Design</td>
<td>50,001</td>
</tr>
<tr>
<td>20-59(30)A</td>
<td>Train-the-Trainer Regional Workshops for Incident Command System (ICS) Training for Field Level Transportation Supervisors and Staff</td>
<td>100,000</td>
</tr>
<tr>
<td>SCOR_Tech</td>
<td>SCOR/RAC Website Enhancement</td>
<td>38,040</td>
</tr>
<tr>
<td><strong>FY Total</strong></td>
<td></td>
<td><strong>1,698,941</strong></td>
</tr>
</tbody>
</table>

**FY 2017**

<table>
<thead>
<tr>
<th>Project code</th>
<th>Project description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-44(08)</td>
<td>NCHRP Comprehensive Communications Plan</td>
<td>100,000</td>
</tr>
<tr>
<td>20-44(09)</td>
<td>Quantitative and Qualitative Methods for Capturing the Impacts and Value of NCHRP Research</td>
<td>1,000,000</td>
</tr>
<tr>
<td>15-50</td>
<td>Guidelines for Integrating Safety and Cost-Effectiveness into Resurfacing, Restoration, and Rehabilitation Projects</td>
<td>71,468</td>
</tr>
<tr>
<td><strong>FY Total</strong></td>
<td></td>
<td><strong>1,171,468</strong></td>
</tr>
</tbody>
</table>

**FY 2018**

<table>
<thead>
<tr>
<th>Project code</th>
<th>Project description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-44(06)</td>
<td>Consultant Support for Massachusetts DOT’s Commission on the Future of Transportation in the Commonwealth</td>
<td>100,000</td>
</tr>
<tr>
<td>Project code</td>
<td>Project description</td>
<td>Amount</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>03-113</td>
<td>Guidance for Traffic Signals at Diverging Diamond Interchanges and Adjacent Intersections</td>
<td>99,934</td>
</tr>
<tr>
<td>03-121</td>
<td>Incorporating Freight, Transit and Incident Response Stakeholders into Integrated Corridor Management (ICM): Processes and Strategies for Implementation</td>
<td>149,743</td>
</tr>
<tr>
<td>03-127</td>
<td>Cybersecurity of Traffic Management Systems</td>
<td>32,200</td>
</tr>
<tr>
<td>17-73</td>
<td>Conducting Systemic Pedestrian Safety Analyses</td>
<td>154,000</td>
</tr>
<tr>
<td>20-44(07) [10-86A]</td>
<td>Implementing Single-User Software for Bidding Alternative Drainage Pipe Systems</td>
<td>50,530</td>
</tr>
<tr>
<td>24-42</td>
<td>Underwater Installation of Filter Systems for Scour and Other Erosion Control Countermeasures</td>
<td>50,000</td>
</tr>
<tr>
<td>20-44(06) Phase 2</td>
<td>Consultant Support for Massachusetts DOT’s Commission on the Future of Transportation in the Commonwealth</td>
<td>145,570</td>
</tr>
<tr>
<td>20-44(10) [15-44]</td>
<td>Guidelines for the Use of Mobile LIDAR in Transportation Applications</td>
<td>6,000</td>
</tr>
<tr>
<td>20-44(11)</td>
<td>Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies and Improving Management of Transportation Information</td>
<td>80,000</td>
</tr>
<tr>
<td>24-40</td>
<td>Design Hydrology for Stream Restoration and Channel Stability at Stream Crossings</td>
<td>99,988</td>
</tr>
<tr>
<td>20-44(12)</td>
<td>Implementing a Transportation Agency Data Self-Assessment</td>
<td>220,000</td>
</tr>
<tr>
<td>20-44R</td>
<td>Loaned staff for impact analysis</td>
<td>28,344</td>
</tr>
<tr>
<td>20-44TS (New Trvl)</td>
<td>Travel Support for Implementation Activities</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td><strong>FY Total</strong></td>
<td><strong>1,221,309</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Grand total</strong></td>
<td><strong>4,091,718</strong></td>
</tr>
</tbody>
</table>
Information Dissemination Activities

- NCHRP Impact Report 2018 - First attempt to document and present the value, in the form of outcomes and impacts, of the application of NCHRP research results. Containing data, case studies, and anecdotes compiled from a variety of different sources, this report presents an overview of recent NCHRP research results, how the results are disseminated, and the impacts of their application.
- Research Makes the Difference - Annual eight-page brochure, drawing from the 2015, 2016 and 2017 AASHTO RAC High Value Research compilation and from NCHRP suggestions.
- Impacts on Practice - Readable narrative the impact of the selected NCHRP research projects on state DOT practice.
- Webinar Organization and Communication Services - Prepare the TRB Webinar Submission Forms detailing NCHRP’s proposed research projects for the two cycles of the TRB webinar series; prepare moderator PowerPoint template and talking points, and speaker tips (first cycle only); coordinate with NCHRP manager and TRB webinar staff throughout the process; and follow up with presenters and moderators after TRB has made the webinar selections.
- Paths to Practice - Capture in an interesting, readable narrative successful approaches used for putting NCHRP research to use.
- CEO Briefing / Program Folio - Gather and develop content aimed at highlighting recent NCHRP program and project activities and accomplishments for DOT CEOs.
- Research Briefs - Two-page briefs to disseminate information about key new NCHRP projects. Finalize and deliver 15 briefs in electronic format each year.
- Field Folios / Subject Compilations - Summaries of NCHRP research in key topical areas (e.g. safety, traffic engineering, pavements, structures, etc). Finalize and deliver up to 10 Field Folios in electronic format each year.
- Report Distribution Assistance - Expand and customize alerts for new NCHRP reports by subject area to better promote use of the results. Develop distribution channels and lists that could be used to more effectively target research findings and communication approaches for pushing research results out to these target audiences.
- Tracking Implementation - Develop an online survey for use in gathering information about the use of NCHRP research results from panel members, principal investigators and other research stakeholders (such as DOT managers or field personnel). Create the survey recipient list, distribute the survey and analyze the results.

Contractor Selection
For support of individual research projects, decisions regarding contractor selections rest with the affected project panels. Panels have the option of continuing with the existing contractor, sole-sourcing small efforts to uniquely qualified agencies, or an open solicitation. Funds spent on activities will range from a few thousand dollars to support travel and presentations to approximately $100K to $300K for activities such as further testing or workshops. And for program related support, the projects are relatively small ($25K to $50K) and are typically sole-sourced to qualified agencies or individuals.

2. Anticipated Accomplishments When Funds Requested Have Been Expended

Given the remaining budget balance and the small number of potential implementation requests currently under development, R&I may choose to not make an allocation for FY 2020. The principal recommendation for Project 20-44 is unchanged: to maintain the program-level activity and to address unanticipated opportunities that arise during or on completion of individual project-level activity. In 2014, SCOR formed an NCHRP Process Improvement Task Force. One of the key recommendations of this task force was to review the results of CTC and Associates report Evaluating Implementation of NCHRP Products: Building on Successful Practices and implement an NCHRP plan: program of practices to facilitate implementation of NCHRP research results. In FY2016 and beyond, TRB/NCHRP will make use of 20-44 funding to implement projects approved by the NCHRP 20-44 Panel.

3. Funds

<table>
<thead>
<tr>
<th></th>
<th>FY 2016</th>
<th>FY 2017</th>
<th>FY 2018</th>
<th>FY 2019</th>
<th>FY 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funds allocated to 20-44</td>
<td>2,000,000</td>
<td>2,000,000</td>
<td>2,000,000</td>
<td>2,000,000</td>
<td></td>
</tr>
<tr>
<td>Balance brought forward</td>
<td>301,059</td>
<td>1,129,591</td>
<td>1,908,282</td>
<td>3,908,282</td>
<td></td>
</tr>
<tr>
<td>(Less) Total funds programmed</td>
<td>1,698,941</td>
<td>1,171,468</td>
<td>1,221,309</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance</td>
<td>301,059</td>
<td>1,129,591</td>
<td>1,908,282</td>
<td>3,908,282</td>
<td>3,908,282</td>
</tr>
</tbody>
</table>

4. Interpretation of AASHTO Problem Statement by Panel
In an applied research program like the National Cooperative Highway Research Program, application of results is the most important measure of success. The NCHRP has been successful by this measure; results of NCHRP research are used by AASHTO committees and member departments, but there is a need to continually look for ways to do better.

The following activities are examples of areas that benefit from greater attention: a) validating research products (e.g., testing NCHRP-developed computer software before widespread distribution); b) using innovative dissemination media to supplement or replace the written report; c) working with AASHTO committees and other code-writing groups to facilitate adoption of NCHRP recommendations; d) providing financial support for NCHRP researchers to assist potential users of NCHRP products; e) offering peer exchanges or demonstrations focused on new NCHRP research results, and f) tracking and documenting applications of NCHRP research.

5. Original AASHTO Problem Statement Number

Problem No. 1996-SP-32

6. Research Assignment to Date

NCHRP Project 20-44, “Accelerating the Application of NCHRP Research Results”

7. Review Dates

| 20-59(49) | Facilitation and Coaching Support for the 50 States Exercise | $ 450,000 |
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objective of this project is to plan and manage the execution of domestic technology scans, each addressing a single technical topic. The purpose of each scan and of the program as a whole is to facilitate information sharing and technology exchange among the states and other transportation agencies and identify actionable items of common interest, thereby accelerating the rate of beneficial innovation.

A business plan and pilot demonstration with two scans were funded by FY 2005 and FY 2006 allocations. Subsequent SCOR allocations of $500,000 each, from FY 2007 through FY 2012, enabled the program's initiation and engagement of a contractor to manage scan logistics and provide a yearly assessment of program performance. The primary contractor was engaged for an initial 3-year term with provision for a second 3-year term subject to availability of funds. That contract became effective 12/27/2007. SCOR allocated an additional $200,000 of FY 2009 funds to be used particularly for monitoring scan impact and exploring ways to enhance scan effectiveness. The NCHRP project panel used these funds to assess scan impact and explore the mechanisms underlying effective dissemination within and among state transportation agencies. Scan planning and dissemination activities were modified to apply lessons learned from these activities.

A 2\textsuperscript{nd} phase of the program was initiated in 2013. A competitive procurement was awarded with terms similar to the 1\textsuperscript{st} phase of the program. In approving this 2\textsuperscript{nd} phase, SCOR increased the annual allocation to $600,000 to account for increased costs and increased levels of effort on post-scan information dissemination activities. This second phase is ending with scans initiated in CY2018.

A 3\textsuperscript{rd} phase is envisioned to be initiated in 2019. Current plans entail a management review of scan dissemination activities, to be conducted during the first year of the 3\textsuperscript{rd} phase. At least until that review is completed, the requested funding level for the Domestic Scan Program will be maintained at $600,000. To facilitate program management by enabling work on newly selected scan topics to begin immediately following selection, a one-time request for a 2-year funding allocation is being made.
From the program’s initiation, NCHRP funds have from time to time been supplemented by additional amounts provided by FHWA; other appropriate sponsors would be welcomed. From the project’s pilot phase through September 2018, such supplemental sponsorship has totaled approximately $588,000.

The NCHRP project panel selects scan topics from among numerous proposals received each year in response to AASHTO’s solicitation, sometimes combining multiple proposals into a single scan. Individuals who submitted selected proposals are included when possible in the scan teams. Each scan team produces a report and presentations of the team’s findings and a specific plan of actions to encourage dissemination of useful ideas and lessons learned by the developers and early adopters of these ideas. Scan-team reports are made available from NCHRP’s project web page. Through September 2018, scans on 39 diverse topics have been scheduled; 32 scan-team reports have been released.

Scan-team members may receive limited support for expenses related to presenting these ideas and lessons to colleagues in other agencies; some scan teams organize post-scan symposia or other activities to encourage broader dissemination of the team’s findings. The project panel monitors these dissemination activities and explores new ways to accelerate innovation among transportation agencies. Analysis of dissemination experience indicates that scan information reaches well beyond the scan team.

The panel’s request for FY 2020, for $600 thousand, conforms to recent past practice and will enable the program to continue without interruption as a 3rd phase is initiated. The panel is undertaking a competitive procurement for logistics support on terms similar to those of the initial phases, but anticipates that the 3rd phase funding requests may include additional funds to account for cost increases and to enable greater emphasis to be placed on dissemination of scan results.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The requested funding will enable scheduling and execution of two to three new scan topics and development of new efforts to accelerate the rate of innovation within and among transportation agencies. The panel anticipates the current request will initiate the 3rd phase of the program, and that subsequent requests for annual funding will support the 3rd 6-year term of effort, commencing with a FY 2021 request.
3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Initial Allocation</td>
<td>250</td>
<td>-0-</td>
<td>-0-</td>
<td>1,000</td>
<td>700</td>
<td>4,500</td>
<td>1,200</td>
</tr>
<tr>
<td>Continuation Allocation</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Less Obligation</td>
<td>250a</td>
<td>-0-</td>
<td>1,000b</td>
<td>510b,c</td>
<td>4,690b,c</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>190c</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Total Available</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Recommended Addition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,200</td>
</tr>
</tbody>
</table>

Assignment to specific projects: NCHRP 20-68, $50K; NCHRP 20-68(01), $200K; NCHRP 20-68A, $3.0M; NCHRP 20-68B/C, $200K; NCHRP 20-68A(02), $3.6M. FY2020 funds will be used for NCHRP 20-68D.

4. Interpretation of AASHTO Problem Statement by Panel

Continuing innovation in the practices of U.S. transportation agencies has brought substantial benefits to the nation. Examples of beneficial innovation range from new materials used in pavements and structures, to new ways of collecting and analyzing information about transportation system users and the environment in which the system operates, to new ways of funding the investments needed to improve public safety and efficiency of travel.

Beneficial innovation occurs in any field when new ideas are disseminated and widely adopted by practitioners. Experience in many fields illustrates that expanding the extent of information exchange among practitioners and accelerating the rate of the exchange facilitate innovation.

Experience also shows that personal contact with new ideas and their application is a particularly valuable means for information exchange. U.S. engineering professionals have visited their colleagues in other countries and returned with information that they have subsequently communicated to their domestic colleagues and seen applied to improving domestic practice. The American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and others have been active in technology transfers at the international level with their involvement in such activities as NCHRP Project 20-36 on “Highway Research and Technology---International Information Sharing.”

These experiences have shown that the “scan” approach is a productive means for encouraging the spread of information and innovation. Many international program participants and observers have noted that new ideas are emerging in state and local
transportation agencies around the United States, and that faster dissemination of many of these ideas could yield benefits similar to those associated with international information exchange. Domestic scans conducted by various FHWA offices as well as through the NCHRP illustrate the potential value of a domestic scan program.

A scan program entails four key steps. First, knowledgeable people identify novel practices in their field of interest. Second, these people assess the likelihood that these new ideas might beneficially be applied in other settings. Third, new practices that offer the most promise are selected and field visits are made to observe the practices, identify pertinent development and application issues, and assess appropriate technology transfer opportunities and methods. Finally, the results of the initial steps are documented for use by those who participated and for others to apply.

Effective scan programs both supplement and make use of other mechanisms for information exchange such as publications in trade and professional journals, conferences, and peer-to-peer forums. A scan program focuses on face-to-face discussion of current experience, providing opportunities for a uniquely rich exchange of information that is difficult or impossible to replicate through written materials, telephone conversations, and e-mail correspondence. The informal discussions among the scan participants contribute to the extraction of useful information from the individual participant’s observations. Executing an effective scan program requires sound understanding of the topic areas to be considered, insightful selection of topics and new ideas to be observed, careful selection of participants who can provide useful insights from their observations, and thoughtful documentation and dissemination of each scan’s results. Managing the domestic scan program additionally requires that resources be conserved by not duplicating the information exchange activities of others.

5. Original AASHTO Problem Statement Number

Problem No. 2005-SP-05, 2008-SP-08

6. Research Assignments to Date

NCHRP Project 20-68, “US Domestic Scan Program (Business Plan)” (completed)
NCHRP Project 20-68(01), “US Domestic Scan Program Pilot” (completed, 2 scans)
NCHRP Project 20-68A, “US Domestic Scan Program” (contractor engaged for 3-year term, renewed for second 3-year term)
NCHRP Project 20-68A(02), “US Domestic Scan Program” (contractor engaged for 3-year term, renewed for second 3-year term, extended 1 additional year to accommodate changes in NCHRP schedules and completion of assigned scan topics)
NCHRP Project 20-68B(01), “Accelerating the Rate of Innovation Among State DOTs—Tracing Domestic Scan Impacts”
NCHRP Project 20-68B(02), “Accelerating the Rate of Innovation Among State DOTs—Tracing Domestic Scan Impacts”
NCHRP Project 20-68C, “Research on Innovation Networks--Domestic Scans”
7. Review Date

09/11/2018, 12/4/2018
Present Expiration Date: Continuing
Recommended Allocation: $475,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
The AASHTO Special Committee on Research & Innovation created NCHRP 20-123 to provide a flexible and ongoing source of funding for AASHTO committees and councils for advancing and implementing their vision, mission, and strategic goals, including the role that research can play their efforts. While activities funded by this project are not research projects, they must be an eligible use of SPR-B research funds.

No projects had as yet been funded at the time this continuation request was prepared, but two requests totaling $475,000 are under consideration. Since no projects have been funded, no listing of projects accompanies this continuation request.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
This continuation request will support, for another year, funding for research-related activities needed by AASHTO committees and councils. Activities envisioned to be eligible for funding include but are not limited to the preparation of research road maps, research scoping studies, peer exchanges, updates of AASHTO specifications and manuals maintained by a committee, and updates to strategic plans.

3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th>FY 2019</th>
<th>FY 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuation Allocation</td>
<td>1,500</td>
<td></td>
</tr>
<tr>
<td>Carried Forward</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Less Obligation</td>
<td>475</td>
<td></td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>1,025</td>
<td></td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Total Available</td>
<td>1,025</td>
<td></td>
</tr>
<tr>
<td>Recommended Addition</td>
<td></td>
<td>475</td>
</tr>
</tbody>
</table>

* A total of $475,000 in requests is under consideration and should be acted upon before April 9, 2019

4. Interpretation of AASHTO Problem Statement by Panel
A program is needed that can respond to the needs of AASHTO committee and councils to assist them in identifying and identifying research needs that are important
to member state agencies, as well as other activities to assist committees and councils conduct other eligible activities that are related to research.

5. Original AASHTO Problem Statement Number
This project did not result from the submission of a problem statement; it was created and decided upon by the AASHTO Special Committee on Research and Innovation at their March 2018 meeting.

6. Research Assignment to Date
NCHRP Project 20-123, Support for AASHTO Committee and Councils

7. Review Date
December 1, 2019

Accountability Report for NCHRP Project 20-123
“Support for AASHTO Committees and Councils”

Purpose: NCHRP 20-123 provides AASHTO committees and councils with timely access to funds to support their missions with the assistance of consultants, for activities that SPR-B eligible.

Started: FY 2019

Funding: Allocated in 2019: $1,500,000
Requested in 2017: $475,000

Problem Solicitation: Needs are identified by each AASHTO committee or council, and members or AASHTO staff submit a funding request to NCHRP.

Process for Selecting Studies: Funding requests are considered and approved at periodic meetings of the Project 20-123 panel; meetings are held via conference call as needed in response to receipt of a funding request. The panel includes five members, each drawn from the Councils on Highways and Streets, Active Transportation, and Public Transportation; the Committee on Administration; and the Special Committee on Research and Innovation. The panel also includes liaisons from FHWA, and TRB. Selection criteria are listed in Appendix B.

Consultant Selection: The work will be performed by a contractor and overseen by a panel formed for the specific task and appointed by NCHRP. The panel is responsible for selecting its contractor. This may be a sole source contract, but generally proposals are solicited competitively.
Studies Requested Last Year: Two requests for a total of $475,000 were submitted for FY 2019.

Studies Funded Last Year: No funding decisions were made last year.

Studies Completed Last Year: No projects were completed in 2018.

Distribution of Findings: Final deliverables will be provided to the leadership of the requesting committee or council, and will be posted as appropriate on the NCHRP website.

Use of Findings: The reports are of direct use to members of the requesting committee or council. To the degree that NCHRP problem statements result from these efforts, the NCHRP program should benefit from the submission of thoughtful, well-written, and prioritized research problem statements. thereby contributing to NCHRP’s ability to address important and meaningful research questions.

Next Year’s Studies: This is unknown at this time.

Appendix A

NCHRP Project 20-123
Completed and Active Research Projects

<table>
<thead>
<tr>
<th>Task</th>
<th>Title</th>
<th>Requestor</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 2019</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 1</td>
<td>Transportation Asset Management Strategic Planning and Research Roadmap Development</td>
<td>Committee on Planning</td>
<td>Decision Pending</td>
</tr>
<tr>
<td>Task 2</td>
<td>Synthesis of Recent Active Transportation Related Research and Creation of Research Roadmap</td>
<td>Council on Active Transportation</td>
<td>Decision Pending</td>
</tr>
</tbody>
</table>
Appendix B

NCHRP Project 20-123
Support for AASHTO Committees and Councils

GUIDELINES FOR ALLOCATING RESEARCH FUNDS

Tasks conducted under NCHRP Project 20-123 must:

1. Address a research-related need identified by an AASHTO committee and Council:
   a. Prepare or update a research roadmap or prioritized list of specific research needs
   b. Updating committee or council strategic plans that include a research component
   c. Research scoping study for a narrow research topic
   d. Non-research and development activities to update specifications and manuals maintained by a committee or council, using previously conducted research and/or convening experts to arrive at a consensus.
   e. Peer exchanges

2. Be limited in scale (less than $250,000)

3. Be completed within 18 months.

4. Result in, or contribute to, the development of high-quality research problem statements that can be submitted to NCHRP. Problem statements may also be developed that an individual state DOT may undertake in its own research program or in collaboration with other state DOTs in a pooled fund project. The effort may also identify research needs that other entities would be interested in funding or pursuing.

5. Have widespread benefit throughout the state DOT community represented on the committee or council.

6. Cannot be met with another funding source.
Research Projects
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objectives of this research were (1) to investigate the effects of urban and suburban arterial lane widths on operations and safety for all users, (2) produce guidelines for practitioners to determine lane configuration for reconstruction and new construction projects, and (3) propose appropriate revisions to the AASHTO Green Book.

Additional funding is requested to enable a new contractor to complete this project. The original contractor completed data collection, but was significantly behind schedule and disagreed with BNCHRP and the project panel about the fundamental approach to the research. For this reason, the contact was allowed to expire on October 5, 2018. The NCHRP and the project panel agree that the research should be completed by a new contractor. The Data collected under the original contract and the interim reports will be made available as part of a new Request for Proposals. The remaining funding of $150,000 is, however, insufficient; additional funds are needed to allow a new contractor to review the existing data and reports, to update the literature review (the project began in 2014), and to complete the remaining tasks.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The requested funds will be used to collect any additional data and complete the project pursuant to the original scope of work.
3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th>FY2014</th>
<th>FY2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Initial Allocation</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>Continuation Allocation</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Less Obligation</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Total Available</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Recommended Addition</td>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>

4. Interpretation of AASHTO Problem Statement by Panel

In an era of multimodal design and expensive right-of-way, agencies must make decisions on how to best accommodate users of the roadway system within limited budgets. One of the driving decisions is how wide the travel lanes should be while balancing these interests and operational and safety perspectives.

A few recent research projects have examined the relationship between lane width and safety on urban and suburban arterials. These studies found no general indication (with a few exceptions) that the use of lanes narrower than 12 feet increased crash frequencies. While the research provided excellent insight into lane width/safety relationships, it did not address speed, volume, transit, heavy vehicles, on- and off-street neighboring spaces (e.g., turn lane, bike lane, on-street parking, shoulder width, curb and gutter, another lane next to lane of interest, or the proximity of objects such as utility poles, trees, or street furniture on the roadside), bicycle and pedestrian use, and shared versus exclusive lane use. Therefore, additional research is needed to better answer these questions.

5. Original AASHTO Problem Statement Number

Problem No. 2014-G-10

6. Research Assignment to Date

NCHRP Project 03-112, Proposed Practices for the Application of Dynamic Lane Use Control.

7. Review Dates

Oct 2018
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objective of NCHRP Project 15-61, “Applying Climate Change Information to Hydrologic and Hydraulic Design of Transportation Infrastructure,” is to develop a proposed AASHTO design guide of national scope that provides hydraulic engineers with the tools needed to amend current practice to account for climate change.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

Integrating the effects of climate change into hydrology and hydraulics (H&H) practice is a difficult and complex task, due to the dynamic nature of climate change and its potential effects on the transportation infrastructure.

The research agency for Project 15-61 delivered an initial version of the proposed AASHTO design guide that the project panel reviewed and accepted as a satisfactory first step. The panel identified several topics requiring further analysis and elaboration before the design guide is submitted to the Technical Committee on Hydrology and Hydraulics (TCHH) for consideration for adoption by AASHTO:

- The “Levels of Analysis” presented need further elaboration, with particular emphasis on the means to determine, at each level, whether the analyst should move to a higher level of analysis.
- Resilience in place under current design methodology.
- The inland hydrology methodology uses the 10-year, 24-hour storm to pivot to other storm frequencies and durations. The project panel is uncertain if the guide’s analysis of future change in 10-year storm frequency and duration is correctly framed and if use of the 10-year, 24-hr storm to estimate the 100-year, 24-hr storm is adequate.
- Further discussion and validation of the use of regression equations in the guide.
- Further analysis to validate the proposed process of amending rainfall Intensity-Duration-Frequency (IDF) curves.
• The guidance on selecting climate models does not adequately address the use of dynamical downscaling and appears to advocate an unbalanced statistical design in analysis of GCM output.
• Regional applicability/portability of methodology.
• Bottom up design applications.
• Coastal surge/inland compound designs.

The project panel respectfully requests $400,000 in FY 2020 funds to address these six areas in preparing a final version of the design guide for consideration by AASHTO TCHH.

3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th>FY 2016</th>
<th>FY 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Initial Allocation</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>Continuation Allocation</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Less Obligation</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Total Available</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Recommended Addition</td>
<td></td>
<td>400</td>
</tr>
</tbody>
</table>

4. Interpretation of AASHTO Problem Statement by Panel

Transportation hydraulic engineers are being asked to account for global climate change within hydrologic and hydraulic (H&H) design practice. Current H&H design procedures stipulate use of historical data that are assumed to represent a stationary process. Climate change introduces non-stationary risks such as sea level and temperature rise, and changes in timing and distribution of precipitation, snowpack, and snowmelt. Failure to account for such non-stationary risks may compromise the operational characteristics of existing and future transportation infrastructure.

Climate change scientists employ outputs from a cascade of models to develop regional scenarios representing these non-stationary phenomena that are not associated with specific probabilities. Existing guidance for H&H design does not provide methods to incorporate such information. Collaborative efforts and a common set of terms and definitions between climate change scientists, hydrologists, hydraulic engineers, and coastal engineers are essential to harmonize climate change inputs and H&H design practice.

Incorporating the results of climate models may have large cost implications for future infrastructure. For example, overestimates of the magnitude of peak flows can result in costly oversizing of drainage infrastructure, while underestimates might leave infrastructure vulnerable and the resultant flooding impacts on surrounding lands and
structures inadequately addressed. It is often questioned if the magnitude of change in hydrologic and hydraulic inputs due to climate change are within the range of uncertainties accounted for in the current state of practice and how the uncertainties vary for the design of various hydraulic features ranging from stormwater management facilities to bridges, given that they are typically evaluated for varying extreme events. Furthermore, accounting for climate change in hydraulic design is complicated by additional non-stationary processes arising from urbanization and other land cover changes.

Research is needed to provide hydraulic engineers with a practical guide to (1) account for the effects of climate change in hydraulic design where appropriate and (2) justify when such changes are not warranted for a project of a particular type or scale.

The following table provides just a few of the many possible examples comparing current hydraulics and hydrology (H&H) practice, potential climate change science inputs to H&H design, and the resulting obstacles to integration of climate change science into H&H practice that will be addressed by the proposed design guide.

<table>
<thead>
<tr>
<th>Current H&amp;H Practice</th>
<th>Climate Change Input to H&amp;H</th>
<th>Obstacles to Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short duration (&lt; 1 hr.) rainfall intensities for storm drain and channel design</td>
<td>Long durational, seasonal projections</td>
<td>Difference in scale in time, space, and certainty</td>
</tr>
<tr>
<td>Statistical design flow developed from stream flow records</td>
<td>Regional projections of stream flow trends</td>
<td>Difference in scale in stream flow projections</td>
</tr>
<tr>
<td>Multi-year daily precipitation for water quality models</td>
<td>Precipitation based on projected atmospheric forcing</td>
<td>Daily precipitation uncertain</td>
</tr>
<tr>
<td>Historical tide gauge records as input to storm surge models and other analyses of extreme water levels</td>
<td>Eustatic sea level rise scenarios adjusted for local conditions (i.e., relative sea level change rates)</td>
<td>Geographically appropriate methods to incorporate climate change data (e.g., sea level, wave climate, storm climatology) into extreme water level analyses</td>
</tr>
</tbody>
</table>

5. Original AASHTO Problem Statement Number

Problem No. 2016-B-08

6. Research Assignments to Date

NCHRP Project 15-61, “Applying Climate Change Information to Hydrologic and Hydraulic Design of Transportation Infrastructure”
7. Review Dates

3/2/2017, 4/10/2017, 12/5/2017, 8/16/2018, 9/5/2018, 10/30/2018
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objective of this research is to develop methods for performing quantitative analysis of safety design decisions on pedestrian and bicycle safety. Similar to other research performed for the Highway Safety Manual, the models developed for this project will support data-driven decision making in roadway planning, design, and operations.

In Phase I of the project, the contractor proposed three potential plans for collecting data and developing safety performance functions (SPFs) to fulfill the objectives of the project and provide users with analysis options that allow them to work with the data they have available:

- **Workplan A**: develop SPFs using available exposure data. This workplan will develop SPFs for urban roadway segments and intersections using pedestrian and bicycle volumes.
- **Workplan B**: develop risk-based approach to pedestrian and bicycle crash prediction based on the Roadway Assessment Programs. This workplan will assess sensitivity in factors in the models used for the International and United States Road Assessment Programs (iRAP and usRAP, respectively) to crash risk, and will develop models for specific urban and rural facility types. Some pedestrian and bicycle exposure data will be needed.
- **Workplan C**: develop risk-based models based on crash data. These SPFs will estimate safety performance for pedestrians and bicycles in the absence of relevant crash data.

Together, the three plans develop models to address a range in HSM user needs and would allow users to quantitatively assess pedestrian and bicycle safety performance regardless of available volume data or facility location and type. Though all three workplans would add value to the HSM, the original funds are not sufficient to allow work to be completed for all three. At the interim meeting, the panel approved the Phase I report and, based upon the research team’s recommendation, decided to proceed with Workplans A and B with the intent that these models can be included in the second edition of the HSM.
2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The requested funds will be used to perform the research on Workplan C, so that this option for quantifying safety performance for pedestrians and bicycles can be included in a future edition of the HSM (this is not intended to be included in the forthcoming second edition of the HSM). The models developed will estimate pedestrian and bicycle safety performance based on the presence or absence of contributing factors. This work will address both urban and rural areas without requiring pedestrian and bicycle volume data and will therefore fill remaining gaps in methodologies for HSM users.

This additional research will result in a methodology to calculate a risk score based on the overall contributions of each factor contributing to the probability of a crash, rather than an SPF similar to those currently presented in the HSM. The risk score then serves as the estimate of pedestrian and bicycle safety performance.

This approach is similar to what several agencies are doing in applying a systemic safety management approach. It is quantifying the relative risk of contributing factors to pedestrian and bicycle crashes. This research would be performed on a larger scale than what individual agencies can do on their own. The benefit of executing all three methodologies developed in the original project and through this proposed continuation is that it will be possible to compare the results of all three methods to see how consistent they are, and then either combine results if possible, or recommend one approach (model) over the other based on our confidence in the modeling approach and validity of the results.

3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th>FY 2017</th>
<th>FY 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Initial Allocation</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Continuation Allocation</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Less Obligation</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Total Available</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Recommended Addition</td>
<td></td>
<td>320</td>
</tr>
</tbody>
</table>

4. Interpretation of AASHTO Problem Statement by Panel

This project was originally proposed and funded for FY 2017 to help address increasing use of active transportation as well as increases in pedestrian and bicyclist fatalities and serious injuries, and the need for this research is still very much, if not more, necessary. The ability to have clear estimates of impacts of roadway decisions on vulnerable users is integral to performance-based transportation programs. Data collection and modeling techniques, as well as demand for these models, have advanced since the development and publication of the first edition of the Highway Safety Manual to the extent that it is a realistic objective to provide options for including pedestrian and bicycle models that will
enhance transportation professionals’ ability to address safety performance for all road users. In addition to the AASHTO committees that have historically been involved in the development and use of the HSM (Safety, Design, and Traffic Engineering), the Council on Active Transportation is interested in advancement of pedestrian and bicycle quantitative safety analysis, which has been historically challenged by availability of data and appropriate methods.

5. Original AASHTO Problem Statement Number

Problem No. 2017-G-04

6. Research Assignment to Date

NCHRP Project 17-84, Pedestrian and Bicycle Safety Performance Functions for the Highway Safety Manual

7. Review Dates

Oct 2018
1. Problem Statement as Received from AASHTO

Problem has been jointly funded by TCRP A-36, NCHRP 20-59 via 20-59(49) and ACRP 04-04B.

2. Interpretation of AASHTO Problem Statement by Project Panel

Develop and deploy the Transportation Emergency Response Application (TERA) as a transportation-specific version of the Emergency Management Staff Trainer (EMST).

TERA was designed to leverage the utility of existing, robust, scenario-based, emergency preparedness training and exercise software designed under the name Emergency Management Staff Trainer (EMST, found at https://train-emst.com). The goal of TERA has been to enable more effective learning and practicing of Emergency Operations Center (EOC) response by personnel using EMST loaded with specialized transportation scenarios. These scenarios allow for transportation-specific roles, interactions, emergency tasks, and other relevant context to be easily “played” by transportation emergency management personnel who may be assigned with various degrees of training and experience to an EOC that is managed using various levels of planning. To date, and as a result of previous NHCRP, TRB and ACRP funding, TERA now includes 21 different transportation emergency scenarios and over 1300 simulated emergency management interactions for use by Airport, DOT and Transit EOCs.

3. Research Assignment to Date

During a meeting of the TCRP A-36 Panel on November 2-3, 2017, the panel recommended additional funding of TERA in 2019 to enable broader use, specifically to accomplish new user outreach, existing user support and user requests for system optimization. However, during new user engagement this year, significant challenges became apparent, including differences in the ease with which transportation personnel are able to adopt and adapt TERA.
EMST was originally developed to support traditional emergency response organizations -- organizations that regularly plan, train and exercise for complex emergencies that usually occur in a multi-agency environment. Transportation agencies, however, while well-versed in transportation response, are generally less familiar with national doctrines and norms that guide complex, multi-agency response. Moreover, few transportation agencies below the state level have dedicated emergency management staff or preparedness budgets with which to regularly and adequately engage staff or conduct emergency planning, training and exercising. Consequently, the notion of an emergency management program is still nascent across much of the transportation domain. Ultimately, when transportation agencies lack a plan to manage an EOC and a staff trained to implement emergency plans, deploying meaningful, scenario-based training and exercises becomes problematic.

To further investigate this apparent obstacle to broader TERA use and enhanced emergency management program development in the transportation domain, co-principal investigators from Engineering and Computer Simulations (ECS) and Complete EM, convened a small group of subject matter experts comprised of Mineta Transportation Institute (MTI) staff responsible for numerous DOT emergency preparedness outcomes and a representative from Emergency Preparedness Solutions (EPS, a previous ACRP contractor responsible for implementing TERA in the Airport sub-domain). Ultimately, this group arrived at the following conclusion:

Although several emergency management courses and generic planning templates are currently available to transportation emergency managers, including an older guide developed by NCHRP, a simple, practical and comprehensive emergency preparedness program development guide for transportation emergency managers, that is generally applicable to all transportation EOCs and is consistent with ICS/NIMS/HSEEP doctrines, does not currently exist. Such a guide and incidental implementation support would help emergent and part-time transportation emergency managers to understand, plan and implement an emergency preparedness program practically-sized to their agency’s needs, capabilities and challenges. Having an improved, transportation-specific guide would help close the gap in transportation emergency preparedness, and enable quicker and more effective uptake of TERA as a valuable, scenario-based training and exercising tool that helps organizations apply prerequisite planning and program development.

Ultimately, this group concluded that such a guide should include:

- A brief but comprehensive program development narrative, consistent with national doctrines such as the National Preparedness Goal (NPG), Threat and Hazard Identification and Risk Assessment (THIRA), Developing Emergency Operations Plans (CPG101), National Incident Management System (NIMS), and the Homeland Security Exercise and Evaluation Program (HSEEP) to serve as an overall guide to transportation agency emergency managers who wish to initiate or enhance a simple, effective and sustainable preparedness program;
- A checklist of emergency management transportation capabilities for a transportation agency to build and maintain;
- A list of terminal and enabling learning objectives for transportation emergency managers and EOC staffs;
- A compendium of program development resources (i.e. emergency management doctrine, how-to videos, form sets, sample plans, exercise plan templates); and
- An introduction to TERA, describing how the system can efficiently amplify the effects of training, increase readiness and improve the outcomes of transportation agency EOCs.

4. Funds requested

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocation</td>
<td>435,000</td>
<td>94,000</td>
<td>132,000</td>
<td>155,000</td>
<td>25,000</td>
<td>220,000</td>
<td>360,000</td>
<td>50,000</td>
<td></td>
</tr>
<tr>
<td>Obligation</td>
<td>435,000</td>
<td>94,000</td>
<td>132,000</td>
<td>155,000</td>
<td>25,000</td>
<td>220,000</td>
<td>360,000</td>
<td>50,000</td>
<td></td>
</tr>
<tr>
<td>Total Available</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>450,000</td>
</tr>
<tr>
<td>Recommended Action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TCRP Total Funds Obligated $640,000
ACRP Total Funds Obligated $25,000*
NCHRP Total Funds Obligated $806,000
Combined Total Funds Obligated $1,471,000
Total Available -0-

*ACRP has separately contracted for several related projects. The funds above have been contracted under TCRP A-36.

Cost-sharing for this continuation request scope of work: TCRP has approved $50,000 in FY 2019 funds; ACRP funds will be requested in March 2019 in the amount of $250,000; and NCHRP FY 2020 funds are requested in the amount of $450,000.

5. Anticipated Position when Funds Allocated have been Expended

This panel has been active since 2010, working with a competitively-selected contractor, Engineering & Computer Simulations, Inc. (ECS), to develop the Transportation Emergency Response Application (TERA), which:
- Provides training and simulation exercises for command- and management-level of transit and state DOT emergency roles.
- Promotes active learning by using interactive simulations for each transportation domain.
- Allows for immediate use by agencies after half-day webinars or on-site demonstrations.
Contains, when enhancements now underway are completed in December 2018, twelve (12) training and exercise scenarios for transit and state DOT roles during emergencies, including:
1. Active Shooter
2. Blackout
3. Computer Hack (Power Outage)
4. Earthquake
5. Hazardous Material
6. Hurricane
7. Riverine Flood
8. Wildfire
9. Bus used to injure pedestrians (Vehicle Ramming)
10. Transit-impacted Contagious Disease
11. Traffic Incident Management (TIM) Capstone
12. Contagious Disease

Includes, nine (9) airport training and exercise scenarios developed by the Airport Cooperative Research Program (ACRP), including:
1. Bomb Threat
2. Fuel Farm Fire
3. Hazardous Materials
4. Mass Casualty Incident
5. Power Outage
6. Sabotage
7. Severe Storm
8. Terminal Fire
9. Water rescue

Leverages findings and recommendations contained within TCRP Web-Only Document 60 / NCHRP Web-Only Document 200: Command-Level Decision Making for Transit Emergency Managers


Scope

The objective of this continuation funding request is to address a significant and fundamental challenge to emergency management program evolution within the transportation domain, and better enable the use of TERA as a comprehensive, effective and efficient preparedness tool. This request will assemble a diverse team of subject matter experts to develop a guide and set of integrated tools for use by both nascent and established emergency management programs in the airport, highway and transit transportation sub-domains. Specifically, it will provide definitions and examples of emergency management programs practical to implement within the transportation domain, and provide tools that allow better understanding of national doctrines, and rapid development of emergency management capability in the multi-faceted and
austere environment that typically characterizes transportation emergency management programs.

Program Development Narrative

ECS and a carefully-selected team of subject matter experts will create a narrative guide to describe the practical application of emergency management principles within the transportation domain. The guide will provide emergency management program definitions, crucial transportation context and a practical roadmap for program development. A brief, companion video will also be developed for use as an initial outreach tool (i.e. to be placed on YouTube with a link to the actual guide) and will be placed within TERA as part of the existing resource library. Those who use the guide will gain an understanding of what it means to establish an effective transportation emergency management program, how such a program can be efficiently developed and what opportunities and challenges are inherent in program development. Users will also have a roadmap for program development to use depending on the needs and capabilities of their particular organizations.

Capabilities Checklist

Understanding what threat-informed capabilities are essential to transportation emergency management success, how those capabilities interact with those of other domains and how capabilities can be efficiently developed within various transportation agencies is crucial to achieving preparedness. ECS, along with its team of carefully-selected subject matter experts, will develop a checklist of core capabilities for transportation agencies consistent with the locally developed THIRA, the National Preparedness Goal, the five National Preparedness Frameworks and the Department of Homeland Security’s (DHS) Core Capabilities. The checklist will be accompanied by brief introductory videos for each capability, will clearly define alternative capability targets for transportation agencies of various sizes and purposes, and suggest how each capability can be most efficiently developed. Once completed, the checklist will be used to develop exercise evaluation guides consistent with DHS’s Homeland Security Exercise and Evaluation Program (HSEEP) guides used to evaluate exercises. The checklist and videos will also be added to the TERA library for later reference by users.

Terminal and Enabling Learning Objectives

Equal in importance to the development of specific transportation emergency management capabilities is the development of staff who can perform various roles during response and recovery. To enable airport, transportation and transit staff members to effectively develop these seldom-used skills, the ECS team will define critical emergency management roles, and performance objectives for each role, consistent with the Incident Command System as the base structure under NIMS. Using terminal and enabling learning objectives, ECS will develop brief videos to serve as introductions to each role and embed these videos within TERA to enhance the learning environment, particularly for individuals new to emergency management.
Compendium of Program Development Resources

Because numerous important but lengthy and complex program references confound the part-time or infrequent transportation emergency manager, ECS will facilitate a concise introduction to these references by placing them all in the TERA system and providing a guide to their use. Once completed, TERA users will quickly be able to scan a selection of program development references, understand their purposes and be able to use them effectively. The ECS team will also link these program references to scenario-based tasks and roleplay instances so that users may quickly consult a reference document at will, before, during and after active scenario play.

Introduction to TERA

Because more emergency management programs and staff in the transportation domain will be poised to use TERA once they better understand their own program requirements and begin to establish programs, TERA users should readily see how the system helps them meet each local emergency management program requirement. To this end, ECS will create an interactive program development roadmap that demonstrates each step of development and how TERA supports it.
## Budget

<table>
<thead>
<tr>
<th>Item</th>
<th>Total Cost</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Development Narrative</td>
<td>$175,000</td>
<td>Includes a comprehensive program development guide with sections specific to the unique requirements of transit, highway and airport programs. Also includes a program development introductory video.</td>
</tr>
<tr>
<td>Capabilities Checklist</td>
<td>$150,000</td>
<td>Includes checklist of transportation emergency management capabilities and brief videos to describe each capability.</td>
</tr>
<tr>
<td>Terminal and Enabling Learning Objectives</td>
<td>$150,000</td>
<td>Includes list of key transportation emergency management roles and learning objectives for each role. Also includes videos to introduce each role and to assist in staff training.</td>
</tr>
<tr>
<td>Compendium of Program Development Resources</td>
<td>$85,000</td>
<td>Embeds all significant program reference documents in TERA and provides a references summary for easier use by TERA operators.</td>
</tr>
<tr>
<td>Introduction to TERA</td>
<td>$190,000</td>
<td>Includes an interactive program development roadmap and demonstrates how TERA aids in program development, including planning, training, equipping, supplying, exercising, and evaluating.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>750,000</strong></td>
<td></td>
</tr>
</tbody>
</table>
Continuation Request
Project 20-102, FY 2020
Impacts of Connected Vehicles and Automated Vehicles on State and Local Transportation Agencies

Present Expiration Date: Continuing
Recommended Allocation: $1,500,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

In 2014, NCHRP Project 20-24(98) developed a research roadmap addressing the policy, planning, and implementation issues associated with connected vehicles (CV) and automated vehicles (AV) that state and local transportation agencies will face. NCHRP Project 20-102(19) is updating that roadmap (current edition is available at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4476).

The NCHRP 20-102 Panel decides which tasks will be undertaken using the funds at their disposal based upon the research roadmap and developments in the public and private sectors. Tasks currently underway are listed below in Item #6. These decisions have been influenced by input from, among others:

- U.S. Department of Transportation (including ITS JPO, FHWA, and NHTSA)
- Cooperative Automated Transportation (CAT) Coalition, an AASHTO led group supporting implementation of standards and guidance for vehicle to infrastructure (V2I) technologies, including CV technologies.
- TRB Forum on Automated Vehicles and Shared Mobility
- Various AASHTO and TRB Standing Committees
- Connected Vehicle Pooled Fund Study
- Crash Avoidance Metrics Partnership (CAMP), a group of vehicle manufacturer representatives that collaborates on pre-competitive crash avoidance research projects of mutual interest
- Presentations and discussions at the Automated Vehicle Symposia

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The requested funds will be used to carry out additional tasks, likely drawing from the research roadmap (mentioned in Item #1). Candidate tasks include (these were the second tier of priorities during the most recent selection):

- Alternative Scenarios for Synergy Among Automated Vehicles, Shared Mobility, and Alternative Fuels
- Infrastructure/Land Use Impacts of Shared Automated Vehicles
• Implications for Work Zones
• Analysis on the Impacts of Advanced Automated Transit
• CV/AV Applications for Government Truck Fleets
• CAV and Shared Mobility Impacts on Travelers with Accessibility Restrictions

3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Initial Allocation</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuation Allocation</td>
<td>-0-</td>
<td>1,000</td>
<td>1,500</td>
<td>2,150*</td>
<td>1,500</td>
<td></td>
</tr>
<tr>
<td>Less Obligation</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>-0-</td>
<td>-0-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td>-0-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Available</td>
<td>-0-</td>
<td>-0-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended Addition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,500</td>
</tr>
</tbody>
</table>

*$650k programmed directly by SCOR as Task 15

4. Interpretation of AASHTO Problem Statement by Panel

Connected vehicle technologies are being developed to enable safe, interoperable networked wireless communications among vehicles (V2V), the infrastructure (V2I), and travelers’ personal communication devices (V2X). These technologies are intended to reduce highway crashes; provide data for assessing the performance of the transportation system; provide continual access to accurate information on the operation of the system to travelers; and reduce unnecessary stops, delays, and emissions.

Automated vehicle technologies are also under development that will significantly change fundamental planning, design, and operational characteristics for the road network. Some industry leaders expect that Level 4 vehicle automation (under NHTSA and SAE definitions) will be available on the market by 2018. Fully autonomous, driverless vehicles (SAE Level 5 automation) could be on the market by 2025.

For Level 5 automation, “the vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip.” (NHTSA, Preliminary Statement of Policy Concerning Automated Vehicles) Level 4 automation is essentially the same as Level 5, without any driver supervision (e.g., there is no expectation that the driver will be engaged), over a limited driving domain. These vehicles may be safer than current models.

Connected vehicles and automated vehicles are essentially different technologies, though some of the challenges they present to transportation agencies will be similar. These two technologies may converge or diverge from each other based largely on
developments in the private sector (e.g., vehicle manufacturers, third-party vendors). While some actors envision a completely autonomous vehicle that does not require communication with other entities, others see serendipities between the two technologies. This project will address both technologies (including the combination) under the umbrella term of CV/AV. The individual tasks that compose the project will clearly identify which technologies are to be addressed.

5. Original AASHTO Problem Statement Number

Problem No. 2015-G-30

6. Research Assignment to Date

NCHRP Project 20-102, Impacts of Connected/Automated Vehicles on State and Local Transportation Agencies.

Publications (Completed Tasks)

<table>
<thead>
<tr>
<th>Task</th>
<th>Title</th>
<th>Funds</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies</td>
<td>$400k</td>
<td>Report 845</td>
</tr>
<tr>
<td>2</td>
<td>Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations</td>
<td>$150k</td>
<td>Web-Only Doc 239</td>
</tr>
<tr>
<td>3</td>
<td>Challenges to CV and AV Applications in Truck Freight Operations</td>
<td>$150k</td>
<td>Web-Only Doc 231</td>
</tr>
<tr>
<td>7</td>
<td>Implications of Connected and Automated Driving Systems</td>
<td>$350k</td>
<td>Web-Only Doc 253</td>
</tr>
<tr>
<td>8</td>
<td>Dedicating Lanes for Priority or Exclusive Use by Connected and Automated Vehicles</td>
<td>$350k</td>
<td>Report 891</td>
</tr>
<tr>
<td>9</td>
<td>Updating Regional Transportation Planning and Modeling Tools to Address Impacts of Connected and Automated Vehicles</td>
<td>$300k</td>
<td>Report 896</td>
</tr>
</tbody>
</table>
# Active Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Title</th>
<th>Funds</th>
<th>Exp. Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Evaluation Guidance for AV Pilot and Demonstration Projects (incorporated into NCHRP 08-116, Framework for Managing Data from Emerging Transportation Technologies to Support Decision-Making)</td>
<td>$75k</td>
<td>2020 Q2</td>
</tr>
<tr>
<td>5</td>
<td>Strategic Communications Plan for NCHRP 20-102</td>
<td>$100k</td>
<td>2019 Q4</td>
</tr>
<tr>
<td>6</td>
<td>Road Markings for Automated Vehicles (Phase I results available in 2018 Q1)</td>
<td>$400k</td>
<td>2019 Q4</td>
</tr>
<tr>
<td>10</td>
<td>Cybersecurity Implications of CV/AV Technologies on State and Local Transportation Agencies (incorporated into NCHRP 03-127, Cybersecurity of Traffic Management Systems)</td>
<td>$250k</td>
<td>2019 Q4</td>
</tr>
<tr>
<td>11</td>
<td>Mobility-on-Demand and Automated Driving Systems: A Framework for Public-Sector Assessment</td>
<td>$100k*</td>
<td>2020 Q2</td>
</tr>
<tr>
<td>12</td>
<td>Business Models to Facilitate Deployment of CV Infrastructure to Support AV Operations</td>
<td>$400k</td>
<td>2019 Q4</td>
</tr>
<tr>
<td>13</td>
<td>Planning Data Needs and Collection Techniques for CV/AV Applications (will be incorporated into NCHRP 08-119, Developing Data Standards and Guidance for Transportation Planning and Traffic Operations)</td>
<td>$250k</td>
<td>2021 Q2</td>
</tr>
<tr>
<td>14</td>
<td>Data Management Strategies for CV/AV Applications for Operations (will be incorporated into NCHRP 08-119, Developing Data Standards and Guidance for Transportation Planning and Traffic Operations)</td>
<td>$250k</td>
<td>2021 Q2</td>
</tr>
<tr>
<td>15</td>
<td>Impacts of Connected and Automated Vehicle Technologies on the Highway Infrastructure</td>
<td>$650k</td>
<td>2020 Q3</td>
</tr>
<tr>
<td>16</td>
<td>Preparing TIM Responders for Connected Vehicles and Automated Vehicles</td>
<td>$250k</td>
<td>2021 Q2</td>
</tr>
<tr>
<td>17</td>
<td>Deployment Guidance for CV Applications in the Open Source Application Development Portal</td>
<td>$450k</td>
<td>2021 Q2</td>
</tr>
<tr>
<td>19</td>
<td>Update AASHTO’s Connected Vehicle/ Automated Vehicle Research Roadmap</td>
<td>$125k</td>
<td>2020 Q2</td>
</tr>
<tr>
<td>20</td>
<td>Workforce Capability Strategies for State and Local Agencies</td>
<td>$300k</td>
<td>TBD</td>
</tr>
<tr>
<td>21</td>
<td>Infrastructure Modifications to Improve the Operational Domain of Automated Vehicles</td>
<td>$400k</td>
<td>TBD</td>
</tr>
</tbody>
</table>
22  State and Local Impacts of Automated Freight Transportation Systems  $350k  TBD

23  Potential Impacts of Highly Automated Vehicles and Shared Mobility on Traveler Behavior (will incorporate TCRP B-47, Mobility Inclusion for Un(der)served Populations with the Emerging Technologies)  $450k  TBD

24  Infrastructure Enablers for Connected and Automated Vehicles and Shared Mobility—Near-Term and Mid-Term  $600k  TBD

* An additional $200,000 was added to Task 11 to address mobility-on-demand.

7. Review Dates

Continuation Request
Project 22-40, FY 2019
Update to AASHTO M 180-18 and Associated Highway Guardrail Specification

Completion Date: 28 February 2021 (estimated)
Recommended Allocation: $250,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objectives of NCHRP Project 22-40, “Update to AASHTO M 180-18 and Associated Highway Guardrail Specifications,” are to (a) perform a comprehensive review of AASHTO M 180-18, Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail, and its associated AASHTO and ASTM standards and (b) propose needed revisions to bring the specifications into conformance with current requirements and the state of practice for highway guardrail systems. The revised standard shall specify—or make reference to standards for—materials for components of the highway guardrail system, including beams, posts, end terminals, connecting hardware, etc. The proposed revisions and supporting commentary shall be provided to Technical Subcommittee 4d of the AASHTO Committee on Materials and Pavements (COMP TS 4d) and the AASHTO Technical Committee for Roadside Safety (TCRS) for review and possible adoption.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The use of high-tension cable barriers (HTCBs) is growing across the United States. NCHRP Synthesis Project 20-05/Topic 46-14, “Practices for High-Tension Cable Barrier,” summarized the state of the practice for these systems. The synthesis identified the need for an HTCB materials specification comparable to AASHTO M 180 for guardrail systems. This need was confirmed by NCHRP Project Panel 22-40 during the development of the Request for Proposals for Project 22-40. The panel respectfully requests $250,000 in FY 2020 funding for development of the specification.

The requested funds will enable development of a proposed AASHTO specification for the materials used in HTCB systems for consideration by Technical Subcommittee 4d of the AASHTO Committee on Materials and Pavements (COMP TS 4d) and the AASHTO Technical Committee for Roadside Safety. This AASHTO materials specification will also provide manufacturers with a common standard rather than varying state-specific
criteria.

The proposed HTCB specification will address the following items at a minimum:

- Engineering properties of the various steel components
  - Posts
  - Cable
  - Cable end treatments
  - Turnbuckles
  - Other hardware
- Galvanizing requirements, including an option for stainless steel
- Engineering properties for the concrete used for the end terminal anchors and post bases
- Appropriate geotechnical exploration and testing to derive critical geotechnical engineering design values
- The AASHTO/ASTM test methods required to determine these engineering properties
- The method of acceptance for these components
  - Field inspection
  - Manufactures certification
  - Independent lab certification
  - Sampling and testing by the owner

3. Funds (in thousands)

<table>
<thead>
<tr>
<th></th>
<th>FY 2019</th>
<th>FY 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO Initial Allocation</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Continuation Allocation</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Less Obligation</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Balance (earmarked)</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Reallocation</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Total Available</td>
<td>-0-</td>
<td></td>
</tr>
<tr>
<td>Recommended Addition</td>
<td></td>
<td>250</td>
</tr>
</tbody>
</table>

4. Interpretation of AASHTO Problem Statement by Panel

Many states use AASHTO and ASTM standard specifications for their guardrail components. Changes to the state of practice and to guardrail materials have created a need to revise AASHTO Standard Specification M 180-18, Corrugated Sheet Steel Beams for Highway Guardrail, and its associated material standards, including those referenced in M 180-18.

A lack of consistent standards can increase fabrication costs for hardware suppliers and ultimately transportation agencies. A manufacturer can spend a significant amount of
resources matching one state’s standards only to start completely over to match another state’s standards. Consistency of specifications will also help to increase competition, allowing for the possibility of lower hardware costs for transportation agencies.

Some examples of developments in materials and the state of practice for highway guardrail systems that are not currently addressed by AASHTO M 180-18 are:

- The asymmetrical W-Beam to thrie-beam transition section that has been in use for a number of years.
- Inconsistency in the material requirements for thrie-beam terminal transitions and connections.
- Use of high-strength steel bolts connecting thrie-beam terminal connectors to rigid barrier.
- Multiple slot patterns for thrie-beam terminal connectors, thrie beam, and W-beam rails.
- Lack of consistent markings for components of the highway guardrail system.
- Changes to the applicable locations and geometric equivalents for ASTM standard bolts.
- Use of multiple grades for steel posts.
- Lack of guidance for shop-bent W-beam or thrie-beam rails (e.g., longitudinal radius of curve, radius tolerances, marking of beam radius to aid maintenance, etc.).
- Lack of changes to the appropriate dimensions and tolerances (metric and inch) for holes in steel guardrails and posts.
- Lack of standards for swage fittings.
- Changes to bolt tolerance, shape, and torque requirements.
- Lack of paint and thermal spray specifications for guardrail beams and posts to meet the requirements for Type III guardrails.
- Implications of the greater longevity of painted weathering steels compared to ordinary carbon steels.
- Need for specifications for stainless steel beams, posts, and bolting to meet the requirements for Type IV guardrails.

Recent years have seen an increased focus on the performance of roadside hardware. Research is needed to assure that transportation agencies are specifying and using correct materials in their highway guardrail systems.

5. Original AASHTO Problem Statement Number

Problem No. 2019-D-08

6. Research Assignments to Date

NCHRP Project 22-40, “Update to AASHTO M 180-18 and Associated Highway Guardrail Specifications”
7. Review Dates

8/28-29/2018, 11/28/2018
Part II

New Problems
# FY 2020 CANDIDATES FOR FUNDING AS NEW PROBLEMS

## Table of Contents

<table>
<thead>
<tr>
<th>Problem No</th>
<th>Title</th>
<th>Submitter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020-A-01</td>
<td>Selecting the Appropriate Magnitude, Boundaries, and Methods for Value Capture Funding ($400,000-24 months)</td>
<td>AASHTO Committee of Funding and Finance</td>
<td>A-01/1</td>
</tr>
<tr>
<td>2020-A-02</td>
<td>The Application of Federal Funding Flexibility at the State DOTs ($400,000-18 months)</td>
<td>AASHTO Committee of Funding and Finance</td>
<td>A-02/1</td>
</tr>
<tr>
<td>2020-A-03</td>
<td>Secure Information Environments for Collaboration and Knowledge Sharing: Guidance for State DOTs ($300,000-12 months)</td>
<td>AASHTO Committee on Knowledge Management</td>
<td>A-03/1</td>
</tr>
<tr>
<td>2020-A-04</td>
<td>Targeted Guidance and Information Support to State DOT CEOs on Cybersecurity Issues and Protection Strategies ($350,000-18 months)</td>
<td>AASHTO Committee on Transportation System Security and Resilience &amp; Committee on Data Management and Analytics</td>
<td>A-04/1</td>
</tr>
<tr>
<td>2020-A-05</td>
<td>Cost Savings Analysis of Statewide Insurance Pooling for Public Transit ($281,250-18 months)</td>
<td>AASHTO Council on Public Transportation</td>
<td>A-05/1</td>
</tr>
<tr>
<td>2020-A-06</td>
<td>Guidebook for P3 Project Arrangements and Performance Metrics ($500,000-36 months)</td>
<td>Georgia</td>
<td>A-06/1</td>
</tr>
</tbody>
</table>

### A – Administration

### B – Transportation Planning

<table>
<thead>
<tr>
<th>Problem No</th>
<th>Title</th>
<th>Submitter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020-B-01</td>
<td>Beneficial Reuse of Lightly Contaminated Material from Transportation Construction, Maintenance, and Operation Activities ($375,000-36 months)</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-01/1</td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>2020-B-02</td>
<td>Best Practices for Project-Level Analyses for Air Quality</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-02/1</td>
</tr>
<tr>
<td></td>
<td>($600,000-36 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-03</td>
<td>Combining Compost and Phosphorus Sorption Media into a Homogenized &quot;Mix&quot; for Stormwater Treatment</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-03/1</td>
</tr>
<tr>
<td></td>
<td>($400,000-500,000-24-48 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-04</td>
<td>Developing Cost-Effective Approaches to Site Selection for Wildlife Crossings</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-04/1</td>
</tr>
<tr>
<td></td>
<td>($350,000-30 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-05</td>
<td>Effective On-Bridge Treatment of Stormwater</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-05/1</td>
</tr>
<tr>
<td></td>
<td>($500,000 - 4-5 years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-06</td>
<td>Evaluating and Improving Current Practices for Temporarily Deterring Bat Use of Bridges</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-06/1</td>
</tr>
<tr>
<td></td>
<td>($450,000-48 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-07</td>
<td>Methodology for Analyzing Noise and Vibration Impacts on Different Terrestrial Species</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-07/1</td>
</tr>
<tr>
<td></td>
<td>($300,000-24 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-08</td>
<td>National Synthesis of Project-Level Programmatic Agreements for Expediting Section 106 Consultation in Project Delivery</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-08/1</td>
</tr>
<tr>
<td></td>
<td>($150,000-12-18 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-09</td>
<td>Quiet Bridges: Design, Construction, and Modification</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-09/1</td>
</tr>
<tr>
<td></td>
<td>($99,000-12 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-10</td>
<td>Streamlining Transportation Conformity Processes</td>
<td>AASHTO Committee on Environment and Sustainability</td>
<td>B-10/1</td>
</tr>
<tr>
<td></td>
<td>($500,000-24 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-11</td>
<td>Developing an AASHTO Guide to System Level Asset Valuation in Support of Transportation Asset Management Decision Making</td>
<td>AASHTO Committee on Performance-Based Management</td>
<td>B-11/1</td>
</tr>
<tr>
<td></td>
<td>($600,000-18 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-12</td>
<td>Emerging Issues: Impact of New Disruptive Technologies on the Performance of DOTs</td>
<td>AASHTO Committee on Performance-Based Management</td>
<td>B-12/1</td>
</tr>
<tr>
<td></td>
<td>($250,000-24 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-13</td>
<td>Guidebook for Identifying and Implementing Forecasting Techniques for Effective Target Setting</td>
<td>AASHTO Committee on Performance-Based Management</td>
<td>B-13/1</td>
</tr>
<tr>
<td></td>
<td>($500,000-24 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-B-14</td>
<td>Snapshots of Planning Practices</td>
<td>AASHTO Committee on Planning</td>
<td>B-14/1</td>
</tr>
<tr>
<td></td>
<td>($300,000-42 months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>2020-B-15</td>
<td>Incorporating Resilience Concepts and Strategies in Transportation Planning Efforts ($120,000-12 months)</td>
<td>AASHTO Committee on Transportation System Security and Resilience</td>
<td>B-15/1</td>
</tr>
<tr>
<td>2020-B-16</td>
<td>Synthesis of Recent Active Transportation Related Research and Creation of Research Roadmap for Council on Active Transportation (NCHRP 20-123) ($350,000-12 months)</td>
<td>AASHTO Council on Active Transportation</td>
<td>B-16/1</td>
</tr>
<tr>
<td>2020-B-17</td>
<td>Best Practices in Determining Rural Transit Fleet Size - How To Provide Service for Changing Demographics of Rural Ridership (Right-Sizing of Rural Transit Fleets) ($250,000-18 Months)</td>
<td>AASHTO Council on Public Transportation</td>
<td>B-17/1</td>
</tr>
<tr>
<td>2020-B-18</td>
<td>Best Practices on Transit Options for Discharged Patients from Healthcare Providers ($250,000-18 months)</td>
<td>AASHTO Council on Public Transportation</td>
<td>B-18/1</td>
</tr>
<tr>
<td>2020-B-19</td>
<td>Best Practices in Coordination of Public Transit and Ride Sharing ($250,000-18 months)</td>
<td>AASHTO Council on Public Transportation</td>
<td>B-19/1</td>
</tr>
<tr>
<td>2020-B-20</td>
<td>Access to Jobs, Economic Opportunities and Education in Rural Areas ($250,000-18 months)</td>
<td>AASHTO Council on Public Transportation</td>
<td>B-20/1</td>
</tr>
<tr>
<td>2020-B-21</td>
<td>Trade-Off Analysis: A Multi-Modal Guide for Rural Transportation Investment Analysis ($500,000-30 months)</td>
<td>AASHTO Special Committee on Research and Innovation</td>
<td>B-21/1</td>
</tr>
<tr>
<td>2020-B-22</td>
<td>Accessing America's Great Outdoors: Understanding Recreational Travel Patterns, Demand, and Future Investment Needs for Transportation Systems ($450,000-24 months)</td>
<td>AASHTO Special Committee on Research and Innovation/Committee on Planning/Tennessee</td>
<td>B-22/1</td>
</tr>
<tr>
<td>2020-B-23</td>
<td>Development and Implementation of the National Intercity Bus Atlas ($600,000-18 months)</td>
<td>AASHTO Special Committee on Research and Innovation</td>
<td>B-23/1</td>
</tr>
<tr>
<td>2020-B-24</td>
<td>Enabling On-demand, Multi-modal Trips to be Booked in Real-time in Rural America ($700,000-24 months)</td>
<td>AASHTO Special Committee on Research and Innovation</td>
<td>B-24/1</td>
</tr>
<tr>
<td>2020-B-25</td>
<td>Guidebook on Integrating Freight Movement into 21st Century Communities' Land Use, Design, and Transportation Systems ($500,000-18 months)</td>
<td>AASHTO Committee on Urban Freight Committee/Minnesota DOT</td>
<td>B-25/1</td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>2020-B-26</td>
<td>Reliability and Quality of Service Evaluation Methods for Rural Highways ($400,000-24 months)</td>
<td>Arkansas SHTD</td>
<td>B-26/1</td>
</tr>
<tr>
<td>2020-B-27</td>
<td>Handbook for Sustainable Roadside Stormwater Infrastructure ($300,000-24 months)</td>
<td>California</td>
<td>B-27/1</td>
</tr>
<tr>
<td>2020-B-28</td>
<td>Application of Carbon Capture, Utilization, &amp; Sequestration Technologies to Transportation Infrastructure Construction Materials ($500,000-30 months)</td>
<td>California</td>
<td>B-28/1</td>
</tr>
<tr>
<td>2020-B-29</td>
<td>Analytic Approaches to Understand How Freight Transportation is Influenced by Land Use Context and Transportation Conditions ($400,000-24 months)</td>
<td>Federal Highway Administration</td>
<td>B-29/2</td>
</tr>
<tr>
<td>2020-B-30</td>
<td>A Comprehensive Evaluation of the Benefits and Costs of Railroad Quiet Zones ($400,000-18 months)</td>
<td>Iowa</td>
<td>B-30/1</td>
</tr>
<tr>
<td>2020-B-31</td>
<td>Engaging the &quot;Right&quot; Players to Expand the Playbook of Workable Urban Freight Solutions ($450,000-24 months)</td>
<td>AASHTO Committee on Urban Freight Committee/ Minnesota</td>
<td>B-31/1</td>
</tr>
<tr>
<td>2020-B-32</td>
<td>Land-Use Development Guide for Hazardous Materials Transportation ($500,000-24 months)</td>
<td>Minnesota / North Carolina</td>
<td>B-32/1</td>
</tr>
<tr>
<td>2020-B-33</td>
<td>Capturing Low-Incidence/High-Impact Travel in Household Travel Surveys ($300,000-24 months)</td>
<td>Ohio</td>
<td>B-33/1</td>
</tr>
<tr>
<td>2020-B-34</td>
<td>Incorporating the Demand, Capacity, and Operational Impacts of Incidents and Safety Treatments in the HCM Freeway Facilities Methodology ($400,000-24 months)</td>
<td>Texas</td>
<td>B-34/1</td>
</tr>
<tr>
<td>2020-B-35</td>
<td>Regulatory and Policy Actions to Facilitate Truck Automation Technology ($350,000-24 months)</td>
<td>Texas</td>
<td>B-35/1</td>
</tr>
</tbody>
</table>

**C – Design**

<table>
<thead>
<tr>
<th>Problem No</th>
<th>Title</th>
<th>Submitter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020-C-01</td>
<td>Bridge Deck Overhangs with MASH-Compliant Railings ($500,000-24 months)</td>
<td>AASHTO Committee of Bridges and Structures (COBS)</td>
<td>C-01/1</td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>2020-C-02</td>
<td>Visual and Augmented Reality for Integration and Effective Use of Heterogeneous Data from Visual Inspection, NDT/E and SHM ($500,000-24 months)</td>
<td>AASHTO COBS, T-9/New York State</td>
<td>C-02/1</td>
</tr>
<tr>
<td>2020-C-03</td>
<td>Best Practices for Steel Coating and Recoeating Warranty Contract Requirements ($150,000-12 months)</td>
<td>AASHTO COBS, T-9 snf COM, Bridge Technical Working Group (Committee on Bridges and Structures)</td>
<td>C-03/1</td>
</tr>
<tr>
<td>2020-C-04</td>
<td>Rational Tolerances for Fabrication of Steel Bridge Members ($600,000-30 months)</td>
<td>AASHTO Committee on Bridges and Structures</td>
<td>C-04/1</td>
</tr>
<tr>
<td>2020-C-05</td>
<td>Developing High Strength Corrosion Resistant Steel Strands for Prestressing ($600,000-36 months)</td>
<td>AASHTO Committee on Bridges and Structures</td>
<td>C-05/1</td>
</tr>
<tr>
<td>2020-C-06</td>
<td>Evaluating the Completeness and Accuracy of Existing Utility Records ($300,000-24 months)</td>
<td>AASHTO Committee for Right-of-Way, Utilities &amp; Outdoor Advertising Control</td>
<td>C-06/1</td>
</tr>
<tr>
<td>2020-C-07</td>
<td>Evaluation of Tools and Methods to Mitigate and Manage Utility-Related Risks on State Department of Transportation Projects ($400,000-24 months)</td>
<td>AASHTO Committee for Right-of-Way, Utilities &amp; Outdoor Advertising Control</td>
<td>C-07/1</td>
</tr>
<tr>
<td>2020-C-08</td>
<td>Utility Conflict Impacts During Highway Construction ($400,000-24 months)</td>
<td>AASHTO Committee for Right-of-Way, Utilities &amp; Outdoor Advertising Control</td>
<td>C-08/1</td>
</tr>
<tr>
<td>2020-C-09</td>
<td>Outdoor Advertising Control Program Reference Manual for State Departments of Transportation ($200,000-18 months)</td>
<td>AASHTO Committee on Right of Way, Utilities and Outdoor Advertising Control</td>
<td>C-09/1</td>
</tr>
<tr>
<td>2020-C-10</td>
<td>Valuation of Permitting Utility and Communications Installations in Public ROW ($350,000-24 months)</td>
<td>AASHTO Committee for Right-of-Way, Utilities &amp; Outdoor Advertising Control</td>
<td>C-10/1</td>
</tr>
<tr>
<td>2020-C-11</td>
<td>Methodology for Addressing Project Constraints in Early Construction Cost Estimates ($130,000-$180,000 – 12-18 months)</td>
<td>AASHTO Committee on Design</td>
<td>C-11/1</td>
</tr>
<tr>
<td>2020-C-12</td>
<td>Methodology to Define New AASHTO Green Book 7.0 Context Classification Settings Implementation as Related to Active Transportation Infrastructure ($300,000-20 months)</td>
<td>AASHTO Council on Active Transportation</td>
<td>C-12/1</td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>2020-C-13</td>
<td>Impact Performance Assessment of Barrier Performance at High Speeds ($600,000-36 months)</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
<td>C-13/1</td>
</tr>
<tr>
<td>2020-C-14</td>
<td>Developing Testing Protocol for a Family of Devices - Signs, Breakaway Poles and Work Zone Devices ($500,000-36 months)</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
<td>C-14/1</td>
</tr>
<tr>
<td>2020-C-15</td>
<td>Development of a Crash Data Collection Tool for MASH In-Service Performance and Application Guidelines ($400,000-24 months)</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
<td>C-15/1</td>
</tr>
<tr>
<td>2020-C-16</td>
<td>Crashworthiness of Barrier Attachments ($650,000-36 months)</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
<td>C-16/1</td>
</tr>
<tr>
<td>2020-C-17</td>
<td>MASH Performance Evaluation of Safety Grates for Culverts ($600,000-36 months)</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
<td>C-17/1</td>
</tr>
<tr>
<td>2020-C-18</td>
<td>Understanding and Analyzing the Contributing Factors to Crashes ($650,000-36 months)</td>
<td>AASHTO Committee on Safety</td>
<td>C-18/1</td>
</tr>
<tr>
<td>2020-C-19</td>
<td>Supporting Data-Driven Decision Making Through an Expansion of the Human Factors Guidelines for Road Systems ($550,000-27 months)</td>
<td>AASHTO Committee on Safety</td>
<td>C-19/1</td>
</tr>
<tr>
<td>2020-C-20</td>
<td>Estimating Safety Performance of Infrastructure Improvements Incorporating Consideration of Driver Behavior ($600,000-36 months)</td>
<td>AASHTO Committee on Safety</td>
<td>C-20/1</td>
</tr>
<tr>
<td>2020-C-21</td>
<td>Methods for Short-Term Crash Prediction ($650,000-30 months)</td>
<td>AASHTO Committee on Safety</td>
<td>C-21/1</td>
</tr>
<tr>
<td>2020-C-22</td>
<td>The Effect of Vehicle Mix on Crash Frequency and Crash Severity ($400,000-30 months)</td>
<td>AASHTO Committee on Safety</td>
<td>C-22/1</td>
</tr>
<tr>
<td>2020-C-23</td>
<td>Model Procedures for Post-Event Bridge Damage Assessment and Engineering Evaluation ($300,000-36 months)</td>
<td>Alaska DOT and Public Facilities</td>
<td>C-23/1</td>
</tr>
<tr>
<td>2020-C-24</td>
<td>Design to Reduce Motor Vehicle/Bike Conflicts at Intersections ($600,000-24 months)</td>
<td>California</td>
<td>C-24/1</td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------</td>
<td>------</td>
</tr>
<tr>
<td>2020-C-25</td>
<td>Safety Evaluation of On-Street Bikeway Designs ($500,000 -24 months)</td>
<td>California</td>
<td>C-25/1</td>
</tr>
<tr>
<td>2020-C-26</td>
<td>Guidebook for Safe and Effective Application of Bicycle Boulevards ($350,000-18 months)</td>
<td>California</td>
<td>C-26/1</td>
</tr>
<tr>
<td>2020-C-27</td>
<td>Design of Geosynthetic MSE Walls Subjected to Vehicle Impact on Roadside Barrier Systems Placed on Top of Them ($700,000-36 months)</td>
<td>Massachusetts</td>
<td>C-27/1</td>
</tr>
<tr>
<td>2020-C-28</td>
<td>Best Practices for Networking and Historical Data Collection for Traffic Signal Systems ($200,000-24 months)</td>
<td>Texas</td>
<td>C-28/1</td>
</tr>
<tr>
<td>2020-C-29</td>
<td>Identify Effects of Flexible Pylon Barriers for Increased Bike Lane Usage ($200,000-12-18 months)</td>
<td>Texas</td>
<td>C-29/1</td>
</tr>
</tbody>
</table>

**D – Materials and Construction**

<p>| 2020-D-01 | Structural Design Methodology for Cured in Place Pipe (CIPP) Liners in Gravity Stormwater Conveyance Conduits ($600,000-24 months) | Florida          | D-01/1 |
| 2020-D-02 | Developing Endurance Characterization Curves for GFRP Reinforcing Bars for Structural Concrete ($400,000-36 months) | Florida          | D-02/1 |
| 2020-D-03 | Protocols for the Continuous Pavement Deflection Measuring Devices: Calibration and Structural Assessment ($450,000-24 months) | Louisiana        | D-03/1 |
| 2020-D-04 | The Efficacy of Emulsion-based Rejuvenating Seals ($450,000-24 months) | Rhode Island     | D-04/1 |
| 2020-D-05 | Construction Specifications for Pavement Treatments - Slurry Seals and Tack Coats ($125,000-12 months) | Rhode Island     | D-05/1 |
| 2020-D-06 | Guidelines for the Procurement of Nondestructive Testing and Evaluation and Structural Health Monitoring based on Best Practices and Vendor Qualification for State and Local Transportation Agencies ($150,000-16 months) | AASHTO Committee on Maintenance | D-06/1 |</p>
<table>
<thead>
<tr>
<th>Problem No</th>
<th>Title</th>
<th>Submitter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020-D-07</td>
<td>Guide Construction Specifications for Cold In-place Recycling (CIR) and Cold Central Plant Recycling (CCPR) ($175,000-12 months)</td>
<td>AASHTO Committee on Maintenance</td>
<td>D-07/1</td>
</tr>
<tr>
<td>2020-D-08</td>
<td>Improvement of Certification Method of Inertial Profiling Systems for Network Data Collection ($125,000-14 months)</td>
<td>AASHTO Committee on Materials and Pavements</td>
<td>D-08/1</td>
</tr>
<tr>
<td>2020-D-09</td>
<td>Performance Specifications Implementation Guide ($400,000-24 months)</td>
<td>AASHTO Committee on Materials and Pavements</td>
<td>D-09/1</td>
</tr>
<tr>
<td>2020-D-10</td>
<td>Manual for Incorporating NDT in Quality Assurance ($250,000-24 months)</td>
<td>AASHTO Committee on Materials and Pavements</td>
<td>D-10/1</td>
</tr>
<tr>
<td>2020-D-11</td>
<td>Trackless Tack and Tack Coats for Different Paving Applications ($500,000-24 months)</td>
<td>AASHTO Committee on Materials and Pavements</td>
<td>D-11/1</td>
</tr>
<tr>
<td><strong>E - Soils and Geology</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-E-01</td>
<td>Selection and Use of Flow Resistance Values in Two-Dimensional (2D) Hydraulic Models ($500,000-30 months)</td>
<td>Ohio</td>
<td>E-01/1</td>
</tr>
<tr>
<td><strong>F – Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-F-01</td>
<td>Strategies to Maximize Vehicle and Equipment Resale Values to Optimize Fleet Total Cost of Ownership ($300,000-18 months)</td>
<td>AASHTO Committee on Maintenance</td>
<td>F-01/1</td>
</tr>
<tr>
<td>2020-F-02</td>
<td>Benefit-Cost Analysis of Chip Seal Binder Alternatives ($600,000-36 months)</td>
<td>AASHTO Committee on Maintenance</td>
<td>F-02/1</td>
</tr>
<tr>
<td>2020-F-03</td>
<td>Guidelines for Incorporating Maintenance Costs into a Transportation Asset Management Plan ($200,000-15 months)</td>
<td>AASHTO Committee on Maintenance</td>
<td>F-03/1</td>
</tr>
<tr>
<td><strong>G – Traffic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-G-01</td>
<td>Traffic Signal Change and Clearance Intervals for Left-Turn Phases ($200,000-12 months)</td>
<td>AASHTO Committee on Traffic Engineering</td>
<td>G-01/1</td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>2020-G-02</td>
<td>Temporary Traffic Control at Driveways within a One-Lane, Two-Way Section ($200,000-12 months)</td>
<td>AASHTO Committee on Traffic Engineering</td>
<td>G-02/1</td>
</tr>
<tr>
<td>2020-G-03</td>
<td>Crash Modification Factors for Intelligent Transportation Systems (ITS) Applications ($250,000-18 months)</td>
<td>AASHTO Committee on Transportation System Operations</td>
<td>G-03/1</td>
</tr>
<tr>
<td>2020-G-04</td>
<td>Determining the Readiness and Effectiveness of Freeway-Based Corridor V2X Applications for Improving Congestion and Safety ($500,000-30 months)</td>
<td>AASHTO Committee on Transportation System Operations</td>
<td>G-04/1</td>
</tr>
<tr>
<td>2020-G-05</td>
<td>Utilizing Connected &amp; Automated Vehicle (CAVs) Data to Enhance and Optimize Freeway Operations Strategies, Algorithms and Performance Measures ($500,000-24 months)</td>
<td>AASHTO Committee on Transportation System Operations</td>
<td>G-05/1</td>
</tr>
<tr>
<td>2020-G-06</td>
<td>Experimental Implementation of Big Data Analytics for Traffic Incident Management ($500,000-30 months)</td>
<td>AASHTO Committee on Transportation System Operations</td>
<td>G-06/1</td>
</tr>
<tr>
<td>2020-G-07</td>
<td>MIRE Data Requirements Supporting Safety Improvements on Unpaved Roads ($300,000-12-18 months)</td>
<td>AASHTO Special Committee on Research and Innovation</td>
<td>G-07/1</td>
</tr>
<tr>
<td>2020-G-08</td>
<td>Acceleration and Deceleration Rates used in Roadway Design Criteria ($500,000-18 months)</td>
<td>AASHTO Technical Committee on Geometric Design</td>
<td>G-08/1</td>
</tr>
<tr>
<td>2020-G-09</td>
<td>Designing for Target Speed ($750,000-36 months)</td>
<td>AASHTO Technical Committee on Geometric Design</td>
<td>G-09/1</td>
</tr>
<tr>
<td>2020-G-10</td>
<td>Advanced Modeling of Driver Performance on Horizontal Curves ($1,000,000-18 months)</td>
<td>AASHTO Technical Committee on Geometric Design</td>
<td>G-10/1</td>
</tr>
<tr>
<td>2020-G-11</td>
<td>Aligning Geometric Design Controls, Criteria and Elements with Roadway Context, Modal Priority and Functional Classification ($350,000-18 months)</td>
<td>AASHTO Technical Committee on Geometric Design</td>
<td>G-11/1</td>
</tr>
<tr>
<td>2020-G-12</td>
<td>Trade-offs for Cross-sectional Reallocation on Urban and Suburban Roads ($400,000-24 months)</td>
<td>AASHTO Technical Committee on Geometric Design</td>
<td>G-12/1</td>
</tr>
<tr>
<td>2020-G-13</td>
<td>Impact of Traffic Speed on Perceived and Actual Risk of Bicycling ($500,000-24 months)</td>
<td>California</td>
<td>G-13/1</td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------</td>
<td>----------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>2020-G-14</td>
<td>Safety Benefits of Lane Reduction on Major Urban and Suburban Streets ($500,000-12-24 months)</td>
<td>District of Columbia</td>
<td>G-14/1</td>
</tr>
<tr>
<td>2020-G-15</td>
<td>Next Generation of the USLIMITS2 Speed Limit Setting Expert System ($350,000-30 months)</td>
<td>Federal Highway Administration</td>
<td>G-15/1</td>
</tr>
<tr>
<td>2020-G-16</td>
<td>Improving Traffic Incident Management in an Automated Vehicle Environment ($250,000-18 months)</td>
<td>Federal Highway Administration</td>
<td>G-16/1</td>
</tr>
<tr>
<td>2020-G-17</td>
<td>Evolving TMC Operation to Emulate a Video Game Environment ($600,000-24 months)</td>
<td>Florida</td>
<td>G-17/1</td>
</tr>
<tr>
<td>2020-G-18</td>
<td>Impacts of Color, Intensity, and Duration of Emergency Traffic Patrol Lights on Human Perception ($500,000-24 months)</td>
<td>Maryland</td>
<td>G-18/1</td>
</tr>
<tr>
<td>2020-G-19</td>
<td>Challenges, Gaps, and Solutions in the Deployment of Advanced Traffic Control (ATC) ($150,000-18 months)</td>
<td>Mississippi</td>
<td>G-19/1</td>
</tr>
<tr>
<td>2020-G-20</td>
<td>Predicting Urban Street Speed and its Relationship to Reliability and Level of Service ($300,000-24 months)</td>
<td>Oregon</td>
<td>G-20/1</td>
</tr>
<tr>
<td>2020-G-21</td>
<td>Applications of RFID and Wireless Technologies for Highway Construction ($400,000-500,000-30-36 months)</td>
<td>South Dakota</td>
<td>G-21/1</td>
</tr>
<tr>
<td>2020-G-22</td>
<td>Attitudinal Study of Seat Belt Use in Rural Areas of Texas ($400,000-24 months)</td>
<td>Texas</td>
<td>G-22/1</td>
</tr>
<tr>
<td>2020-G-23</td>
<td>Effects of Automated/Connected Vehicles (AVs/CVs) on Freeway Capacity and Operations ($500,000-36 months)</td>
<td>Texas</td>
<td>G-23/1</td>
</tr>
<tr>
<td>2020-G-24</td>
<td>Upgrade Existing Traffic Control Devices for Connected and Automated Vehicles ($350,000-24 months)</td>
<td>Texas</td>
<td>G-24/1</td>
</tr>
</tbody>
</table>

**SP – Special Projects**

<table>
<thead>
<tr>
<th>Problem No</th>
<th>Title</th>
<th>Submitter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020-SP-01</td>
<td>Development of Business Case and Communication Strategies for a State DOT Resilience Program ($350,000-18 months)</td>
<td>AASHTO Committee on Transportation System Security and Resilience</td>
<td>SP-01/1</td>
</tr>
<tr>
<td>Problem No</td>
<td>Title</td>
<td>Submitter</td>
<td>Page</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>2020-SP-02</td>
<td>Organizational and Operational Models used by State DOTs for Emergency Response ($600,000-18 months)</td>
<td>AASHTO Committee on Transportation System Security and Resilience</td>
<td>SP-02/1</td>
</tr>
<tr>
<td>2020-SP-03</td>
<td>Effectiveness of Zero-Tolerance Drug &amp; Alcohol Policies for Rural Transportation Agencies ($400,000-18 months)</td>
<td>AASHTO Special Committee on Research and Innovation</td>
<td>SP-03/1</td>
</tr>
<tr>
<td>2020-SP-04</td>
<td>Force Multiplier Toolkit for Rural Traffic Safety Enforcement ($250,000-18 months)</td>
<td>AASHTO Special Committee on Research and Innovation</td>
<td>SP-04/1</td>
</tr>
</tbody>
</table>
Research Field A

Administration
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  
FY2020 NCHRP Problem Statement Outline

Comments: This is the 2nd highest research priority for the Committee on Funding and Finance.

Problem Number: 2020-A-01

1. Problem Title

   Selecting the Appropriate Magnitude, Boundaries, and Methods for Value Capture Funding

2. Background

   In recent years state departments of transportation (DOTs) have been using value capture funding with increasing frequency. Value capture funding includes a variety of techniques that “capture” the economic value added to property or commercial activity by transportation improvement projects. Some of these tools include: land value taxes, betterment levies, special assessment district fees, sale/lease of public land or air rights, transportation utility fees, and joint development fees. Many of these techniques were examined in the recently published NCHRP Research Report 873: Guidebook to Funding Transportation through Land Value Return and Recycling.

   Three areas that the report did not fully investigate were: identifying the boundary of geographic decay of the benefits of a transportation improvement; estimating the magnitude of the benefits created; and, how those factors should influence the method(s) selected. In other words, 1) what distance from a transportation improvement is appropriate to include in a value capture area; 2) how can one estimate the magnitude of the benefits created within that boundary and the time frame for their creation; and 3) how should that affect the value capture method(s) selected and financing options chosen, if financing is needed. This research would attempt to answer those questions for both highway and transit projects, but with an emphasis on highway improvements. More literature already exists for transit-oriented development and the use of value capture to fund transit projects, however there is not a similar study examining this for highway projects.

3. Literature Search Summary

   This research would build upon the recently released NCHRP 873 Guidebook to Funding Transportation through Land Value Return and Recycling. There have
been several other related efforts from TRB, including: TCRP Research Report 190 *Guide to Value Capture Financing for Public Transportation Projects* and NCHRP Synthesis 459 *Using the Economic Value Created by Transportation to Fund Transportation*. This research project will complement these volumes and help provide a thorough set of resources for state DOTs as they consider value capture funding.

4. **Research Objective**

Research needs to be conducted to aid in establishing legally defendable value capture boundaries and funding capture amounts to aid in selecting appropriate methods. The proposed research would generate a report that contains:

- A summary of value capture and available resources related to value capture funding and decision-making
- An analysis of exemplary transportation projects funded by value capture and a discussion of the methods used for value capture funding, focusing on the geographic area of decay of the projects' benefits, the magnitude of the benefits created within an appropriate boundary, and how that should influence the method(s) chosen.
- A model that can be used by state DOTs to determine the suitable method(s) for a particular use
- An executive presentation summarizing the effects and successful approaches to communicate the finding to transportation officials and policy makers.

5. **Implementation Planning**

The results of this research project will be important to officials with state DOTs. The AASHTO Committee on Funding and Finance is a relevant audience within AASHTO, however the Committee on Planning would also be interested in the results. While some state DOTs may be able to implement the practices described in the report easily, many others would likely benefit from a follow-on webinar or peer exchange to disseminate the information.

6. **Estimate of Problem Funding and Research Period**

**Recommended Funding:**

Recommended funding for the research is $400,000.

**Research Period:**

The research effort is expected to take approximately 24 months.

7. **Urgency and Potential Benefits**

Value capture funding is being increasingly applied across the country, and this report will complement the work done through NCHRP, TCRP, and other programs to spread best practices and introduce the concept to new audiences
at state DOTs. There is a rapidly growing body of work dedicated to establishing best practices for value capture funding, and this report would add to that collection. This is the second highest research priority for the AASHTO Committee on Funding and Finance for this research cycle.

8. **Person(s) Developing the Problem Statement**
   Linda Hull, Director, Policy and Legislative Services
   Utah Department of Transportation
   801-965-4253
   lhull@utah.gov
   
   Ben Orsbon, Special Assistant to the Secretary for Policy and Legislative Affairs
   South Dakota Department of Transportation
   605.773.5105
   Ben.Orsbon@state.sd.us
   
   Laura Farmer, Financial Planning Division Administrator
   Virginia Department of Transportation
   804-786-3096
   laura.farmer@vdot.virginia.gov

9. **Nomination for AASHTO Monitor**
   Linda Hull, Director, Policy and Legislative Services
   Utah Department of Transportation
   801-965-4253
   lhull@utah.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
    This statement is submitted by the Committee on Funding and Finance.

11. **Submitted By**
    Alex Clegg, Program Specialist for Transportation Finance
    AASHTO
    202-624-5815
    aclegg@aashto.org

---

**NCHRP Review of A-01**

Reviewed By:
Andrew C. Lemer
alemer@nas.edu
Comments:

Efforts to develop analytical tools for establishing appropriate boundaries for value-capture; selecting appropriate value-recovery mechanisms such as taxes or benefits fees; and estimating the magnitude of revenues and public benefits that may be anticipated from transportation system investments funded with value capture would be logical targets for research to extend work underlying NCHRP Research Report 873. These topics are suggested in the problem statement background but not clearly presented as the objective of the proposed research. If value-capture methods are being used by state DOTs, as the problem statement assets, it would seem plausible that case-study analyses could provide a basis for producing the analytical tools suggested, but it is not clear that such cases exist. Analysts are unlikely to judge investments in urban transit stations comparable to investments in rural highway interchanges, even if examples of the latter have been financed in part through recovery of post-investment land-value increases. This research will probably have to rely on conventional property appraisal methods. In any case, it seems unlikely that land and real estate economic research can produce analytical methods assured to be “legally defendable,” analysis of valuation methods underlying case law for public takings would likely require a larger budget that has been requested.

Review Date:
11/28/2018

FHWA Evaluation of A-01

Stefan Natzke/HEP, Mark Sullivan/HIN, Ross Crichton/HPL - This statement proposes a very practical follow-on to previous NCHRP products (i.e., Synthesis 459 and Research Report 873). The previous products discuss value capture techniques and many related aspects related to them (e.g., the concepts and legal issues). This new proposed research will provide very practical, nuts-and-bolts technical information that will facilitate implementation of value capture techniques. It will blend well with existing research, as well as FHWA’s EDC-5 Value Capture innovation. FHWA’s EVery Day Counts Value Capture Initiative may produce many of the research objectives in Section 4. Should at least be aware of the EDC-5 initiative to ensure no duplication.

AASHTO Committee Evaluation for A-01

Submitted By:
Alex Clegg
AASHTO Staff
Committee on Funding and Finance

Comments:
We agree with the FHWA reviewer that the new research would be useful. The intent of the research would be to supplement, not duplicate, the research and products produced in the EDC-5 initiative. We would monitor the outcome of the EDC-5 efforts closely before our final RFP is drafted and issued to ensure no duplication would occur. The objectives should be clarified to contain what is in the problem statement background if that is not clear. There are many cases successfully establishing appropriate boundaries for value-capture; selecting appropriate value-recovery mechanisms such as taxes or benefits fees; and estimating the magnitude of revenues and public benefits. The EDC-5 effort mentioned by the FHWA reviewer is developing some value capture case studies that could be analyzed to determine how the: 1. Boundaries were determined; 2. Value recovery methods were selected; and, 3. Magnitude of the revenues and public benefits were determined. More value capture case studies may be needed than the EDC-5 effort will develop. The point of our research is to identify, investigate, and validate appropriate methods and analytical techniques used to make the choices on these three key factors. There is a legal "presumption of validity" that the methods, boundaries, revenues, and benefits chosen by the governing body are appropriate and valid. Anyone contesting that must prove the approach is inappropriate or invalid. The point of the research is to strengthen everyone's understanding regarding what is appropriate and valid. Then choices of boundaries, methods, revenues, and benefits can be substantiated so implementation of value capture can proceed without significant risk of it being legally contested and overturned. Generating the model to determine suitable methods would help make that possible.
Problem Number: 2020-A-02

1. Problem Title
The Application of Federal Funding Flexibility at the State DOTs

2. Background
Congress has provided state departments of transportation (DOTs) with some flexibility to transfer funds between federal highway funding categories. State DOTs use this flexibility to fund state and local transportation projects, transit services, and generally maximize the effectiveness of their federal funds. However, some programs have restrictions on transferability that impede project implementation.

The existing flexibility has allowed states to better align priority needs and available funds, accelerate projects, and has helped some states manage the impacts of federal fund rescissions, which exempts certain funding categories and therefore restricts states from allocating these resources to optimize transportation services. Some states DOTs have used the existing flexibility to transfer federal funds to local transportation projects as well.

States value this critical flexibility, however there is little research showing how crucial this transferability is and the effect of existing transferability restrictions on project implementation. This research project will attempt to measure the extent to which states have used transfer authority, the type of transferability needed, and measure how flexibility has helped state better meet transportation needs and achieve their goals and national goals. It will help determine the additional types of transferability that is needed.

3. Literature Search Summary
Most recently, a 2018 paper sponsored by ADA20 entitled Evaluating the Role of Federal Transportation Funding Flexibly and Investments in Bicycle and Pedestrian Infrastructure looked at the effect of this flexibility on active transportation projects. In 2012, GAO released a report entitled Flexible Funding Continues to Play a Role in Supporting State and Local Transportation Priorities which focused largely on transit programs in a handful of states. This research would complement these two by looking at the system more holistically, focusing on how flexibility is applied to projects beyond what is described above.
4. **Research Objective**

The proposed research would identify and describe the benefits of existing transferability and identify additional transferability opportunities that can improve efficiency, lower costs, and speed project delivery. It would generate a summary report that describes:

- The various transfer methods and philosophies used by state DOTs
- The effectiveness of the various methods
- The impact of this flexibility in managing the impact of rescissions of federal funding and improving project delivery
- The impact of transferability restrictions on project implementation

An executive presentation summarizing the effects and successful approaches would be developed to communicate the finding to transportation officials who may be interested.

The summary report and presentation would convey the limitations, benefits, and new opportunities for transferability.

5. **Implementation Planning**

The results of this research project will be important to officials with state DOTs. The AASHTO Committee on Funding and Finance is a relevant audience within AASHTO, however the Committee on Planning would also be interested in the results. While some state DOTs may be able to implement the practices described in the report easily, many others would likely benefit from a follow-on webinar or peer exchange to disseminate the information.

6. **Estimate of Problem Funding and Research Period**

**Recommended Funding:**

Recommended funding for the research is $400,000.

**Research Period:**

The research effort is expected to take approximately 18 months.

7. **Urgency and Potential Benefits**

Over the past decade, federal transportation funds have become increasingly tight, and states have had to increase their creativity to deliver transportation services. Federal funding uncertainty has not shown signs of slowing (as shown in the FY2019 problem statement *Managing the Effects of Uncertain Federal Funding*, now labeled as NCHRP 19-16), and federal fund flexibility is a crucial to
combat its effects. This is the top research priority for the AASHTO Committee on Funding and Finance for this research cycle.

8. **Person(s) Developing the Problem Statement**

Linda Hull, Director, Policy and Legislative Services  
Utah Department of Transportation  
801-965-4253  
lhull@utah.gov

Ben Orsbon, Special Assistant to the Secretary for Policy and Legislative Affairs  
South Dakota Department of Transportation  
605.773.5105  
Ben.Orsbon@state.sd.us

Laura Farmer, Financial Planning Division Administrator  
Virginia Department of Transportation  
804-786-3096  
laura.farmer@vdot.virginia.gov

9. **Nomination for AASHTO Monitor**

Linda Hull, Director, Policy and Legislative Services  
Utah Department of Transportation  
801-965-4253  
lhull@utah.gov

10. **Potentially Interested AASHTO Councils and/or Committees**

This statement is submitted by the Committee on Funding and Finance.

11. **Submitted By**

Alex Clegg, Program Specialist for Transportation Finance  
AASHTO  
202-624-5815  
aclegg@aashto.org

---

**NCHRP Review of A-02**

Reviewed By:  
Andrew C. Lemer  
alemer@nas.edu

Comments:
There is little question that earmarking of investment funds for particular purposes or programs lowers total returns on aggregate investment. Earmarking typically is justified by organizational or societal objectives that are not readily incorporated into the economic analyses of benefits and costs used to estimate aggregate returns on investment. This proposed research, as currently framed, seems to be aimed explicitly at critiquing federal policies and programs that earmark funds for particular purposes, thus reducing state agency flexibility to use the funds for other purposes. Estimating the opportunity costs of such restrictions and cataloging the ways states have adjusted their programs to maximize the use of federal funds may be a feasible topics for research, but care should be exercised to avoid offering recommendation for changes in federal or states’ policies.

Review Date:
11/28/2018

FHWA Evaluation of A-02

Lucia Olivera, HPTS - We are supportive of this research as it's somewhat related to a topic that OST-R has suggested.

AASHTO Committee Evaluation for A-02

Submitted By:
Alex Clegg
AASHTO Staff
Committee on Funding and Finance

Comments:
This information is particularly timely for two reasons and, therefore, the research project deserves consideration: 1. Performance- and outcome-based transportation programs are increasingly implemented at both the state and federal level as a means to ensure that limited public dollars are expended on projects and activities that best achieve strategic transportation goals. Transferability within the federal program is a tool used by the states to advance those strategic goals. Securing the best value for those limited dollars becomes increasingly important, especially the since the highway trust fund continues to erode. 2. Uncertainty associated with authorization and appropriation of the federal transportation program continues to escalate. That uncertainty is expected to continue for the foreseeable future. As such, the value of transferability to the states will increasingly become important as a tool that allows states to better manage funding uncertainties and cash flow. Better understanding of practices within other states and how transferability could potentially help states and the federal government better navigate and manage these uncertainties
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Problem No: 2020-A-03

1. Problem Title
Secure Information Environments for Collaboration and Knowledge Sharing:
Guidance for State DOTs

2. Background
Transportation agency business practices are evolving rapidly and there are
increased expectations for information access, knowledge transfer, and
collaborative work environments. Each state DOT has unique practices for
information security, cybersecurity, and physical security and varied permissions
for interactive tools, which can make collaboration, information access, and
knowledge sharing frustrating and only partially successful.

Cybersecurity is a business risk, but too much security can stymie access to data
and information for legitimate needs and stimulate public disclosure requests and
workload. Alternatively, too much access, or more to the point, too little security,
and can lead to dire consequences as we’ve seen with breaches in the federal
government (OPM in 2013), health industry (healthcare.gov in 2018), creditors
(Equifax in 2017), retail (Macy’s in 2018), and airline industries (Delta in 2018). In
the transportation community, this balance between information security and
access issues cut across all modes, all industries, the private sector as well as
public, national, state and local, and international; i.e., every jurisdiction, every
industry.

Information security needs and interactive access issues impact most business
sectors and there are resources from these other sectors that transportation
agencies can use. Research and guidance has also been developed in the
transportation sector related to cybersecurity and various information sharing
needs. Material from all sectors generally addresses cybersecurity separately from
the business needs for collaboration and data and information sharing. Research
is needed to develop a guidebook of best practices that support the business
needs of state DOTs for secure information systems that support access to
information resources and collaborative work environments within and across
organizations. The guidance that does exist provides a good foundation for this
proposed study.

The results of this research will support all four elements of the AASHTO
Strategic Plan 2014-2019 and support information management and access in
state DOTs.
3. Literature Search Summary

A literature search identifies several relevant resources. Most articles address physical and cybersecurity or collaboration needs but few address them together. The literatures requires a more thorough examination to elicit useful guidance for the development and management of secure multi-organizational collaborative networks. Highlights of the literature are provided below:

Cybersecurity

NCHRP 20-59 (51). Security 101: A Physical Security Primer for Transportation Agencies. This project is currently underway and will be completed this year. It will address infrastructure protection encompassing cyber and physical security but does not appear to examine the business needs for collaborative needs works or human factors of information security beyond training.

Dodaro, Gene L. (2018) High-Risk Series: Urgent Actions Are Needed to Address Cybersecurity Challenges Facing the Nation. Addresses four primary challenges: establishing a comprehensive cybersecurity strategy and effective oversight; security federal systems and information; protecting cyber critical infrastructure; and protecting privacy and sensitive data. The document does not address open government, transparency, or business needs for collaboration.

Li, Ye, et al. (2018) Influence of cyber-attacks on longitudinal safety of connected and automated vehicles. Accident Analysis & Prevention, Volume 121,148-156. This article examined the cybersecurity risks and impacts for connected and automated vehicles.

Collaboration Tools/Human Factors

Schwalb, S. I. (2013). Research Collaboration tools for the US Department of Defense. Information Services and Use (33), 243-250. The Defense Technical Information Center serves the Department of Defense research and engineering community as the central resource for DoD-funded scientific, technical, engineering, and business information and exchange. This article discusses the approach taken to develop secure collaborative tools, intended goals, challenges to adoption of the sites, and some lessons learned.


4. **Research Objective**

This research is intended to develop a primer on information security and access practices; context and resources for effective use of the practices; and the types of practices that may help address specific classifications of data and information for the transportation sector. The types of data vary for different business needs. This study should broadly consider the needs of the state DOTs and provide guidance to assess risks and address security and access needs.

This study should consider current practices within the transportation community and outside the transportation industry.

The product should provide guidance on:

1. Strategies to assess information security risks.
2. The technology needed to provide capabilities for the management and protection of digital assets and to prepare the sector to meet the evolving cybersecurity standards and regulations.
3. The security management strategies that help transport institutions implement governance and operational policies to promote good practices in data sharing and management.
4. Security policy guidelines and interoperable measures for the harmonization of practices across all DOTs and their stakeholders.
5. Knowledge management strategies that enhance DOTs’ understanding of their digital resources and the sharing of such resources across individuals, teams, and organizations in the transport sector and also with other sectors.
6. Guidelines for the sharing of transport-related data among stakeholders of the transport sector, and also the sharing of cybersecurity data (cyber threat data, attack scenarios and best practices in response and defense).

5. **Implementation Planning**

Each state DOT needs to manage its information systems within their state requirements. This guidance will not solve that problem but will provide a justification for exceptions if needed. It will also provide useful information for agency policy and procedure to support government transparency and collaboration. The guidance will provide information to help DOTs select software to improve our capability for collaboration.
The results of this study should be shared through a research report, webinars, discussions at AASHTO committee meetings, and transportation conferences.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**
   
   $300,000

   **Research Period:**
   
   12 months

7. **Urgency and Potential Benefits**

   Information security is an ever present issue and especially for digital resources. At the same time, expectations for government transparency and electronic resources to support collaboration continue to grow. Because of the interaction between state DOTs and each state with other external constituents, national guidance for the selection and management of collaborative platforms would be beneficial. This ongoing self-evident need will only continue to worsen.

   The results of this study will provide valuable information to consider for our state DOT information technology investments and help to align the technology with business needs. If national guidance to support knowledge transfer and collaboration are implemented, this will greatly improve information access and support tech transfer and innovation.

8. **Person(s) Developing the Problem Statement**

   - The AASHTO Committee on Knowledge Management and TRB Task Force on Knowledge Management Joint Research Task Group.
   - Leni Oman, Knowledge Strategist, WSDOT, PO Box 47372, 310 Maple Park Ave NW, Olympia WA 98504-7372, 360-705-7974, OmanL@wsdot.wa.gov
   - Jeff Rockower, Administrative Analyst 3, Information Systems, NJ Dept. of Transportation, 1035 Parkway Ave., Trenton, NJ 08625-0600, 609-530-3725, Jeffrey.Rockower@dot.nj.gov
   - Dr. Alexeis Garcia-Perez, Assistant Professor in Cybersecurity Management, Research Centre for Business in Society, Coventry University, UK. alexeis.garcia-perez@coventry.ac.uk
   - Carol Paszamant, Research Librarian, NJ Dept. of Transportation, 1035 Parkway Ave., Trenton, NJ 08618, 609-530-5289, carol.paszamant@dot.nj.gov
   - Bradley Overturf, Transportation Supervising Planner, Connecticut Dept. of Transportation Bureau of Policy and Planning Roadway Information
9. **Nomination for AASHTO Monitor**

TBD

10. **Potentially Interested AASHTO Councils and/or Committees**

Committee on Agency Administration, Committee on Knowledge Management, Committee on Data Management and Analytics. The results of this work will be relevant to all AASHTO committees.

11. **Submitted By**

Leni Oman on behalf of the AASHTO Committee on Knowledge Management, 360-705-7974, OmanL@wsdot.wa.gov.

---

**NCHRP Review of A-03**

Reviewed By:
Andrew C. Lemer
alemer@nas.edu

Comments:

The proposed research objective seems more modest and appropriate than the project title and background would suggest. Transportation agencies must maintain balance among objectives of providing access to data acquired for their business purposes, protection of that data’s integrity and ensuring public safety that may depend on the data, and maximizing the public benefits of data usage. Developing a primer to assist agencies with understanding what this balance may entail, how the appropriate balance may change from one type of data to another, what agency data governance practices have been used and may be appropriate in the future, and leading current technology for ensuring data access and security could be very helpful to many agencies. Development of such a primer should build on recent developments of guidance for management of data for transportation asset management, system operations management, incident response management, and the like.

Review Date:
11/28/2018
Submitter Response for 2020-A-03

From: [email: OmanL@wsdot.wa.gov]

Comments: Thank you for the positive feedback.

Contact Info:
Leni Oman, WSDOT, omanl@gmail.com, 360-705-7974

Review Date: 1/14/18
Problem No:  2020-A-04

1. Problem Title

Targeted Guidance and Information Support to State DOT CEOs on Cybersecurity Issues and Protection Strategies

How can state DOTs use case studies and lessons learned checklists to prepare for, prevent, respond to, and recover from various forms of cyber-attacks?

2. Background

Cyberattacks against financial/credit agencies, health organizations and military establishments have occurred more frequently over the past several years. What is less known to the general public, and perhaps to transportation officials, is that the transportation sector is a prime target for such attacks. As noted in an influential insurance business magazine, "transportation is now the third most vulnerable sector exposed to cyberattacks."\(^1\)

Over the past two years cyberattacks against the Colorado DOT and Maersk have highlighted the challenges that public and private transportation organizations could face with such threats. The magazine article continues, "the transportation sector has a lot more risk in the operational technology side ... how the transportation sector is deploying technology and how technology is infused in the system operation .... GPS tracking, used within the transportation network to identify the location of goods and trucks, the computer networks themselves, and automation are all specific vulnerabilities within this industry." This portrayal does not mention the other functions of state DOTs that could also be highly vulnerable .... human resource and employee databases, data storage, enforcement records (in some cases), legal/contract documents and the like.

It is informative to note that the US General Accountability Office (GAO) has also identified cyber security as a national challenge.\(^2\)

This research focuses on the current and likely future challenges facing state transportation agencies with respect to cybersecurity. A lot of material is available on the technical aspects of protecting agency operations, but very little is aimed at

---

\(^1\) Alicja Grzadkowska, "Transportation is now the third most vulnerable sector exposed to cyberattacks." Insurance Magazine, July 24, 2018

\(^2\) USGAO, "High-Risk Series: Urgent Actions Are Needed to Address Cybersecurity Challenges Facing the Nation," https://trid.trb.org/Results?txtKeywords=cybersecurity#View/1527861
DOT agency leadership that explains how the agency can prepare/prevent such attacks, what to do when they occur, and how to recover from the attack. Given the increased likelihood of future cyberattacks against transportation assets, this research addresses a critical need in a DOT's security and continuity of business strategies and protocols. Importantly, the research will provide a comprehensive examination of all the functions, services, data-focused activities, and sensitive data storage that could be a target of a cyberattack. It will provide DOT officials with an easy-to-use assessment guide on how to identify the greatest risks to the agency, and what types of strategies might be considered.

This research is directly related to the strategic plans/work plans for the Committee on Transportation Security and System Resilience (CTSSR) and the Committee on Data Management & Analytics (CDMA).

3. Literature Search Summary

NCHRP has devoted considerable resources to physical security challenges facing transportation agencies. There is also a proposed NCHRP project NCHRP 20-124, "Deploying Transportation Security Practices in State DOTs" that will focus on developing and implementing a comprehensive deployment and change management strategy assisting states that wish to more effectively evaluate and implement the revised security guidelines recommended in the updated Security 101 primer. This proposed effort will review the current physical and cybersecurity practices of transportation agencies.

A summary of the literature in this area shows many studies and efforts that highlight the need for public agency attention to cybersecurity.³ This literature, however, has focused primarily on raising awareness of how important cybersecurity is to both the day-to-day operations of transportation agencies as well as the long-term evolution of stable agency operations based on command and control technologies. Another focus of the literature is how cybersecurity concerns relate to different technologies of transportation, such as connected/autonomous vehicles,⁴ for different modes,⁵ and to specific types of transportation assets.⁶


⁵ For example, Simmons, H. " Cybersecurity in aviation : constant vigilance required," Journal of Air Law and Commerce, 2017, https://trid.trb.org/Results?txtKeywords=cybersecurity#/View/1501143

Key cybersecurity capabilities described in the 2015 AASHTO *Fundamental Capabilities* report include:7

- Integrate cybersecurity decision making into business processes and investments
- Evaluate and manage agency-specific cyber risks
- Implement industry standards and best practices
- Facilitate discussion and interaction between information technology, engineering, and operational groups to ensure that all systems are adequately addressed.
- Coordinate cybersecurity and cyber incident planning across the enterprise.

The TRB Cooperative Research Programs are supporting several research projects relating to this proposed research. Some of these projects are focusing on the general area of risk management of which cyberattacks will be part of the investigation (for example, Synthesis of Information Related to Airport Practices. Topic S01-19. Data Acquisition and Protocols for Risk Management). As noted earlier, NCHRP 20-115 "Deploying Transportation Security Practices in State DOTs" comes closest to the proposed research, but consists of a more general update of security practices, of which cybersecurity is just one emphasis. NCHRP 03-127 "Cybersecurity of Traffic Management Systems" is an example of an asset-specific research project. A review of the literature and on-going research did not find any DOT leadership-oriented type of research underway or completed.

Another important resource includes the NCHRP 20-59 51(A) *Protection of Transportation Infrastructure from Cyber Attacks: A Primer* (NCHRP 221/TCRP 67). In addition, NCHRP 20-59(54), is producing a white paper on cybersecurity issues and associated research. Research is also available from the American Public Transportation Association (APTA) and FHWA; frameworks such as the NIST Cybersecurity Framework, Control Objectives for Information and Related Technology (COBIT); and standards and guidance from International Organization for Standardization, Information Systems Audit and the Control Association and other sources that can be used to create cyber resilience metrics.

4. **Research Objective**

Recent experience with cyberattacks suggests that state governments in general are not well prepared to handle such incidents. Much of the research conducted to date on cybersecurity has produced important reports and guidance for developing technical and operational strategies for cyber protection. Quite

---

frankly, these reports are cumbersome and not presented in a user-friendly manner.

The purpose of this project is to identify the information needs of high-level state DOT officials with respect to cybersecurity prior to, during and after a cyberattack. These information needs would then be the framework for developing targeted information materials aimed at letting DOT leadership know how they should be preparing their agency for these incidents. It is expected that the project would include a variety of multimedia outreach strategies. Another key element of this research would include identification of best practices in terms of training and maintaining a level of awareness of the criticality surrounding cybersecurity.

5. **Implementation Planning**
   In addition to a checklist or easily-understood written materials, the implementation of the research results would include webinars, role playing exercises, session presentations, peer exchanges and incorporation of the research results in new state DOT CEO training efforts. Funds would be provided in the project for such efforts.

6. **Estimate of Problem Funding and Research Period**
   - **Recommended Funding:** $250,000
   - **Dissemination Funding:** $100,000
   - **Research Period:** 18 months

7. **Urgency and Potential Benefits**
   Given the vulnerability of state DOTs to cyberattacks, this research will provide significant benefits to an agency's ability to prepare for, respond to and recover from such attacks. It provides state DOT leadership with the right questions to ask, and an exposure to the circumstances they may face (e.g., a case study of what the Colorado DOT went through). The research results would be disseminated widely among state DOTs and could serve as a benchmark for establishing high level support for cyber protection in the state transportation sector.

   Given the focus of the research, the project has a very high likelihood that research objectives can be successfully achieved and that it will produce implementation-ready products. The focus on highly relevant concerns and vulnerabilities to state DOTs suggests that the research results will be implemented by these agencies.
8. **Person(s) Developing the Problem Statement**

Kim Avery  
Bureau of Field Services Director  
Michigan Department of Transportation  
269-337-3910  
*Averyk@michigan.gov*

Timothy Sexton  
Chief Sustainability Officer  
Minnesota Department of Transportation  
651-366-3622  
*Timothy.sexton@state.mn.us*

9. **Nomination for AASHTO Monitor**

Timothy Sexton  
Chief Sustainability Officer  
Minnesota Department of Transportation  
651-366-3622  
*Timothy.sexton@state.mn.us*

10. **Potentially Interested AASHTO Councils and/or Committees**

NA

11. **Submitted By**

Michael P. Lewis  
Executive Officer  
Colorado Department of Transportation  
303-757-9201  
*michael.p.lewis@state.co.us*

Greg Slater  
Administrator  
Maryland State Highway Administration  
410-545-0400  
*gslater@sha.state.md.us*

---

**NCHRP Review of A-04**

Reviewed By:  
Stephan A. Parker  
saparker@nas.edu
Comments:

This is an important area for state DOT CEOs to address. Given the volume of recent and in-progress research, if funded, this effort might focus principally on implementation. The topic moves rapidly, so a static checklist is going to include a provision to engage staff in ongoing, real-time updates. There are numerous venues through which to do so, many of them supported by the federal government, as well as a TRB subcommittee that meets by videoconference every 2 months.

Review Date:
12/12/2018

________________________________________________________________________

FHWA Evaluation of A-04

Joe Gregory/HOTM - Suggest adding a task to interview key DOT officials as many are beginning to implement cybersecurity best practices.

________________________________________________________________________

AASHTO Committee Evaluation for A-04

Submitted By:
Eric Kopinski
AASHTO Staff
Committee on Transportation System Security and Resilience (TSSR)

Comments:
This problem statement ranked third for AASHTO's Committee on Transportation System Security and Resilience.
Statement of the Research Problem

Transit agencies are finding it increasingly difficult to locate, purchase and maintain adequate and affordable insurance coverage for public transit vehicles. Not only is the cost of adequately insuring all the vehicles in every transit agency increasing, but the ability to cover costs for each agency's individual policy premiums is a challenge as well.

Last year, across-the-board increases in premiums with identical coverage affected all transit providers, especially rural transit providers where the increase was a sizable part of their annual programming. Additionally, the number of smaller insurance agents is decreasing due to the volatile nature and demands of the insurance industry, and insurance coverage requirements in general. Finally, small rural transit agencies often face the largest cost increases due to their small fleet sizes and high annual mileages per vehicle.

Since state departments of transportation either directly purchase the vehicle insurance policy or fund the transit provider’s vehicle insurance policies, this research will provide solution for state seeking to consolidate this practice and implement statewide insurance pools for insuring transit vehicles.

Literature Search Summary

During this literature search, the following three citations with summaries were discovered in relation to cost savings analysis of statewide insurance pooling for public transit.

- **Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services.** Transportation Research Board Special Report, Issue 319, 2016, 188p. Summary - This report analyzes how innovative transportation services, including ridesharing, carsharing, bikesharing, and microtransit, are changing mobility for millions of travelers. Rapidly growing transportation network companies (TNCs), like Uber and Lyft, however, are disrupting conventional taxi and limousine services and raise policy challenges regarding personal security and public safety, insurance requirements, employment and labor issues, and accessibility and equity.
Kerness, Eric; Dettman, Kurt; Evans Jr, James W. Legal Issues with Obtaining Insurance for Large Transit Projects. *TCRP Legal Research Digest, Issue 47, 2014*, 63p. Summary - The report discusses different types of insurance coverage required for large projects and the types of programs available, including OCIPs and owner’s protective professional indemnity insurance, and the benefits, advantages, and disadvantages of such programs as compared to consultant- or contractor-provided insurance programs.

**Revenue, Finance, Pricing, and Economics. Transportation Research Record:** Journal of the Transportation Research Board, Issue 2450, 2014, 188p. Summary - This issue contains 21 papers that explores the modern transportation funding and user-pays principle. Other topics include an evaluation of the Urban Partnership Agreement in Seattle, Washington and its impact on transit; and pay-as-you-drive insurance.

This research, while successful at addressing a unique problem, does not address the research included in this proposal. Here is a summary to address the difference from this proposal:

1. *Between Public and Private Mobility* focuses on using alternate modes of transportation to fulfill first-mile/last-mile trips and only addresses insurance policy questions in relation to the insurance coverage held by Uber/Lyft drivers and rider’s safety.
2. Kerness, et al, is a high level discussion on a variety of insurance options for large-scale transit projects. Insurance coverages mentioned in the article are not the type of coverage proposed in this cost savings research analysis.
3. *Revenue, Finance, Pricing, and Economics*, while the broad in its coverage, maintains the stance of funding and program income, whereas this research proposal will address potential cost savings of statewide insurance policies for all transit agencies, especially since all transit agencies in a state’s program request reimbursement for insurance premiums from the same source of funding.

**Research Objective**

A study should be conducted of the types of insurance available to the transit industry for covering vehicles and explore the cost-savings that could be realized with statewide insurance coverage for all the transit and paratransit vehicles in states. Another objective would be the determining the percentage of insurance administrative costs that could be saved from this approach in comparison to the current individual providers subscribing to a separate policy coverage for fleets.

**Implementation Planning**

Some of the specific Tasks that could be a part of this work include:

- Collecting data on each of their transit agencies’ annual spending on insurance premiums and associated costs; claims; and premium adjustments due to claims for the past three years.
• Canvassing national insurance companies to see what policy options would be available to a state DOT for such a large-scale program with multiple transit agencies involved.
• Completing a cost benefit analysis for each state, and aggregate data for the entire nation.
• Based on the data gathered, conducting a full analysis of information and completing synopsis of the outcomes most likely to be able to be planned for.
• Conducting meetings with transit agency stakeholders to identify what kinds and levels of coverages of insurance they currently hold, and at what cost.
• Verifying data inputs and validating analysis to ensure correct conclusions are drawn.
• Presenting at facilitated meetings in-person or online with stakeholder once the data is compiled and analysis is complete.
• Developing recommendations for implementing statewide insurance pools, including work plan, responsibilities matrix, and timeline to transition from single-agency insurance policies to state-level insurance pool plan.

**Estimate of Problem Funding and Research Period**

**Recommended Funding:** $281,250  
**Research Period:** 18 months

**Urgency and Potential Benefits**

State DOT transit offices view the issue of potential overspending for insurance coverage from two sides in the public transportation industry. From one angle, higher premiums are being charged simply because smaller agencies have smaller fleets, which makes costs higher as a scalar comparison to an agency with a large fleet. Additionally, at the state level, all agencies in the state transit program are requesting reimbursement for costs associated with individual insurance policies.

By studying the true costs of vehicle insurance at the macro and micro levels, identifying cost savings for vehicle insurance would provide overall program savings and allow state DOT transit offices to become better stewards of its funding sources (namely Federal Transit Administration and state budgets). If the cost savings analysis conclusions are true, the results could be replicated across the nation, saving each state, and the entire FTA program, a great deal in insurance premiums for the vehicles that run the transit and paratransit programs in the United States.

This research project, once completed, can change the way insurance premiums are paid and will save each State DOT a significant funding from the FTA that can be redistributed to other needs, decrease premiums, and benefit all of statewide transit programs.
Person(s) Developing the Problem Statement

Mike Spadafore, Public Transportation Manager, Kansas Department of Transportation

Nomination for AASHTO Monitor

Potentially Interested AASHTO Councils and/or Committees

- Standing Committee on Funding and Finance

Submitted By: Council on Public Transportation

Contact(s):
Shayne Gill, Program Director for Multimodal Transportation
Council on Public Transportation
Phone#: (202) 624-3630
Email: sgill@aashto.org

Richard Price, Program Specialist
Multi-State Transit Technical Assistance Program (MTAP)
Phone #: (202) 624-5813
Email: rprice@aashto.org

NCHRP Review of A-05

Reviewed By:
Gwen Chisholm-Smith
gsmith@nas.edu

Comments:

The proposed problem appears to be appropriate for the NCHRP.

The objective of this research is investigate the types of insurance available to the public transportation industry for covering vehicles and explore the cost-savings that could be realized with statewide insurance coverage for all the transit and paratransit vehicles in states. A part of the investigation would be to determine the percentage of administrative costs savings that can be realized from the implementation of a state pooled approach to insurance coverage for transit vehicles.

A quick literature search reveals that there has not been a lot of research done in this area.
The potential payoff from this research may be significant.

The budget is appropriate to the scope.

Review Date:
12/12/2018

FHWA Evaluation of A-05

Khadija Ngozi-Bullock, HPTS - HPTS considers the research effort to be beneficial and thus a good use of research funds. HPTS encourages researchers to consider incorporating additional literature in their literature review on successful insurance pooling efforts at the state level (e.g. health and disability insurance). We believe incorporating the review of such literature can provide a more affective and accurate depiction of the potential costs and benefits of statewide insurance pooling.

Submitter Response for 2020-A-05

From: Richard Price on behalf of the Mike Spadafore, Kansas DOT

Comments:

FHWA Review of A-05, Khadija Ngozi-Bullock, HPTS. HPTS considers the research effort to be beneficial and thus a good use of research funds. HPTS encourages researchers to consider incorporating additional literature in their literature review on successful insurance pooling efforts at the state level (e.g. health and disability insurance). We believe incorporating the review of such literature can provide a more affective and accurate depiction of the potential costs and benefits of statewide insurance pooling.

Spadafore response: Thank you for your review and comments. I agree that a broader review of literature covering other facets of insurance policies being procured could present a more well-rounded view of the true costs of procuring insurance policies to public transportation programs at the state level. I am agreeable to broadening the scope of the proposal to include staff insurance costs as well as vehicle insurance costs.

NCHRP Review of A-05, Gwen Chisholm-Smith, gsmith@nas.edu

The proposed problem appears to be appropriate for the NCHRP. The objective of this research is investigate the types of insurance available to the public transportation industry for covering vehicles and explore the cost-savings that could be realized with statewide insurance coverage for all the transit and paratransit vehicles in states. A part of the investigation would be to determine the percentage of administrative costs
savings that can be realized from the implementation of a state pooled approach to insurance coverage for transit vehicles. A quick literature search reveals that there has not been a lot of research done in this area. The potential payoff from this research may be significant. The budget is appropriate to the scope.

Spadafore response: Thank you for review and comments. I agree that the potential payoff may be significant, both within the scope of this research as well as iteratively in other areas of procurement.

**Contact Info:**
Mike Spadafore
Public Transportation Manager
Kansas Department of Transportation
Mike.Spadafore@ks.gov
(785) 296-4907

Review Date: 1/21/2019
Problem Title
Guidebook for P3 Project Arrangements and Performance Metrics

Background
The infrastructure in the United States, as in many other countries, is aging, and limited public funds are available to maintain the current infrastructure and foster future growth. A potential mechanism to finance a portion of the ongoing transportation infrastructure needs is public-private partnership (P3). By definition, a P3 is a contract between the public and private sectors for the delivery of a project or service in which the private partner provides a significant amount of the necessary financing. There are many examples of successful P3’s in the U.S. and in other parts of the world. In recent years, establishment of the U.S. Department of Transportation Build America Bureau and enabling legislation in many states have facilitated implementation of P3 projects in the transportation sector. However, selection of P3 implementation, just like any other project delivery method, is driven primarily by the goals and objectives of a state Department of Transportation (DOT) and the specific project. State DOTs still face many challenges in aligning these goals and objective to the delivery methods of choice. Also, once a project delivery selection is made, monitoring project performance over the length of the project becomes vital for assessing and improving future project performance and delivery decisions.

Performance metrics in P3 projects should address the public client’s overall strategic plan and mission objectives, plus the overall quality and performance of a given asset. These performance metrics should include key indicators of travel time reliability, safety, overall project physical condition, and other project elements. Despite the importance of performance metrics, knowledge is relatively limited about the most effective practices for selecting metrics, setting metric performance levels, and reasonable approaches to deductions and/or point systems for failure of the concessionaire to meet contract requirements that ultimately align with state DOT goals and objectives. The objective of this project is to develop a structured decision-making model for state DOTs on implementing an effective P3 project from inception to operations, driven by state DOT goals and priorities and assessed by performance metrics pertinent to the selected P3 arrangement (from availability payments, to sharing revenue, to full privatization, etc.). The decision-making model should consider factors such as various P3 arrangements and financing options and resources and time constraints. Based on the results of this research, a guidebook would be developed to provide information on practices that may assist in selecting various P3 arrangements and assessing the project using key performance metrics that align with the project goals and objectives.
The proposed research would address the following questions:

- What are the different arrangements of P3 used in the transportation industry? What are the key selection parameters for each, in light of DOT project goals and objectives?
- What are the key performance metrics for P3 projects? How can they be measured? How effective are they?
- What are effective ways to tie performance metrics to payment mechanisms (i.e. lane availability, route performance, condition criteria, safety performance, unplanned events, etc.) to the P3 contractor?
- If the P3 concessionaire does not comply with performance standards, what actions (e.g., nonconformance reports, penalty point notices, etc.) should be taken?
- If the P3 concessionaire maintains or exceeds the level of performance specified for the majority of the contract term, what incentives, if any, should be provided?
- What techniques have been used to avoid and resolve disputes? Which have been most/least effective?

**Literature Search Summary**

A literature search identified one research project similar in scope: *Quantifying and Benchmarking the Delivery Performance of U.S. Public-Private-Partnership (PPP) Transportation* National Transportation Center at Maryland focused on assessing certain metrics on known projects to provide a statistically significant conclusions on then current trends that substantiated using the P3 method.

Other related research includes the following:


The proposed research will build on previous research that helped describe key outcome metrics such as this to develop a useable guide to practitioners to use in developing P3 arrangements and how to align metrics with state DOT objectives in this arena to advance the practice of using P3 for a delivery method.

**Research Objective**

The purpose of this project is to: (1) investigate the different P3 arrangements used in the transportation industry and link them to state DOT project goals and objectives; (2)
examine performance metrics for P3 projects used by state DOTs and other countries in delivery of transportation infrastructure; (3) document lessons learned; and (4) make implementation recommendations to improve U.S. policy and practice. This project will produce an empirical guidebook based on effective practices regarding selection of performance measures for P3 projects, and provide guidance on selecting different P3 arrangements/structures given state DOT goals and objectives, as well as effective practices for implementing performance measures.

**Implementation Planning**

State DOTs would need to make this product available to key subject matter experts in the agency that are responsible to provide guidance and delivery roles. The PI teams would need to plan on workshops to help facilitate the use of the guidebook, possibly with close coordination with state DOT leadership and private industry leaders, in order to be successful. By synthesizing empirical results gathered from the research and arranging hypothetical but realistic project arrangements for learning purposes, workshops would provide direct insight to practitioners. The research team would develop materials and provide them to state DOT audiences. Finally, the guidebook should be made available as a standalone resource for interested parties to use in setting up programs.

**Estimate of Problem Funding and Research Period**

**Problem Funding:** $500,000
- Researcher Cost: $350,000
- Data collection and synthesis: $50,000
- Dissemination and implementation: $100,000

**Research Period:** 36 months
- Research conduct: 24 months
- Implementation (workshops): 6 months.
- Finalization of guidebook: 6 months

**Urgency and Potential Benefits**

During the development and operational phases of a project, performance metrics will be compared with established performance objectives that serve as a baseline, to determine how successful organizations (and the private sector partner) have been in attaining project objectives. The payoff of this research will be improved decision making for state DOTs before embarking on various P3 arrangements, as well as administration and control of P3 projects, which ultimately will result in higher public satisfaction. The guidelines will become available to transportation agencies through the traditional NCHRP distribution processes.

Because no such guide exists, many state DOTs may miss powerful opportunities to enhance infrastructure systems that otherwise will not be available using conventional methods. P3 arrangements that are not appropriately considered can result in failure of projects to be delivered on time and on budget and provide a negative connotation on the delivery method, which could erode public confidence in the agency.
Since the U.S. as a whole faces major infrastructure needs, and federal funding/pay as you go with traditional Design-Bid-Build does not address the urgency of need nor the flexibility required, this research will provide powerful insight and confidence by leveraging the best of practices with credible program guidance. A limited number of states have been able to leverage P3 opportunities for large projects, and without significant changes in funding and flexibility, major sectors of need will go unanswered in some states for decades due to the knowledge this research would otherwise provide. Members of the TRB Standing Committee for Project Delivery Methods drafted this problem statement using a valuable cross-section of academic and practitioner insight, adding credibility to its timeliness and potential impact. This effort is highly likely to produce DOT-desirable and implementation-ready results as designed, due to the nature of involving DOT practitioners and industry representatives in the final product rollout.

**Person(s) Developing the Problem Statement**
- Darryl D. VanMeter, P.E. – Georgia DOT
- Behzad Esmaeili, Ph.D. – University of Nebraska-Lincoln
- Steve Dewitt, P.E. – ACS Infrastructure Development, Inc.
- Ghada Gad – California State Polytechnic University-Pomona

**Nomination for AASHTO Monitor**
Darryl D. VanMeter, P.E. – Georgia DOT

**Potentially Interested AASHTO Councils and/or Committees**
Construction or Finance Committees.

**Submitted By**
Darryl D. VanMeter, P.E.
Asst. P3 Director/State Innovative Delivery Administrator
Georgia Department of Transportation
600 West Peachtree St NW, 19th Floor
Atlanta, GA 30308
404-631-1703; dvanmeter@dot.ga.gov

---

**NCHRP Review of A-06**

**Reviewed By:**
Andrew C. Lemer
alemer@nas.edu

**Comments:**

It seems unlikely that the proposed objective for this project—developing a “structured decision-making model … on implementing an effective P3…—has not been adequately
accomplished by previous research or that the proposed research will contribute much to advancing practice. Methods for mobilizing public-private partnerships to deliver transportation system investment projects have been popular topics for some time and the available literature is considerably more extensive than this problem statement suggests. The proponents do not show familiarity with, for example, AASHTO's Build America Transportation Investment Center (BATIC) Institute Center for Excellence, US DOT's rules and guidance for P3 development, the guidelines and manuals developed by several state transportation agencies (for example, Virginia, Minnesota, Colorado, Pennsylvania), or recent and ongoing Cooperative Research Programs work on the topic. Performance metrics for project delivery (for example, time to complete according to specifications, project cost and anticipated budget, budget compared to net public benefit) are different from performance metrics for the transportation system asset produced (is “quality” different from “performance”?), but the problem statement seems to conflate and confuse the two concerns.

Review Date:
11/28/2018

AASHTO Committee Evaluation for A-06

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This submission is supported by Council on Active Transportation based on survey results

Submitted By:
Alex Clegg
AASHTO Staff
Committee on Funding and Finance

Comments:
The study would provide states wit a beneficial tool to help evaluate P3s. The state of the practice is changing so quickly, updated and recent information is important to help states.
II. PROBLEM TITLE


III. RESEARCH PROBLEM STATEMENT

In recent years, State DOTs have faced the challenge of increasing demands of Construction Inspection (CI) staffing due to a more technically and contractually complex construction project environment. This has been exacerbated by the retirement of the baby-boomer generation from the workforce and with them, their many years of experience. According to the Georgetown Center on Education and the Workforce, by 2020, 65 percent of American jobs will require some form of post-secondary degree or credential. The required skill set of the Construction Inspector has also changed, requiring not only technical skills that have been in place for decades, but also the adaptation of those skills due to improvements in technology and differing forms of construction contracting, such as Design-Build and Risk Based Inspection.

In some states, construction volume has increased and/or the numbers of state employees has decreased, giving consultants a larger role in supporting State DOTs’ CI needs. The lack of a national standard for the required combination of skills, especially for consultant-hired inspectors, is a dominant factor supporting the need for research. State DOTs recognize that the performance of CI is necessary in order to fulfill policy directives of ensuring that projects under their jurisdiction are constructed in conformance with the state and FHWA approved plans and specifications. Consultant Inspection must be utilized to augment state DOTs’ workforce. However, outsourcing CI tasks to consultant inspectors presents specific challenges to state DOTs. One of the main challenges currently faced is the lack of a national standard for the skill set of consultant inspectors on the basis of validated formal education, experience and certifications.

IV. RESEARCH OBJECTIVE

The main objective is to identify activities and policies that have demonstrated a potential to ensure that inspectors possess the capabilities that will be required in the years ahead. This will be done by studying the current status of inspector capabilities and by benchmarking state-of-the-practice programs for the formal education, experiential learning, and certification of personnel:
• Existing Skills: Identify existing educational and career backgrounds, and levels of relevant skills of individuals who are entering their first CI jobs.
• Formal Education: Identify formal education and training programs for individuals entering CI positions.
• Certification: Identify programs that provide for the certification of an individual’s acceptable levels of appropriate CI skills.
• Experiential Learning: Identify programs that provide formal internships that combine education with on-the-job training and experience for individuals training to become inspectors.
• Quality: Identify programs that provide assured training, experience and certification of inspectors.
• Increasing Skills: Investigate inspector career pathways that result in increased capabilities, and the additional formal education, additional experience, and additional certifications that form the basis for the increased capabilities.

This study will assemble a national set of effective practices and develop reports, case studies, and guidelines that can be utilized by agencies to implement based on local statutory and/or policy requirements for the development and implementation of individual state CI formal educational, experiential and certification qualification programs and standards. The guidelines should include a methodology to compare existing program alternatives on a basis of both potential cost and time savings. It should also incorporate guidance that allows DOTs to be able to justify the costs of the proposed CI formal educational, experiential and certification qualification and development program alternatives on a basis of offsetting construction quality benefits.

Specific Tasks of the research to accomplish the main objective include:
• Task 1 – Benchmark the state-of-the-practice of CI formal educational, experiential and certification qualification programs;
• Task 2 – Review the legal issues involved with CI formal educational, experiential and certification qualification programs as well as barriers to implementation and identify remedies that have been successfully implemented; Prepare a white paper documenting the results of tasks 1 and 2.
• Task 3 – Select a representative set of case study programs from public transportation agencies with appropriate experience that can be studied in depth to identify both best practices and lessons learned;
• Task 4 - Prepare a research work plan that describes the details of the research methodology and methods for identifying best practices and developing conclusions;
• Task 5 - Execute the research work plan and prepare an interim research report that articulates the data collection and analysis as well as emerging conclusions, effective practices, lessons learned and a proposed outline for the guidelines; Case study report; draft language; spec language; legislative language;
• Task 6 - Prepare the draft guidebook for implementing consultant CI formal educational, experiential and certification qualification on construction projects delivered with DBB, CMGC, and DB. Incorporate review comments as required and validate the guideline’s efficacy with a case study DOT;
• **Task 7** - Publish the final guideline and a final research report that details the full results of the research.

V. **ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD**

**Recommended Funding:**
Recommended funding for the project is $250,000 to $300,000

**Research Period:**
It is estimated that 24 months will be required to perform the research.

The anticipated budget and schedule are based on assumptions for required resources to support on-site collection of case study project data, the assembly of the contents of the guidelines and validation of the guidebook in the field directly with a case study DOT.

VI. **URGENCY, COST EFFECTIVENESS, AND IMPLEMENTATION**

The intent of this project is to furnish:
1. Reports with summary information, including performance indicators, about the programs and practices conducted or supported by DOTs and/or by a representative sample of CEI firms; and,
2. Case studies with additional details of a few successful efforts; and,
3. Suggested guidelines for developing and administering a program to ensure well-qualified inspection personnel for transportation construction projects.

The need for this is immediate and threefold:
• First, DOT workforce numbers are declining and the need to outsource to consultant CI’s with validated credentials is becoming greater than ever.
• Secondly, as large numbers of experienced CIs retire, their younger replacements often lack the experience to adequately fill those roles without additional training, experience and certification. What’s more, as inspectors with validated training, experience and certifications are promoted, this will lead to other vacancies in the inspection team that will need to be filled by newer candidates.
• Thirdly, the national infrastructure crisis has precipitated a huge increase in DOT construction volume which, in turn, is forcing DOTs to cover projects with consultant CIs. In many cases, this is occurring at a time when budgets are stretched thin, placing a premium on any practices that can increase cost effectiveness, while ensuring that DOTs are meeting their statutory responsibilities for both state and federal quality management and control.

For DOTs that have not already implemented a comprehensive program for inspector qualification by education, experience and certification, the payoff of this research could be significant in both construction cost and time savings. It would also reduce overall life cycle costs of typical projects by utilizing highly qualified consultant CIs to assure that construction quality standards are met.

A compendium of reports, case studies, and guidelines should allow implementation to be customized by each state DOT and private sector firm, while facilitating the portability
of qualifications by CIs who perform inspection work for different agencies. This would enable utilization of common training and credentialing resources, which, in turn, spreads out the costs of those resources, while increasing the pool of expertise available for their production.

VII. RELATED RESEARCH

SHRP 2 Report S2-R03-RR-2: Guide to Identifying and Reducing Workforce Fatigue in Rapid Renewal Projects
NCHRP 20-107 Effective Construction Project Staffing Strategies for Transportation Agencies
Scan 15-01 Developing and Maintaining Construction Inspection Competence

VIII. PERSON(S) DEVELOPING THE PROBLEM

Randall Over, PE – Consultant for Columbus State Community College
Doug Gransberg, PE - Chair AFH15

IX. PROBLEM MONITOR

The TRB Committees AFH10 Construction Management and AFH15 are submitting this problem statement through the sponsorship of the AASHTO Committee on Construction and the Ohio Department of Transportation.

X. DATE AND SUBMITTED BY

October 30, 2018

Jason Humphrey, P.E.
State Construction and Maintenance Engineer
South Dakota Department of Transportation
700 E Broadway Avenue
(605) 773-3571

Research Section Chair, AASHTO Committee on Construction

NCHRP Review of A-07

Reviewed By:
Lawrence D. Goldstein
lgoldstein@nas.edu

Comments:
This research proposal appears to address a realistic need for improving the process of inspection in a context of reduced resources. The research objective is comprehensive, but requires differentiation between what is the study objective and steps in the research process. Added to the analysis should be an ability to address changing technologies and how those changes will impact the changing demands for properly trained inspectors, both within state DOTs and as required in supporting consulting services. This study should also reflect work that is only now beginning for NCHRP 02-25 on Workforce 2030: Recruiting and Training the Next Generation Transportation Construction Workforce. $300,000 for the study is a minimum given the expected products.

Review Date:
12/4/2018

FHWA Evaluation of A-07

A.Nieves/J. Withee, HIF - We feel that funding is better spent identifying the needs for training and identifying States that don’t have formal training and certification programs to identify their needs rather than asking the States what they have. The problem statement needs revision to reflect the reality on the ground of the current and future need. Consider the findings of a recent NCHRP domestic scan titled "Developing and maintaining construction inspection competence". Corrigan/HRD-20 - Cited urgency and need is clearly documented and workforce development is an urgent issue identified by the construction community. The proposed budget appears low considering the breadth of investigation and expertise needed to address all elements cited; education, training, experience, certifications, qualifications, policy, costs and time savings vs. construction quality, legal issues, legislative language, case studies, best practices, and multiple contract/project delivery types. Scope may need to be narrowed or budget increased. Are the Task 3 case studies supposed to be conducted prior to the preparation of the research work plan in Task 4 in order to help inform and develop the research work plan; or should the case studies be developed in parallel with the execution of the research work plan as part of the guidance development?

AASHTO Committee Evaluation for A-07

Submitted By:
Eric Kopinski
AASHTO Staff
Committee on Construction (COC)
Comments:
This has the highest support of the AASHTO Construction Committee.
Research Field B

TRANSPORTATION PLANNING
1. Problem Title
Beneficial Reuse of Lightly Contaminated Material from Transportation Construction, Maintenance, and Operation Activities

2. Background
Transportation agencies generate and then pay to dispose of large quantities of lightly contaminated materials such as street sweepings, gravel shoulder cuttings, ditch spoils, stormwater debris, and other roadside materials. These lightly contaminated materials are generated as part of routine maintenance or encountered during construction projects. Reuse, rather than landfilling these materials, is an environmental and economic benefit. Unfortunately due to regulations, specifications, stockpiling restrictions, inconsistent testing requirements, and long-term liabilities, there is a lack of reuse of these materials even though there is a high cost savings potential. Due to unfavorable regulations, uncertainty in environmental impact, and unknown engineering properties, there are many detractors to the reuse of these materials. Transportation agencies are generating increasing volumes of such materials, since new testing protocols detect contaminants in materials that had been previously thought of as clean. For example, due to improved contaminant detection technology many agencies are required to increase the frequency of street sweeping to meet Municipal Separate Storm System (MS4) standards, which in turn generates more lightly contaminated material. Once these materials have been deemed contaminated, the materials must be properly disposed of in regulated landfills; therefore, more money is being spent on disposal. DOT's from across the country are interested in solutions to this costly and mounting lightly contaminated material problem.

3. Literature Search Summary
The TRB TRID and RIP databases, as well as others, were used to search for research and literature related to specifications and reuse options for lightly contaminated transportation material. This literature search resulted in some research dealing with these materials, such as Washington State University's ongoing Evaluation of On-site and In-situ Treatment Alternative for Contaminated Soils for the Illinois Center for Transportation and Illinois DOT. However, the focus of most research has been on testing and characterization of materials, not on potential reuse. Extensive research has been conducted on chemical composition, gradation of sediment, and health hazards associated with such material. Most management practices suggested involve treatment and disposal options. There are, however, some instances in which lightly contaminated materials have been reused successfully. A handful of DOTs (Oregon DOT, for example) have performed analyses of beneficial reuse and potential implementation within their own states. Other states have developed guidance documents, such as the Virginia DEQ Guidance Memo No. LPR-SW-04-2012 for the...
Management and Reuse of Contaminated Media. However, these analyses and guidance documents lack regional and nationwide applications and recommendations. There is no comprehensive document that provides technical guidance and justification for beneficial reuse of contaminated materials that spans varying regions across the nation, however state-specific documents may prove useful in developing those types of guidelines. The proposed research project statement aims to fill this gap by providing specific technical guidance to DOTs for potential reuse opportunities of lightly contaminated materials including cost benefit information and case studies of successful reuse based on the materials’ physical properties.

4. Research Objective
The objective of this research is to provide proposed technical guidance and justification to DOTs for selecting and implementing potential reuse opportunities for lightly contaminated materials generated through transportation practices. The research objectives will be met through the following tasks and related activities:

Task I: Comprehensive literature review of existing specifications and regulations related to the beneficial reuse of lightly contaminated transportation materials
- Identification of states with favorable specifications, regulations, and testing through means such as a survey, online search, or other measures that encompass several DOTs from each of the four AASHTO regional associations
- Comparison of how different states define lightly contaminated materials, i.e., materials generated from routine maintenance practices, materials discovered during construction processes, etc.
- In-depth discussions with states with successful reuse protocols through interviews, workshops, or other means
- Analysis of what makes favorable specifications, regulations, and testing protocols function
- Synthesis of potential end uses as well as cost benefit information, life cycle cost, and mechanical and environmental risk for these end uses, based on both contaminant levels and physical properties

Task II: Case studies highlighting successful implementation of beneficial reuse of lightly contaminated transportation materials
- Compilation of detailed case studies of states with successful reuse implementation identified during Task I
- Inclusion of several DOTs from each of the four AASHTO regional associations
- Detailing of factors that made reuse implementation successful as well as how similar reuse could be implemented in other states

Task III: Decision-making tree regarding beneficial reuse of lightly contaminated transportation materials
- Identification and development of a decision-making protocol regarding available material and potential end uses
- Development of guidance regarding regulations, specifications, and testing based on desired reuse application

Task IV: Dissemination of results in a manner that will facilitate reuse of lightly contaminated transportation materials
• Synthesis of findings to produce a guidance and justification document for use with regulatory agencies
• Incorporation of technological tools to encourage access to findings, i.e., a web-based document, GIS-based portal, or other innovative ideas
• Production of final report synthesizing results of Tasks I through IV.

5. Implementation Planning
The primary drivers of implementation for the proposed work will be DOT staff involved in environmental management, sustainability, and waste management. Another important target includes regulatory agencies that are responsible for approving reuse of lightly contaminated materials. Deliverables shall be created with both of these end users in mind, as DOTs will likely need to present technical justification to regulatory agencies to gain approval for material reuse.

6. Estimate of Problem Funding and Research Period
$375,000 over a 36 month period

7. Urgency and Potential Benefits
With DOTs generating increasing amounts of lightly contaminated materials and spending more money on their disposal, it is becoming an urgent need to implement reuse. Industrial by-product reuse in many states has shown that proper reuse of lightly contaminated materials is a benefit because: 1) using lightly contaminated materials reduces the need for virgin materials, and 2) using lightly contaminated materials reduces the need to use valuable landfill space. Due to the many different regulations across the country, DOTs do not have agreed upon standards, testing methods, or guidelines for the reuse of lightly contaminated transportation materials. Potential benefits enabled through the proposed technical guidance measures include:
• Cost reduction associated with the use of less virgin raw material, reduced hauling costs, and reduced landfill tipping fees
• Greater predictability for construction and maintenance costs
• Reduction in carbon footprint
• Potential for public-private partnerships, as private industries may want to utilize lightly contaminated material in select commercial products

8. Person(s) Developing the Problem Statement
Cyrus Parker, LG, PE, CPM
GeoEnvironmental Supervisor
North Carolina DOT
(919) 707-6868; cfparker1@ncdot.gov

David Wilson,
Env. Program Mgr., Compliance – Haz. Mat. – Industr. Hygiene
Virginia DOT
(804) 786-5588; david.wilson@vdot.virginia.gov

Andrew Graettinger, Ph.D., Professor, Dept. of Civil, Con., & Env. Eng.
The University of Alabama
10. Nomination for AASHTO Monitor
Cyrus Parker, LG, PE, CPM
GeoEnvironmental Supervisor - North Carolina Department of Transportation
(919) 707-6868; cfparker1@ncdot.gov

11. Potentially Interested AASHTO Councils and/or Committees
AASHTO Committee on Environment & Sustainability; AASHTO Subcommittees on Construction, Maintenance, & Materials; and TRB Committee on Resource Conservation & Recovery (ADC60)

12. Submitted By
Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
Office of Environmental Services Administrator, Ohio DOT
1980 West Broad Street, Mail Stop 4170
Columbus, OH 43223
(614) 644-0377; Tim.Hill@dot.ohio.gov

NCHRP Review of B-01

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:
It would be beneficial to understand the practices of states in reusing lightly contaminated materials and develop guidance to keep these materials from only going to landfills.

Review Date:
11/30/2018

FHWA Evaluation of B-01

Connie Hill/HEPN Paul Pisano/HOTO - The proposed study would be of significant national interest, and the results would provide States with needed guidance on the reuse of lightly contaminated materials generated during construction, operations and maintenance of transportation projects and facilities. The study should receive favorable
consideration for the 2020 research cycle; however, it is suggested that the Task I review include both state and any applicable federal regulations.
1. **Best Practices for Project-Level Analyses for Air Quality**

2. **Background:** Air quality project-level analyses (PLAs) that state Departments of Transportation (DOTs) are required to prepare for purposes of the National Environmental Policy Act (NEPA) and the EPA transportation conformity rule have become much more complicated, time-consuming and costly to prepare in the past decade or so, due primarily to the issuance of new (or new to transportation) regulatory models and associated guidance by EPA in 2010. This study would review current practices and develop comprehensive guidance for state DOT staff and their consultants for best practices (BPs) for PLAs conducted for US/California regulatory purposes. A BPs web page would be developed to facilitate access for modelers to the new guidance and associated templates, tools and case studies, provide a forum for discussion, and allow targeted updates on an as-needed basis in the future as regulatory models and guidance change. The website-based new guidance would be a major benefit to all state DOTs and help them to:

- Streamline the preparation of PLAs, reducing time and costs for all projects
- Improve accuracy and minimize risk for larger projects that involve more complex modeling or have a greater degree of public interest (while still streamlining to the extent feasible)
- Facilitate the implementation of best practices with tools, templates and case studies, all provided via the website
- Train state DOT staff and consultants, particularly those new to the air quality discipline that may be unfamiliar with all the regulatory requirements and the best means to meet them at reasonable cost and risk for their respective agencies. Training and QA/QC would be facilitated by the provision of case studies (based on the recommended BPs) and a complete set of model input and output files for all typical project types and regulatory pollutants.
- Budget time and cost for consultant PLAs appropriately

The BPs would cover all aspects of PLAs including scoping/screening, modeling and analysis for all regulatory pollutants, mitigation, quality assurance and control (QA/QC), consultation, risk management, and documentation. Modeling and analysis includes traffic, emission (including construction), and dispersion modeling (including the determination of background concentrations), and qualitative analyses where applicable. Regulatory pollutants to be covered by the BPs include carbon monoxide (CO), particulate matter (PM), mobile source air toxics (MSATs), indirect effects and cumulative impacts (IECI), and, where required locally, greenhouse gases (GHGs.)
**Note:** The development of best practices for PLAs for PM is a priority specified in the AASHTO Strategic Plan (June 2015), which this study would accomplish as part of its broader objective to address all regulatory pollutants and all aspects of PLAs. It was also the second highest ranked research topic by the AASHTO Air Quality, Climate Change and Energy Subcommittee in their 2018 review. The topic (or closely related topics such as streamlining PLAs) was also identified as a priority by the Project-Level Analysis Subcommittee of the TRB Transportation and Air Quality Committee (ADC20) in each of their annual meetings from 2012 through 2015, and 2017.

3. **Literature Search Summary:** A search on TRID was conducted. The references identified however only partially address the topic (limited to one step in the modeling chain, one pollutant etc.) and do not cover the topic comprehensively as proposed in this study. The proposed study would therefore build upon the references identified here and in the course of the study to create a comprehensive new resource covering all steps in the modeling chain and all pollutants in the US/California regulatory context. The references identified here include:

**Screening/Programmatic Agreements:**
  This study developed templates for clearing projects (typically ones of smaller scope or expected impacts) for one pollutant (CO). An update is in progress under Task 104.

**Traffic or Travel Demand Modeling:**
  This recent report was designed as a supplement to NCHRP 765, which is the standard reference for traffic for project-level design purposes and may serve as a good example of the level of detail and coverage proposed for the air quality BPs.

**Emission Modeling:**

**Dispersion Modeling (including Background Concentrations):**
Best Practices, Streamlining and Overviews:


4. Research Objective: Develop a comprehensive set of BPs for PLAs for US regulatory application that serves to not only streamline the overall process to the extent feasible (while maintaining quality) but also to improve accuracy and reduce uncertainty where needed. Good examples of streamlining practices include the use of programmatic agreements, pre-vetted modeling inputs, template tools and documentation, etc. The BPs should also be designed to serve as a standard reference or training guide for staff new to air quality modeling and analysis for US regulatory applications, and provide guidance on scoping and appropriately budgeting time and cost for consultant analyses by project type, pollutant and level of public interest. The BPs must also include case studies that are complete with sample documentation and sets of model input and output files for all typical project types for each regulatory pollutant, which together helps with training, quality control, and reducing time and cost for analyses.

Deliverables are expected to include interim memos as needed, draft and final guidance (website), related presentations and training materials/case studies/modeling files, draft and final study reports, and tools and templates as recommended for use in best practices in the final guidance.

5. Implementation Planning: Implementation may be facilitated by dissemination by AASHTO of the new BPs and associated training materials and presentations to members of the AASHTO Air Quality, Climate Change and Energy Subcommittee (AQCCCES) as well as the TRB Transportation and Air Quality Committee (ADC20). Presentations by the project team to AQCCCES as well as ADC20 are expected.

6. Estimate of Problem Funding and Research Period

Recommended Funding: The study is expected to involve the equivalent of two professional staff for 18 months each at a rate of $200 thousand per year, or $600 thousand overall.

Research Period: Two years total.
7. **Urgency and Potential Benefits**: State DOTs would benefit from a set of recommended BPs that would serve to minimize the time and cost for preparing PLAs while not increasing risk. It would be timely given that much more complicated modeling requirements were introduced in 2010, and significant experience has been gained in responding to those new requirements, but a systematic assessment has not yet been conducted to determine best practices. Additionally, the new guidance would serve as a training aid for staff new to the regulatory air quality arena, and help them appropriately budget time and cost for projects considering the project type, pollutants involved, and level of complexity and public interest.

More specifically, the proposed study would have the following major benefits:

(a) It addresses critical needs and strategic objectives of state DOTs for streamlining the preparation of project-level air quality analyses that meet all US/California applicable regulatory requirements while minimizing risks as appropriate.

(b) It can be successfully achieved within the constraints of the proposed time and budget.

(c) It will produce implementation-ready products, both in terms of the new guidance to be developed as well as the associated website and tools.

(d) It is highly likely that the deliverables (guidance and tools) will be implemented by state DOTs, as the need is high and AASHTO will be able to support its implementation.

8. **Person(s) Developing the Problem Statement**

Christopher Voigt  
Environmental Engineer Senior  
Virginia Department of Transportation  
(804) 371-6764  
Christopher.Voigt@vdot.virginia.gov

Natalie Liljenwall  
Environmental Engineering Program Leader, P.E.  
Oregon DOT Geo-Environmental Section  
503-986-3456  
natalie.liljenwall@odot.state.or.us

9. **Nomination for AASHTO Monitor**

Christopher Voigt  
Environmental Engineer Senior  
Virginia Department of Transportation  
(804) 371-6764  
Christopher.Voigt@vdot.virginia.gov
10. **Potentially Interested AASHTO Councils and/or Committees**

   *Not applicable as the problem statement is being submitted by an AASHTO Committee.*

11. **Submitted By**

    Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
    Office of Environmental Services Administrator, Ohio DOT
    1980 West Broad Street, Mail Stop 4170
    Columbus, OH 43223
    (614) 644-0377; Tim.Hill@dot.ohio.gov

---

**NCHRP Review of B-02**

**Reviewed By:**
Ann M. Hartell
ahartell@nas.edu

**Comments:**

This problem statement describes a suite of activities and research products that seem well-suited for the NCHRP 20-44 Implementation Support program, or alternatively if lead by AQCCES, for the 20-123 Support for AASHTO Committees & Councils program.

This problem statement could potentially be combined with 2020-B10 with the combined effort targeted to produce a synthesis of current streamlining practices (including the identification of successful practices for project-level and regional analyses), paired with support for implementation through a community of practice, training, and similar activities. The estimate of funding and research period for such a combined effort is $500,000 and 30 months.

**Review Date:**
11/19/2018

---

**FHWA Evaluation of B-02**

Cecilia Ho/HEP - This problem statement is not likely to produce a useful product because it is trying to do too much at the same time. It has asked the contractor to include all aspects of project-level air quality analysis from scoping to documentation and asked for the inclusion of all pollutants including CO, PM, MSATs, and GHGs. It
would be more useful to focus on quantitative PM hot-spot analyses done for transportation conformity purposes, which the problem statement refers to indirectly in Section 7 "Urgency and Potential Benefits" when it mentions "much more complicated modeling requirements...introduced in 2010". A Systematic assessment of all of the quantitative PM-hotspot analyses conducted since the 2010 requirement was put in place would be helpful to get the big picture of the number and type of projects that these are conducted for and the best practices for conducting them as illustrated by a few case studies. The problem statement should be careful to only ask contractors to write best practices and not guidance, which should be left to federal regulatory agencies.

AASHTO Committee Evaluation for B-02

Submitted By:
Eric Kopinski
AASHTO Staff
Committee on Environmental and Sustainability (CES)

Comments:
Selected by AASHTO CES as top problem statement.
Combining Compost and Phosphorus Sorption Media into a Homogenized “Mix” for Stormwater Treatment

Treating highway stormwater is an ongoing challenge. In particular, certain pollutants, such as dissolved phase metals, present difficulties for basic treatment techniques for “settling out” of solids. Compost is a treatment media that has demonstrated reduction of dissolved metals concentrations, primarily via sorption, as well as other pollutants. Compost can also increase infiltration on highway embankments, improving total stormwater pollutant load removal.

For these reasons, certain Best Management Practices (BMPs) such as Compost Amended Vegetated Filter Strips, Bioswales and Bioretention facilities use compost to treat highways runoff.

However, compost amendments export phosphorus. In receiving water bodies phosphorus is a major water quality pollutant, contributing to large anoxic and hypoxic zones unable to support aquatic life, cyanobacteria toxicity affecting drinking water, and others. As a result, compost amendments are generally not applied where runoff discharges to waterbodies that are water quality limited for phosphorous. Phosphorus is a common water quality pollutant. Total Maximum Daily Loads (TMDLs) for phosphorous have been established in numerous watersheds across the country in diverse regions, including those draining to Chesapeake Bay, in the Midwest, the south, arid western states as well as the Pacific Northwest. Excluding a whole class of effective and inexpensive BMPs from use in phosphorous impaired watersheds puts a burden on DOTs that must treat for multiple pollutants.

Many studies have demonstrated phosphorus removal from water by various types of media. The primary treatment mechanism observed in these studies is sorption, where phosphorus adheres to the media. Proven media with phosphorus sorption capabilities include lime and aluminum water-treatment residuals, limestone, oyster shells, dolomite, gypsum, and others (Adhikari et al., 2016; Penn et al., 2007).

Blending a phosphorus sorption media with compost may produce a stormwater treatment mix (Mix) with minimal phosphorous export. Creating such a Mix would allow transportation agencies to use compost to remove dissolved metals and other pollutants from runoff in areas where phosphorus concerns normally preclude compost applications.

Determining an ideal compost and phosphorus sorption media mix (Mix) requires several areas of consideration, including:
• Types and characteristics of phosphorus sorption media to use in the Mix.
• Mix’s ability to reduce phosphorus exports.
• Mix’s ability to reduce metals and other stormwater pollutants.
• Hydraulic retention time needed to reduce phosphorus exports and treat other stormwater pollutants.
• Ideal ratio of compost to phosphorus sorption media.
• Effective lifespan of Mix’s ability to adsorb phosphorus.
• Cost and feasibility of obtaining the Mix.
• Ability to use standard equipment to apply the Mix.

Developing the ideal Mix requires controlled comparison studies. This proposed research consists of an extensive literature review to identify sorption media(s), laboratory column tests of candidate mixes, and field tests of promising mixes.

In addition to determining the test media via literature review, this proposal posits testing at least three particular media: limestone, dolomite, and gypsum. The calcareous nature of these media adsorb phosphorus, and all three have demonstrated significant phosphorus removal from water. All three media are large-scale agricultural amendments and have the benefits of the existing agricultural infrastructure, including: availability in most areas, established transport systems for large volumes, large scale spreading, mixing and application techniques, and competitive cost and economic structures.

III. Literature Search Summary

There are numerous studies demonstrating the phosphorus adsorption potential of various media, including the three cited in the Background section. Some studies have applied these media down-gradient of compost, post application, to capture phosphorus exports.

However, little research has been conducted on developing the homogenized compost and phosphorus sorption Mix that would feasibly incorporate into standard DOT compost spreading applications. A review of the Transport Research International Documentation database (TRID) and other sources found no specific study researching such a Mix.

Some studies addressing phosphorus removal media include:


IV. Research Objective

Objective 1: Develop a practical enhanced compost Mix that effectively limits phosphorous export while maintaining the pollutant removal and hydrologic capabilities of standard compost used in stormwater treatment BMPs.

Objective 2: Develop guidance on the use, limitations, design and implementation of the Mix. The guidance intends to be a practical manual for those who select and design stormwater treatment BMPs. It will be broadly applicable and not limited to a narrow range of conditions or geography.

Achieving the project’s objectives involves the following tasks:

Task 1: Conduct a survey and synthesis of existing literature related to phosphorus sorption media.

The survey should focus on the following areas:

- Identifying media with proven phosphorus sorption capabilities.
- Ideal hydraulic residence time for phosphorus removal by the media.
- Ideal size of media for both treatment and application with compost amendment.
- Effective phosphorous removal capacity and lifespan of the media.
- Leaching of pollutants from the media.
- Effects of environmental factors (climate, underlying soil types, etc.) on the above characteristics.

The synthesis report should cover the above elements and include a gap analysis of information required to complete the project.

Task 2: Design and implementation testing of one or more compost and phosphorus sorption media mixes.

Note: this proposal recommends limestone, dolomite, and gypsum as suitable test media for study. Research in Task 1 may add or eliminate media for testing in Task 2.

Testing of Mix(s) involves two phases:

1) Laboratory controlled Mix(s) testing – This phase will identify promising Mix(s) suitable for field testing.

2) Field testing of the effective Mix(s) – This phase will test the promising Mix(s) for real world applicability.

Exact details of the testing will be contingent on numerous factors, such as Mix(s) characteristics, funding, and others; but ideally would include:
Laboratory Testing
- Use column testing to ensure standardized conditions.
- Test Mix(s) with expected high probability of success, based on the literature review.
- Measure influent to effluent pollutants concentrations and volumes. At minimum, influent water should contain significant concentrations of pollutants representative of highway runoff.
- Conduct statistical tests and sample size analyses to obtain and analyze statistically robust data.

Field Testing
- Test Mix(s), proven effective by laboratory tests, in real world field conditions.
- Test influent to effluent concentrations and volumes.
- Test Mix(s) applications through actual storm events, capturing representative highways storm conditions.
- Reference established storm event and sampling criteria.
- Assess longevity of the Mix(s) treatment performance.
- Conduct statistical tests and sample size analyses to obtain and analyze statistically robust data.

Task 3: Develop guidance for the use, design, and implementation of the Mix(s).

V. Implementation Planning

The audience for this research are stormwater practitioners who evaluate, select, and design stormwater BMPs; and DOT environmental staff who ensure projects meet environmental permit requirements, and who negotiate stormwater management actions with regulatory agencies. Results of the research would disseminate through AASHTO and/or FHWA webinars, focused articles in stormwater trade publications, and presentations at venues such as Transportation Research Board annual or midyear meetings, and the National Hydraulic Engineering Conference.

VI. Estimate of Problem Funding and Research Period

Recommended Funding: $400,000 - $500,000 (will be affected by the number of mixes and the specific pollutants selected for study)
Research Period: 2-4 years

VII. Urgency and Potential Benefits

Compost applications have the ability to effectively and affordably treat stormwater runoff, such as from highway sheet flow. Reducing phosphorus exports from compost may dramatically increase the areas where state DOTs can apply compost BMPs.

VIII. Person Developing the Problem Statement

Brandon Slone
Stormwater Monitoring and Research Analyst Lead
Environmental Services Office
Contributors and reviewers included several staff from other state DOTs.

**IX. Nomination for AASHTO Monitor**
Brandon Slone
Stormwater Monitoring and Research Analyst Lead
Environmental Services Office
Washington State Department of Transportation
(360) 628-6103
slonebr@wsdot.wa.gov

**X. Submitted By**
Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
Office of Environmental Services Administrator, Ohio DOT
1980 West Broad Street, Mail Stop 4170
Columbus, OH 43223
(614) 644-0377; Tim.Hill@dot.ohio.gov

---

**NCHRP Review of B-03**

**Reviewed By:**
Ann M. Hartell
ahartell@nas.edu

**Comments:**

The proposed research offers the opportunity to develop an innovative and useful approach to improving stormwater treatment. The scope outlined in the problem statement includes the development and testing (both in a lab in the field) of three media, which would likely require a considerably larger budget than is proposed. (For reference, the current NCHRP 14-39 study has a budget of ~$500,000 to conduct lab and field testing for a single compost application for stormwater treatment.) Depending on the timelines needed to evaluate longevity of performance, the duration of the study might need to be extended.

With a budget of $750,000, the scope could include lab and field testing of up to two media that the results of the early phases of the project find are most promising.

**Review Date:**
11/20/2018

---

B-03/5
FHWA Evaluation of B-03

Damaris Santiago/HEP - This project is another example of creating another form/type of BMP by changing the composition of another existing BMP. $400-$500K for a research project of this sort is not a high priority when some State DOTs are not utilizing any form of basic BMP properly.

AASHTO Committee Evaluation for B-03

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
The Committee on Design's Technical Committee on Hydrology and Hydraulics is very supportive of this project. Please include a TCHH member on the panel.
Developing Cost-Effective Approaches to Site Selection for Wildlife Crossings

Wildlife-vehicle collisions (WVCs) are a common safety concern when large ungulates (e.g., deer, elk) are involved and can require additional coordination and mitigation when species listed under state or federal endangered species laws are implicated. In 1995, WVCs were estimated to cause 200 fatalities, 29,000 injuries and $1 billion in property damage across the nation each year (Conover et al., 1995). While updated statistics are lacking, those numbers have likely increased due to additional land development and traffic volumes, including in rural areas where animals of multiple wildlife guilds are more likely to be hit.

Investments in wildlife crossings have demonstrated success in reducing wildlife collisions and increasing habitat connectivity. For instance, after Arizona installed several wildlife crossings and exclusion fencing along 3 different corridors with relatively high levels of WVCs, a reduction of 97% in collisions was observed (Gagnon et al. 2010, 2015, 2017). A wildlife overpass in Wyoming similarly observed a 70% reduction in WVCs within a few years of construction, and promoted the continuation of a 6,000-year-old pronghorn migration route (Seidler et al., 2018; see also, Sawyer et al., 2012). Incorporating project features that promote wildlife connectivity into routine projects can also improve the viability of many species, making it less likely that they will become listed under the Endangered Species Act, and, therefore, subject to more rigorous legal protections. Early investment in these structures could translate into real cost and time savings for departments of transportation (DOTs). For example, after four endangered ocelots were killed along a highway in Texas following the placement of a new traffic barrier, the state was required to build four wildlife crossings at a cost of $6.4 million, not including the time and money for pre- and post-project monitoring requirements. Meanwhile, Texas previously installed ocelot wildlife crossings for just $400,000 when those structures were built as part of an existing project.

State DOTs have access to information on how to construct wildlife crossings, but less information exists on how to identify optimal locations for selecting sites to build crossings that incorporate both engineering and wildlife usage concerns. DOTs use land use data, general knowledge of migration pathways or potential linkages (if known), and roadkill or animal telemetry data to select sites, most of which are time and resource intensive. Circuit theory, which looks at gene flow across complex landscapes (similar to
electricity flowing through a circuit), is one of several modeling approaches that leverage computer technology to predict optimal sites for crossings. The purpose of this research is two-fold: (1) review and summarize modeling approaches to wildlife crossing site selection for a range of wildlife guilds (e.g., large mammals; medium-sized mammals; semi-arboreal; semi-aquatic; small mammals; amphibians; reptiles); and (2) compare the efficacy and cost effectiveness of modeling approaches to the current methods commonly employed by DOTs.

4. LITERATURE SEARCH SUMMARY
A search of existing literature was performed using Google Scholar, Science Direct, TRID and RIP. Several approaches on how to identify wildlife corridors are represented in the literature, including circuit theory (McRae et al., 2008), least-cost path (e.g. Cushman et al., 2009), resistant kernel modeling (e.g. Compton et al., 2007), agent-based movement simulation (Palmer et al., 2010), and Brownian-Bridge movement theory (Coe et al., 2015). The Nature Conservancy also recently developed wildlife connectivity models for some regions of the US using circuit theory. Federal Highway Administration (FHWA) and other organizations have published reports synthesizing information about wildlife collisions and how to construct them (e.g. Clevenger & Huijser, 2011). Ongoing research includes two NCHRP studies on crossing and fencing designs for smaller terrestrial wildlife (NCHRP 25-25 Task 113) and obtaining mitigation credit for wildlife crossings (NCHRP 25-25 Task 117). There is also an ongoing pooled-fund study on Wildlife Vehicle Collision Reduction and Habitat Connectivity (TPF 5(358)). These ongoing studies do not compare modeling to field collected data for wildlife crossing site selection.

Despite this past and ongoing research, little guidance exists to bridge academic investigation of the effectiveness of modeling approaches to identify optimal wildlife crossing sites compared to collection of empirical data through field studies. With this project, researchers will perform a review of wildlife corridor modeling approaches to provide state DOTs with recommendations about how to efficiently select optimal locations for wildlife crossings based on landscape and cost considerations, and how to incorporate these techniques into multiple levels of transportation planning.

5. RESEARCH OBJECTIVE
Wildlife collisions and subsequent ecological effects are critical issues that state DOTs must evaluate when designing safe and cost-effective roadways. Technology and data exist to minimize the incidence of WVCs. This project will reduce barriers to implementing wildlife crossing site selection by synthesizing past research and developing approaches that state DOTs can incorporate into regional, state, and project-level planning.

Task 1: Literature review and summary
- Identify and summarize modeling approaches, like circuit theory, to identify wildlife crossing locations, including cost, time and ease of acquiring data
• Summarize available information on costs associated with wildlife collisions, Endangered Species Act coordination, and other costs associated with not incorporating wildlife crossings into routine transportation projects
• Conduct a survey of DOTs to develop a list of methods used to delineate wildlife corridors and select sites for building crossings.

Task 2: Compare wildlife crossing site selection approaches
• Summarize current approaches used by DOTs to site wildlife crossings
• Identify and obtain existing data sets DOTs have collected for the purpose of locating crossings, such as roadkill, telemetry and expert site selection
• Develop models (or identify existing ones) and compare the results to field-collected data (roadkill, telemetry, etc.) for different wildlife guilds

Task 3: Synthesize information from Tasks 1 and 2
• Summarize current approaches used by DOTs to site wildlife crossings
• Identify and obtain existing data sets DOTs have collected for the purpose of locating crossings, such as roadkill, telemetry and expert site selection
• Develop models (or identify existing ones) and compare the results to field-collected data (roadkill, telemetry, etc.) for different wildlife guilds

6. IMPLEMENTATION PLANNING
The target audience for this research would be state DOT planners, design engineers, environmental planners, biologists, municipal planning staff, and maintenance staff. AASHTO and TRB committees can promote the final products of this project. The research team can also target findings to regions that share common ecological connectivity concerns.

7. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $350,000
Research Period: 30 months

8. URGENCY AND POTENTIAL BENEFITS
Climate change, land use changes, and increasing numbers of vehicles are creating habitat fragmentation and disruption on a speed and scale that have not been experienced before. As these factors gain pace, state DOTs could begin to see more interactions with wildlife and motor vehicles and also more project delays associated with Endangered Species Act concerns. Wildlife crossings are increasingly being incorporated in projects, but it is less clear whether site selection methods being used are economically and environmentally optimal for target species. This project would help evaluate existing practices and would bridge academic findings with state DOT implementation.

9. PERSONS DEVELOPING THE PROBLEM STATEMENT
Erika Furlong, JD
Kris Gade, PhD
Environmental Planner
10. NOMINATION FOR AASHTO MONITOR

Erika Furlong, JD
Environmental Planner
Delaware DOT
302-760-2107
Erika.Furlong@state.de.us

11. Potentially Interested AASHTO Councils and/or Committees
AASHTO Committees on Environment and Sustainability, Traffic Engineering, Safety, and Planning; TRB Standing Committees on Ecology and Transportation (ADC30); Resource Conservation and Recovery (ADC60); Landscape and Environmental Design (AFB40); Safety, Data, Analysis and Evaluation (ANB20); Transportation Planning Applications (ADB50) and Transportation Needs of National Parks and Public Lands (ADA40).

12. Submitted By
Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
Office of Environmental Services Administrator, Ohio DOT
1980 West Broad Street, Mail Stop 4170
Columbus, OH 43223
(614) 644-0377; Tim.Hill@dot.ohio.gov

Literature Cited


---

NCHRP Review of B-04

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The proposed project addresses a gap in road ecology practice. Improving the methods used to site crossings and applying these methods as part of the planning process rather that later, during the project design process, could improve the effectiveness of crossing designs, reducing WVCs and wildlife fatalities. An assessment of modeling techniques, including information about data requirements, analytic and technical capacity needed, and model performance, would support DOT efforts to integrate wildlife crossings into planning processes. For the proposed budget, the project could focus on methods, and provide information on their efficacy and resource requirements coupled with guidance on how to select an appropriate method for a particular planning context. Note that past experience has shown that documenting costs associated with
state DOT processes related to regulatory compliance and specific elements of the planning process is a serious challenge.

Review Date:
11/20/2018

---

**FHWA Evaluation of B-04**

Damaris Santiago/HEP - The proposal could generate useful information, but has a steep price tag ($350K) for a literature review and synthesis/report.

---

**AASHTO Committee Evaluation for B-04**

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
Not sure this is a high priority nationwide
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline  
Problem No:  2020-B-05  

1. Problem Title  
Effective On-Bridge Treatment of Stormwater  

2. Background  
Stormwater treatment of bridge deck runoff has always been a difficult design challenge. Traditional methods of treating bridge deck runoff suggest treating an equivalent area of roadway offsite that discharges to the same receiving water body or piping the bridge deck stormwater to an offsite treatment location.  
NCHRP Report 778 Bridge Stormwater Runoff Analysis and Treatment Options states, “Treatment of runoff from a comparable section of highway on land is preferable to treatment of runoff from the bridge deck...”. In situations where offsite mitigation is not acceptable due to local regulations surrounding the sensitivity of the receiving water body or site-specific bridge conditions (load restrictions or long bridges with very flat grades) that make piping bridge runoff to the bridge ends for offsite compensatory treatment infeasible or undesirable, stormwater designers have very few options for effective on-bridge treatment of stormwater.  

There is an urgent need to develop more options for on-bridge treatment of stormwater. NCHRP 778 gives a step-by-step analysis to aid stormwater designers in selecting BMPs for treating bridge runoff. However, the only on-bridge BMP suggested in NCHRP 778 is use of Permeable Friction Course (PFC). NCHRP 767 Measuring and Removing Dissolved Metals from Stormwater in Highly Urbanized Areas says PFC overlays are effective in reducing Total Suspended Solids (TSS) in highway runoff but lack the effectiveness in removing dissolved constituents. Because of this PFCs will not work over rivers, streams, or lakes where there are stringent discharge requirements, or water quality or endangered species concerns. NCHRP Report 767 presents a conceptual on-bridge BMP design that includes an inlet scupper and filtration media to treat metals discharged in stormwater runoff. Unfortunately, this on-bridge BMP is only conceptual. It still needs testing and has no design criteria or specifications. Compared to collecting and conveying bridge runoff for offsite treatment, on-bridge stormwater treatment has many challenges to overcome which this research proposal would address. For long bridges, both methods would require bridge drains. Depending on how efficient the on-bridge BMPs are at treating and discharging water through the bridge deck, they could add weight to the bridge design, which could increase the overall cost of the bridge. The on-bridge BMP might also require more spread width for flow to allow runoff to enter the inlet if the media isn’t very efficient at treating and passing stormwater through the drain. Maintenance of on-bridge BMPs may require closing down one lane which might inconvenience the
traveling public and increase safety concerns. The on-bridge BMP must be able to remove the pollutants of concern from bridge deck runoff, have comparable weight requirements to a standard ‘collect and pipe to offsite’ system, be quick and easy to maintain, and have a relatively long life. A significant benefit of an on-bridge BMP would be the ability to allow treated stormwater to drop into the waterbody below without further stormwater pipes or infrastructure. This would work well for a stormwater retrofit of an existing bridge.

Today’s current treatment technologies utilize media filtration to remove many pollutants of concern. Many DOTs utilize media filtration for rapid passive filtering of stormwater along the roadway. The same concept could be applied to on-bridge stormwater treatment. This research would identify filter media and mixes that would be successful in an on-bridge application. It would give stormwater designers a realistic idea of what the options truly are for on-bridge stormwater treatment.

3. Literature Search Summary

There are many studies and articles surrounding the subject of characteristics of bridge runoff, how to treat bridge runoff at the end of a bridge, and BMPs that are effective at treating bridge runoff where the BMP is at the end of a bridge. There is very little literature regarding on-bridge runoff treatment BMPs. Additional material for reference is presented below:

4. Research Objective

Objective 1: Identify media filter materials and different media filter material mixes that effectively remove the major classes of highway runoff pollutants dissolved metals, nutrients and petroleum hydrocarbons (including Polyaromatic Hydrocarbons—PAH) from stormwater. The materials must be usable in the on-bridge BMP configuration(s) by having the appropriate hydraulic characteristics for efficient drainage, sufficient pollutant removal capacity, and minimal maintenance and replacement frequencies.

Objective 2: Identify and develop two or more practical on-bridge BMP configurations that can be used to treat stormwater on the bridge structure. The configurations should be able to be installed on new bridge and bridge retrofit scenarios without requiring increases in the load bearing capacity of the bridge, and should allow for easy access and maintenance.

Objective 3: Develop guidance on the selection, design, placement, and maintenance of the identified on-bridge stormwater treatment BMPs, the selection of the appropriate media filter materials and mixes, and the advantages and limitations of the BMPs and media filter materials. The guidance is to be aimed at designers.

Achieving the project’s objectives involves the following tasks:

Task 1: Collection, review, and analysis of available existing information. Information of interest includes:

- On-bridge treatment BMPs that are currently in place, their design, effectiveness, and maintainability.
- Bridge drainage and scupper designs that may influence or may be modified to support on-bridge BMPs.
- Structural and other constraints that may affect the feasibility or placement of on-bridge BMPs.
- Pollutants of concern.
- Media filter material (non-proprietary) and treatment mixes currently used in stormwater BMPs, with a focus on effectiveness of treatment for the various target pollutants, pollutant removal capacity, hydraulic characteristics, availability, and cost.

Information may come from literature review and surveys of DOTs and other practitioners.
Task 2: Testing of potential filter media mixes. Based on the information developed in Task 1, select media filter material mixes that appear promising for use in on-bridge BMPs. Enough media material types should be selected to address each of the major classes of pollutants of concern. Testing of filter media mixes will have two phases. Laboratory testing will focus on pollutant removal capability and capacity and hydraulic characteristics. Media types that demonstrate performance that indicates that they are well suited for on-bridge BMPs will then be field tested. The results of the laboratory and field testing will be used to select preferred media mixes and to inform BMP design.

Task 3: Develop one or more standardized BMP designs for on-bridge treatment of highway runoff using the media filter materials selected as a result of Task 2. The designs should be flexible enough, individually or as a group, to accommodate the different pollutant removal and hydraulic characteristics of the media filter material. They should also be configured for easy maintenance.

Task 4: Field testing of on-bridge treatment of highway runoff using BMP designs from Task 3. The field testing should follow national BMP testing protocols such as the Washington State Department of Ecology’s Testing Approval Protocol Ecology (TAPE) or the New Jersey Corporation for Advanced Technology (NJCAT) to show what types of pollutant removals each BMP design achieves.

Task 5: Develop guidance for media type, media mix selection, BMP design, and maintenance of on-bridge stormwater treatment BMPs. This guidance will include:

- Description of the media filter materials for removing pollutants of concern from bridge stormwater runoff.
- Selection criteria for on-bridge BMP design, including choice of the media filter mix, the type of BMP (assuming more than one is developed), the sizing criteria, and spacing and placement recommendations.
- Design criteria to figure out how much filter material is optimal for the flow it receives.
- Maintenance requirements, including the maintenance schedule, type of maintenance activities and lifecycle costs.

5. Implementation Planning

The audience for this research is stormwater designers who evaluate, select, and design stormwater BMPs; and DOT environmental staff who ensure DOT projects meet environmental permit requirements, and who negotiate stormwater management criteria with regulatory agencies. Results of the research will be disseminated through AASHTO or FHWA webinars, focused articles in stormwater trade publications, and presentations at venues such as Transportation Research Board annual or midyear meetings, and the National Hydraulic Engineering Conference.

6. Estimate of Problem Funding and Research Period
7. **Urgency and Potential Benefits**

Many bridges have downspouts that discharge untreated bridge stormwater runoff directly into water bodies. Bridge runoff contains pollutants of concern including petroleum and petroleum by-products, particularly PAHs, which are major contributors to toxicity of highway runoff. A greater focus on those pollutants from resource and regulatory agencies can be expected in the near future. Bridges that have direct down spouts don’t have very many options for stormwater treatment. The current recommendation for treating bridge runoff is to collect it and pipe it to the bridge ends for treatment. For very long bridges and existing bridge retrofits, this becomes a problem since the weight of that conveyance system may be too heavy. Research to explore on-bridge treatment options is needed so we can address the issue of realistically retrofitting bridge downspouts to improve the water quality of stormwater discharge.

8. **Person(s) Developing the Problem Statement**

Alex Nguyen, Highway Runoff Program Manager, HQ Hydraulics Section - Stormwater Unit, Washington State Department of Transportation
15700 Dayton Ave N Mail Stop 138 Seattle, WA 98133 (206) 440-4537 nguyeal@wsdot.wa.gov

9. **Nomination for AASHTO Monitor**

Alex Nguyen, Highway Runoff Program Manager, HQ Hydraulics Section - Stormwater Unit, Washington State Department of Transportation
15700 Dayton Ave N Mail Stop 138 Seattle, WA 98133 (206) 440-4537 nguyeal@wsdot.wa.gov

11. **Submitted By**

Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
Office of Environmental Services Administrator, Ohio DOT
1980 West Broad Street, Mail Stop 4170
Columbus, OH 43223
(614) 644-0377; Tim.Hill@dot.ohio.gov

---

**NCHRP Review of B-05**

Reviewed By:
Waseem Dekelbab
wdekelbab@nas.edu

Comments:

The problem statement is well written, and the research objective is well-defined. The problem is suitable for funding in the FY 2020 NCHRP.
Review Date:
12/10/2018

FHWA Evaluation of B-05

Damaris Santiago/HEP - On bridge treatment form of BMPs are not a widely accepted form of BMP. Most State DOTs prefer reducing the runoff of water before heading onto the bridge itself and also any form of scuppers on a bridge system calls for increase maintenance. This form of treatment may be prioritized in the western States, but does not represent a problem nationwide.

AASHTO Committee Evaluation for B-05

Submitted By:
Eric Kopinski
AASHTO Staff
Committee on Environmental and Sustainability (CES)

Comments:
Selected by AASHTO CES as second highest ranked problem statement.

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
Please include a member of the Committee on Bridges & Structures on the panel.

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
The Committee on Design's Technical Committee on Hydrology and Hydraulics has concerns about the effectiveness of filtering media due to the extensive maintenance required, as previous research efforts for catch basin inserts highlight.
1. Problem Title
Evaluating and Improving Current Practices for Temporarily Deterring Bat Use of Bridges

2. Background
Bridge repair and replacement projects are required to implement measures to avoid and minimize impacts if protected bats are present. Furthermore, bats across the United States are threatened by a relatively new fungal disease known as white-nose syndrome (WNS). WNS has resulted in bat population declines of over 90% in parts of the northeastern U.S., and the fungus is continuing to spread westward. These declines most recently resulted in the U.S. Fish and Wildlife Service (USFWS) listing the northern long-eared bat (*Myotis septentrionalis*) as threatened under the federal Endangered Species Act in 2015, and it is anticipated that additional bat species will be listed in the coming years. Many states have protections for other bat species as well. The northern long-eared bat, as well as other bat species, will utilize bridges as day-time and/or night-time roosting habitat, as well as places to form maternity colonies where they give birth and raise their young.

Measures to reduce impacts to bats may include timing restrictions to avoid the season when bats are present; deterring or excluding bats from using bridges during maintenance and construction activities; and, in some cases, providing alternate roosting locations. Timing restrictions can be challenging to implement, especially in parts of the country with long and cold winters and short summer construction seasons. Exclusion and deterrence measures of various types have been recommended but are not always successfully implemented, which can result in work delays if bats continue to use the bridge. Some methods are more expensive for materials or labor for installation and maintenance than others. A current NCHRP 25-25 project is synthesizing information on artificial bat roost designs (Task 102). This research will focus on strategies and practices for temporarily deterring and excluding bats from using bridges to facilitate construction and maintenance activities.

The objectives of this project include: gathering existing information; surveying DOTs to learn about the costs and success rates for different exclusionary techniques; field testing a subset of measures in different regions of the US; and developing a summary of practices for use by DOTs in planning for work on bridges with bats. These techniques may include technology such as non-lethal ultrasonic acoustic devices, physical exclusionary devices, and light devices.
These devices may be used in the field to temporarily deter or exclude bats from roosting on bridges ahead of construction or maintenance activities, while minimizing harm to bats and non-target species. This research aligns with the goals of the CES Natural Resources Subcommittee to increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services, particularly Objectives 2.1: target emerging issues of particular importance to members and 2.2: disseminate successful strategies, lessons learned, techniques and technologies for addressing DOT Natural Resources issues, requirements and goals. This topic is of particular interest to the CES Subcommittee on Natural Resources.

3. Literature Search Summary
General guidance for bat exclusion has been developed by Bat Conservation International and other conservation groups. Various Departments of Transportation (DOTs) and natural resource agencies in the US, Canada and the United Kingdom have also developed guidance, which have been implemented with varying degrees of success in the US.

A review of TRID produced recent studies on predicting which bridges are most likely to contain roosting bats in Iowa (Bektas et al. 2018), studying assessment methods for bats in bridges in New England (Civjan et al. 2017), and investigating environmental factors that influence which bridges are used by bats in Georgia (Cleveland and Jackson 2013). However, information on the success and costs of deterrence methods in the transportation environment is not readily available. There is an ongoing study synthesizing information on artificial bat roosts (NCHRP 25-25 Task 102).

Bat Conservational International. 1999. Bats in American Bridges
Caltrans. 2004. California Bat Mitigation Techniques, Solutions, and Effectiveness
Connecticut Department of Transportation. 2015. Best Management Practices for Bat Species Inhabiting Transportation Infrastructure

4. Research Objective
This project will collect information on currently used and innovative methods for temporary bat deterrence and exclusion from bridges to facilitate construction and maintenance activities. The result will be a webpage containing fact sheets on different methods, plan sheets where applicable, and summary of the efficacy and efficiency of those methods in a handbook with best practices for implementing different solutions.

Task 1: Literature Review
- Identify and summarize approaches to deter bats
- Summarize available information on costs associated with each approach.

Task 2: Survey of DOTs and other relevant participants
- Summarize current approaches to temporarily deter bats on bridges and other similar structures, with an emphasis on threatened and endangered bat populations.

Task 3: Regional field trials of selected methods
- Specific methods to be field tested to be determined in conjunction with panel.
- Field tests should include day roosts, maternity roosts, and night-only roosts.
- Regional testing sites to evaluate efficacy of exclusion measures on different genera of bats (Myotis, Eptesicus, Perimyotis, Tadarida, etc.)
- Monitor bat behavior during the deployment of exclusion measures
- Assess whether bats return once exclusion measures are removed

Task 4: Develop materials
- Fact sheets on different methods – pros and cons, material and labor cost to install and maintain, timing
- Collected or newly developed plan sheets for methods that require physical installation on bridges
- Handbook for bat deterrence and exclusion from bridges

Task 5: Final report and webpage

5. Implementation Planning
The target audience for the research findings and products are state DOT design and maintenance engineers, environmental planners, biologists, and maintenance staff. These are the staff faced with finding solutions to conducting work on bridges that are used by bats. Providing a webpage with fact sheets, plan sheets, and a handbook summarizing available methods and the best way to implement each will allow practitioners to benefit from the collective experience of other DOTs and bat experts. AASHTO committees with likely responsibility for adoption of the results include the Committee on Environment and Sustainability, Standing Committee on Maintenance, and Standing Committee on Design.

6. Estimate of Problem Funding and Research Period

**Recommended Funding:** Total: $450,000
Research Period: 48 months

7. Urgency and Potential Benefits
   • Make permitting, construction, and maintenance timelines more predictable and easily manageable
   • Long-term agency cost savings
   • Provide DOTs with effective strategies for meeting current and anticipated regulatory requirements for work on bridges with bat use
   • Minimize the transportation sector’s impacts on imperiled bat species
   • Demonstrate due diligence and interagency collaboration on environmental issues

8. Person(s) Developing the Problem Statement
   Christopher Smith  Kris Gade  Morgan Niccoli
   Wildlife Ecologist  Roadside Resources  Ecology Team Leader
   Minnesota Dept of Transportation  Specialist  Georgia Dept of Transportation
   651-366-3605  Arizona Dept of Transportation  404-631-1887
   Christopher.E.Smith@state.mn.us  602-292-0301  MNiccoli@dot.ga.gov
   KGade@azdot.gov

9. Nomination for AASHTO Monitor
   Christopher Smith  Wildlife Ecologist  Minnesota Dept of Transportation
   651-366-3605, Christopher.E.Smith@state.mn.us

10. Potentially Interested AASHTO Councils and/or Committees
    Submitted by the AASHTO Committee on Environment and Sustainability (CES); also of potential interest to the Committee on Bridges and Structures and the Committee on Maintenance and the TRB Standing Committee on Ecology and Transportation (ADC30)

11. Submitted By
    Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
    Office of Environmental Services Administrator, Ohio DOT
    1980 West Broad Street, Mail Stop 4170
    Columbus, OH 43223
    (614) 644-0377; Tim.Hill@dot.ohio.gov

NCHRP Review of B-06
Comments:

The problem statement describes an issue of increasing concern for state DOTs. Providing guidance on appropriate techniques for bat deterrence would support state DOT efforts towards environmental stewardship and regulatory compliance. The description of tasks includes multiple field tests, for different types of roosts, different species and different regions. To accomplish this, a substantially increased budget is needed. The length of the project, to permit assessment of whether or not bats return after exclusion measures are removed, might require an extended research period as well. In addition, securing tests sites will likely provide a considerable challenge as agreement to participate would need to involve state DOTs and their regulatory partners, adding a layer of uncertainty for the project. An increased budget to $500,000 could support limited field testing of the methods identified as most promising in the early phase of the project.

Review Date:
11/20/2018

FHWA Evaluation of B-06

Damaris Santiago/HEP - Review of techniques with some live field testing. Could provide valuable information.

AASHTO Committee Evaluation for B-06

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This has good implementation potential, but may be a medium priority.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline  
Problem No:  2020-B-07

1. Problem Title  
Methodology for analyzing noise and vibration impacts on different terrestrial species

2. Background  
The objective of this project is to develop a consistent methodology for analyzing noise and vibration impacts on different terrestrial species. Develop standard metrics and procedures for the state Department of Transportations (DOTs) to conduct noise analyses of highway projects on terrestrial wildlife based on science and good practice.

State and federal wildlife regulatory agencies are implementing requirements to meet certain noise thresholds for highway transportation projects to minimize noise and vibration impacts on wildlife. These impact analyses may be required during the Section 7 consultation process or for other wildlife impact analysis under NEPA. Currently, DOTs have little-to-no guidance from federal agencies on how to conduct the noise and vibration analyses specific to wildlife. This lack of guidance results in noise studies/analyses that may be inaccurate, non-comparative from state to state (or study to study), or completely unnecessary. In addition, rework of efforts to address these impacts in a manner acceptable to state and federal wildlife regulatory agencies, often results in project delivery delay.

Refining previous methodologies and collecting information on past acceptable noise impact assessment practices may help direct future work to make noise impact assessment methodologies clear and easy to follow. Standardizing a noise and vibration assessment guidance could be the precursor to developing an agreement between the Federal Highway Administration (FHWA) and U.S. Fish and Wildlife Service (FWS) regarding noise analysis methodologies required, and may result in the discovery of possible mitigation methods that could be used prior to construction to attenuate destructive noise levels.

Noise impacts to wildlife vary by species and depend on what is considered a threat to that species. Noise impacts to species are also time-dependent, based on breeding season, rearing, fledging, or migration. The following are examples of noise disturbance to various animals:

1. Some nesting species may be more disturbed by a nearby researcher than construction occurring 100 yards away.
2. If it is a sensitive birthing period, a species may go to great lengths to avoid an impact their offspring and possibly leave favored habitat to do so.
3. A raptor might be tolerant with a disturbance when the young are very small, but when they get close to fledging, disturbance could make the young leave the nest too soon and lower their chance of survival.
4. Noise can interfere when a species relies on their hearing to find mates or food, or for echolocation.
5. Sound vibrations, or percussive sounds, may cause a species to abandon an area.

Certain animal species may be habituated to sound, so examining increases in noise levels over ambient levels may be a better measure of an impact than overall noise levels. Taking noise habituation into consideration when evaluating noise effects on wildlife may reduce the need for unnecessary mitigation on highway projects.

This research will help define the procedures and metrics for conducting analyses to assess noise and vibration impacts on terrestrial wildlife, inform projects when noise mitigation is necessary, and identify effective mitigation alternatives applicable in project construction.

This research task supports the Committee on Environment and Sustainability’s (CES) initiative to streamline the environmental review process and their promotion of practices that encourage interagency cooperation and coordination in the resolution of environmental issues.

3. Literature Search Summary
A cursory search of TRID (https://trid.trb.org) and Research in Progress database (http://rip.trb.org/) under key words “terrestrial noise” did not provide any previous work specific to methodologies for analyzing noise and vibration impacts on different terrestrial species. Currently, Caltrans is the only state that has available protocol for addressing noise impacts to birds and bats.

4. Research Objective
The objective is to develop a consistent methodology for analyzing noise and vibration impacts on different terrestrial species. Develop standard metrics and procedures for the DOTs to conduct noise analyses of our highway projects on terrestrial wildlife based on science and good practice.

Tasks and Deliverables

Task 1: Conduct Interviews of DOTs and of Oil and Gas Companies
Conduct interviews of DOTs in representative ecoregions for information on species consultations or for developed guidance. To narrow the species, or even guilds, identify what species are of most concern to DOTs and which species would benefit from developed noise and vibration assessment guidance. Among
the choices of DOTs, include CA, because of their available protocol for addressing noise impacts to birds and bats, and other states that have expressed an interest include AL, VA, ID, VT, MT, CO, UT, NV, AZ, ND, OK, IL, KY, OH, WY, WV, ME, and NH.

Task 2: Literature Review
Conduct a literature review focusing on those species of concern and ecoregions as identified in Task 1. The proposed research will include a more detailed search of TRB’s TRID (https://trid.trb.org) and Research in Progress (http://rip.trb.org/) databases and a detailed literature review and survey of highway agencies and oil and gas companies with a focus on noise and vibration assessments of differing environments and species, and the mitigation criteria being used to permit various projects (including restrictions, attenuation, monitoring). Identify data gaps in existing literature and practice. Outreach to the USFWS and state Fish and Game organizations to gather input, direction, or requirements they have included during their consultations with stakeholders and evaluate if they are consistent among the various states. Evaluate findings from the interviews and literature review to determine (at a minimum) the different and similar methodologies required for noise and vibration analysis by species, if there are any unsupported restrictions or conservations measures required, what are existing mitigation strategies, what works and what doesn’t, what is the best available science used by the regulatory agencies, and what are the newest mitigation technologies being used relative to species and reducing noise. Develop a draft report, disseminate draft for review, incorporate comments, and prepare a final literature review report.

Task 3: Develop Guidance for Methodologies Used for Analyzing Noise and Vibration Impacts on Various Wildlife Species
Develop standard metrics and procedures for the DOTs to conduct noise and vibration analyses of highway projects on terrestrial wildlife identified in Task 1 and 2, based on science and good practice. Bring stakeholders together from State Highway Agencies (SHAs), FHWA and Regional/State USFWS offices to create these strategies and standards.

Task 4: Develop Guidance for Mitigation for Use on State Highway Agency Projects Under the Agreement of Governing Regulatory Agencies
Develop options for mitigation with and without monitoring that will be acceptable to regulatory agencies, such as a list of tested and viable construction methods to reduce impacts in a variety of environments. Bring stakeholders together from State Highway Agencies (SHAs), FHWA and Regional/State USFWS offices to create these strategies and standards. Make recommendations on where further research is needed.

Develop guidance and document in an agreement, understanding, or other method that documents the acceptance by these stakeholders of the methodologies developed in Task 3 and 4, with support from Tasks 1 and 2. Obtain signatures of these Governing Regulatory Agencies (Regional/State USFWS offices), and FHWA on the final agreement, understanding, or other document as determined appropriate by these stakeholders.

5. **Implementation Planning**

The guidance document will be disseminated to all state DOTs and it is anticipated that webinars and/or trainings will be offered to state DOT noise specialists on how to implement the guidance as well as provide an understanding of any requirements stipulated in a resultant agreement with FHWA and USFWS.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:** $300,000  
   (This funding can be lowered if the number of species being evaluated is limited to a certain number)

   **Research Period:**  
   24 months

7. **Urgency and Potential Benefits**

New guidance would allow DOTs to expedite noise impact analyses; saving substantial time and money by addressing this issue in the impact assessment phase. It could also prevent or lower mitigation costs while increasing effective protections for sensitive species. There is also a benefit from consistency among methodologies so that studies can be comparable and so that the level of effort needed for this analysis can be predicted during project planning.

8. **Person(s) Developing the Problem Statement**

   Noel Alcala, Noise and Air Quality Coordinator  
   Ohio Department of Transportation  
   (614) 466-5222  
   Noel.alcala@dot.ohio.gov

AASHTO Terrestrial Noise Work Group comprised of MEDOT, OHDOT, CODOT, WYDOT, ALDOT, IDDOT, VTDOT, OKDOT, VADOT, MDT, NDDOT, and KYTC.

9. **AASHTO Monitor**

   Noel Alcala, Noise and Air Quality Coordinator  
   Ohio Department of Transportation  
   (614) 466-5222  
   Noel.alcala@dot.ohio.gov
10. Potentially Interested AASHTO Councils and/or Committees
   N/A

11. Submitted By
   Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
   Office of Environmental Services Administrator, Ohio DOT
   1980 West Broad Street, Mail Stop 4170
   Columbus, OH 43223
   (614) 644-0377; Tim.Hill@dot.ohio.gov

NCHRP Review of B-07

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The scope and focus of the problem statement are somewhat unclear. The objective includes a methodology for analyzing noise and vibration impacts on terrestrial species, and then indicates procedures and metrics to be developed not only for terrestrial species, but also aquatic species. Task 1 indicates that interviews with California on their protocol for noise impacts for bats and birds should be conducted, yet these are not terrestrial species.

Securing agreement from regulatory agencies on standards, strategies, and agreements (as suggested in Tasks 3, 4, and 5) is beyond the scope of an NCHRP research project.

A standard metric for states and for a range of species will pose a challenge, given the variation in sensitivity across species to noise and vibration as listed in the Background section. However, the development of a method appropriate for certain, high-profile species for which there is a particular need, coupled with additional information about how to develop a method for other species and contexts, is appropriate. For such an effort, a budget of $350,000 is suggested.

Review Date:
11/19/2018
FHWA Evaluation of B-07

Damaris Santiago/HEPE Aileen Varela-Margolles/HEPN - Proposal to develop national guidance on methodologies used for analyzing noise & vibration impacts on terrestrial wildlife; guidance for mitigating those impacts; and documenting acceptance of those methods. These are worthy pursuits. However, we don't believe developing national guidance is an appropriate subject of a NCHRP research grant. What's more, developing guidance can take many years to achieve, and are subject to the availability of other agency staff. Perhaps one day FHWA HQ can work with FWS HQ and migratory bird program in pursuing these goals.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline

1. Problem No: 2020-B-08

2. Problem Title

National Synthesis of Project-Level Programmatic Agreements for Expediting Section 106 Consultation in Project Delivery

3. Background

Resolving effects of transportation projects on historic properties pursuant to Section 106 of the National Historic Preservation Act and 36 CFR 800 can be one of the most time consuming environmental activities in project development. The streamlining value of statewide program-level Section 106 programmatic agreements (PAs) is well established and studied at the national level (NCHRP 25-25, Task 106 in preparation). What is less known is the value of project-level Section 106 PAs to expedite the delivery of individual, complex transportation projects, typically those for which environmental assessments (EAs) or environmental impact statements (EISs) are being prepared for NEPA purposes. Typically such project-level PAs transform elements of the Section 106 process into post-Section 106 commitments (e.g. deferring archaeological surveys until after a preferred alternative is selected), thus allowing Section 106 to be administratively completed earlier in project development. However, the full range of how project-level Section 106 PAs are being used by state departments of transportation (DOTs) and the Federal Highway Administration (FHWA) presently is unknown, including "extreme" examples that may push the limits of what's allowed by regulation of the Advisory Council on Historic Preservation (ACHP, 36 CFR 800).

4. Literature Search Summary

There is no available literature on the use of project-level PAs except for an on-line guidance document published by the ACHP. In that document the ACHP describes situations for which a project-level PA may be warranted, but does not provide recommendations or examples of specific applications or content since each project-level PA is responsive to specific project circumstances. In the absence of any substantive examples of how project-level PAs are used, state DOTs, the Federal Highway Administration (FHWA), and their State Historic Preservation Officer (SHPO) partners must rely on anecdotal information and outreach to colleagues across the country for examples of project-level PAs. For example, an inquiry by the author of this problem statement to the ACHP for examples of "extreme project-level PAs" resulted in a recommendation to ask FHWA headquarters about one such agreement that was being developed by that agency for a high-profile project in an adjacent state (i.e., typical discovery by anecdote).

5. Research Objective
The objective of this research is to compile and synthesize information on the use, content, and efficiencies provided by Section 106 project-level PAs from across the U.S. This national synthesis will focus on identifying and summarizing project-level PAs that have been executed in the last decade by state DOTs and FHWA, but may also include relevant examples of project-level PAs that have been executed by other agencies like the Federal Transit Administration (FTA), the Federal Railroad Administration (FRA), and the Federal Aviation Administration (FAA). The synthesis also will include recommendations on successful practices, especially for project-level PAs that result in expedited completion of Section 106 requirements for complex transportation projects, including those being implemented by design-builders and/or P-3 concessionaires.

The research can be carried out through the following tasks:

- Task 1: Conduct a preliminary, brief survey of state DOT environmental programs, FHWA Division Offices, and FHWA Headquarters to determine if they have used a project-level PA to conclude Section 106 consultation during the last 10 years. This would be a “yes/no” and “how many” survey to maximize survey response.
- Task 2: The preliminary survey would be followed by a more comprehensive survey of state DOTs, perhaps up to 10, which have the most extensive experience in using project-level PAs to collect pertinent examples that demonstrate the range of provisions and efficiencies afforded to project development. Of particular interest will be project-level PAs that contain efforts to identify historic properties, that defer Section 106 activities and decisions, that provide standing for design-builders and/or P-3 concessionaires to participate in Section 106 consultation, and “extreme” examples of project-level PAs that defer most or all of the Section 106 process to later stages of project development.
- Task 3: The comprehensive survey would be followed by interviews of DOT Section 106 practitioners or other DOT officials responsible for developing the project-level PAs (identified in Task 2) and implementing the terms to ascertain successful practices in using project-level PAs to expedite project development and delivery.
- Task 4: The results of this research will be compiled into a synthesis report highlighting successful practices, accompanied by a PowerPoint presentation.

6. Implementation Planning
The principal stakeholders for this research are state DOTs, FHWA, FRA, FAA, the ACHP, SHPOs, local governments, and private-sector consultant employed by such agencies. The results of this research will give those agencies and organizations detailed guidance, not presently available on a national basis, on how to employ project-level PAs to expedited project development and delivery.

7. Estimate of Problem Funding and Research Period
Funding: $150,000
Research Period: 12-18 months
8. Urgency and Potential Benefits
There is a continuing need for effective tools for expediting project development and delivery, especially for complex and large-scale transportation projects. In addition, the adoption of performance metrics by most state DOTs has increased the focus on meeting or exceeding project delivery (i.e., “ahead of time and under budget”). A national synthesis on the use of Section 106 project-level PAs will provide one such tool at a time when it is ripe for use.

9. Person(s) Developing the Problem Statement
Antony F. Opperman
Cultural Resources Program Manager
Virginia Department of Transportation
Environmental Division
804-371-6749, a.opperman@vdot.virginia.gov

10. Nomination for AASHTO Monitor
Antony F. Opperman
Cultural Resources Program Manager
Virginia Department of Transportation
Environmental Division
804-371-6749, a.opperman@vdot.virginia.gov

11. Potentially Interested AASHTO Councils and/or Committees
AASHTO Committee on Environment & Sustainability

12. Submitted By
Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
Office of Environmental Services Administrator, Ohio DOT
1980 West Broad Street, Mail Stop 4170
Columbus, OH 43223
(614) 644-0377; Tim.Hill@dot.ohio.gov

NCHRP Review of B-08

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
As described, this problem statement appears well suited for the NCHRP Synthesis program.

See NCHRP 25-25/Task 107 Synthesis of Best Practices for the Development and Implementation of Section 106 Delegation Programmatic Agreements for a study currently underway of more general PAs (i.e. not project-level).
FHWA Evaluation of B-08

Owen Lindauer/HEPE - A worthy problem and research approach. The research objective must include a consideration of how the project specific PA satisfies the "reasonable assurance" at the time of a NEPA decision requirement in 23 CFR 771.119(g) for EAs, 771.125(a)(1) for a FEIS, and 771.133 for FEIS, FONSI. While the project specific EA may defer the detailed compliance with Section 106, sufficient Section 106 information and consultation must be completed (especially if a project PA is not drafted) before the NEPA decision such that the FHWA adequately understands project impacts and how those impacts would be addressed.
Problem No: 2020-B-09

1. **Problem Title**
   Quiet Bridges: Design, Construction, and Modification

2. **Background**
   By spanning physical objects such as water features and topographical barriers, bridges connect places of importance. These structures also provide a secondary benefit as a means for wildlife to navigate facilities that may otherwise prove fatal if crossed at grade. To enhance wildlife passage, the research proposal will focus on what work, if any, has been performed to reduce noise generated from bridge structures and determine whether there is a research need to further investigate “quiet bridge” opportunities.

Whether used by wildlife during migration periods, or as a means to traverse fragmented habitat for dispersal purposes or address scarcity of other resources, studies have shown wildlife transitioning from a natural landscape towards transportation features, such as bridges, increase a species' likelihood of avoidance due to increased noise levels. While an extensive body of research exists regarding direct and indirect roadway effects on wildlife, whether it be roadway noise, openness ratios for underpasses and culverts, or lighting, little information is available regarding structural or engineering designs to minimize sound emanating through bridges, or structural modifications.

The benefits of quiet bridge design and/or sound dampening is applicable to a variety of spanning structures; however, it is anticipated the research will focus primarily on ground transportation bridges as they exhibit higher vehicular utilization, and are more abundant, than railway bridges.

3. **Literature Search Summary**
   A search of the AASHTO TRID and Research in Progress databases utilizing the terms “bridge noise and quiet bridge” revealed subject matter peripheral to this research proposal (implementation of modular bridge joints, road surface treatments, and sound walls to reduce noise emissions). However, search results but did not address bridge design, or modifications to existing bridges, to minimize structural sound.

A related project from TRID ([http://trid.trb.org](http://trid.trb.org)) and Research in Progress database ([http://rip.trb.org/](http://rip.trb.org/)) include the following:
• Numerical and Experimental Study on Noise Reduction of Concrete LRT Bridges[1]
  
  - This study revealed a “noise barrier was more effective in reducing the rail noise, and the soft rail pad is more effective to control the bridge noise.” Benefits of sound barriers are known; however, the applicability of rail pads is not relevant to this proposal.

In addition, a paper prepared by Clevenger and Waltho, *Performance Indices to Identify Attributes of Highway Crossing Structures Facilitating Movement of Large Mammals*[2], identified wildlife passage in Banff National Park was positively correlated with openness ratio, but negatively correlated with sound levels.

4. **Research Objective**

The objective of this research is to identify existing structural engineering methods, or modifications to existing roadway bridge structures, that minimize noise emanating from and through roadway bridges.

**Tasks and Deliverables**

**Task 1: Conduct Interviews of DOTs, Engineering Societies, and Road Ecology groups**

Conduct surveys and interviews of Federal Highway Administration, state DOTs, U.S. Fish and Wildlife Service, state wildlife agencies, engineering societies such as the American Society of Civil Engineers (ASCE) Transportation and Development Institute or ASCE Structural Engineering Institute, and road ecology groups to identify existing research and/or designs related to minimizing noise emanating from bridge structures (e.g. minimize sound propagation through use of alternative construction materials, designs to attenuate resonating frequency of standard materials, etc.).

**Task 2: Literature Review**

Conduct a literature review focusing on topical material as identified in Task 1. Identify data gaps in existing literature and current engineering practices following survey results. Evaluate findings from literature review, interviews, and survey results to determine extent of existing available resources, what methods are currently recommended by the regulatory agencies, and what are existing mitigation technologies being used to reduce noise on structures.

**Task 3: Develop Design Guidance to Minimize Noise During Preliminary Engineering and Modifications to Existing Structures**

Following compilation of the data collected in Tasks 1 and 2, design guidance will be developed to 1) provide alternative design methods to limit noise emanating from structures and 2) provide effective post-construction installation methods of sound dampening materials.

5. **Implementation Planning**
The final design guidance will be distributed to state DOTs, road ecology networks, and local, state, and federal wildlife agencies via listservs and a proposed presentation at the 2019 International Conference on Ecology and Transportation.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:** Less than $99,000

   Completion of the research proposal is anticipated to cost less than $99,000. A current investigation into LED lighting effects on wildlife, with a similar research product, is currently being conducted at this price point.

   **Research Period:**
   The research proposal anticipates the preliminary investigation to be completed in less than twelve (12) months. This includes identifying and retaining a qualified group to evaluate the current body of literature on the subject matter, develop and disseminate a survey to groups identified in Task 1, compile survey and interview results, develop design guidance for distribution, and identify areas in need of additional research.

7. **Urgency and Potential Benefits**

   Research needs to enhance wildlife movement is ongoing. At this time, state and federal wildlife officials work with transportation agencies to avoid and minimize direct and indirect noise impacts; however, absent standard specifications for quiet bridge design, the effectiveness of various recommendations are unknown. By compiling the existing knowledge of various structural engineering bodies, and assembling the current body of literature into a comprehensive format, recommendations that are more concise may be provided to guide development of future designs or modify existing facilities to enhance wildlife connectivity.

8. **Person(s) Developing the Problem Statement**

   John M. Taylor, Fish and Wildlife Biologist
   U.S. Fish and Wildlife Service
   (760) 322-2070 x418
   john_m_taylor@fws.gov

9. **Nomination for AASHTO Monitor**

   John M. Taylor, Fish and Wildlife Biologist
   U.S. Fish and Wildlife Service
   (760) 322-2070 x418
   john_m_taylor@fws.gov

10. **Potentially Interested AASHTO Councils and/or Committees**

    N/A
11. **Submitted By**

Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
Office of Environmental Services Administrator, Ohio DOT
1980 West Broad Street, Mail Stop 4170
Columbus, OH 43223
(614) 644-0377; [Tim.Hill@dot.ohio.gov](mailto:Tim.Hill@dot.ohio.gov)

---


---

**NCHRP Review of B-09**

**Reviewed By:**
Waseem Dekelbab
wdekelbab@nas.edu

**Comments:**

The problem statement is well written, and the research objective is well-defined. The problem is suitable for funding in the FY 2020 NCHRP. The problem statement could also be a good topic for NCHRP Synthesis.

**Review Date:**
12/10/2018

---

**FHWA Evaluation of B-09**

Damaris Santiago/HEP - Quiet bridges refers to noise abatement to assist wildlife passage. End result will be guidance for bridge construction at a small prices ($100k). Could be helpful.

---

**AASHTO Committee Evaluation for B-09**

**Submitted By:**
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This may not be a significant need. If it moves forward please include a member of the Committee on Bridges & Structures on the panel.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Problem No: 2020-B-10

1. Streamlining Transportation Conformity Processes

2. Background: The transportation conformity regulation (40 CFR Parts 51 and 93) has been amended repeatedly since “Conformity provisions first appeared in the Clean Air Act Amendments [CAA] of 1977 (Pub. L. 95-135)”, to quote the US Environmental Protection Agency (EPA) in its proposed rule for transportation conformity in 1993. After decades of experience with conformity, there is now a critical need to undertake a comprehensive review of processes as currently implemented by state DOTs and MPOs to comply with conformity requirements, develop realistic cost estimates for those compliance activities, and identify cost-effective options for streamlining the compliance process while meeting all regulatory requirements. The pressing need stems from two challenges:

   - First, the incremental changes introduced by the ongoing series of amendments have resulted in a relatively complex regulation that is increasingly challenging and costly to implement at both the regional and project-levels, i.e., marginal costs have increased while marginal benefits have decreased (or disappeared). For example, for areas that currently have a substantial margin between forecast emissions and the applicable budgets (effectively caps on emissions for each pollutant), passing the regional conformity tests is typically a foregone conclusion, so the six-to-twelve month or more period of time spent on modeling and consultation is effectively a waste of resources. Why take the time and money to do extensive modeling and consultation if the bottom-line results (passing the conformity tests) are known in advance? There has to be a more cost-effective way to show compliance in these cases, e.g., by the transportation conformity rule provision that permits reliance on a previous regional emission analysis (40 CFR 93.122(g)), if it can be broadly implemented in a manner similar to programmatic agreements that are time-tested in applications for NEPA.

   - Second, periodic and occasionally unpredictable court rulings have introduced significant uncertainty (if not a degree of chaos) into the conformity process. For example, the February 2018 court ruling on the revocation by EPA of the 1997 ozone NAAQS was a surprise decision that initially led to a national-level conformity crisis, with federal agencies struggling to react with appropriate and timely guidance pending the results of an EPA petition for rehearing, state and local transportation agencies fearing potentially costly impacts due to an immediate and possibly (lacking federal guidance) retroactive conformity lapse, with our customers, users of the transportation system, ultimately expected to pay all the costs. State DOTs and MPOs as a result have been conducting regional conformity analyses on a rush basis to minimize the impact of this
particular ruling, which when complete would allow all projects required to be in a conforming plan and program to be cleared for implementation and not just those exempt from conformity. While this rush response addresses the immediate problem caused by this particular court ruling, it does not eliminate the threat from other similarly-disruptive court rulings in the future that could delay project implementation. Such periodic conformity crises are unacceptable and, if they cannot always be avoided, means to mitigate the impacts and allow for more cost-effective and realistic responses are needed.

Other related issues contributing to challenges with the current conformity process include:

1) Revocation of previous standards and the impacts this causes to short and long-term planning and to other programs dependent on the standard and the attainment/nonattainment status of the area

2) Legal actions that have caused delays and introduced uncertainties for areas required to perform conformity analyses (similar to the February 2018 court ruling)

3) Analysis tools and processes such as updates to models used in forecasting future emission quantities

4) The relevance of continuing the requirement of performing analysis for carbon monoxide when this pollutant has been virtually eliminated over the past several decades

5) The limit for future NAAQS revisions given the fact that some standards are now approaching background (natural) concentration levels

6) The continuing uncertainty surrounding “interstate transport” of emissions into an area from “upstream sources” over which the area has no control that affects the area

7) The length of time it takes EPA to review mobile source emission budgets

8) The cost and resources needed to be devoted to the current conformity process at a time when State DOTs budgets are limited

The AASHTO Strategic Plan (June 2015) identifies conformity streamlining as a priority under the category of policy analysis and decision-making. It was also identified as a research priority for both regional and project-level analyses by the Project-Level Analysis Subcommittee of the TRB Transportation and Air Quality Committee (ADC20) at the 2013 annual meeting.

### Literature Search Summary

A review of the TRID and RIP databases did not reveal current or past research focused on streamlining the conformity process. A number of papers were identified that reference transportation conformity, but not streamlining per se; they instead focused on EPA requirements and the analysis process. Examples of search results that may serve as references or otherwise support an easier process for making conformity determinations include the following:
4. **Research Objective:** Conduct a comprehensive review of processes as currently implemented by state DOTs and MPOs to comply with transportation conformity requirements, develop realistic cost estimates for those compliance activities, and identify cost-effective options for streamlining the compliance process while meeting all regulatory requirements. Note the development of realistic time and cost data is a major effort that is expected to produce a landmark reference database for future research and policy development.

The study may be phased and include surveys of state DOTs and MPOs, as well as case studies. For example, the first phase may identify issues and potential solutions, while the second may involve the detailed cost assessments and analyses of options for streamlining.

**Note:** If the related FY 2020 NCHRP proposal for “Best Practices for Streamlining Project-Level Analyses for Air Quality” is funded, then this study may focus on regional conformity analyses. Otherwise, the project scope for this study should include both regional and project-level conformity analyses to the extent that funding permits.

5. **Implementation Planning:** The benefit of this research project is to lessen the burden that State DOTs and MPOs will have in making conformity determinations. The US DOT, acting through the FHWA, can serve as a source for training and technical assistance to the States and local MPOs in making “streamlined conformity determinations”. This could lead to reduced costs, time and obligation of other resources by the State DOTs and local MPOs that is now expended under the current approach. As with other training and support provided by USDOT/FHWA, this assistance can be provided through both in-person instructor-led presentations and by webinar-type instructional classes.

Implementation may also be facilitated by dissemination by AASHTO of the study report and associated training materials, as well as presentations to members of the AASHTO COES Air Quality, Climate Change and Energy Subcommittee (AQCCES) as well as the TRB Transportation and Air Quality Committee (ADC20). Presentations by the project team to AQCCES as well as ADC20 are expected.

6. **Estimate of Problem Funding and Research Period**


**Note:** The FY 2020 NCHRP Proposal for “Best Practices for Streamlining Project-Level Analyses for Air Quality” if funded would address streamlining for project-level air quality conformity analyses, but not regional conformity analyses.
**Recommended Funding:** The study is expected to involve the equivalent of two professional staff for 15 months each at a rate of $200 thousand per year, or $500 thousand overall.

**Research Period:** Two years total.

7. **Urgency and Potential Benefits:** State DOTs and MPOs would benefit from the development and implementation of options to streamline conformity compliance activities, which have become increasingly time-consuming and costly. More specifically, the proposed study would have the following major benefits:
   
   (a) It addresses critical needs and strategic objectives of state DOTs for streamlining the preparation of transportation conformity analyses.
   
   (b) It can be successfully achieved within the constraints of the proposed time and budget.
   
   (c) It will produce implementation-ready products, which include not only specific recommendations for streamlining processes but also the creation of a valuable database on the time and costs for conformity analyses that will support future research and policy development needs.
   
   (d) It is highly likely that the deliverables will be implemented by state DOTs, as the need is high and AASHTO will be able to support its implementation.

8. **Person(s) Developing the Problem Statement**

   Christopher Voigt  
   Environmental Engineer Senior  
   Virginia Department of Transportation  
   (804) 371-6764  
   Christopher.Voigt@vdot.virginia.gov

   Kevin Black  
   Federal Highway Administration  
   (410) 962-2177  
   Kevin.Black@dot.gov

9. **Nomination for AASHTO Monitor**

   Christopher Voigt  
   Environmental Engineer Senior  
   Virginia Department of Transportation  
   (804) 371-6764  
   Christopher.Voigt@vdot.virginia.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
Not applicable as the problem statement is being submitted by an AASHTO Committee.

11. Submitted By
Tim Hill, Vice Chair of AASHTO Committee on Environment and Sustainability
Office of Environmental Services Administrator, Ohio DOT
1980 West Broad Street, Mail Stop 4170
Columbus, OH 43223
(614) 644-0377; Tim.Hill@dot.ohio.gov

NCHRP Review of B-10

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
The problem statement is framed by concern over the costs and uncertainties of the air quality conformity process that stem from the complexities of the process itself as well as disruptive court rulings. The objective focuses on the resource costs to agencies of conformity and on finding ways to reduce these costs through streamlining. This has been an area of considerable NCHRP investment in the past and continues through, for example, projects to develop templates for programmatic agreements and other information to support streamlining the process.

The proposed comprehensive review could be a useful exercise to develop a road map of state DOT practices and link them with existing research and successful practices. Such an effort is more closely aligned with the NCHRP Synthesis model. Experience with similar NCHRP efforts to document time and cost for regulatory processes has proven to be extremely difficult; the ability to develop a robust reference of time and cost data may be limited for this topic as well.

The effectiveness of the study in lessening burdens on state DOTs will be hampered by the constraints of current and future regulatory changes, actions of courts, and the acceptability of process changes to regulators, which can vary across the country. Reflecting this, the implementation plan emphasizes potential actions by USDOT and FHWA, suggesting that the audience for this work is federal agencies.

Review Date:
11/19/2018
FHWA Evaluation of B-10

Cecilia Ho/HEPN - I am not sure how this research can actually help with streamlining the process without statutory or regulatory changes. The conformity requirements were prescribed in details in the Clean Air Act. Optioned to "streamline" the process would require changes in regulations (or statute) before they can be implemented.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation
FY2020 NCHRP Problem Statement Outline

1. Problem Title
   Developing an AASHTO Guide to System Level Asset Valuation in Support of Transportation Asset Management Decision Making

2. Background
   Accurate asset valuation will provide relevant and reliable information for decision-making on the effective, efficient and economical management of our highway and transit assets. This is critical to the ongoing sustainability of state and federal government transportation infrastructure services.

   Public infrastructure assets are essential to the delivery of departmental services or State Departments of Transportation (DOT). The correct valuation of these assets will allow the entities responsible for them to correctly assess and account for their service potential. Improved information on valuation will give entities better information to support their decision-making on the future management of these assets.

   Asset management is central to public sector organizations. Governments have increased pressure to provide improved services to their communities, around ageing infrastructure, and around restrictions on the availability of funds. It is important to manage infrastructure assets in a responsible and effective way. Proper management will extend the asset’s expected service life by maintaining its performance beyond the original design life and applying a balance between the costs of excessive planned, and excessive unplanned, maintenance.

   The current federal highway statute (23 USC 119) and regulation (23 CFR 515) require state DOTs to develop a risk-based transportation asset management plan (TAMP), that includes a valuation of pavements and bridges on the National Highway System (NHS). State DOTs are complying with these requirements through various approaches, but have struggled to incorporate asset valuation into asset management practices or infrastructure investment decisions in a consistent, meaningful way. There are standard practices used internationally for incorporating asset valuation into an organization’s financial statements that have not been adopted in the U.S. These are important to asset management to support long-term financial planning, leading to improved financial sustainability. Improved practices in asset valuation will allow agencies to use financial valuation and acknowledge that sustainability is not only about maintaining financial capacity and infrastructure capital.

3. Literature Search Summary
   Research is in its infancy for the use of asset valuation in asset management decision making for U.S. Agencies. The Federal Highway Administration’s (FHWA) report on Incorporating Asset Valuation Into Transportation Asset Management Financial Plans provides fundamental information on Asset valuation for infrastructure and presents information on how different disciplines interpret asset valuation in different ways. The report focuses upon the transportation asset manager’s perspective on asset valuation based on the physical nature, size, age, condition, components, or some derivative of their cost to construct. The report relies on international experience; however, it does not focus on US experience or relate to performance management.

National Cooperative Highway
Research Program (NCHRP) Report 608 states that DOTs typically calculate asset values using the Government Accounting Standards Board (GASB) Statement 34.

Pavement and bridge management systems include cost information in order to predict life cycle cost analysis, using relatively simple models suitable for network level analysis. NCHRP Report 483 presents information on life cycle cost analysis for bridges, with a detailed quantitative treatment of uncertainty and a project-level perspective.

Most recently, NCHRP 19-12 TAMP resulted in, “A Guide to Developing Financial Plans and Performance Measures for Transportation Asset Management,” published in October, 2018. This guide includes definitions of asset valuation approaches, and provides steps for incorporating valuations into a TAMP financial plan. However, it does not describe how valuation can be incorporated into asset management practices such as long-term planning, project prioritization, or funding allocations. This proposed research would build on the efforts of NCHRP 19-12 to provide guidance on further refinement and integration of asset valuation approaches in asset management policies and practices.

4. Research Objective

The objectives of this research are to examine methods for valuation of system assets and develop guidance and one or more example tools to demonstrate quantitative asset-level valuations for an agency. Thorough research should:

- Define various approaches for asset valuation, such as GASB34 and Depreciated Replacement Cost, with a focus on identifying whether current replacement cost or a market value approach should be used, how each is beneficial and can be incorporated into asset management plans and practices.
- Determine a baseline of existing practices currently undertaken by domestic and international highway and transit agencies to identify specific objectives for a standard asset valuation methodology, including case studies of successful implementation.
- Develop a transportation asset valuation guide and methodology for U.S. transportation agencies including a roadmap for implementation of appropriate valuation approaches into work planning and programming practices. The guide should provide practical examples which can be used by asset owners, system operators, and planning organizations to utilize asset valuation to improve the effectiveness of investments in transportation infrastructure.

5. Implementation Planning

The target audience for the research findings and products of this work will be State DOTs, MPOs, transit agencies, and other transportation agencies, as well as researchers and engineering staff involved in transportation. The key decision-makers who can approve, influence, or champion implementation of these research products are the senior staff and executives of the transportation agencies. The AASHTO committees that will be involved in the adoption and implementation of the results will be the AASHTO Committee on Performance Based Management and its subcommittee on Asset Management.

6. Estimate of Problem Funding and Research Period

Recommended Funding:
$600,000

Research Period:
18 months

7. **Urgency and Potential Benefits**

Asset Valuation is an integral part of asset management and cost information is a key component of management systems for major constructed facilities, such as pavements and bridges. Asset Valuation has many audiences and different approaches to determining an assets value and approaches like GASB 34 which has no special treatment for pavements, bridges or other assets. Defining alternate approaches to value assets for utilization in Asset and Performance management and aligning with International methods that allow for the identification and valuation of an agency’s physical capital.

Asset valuation has been successfully integrated into asset management standards in nations with more mature practices, including Australia, New Zealand, and the United Kingdom. As U.S. agencies have gained an understanding of calculating and reporting asset valuation, they have recognized the potential benefit of applying asset valuation to routine planning and programming efforts. Development of a practical guide for implementation of asset valuation will provide agencies with the knowledge and direction needed to leverage asset valuation as a tool for effective asset management.

8. **Person(s) Developing the Problem Statement**

The following individuals contributed to the development of this problem statement: Jim Feda, SC DOT; Tamara Haas, NM DOT; William Johnson, Colorado DOT; Nathan Lee Utah DOT; John Selmer, Iowa DOT; Dave Wresinski, Michigan DOT; Nat Coley, FHWA; Scott Bloxom; Cindy Orndoff; Charles Pilson, Brad Allen;

This problem statement was developed based on research needs identified in the AASHTO TAM Research Roadmap, and through regular member feedback on the need to develop greater consistency across highways and transit agencies with respect to asset valuation.

The following groups were involved in the development of this problem statement:

- AASHTO Committee on Performance-Based Management
- AASHTO Subcommittee on Asset Management
- TRB Committee on Transportation Asset Management (ABC40)
- TRB Committee on Strategic Management (ABC10) – Tamara Haas
- FHWA Transportation Asset Management Expert Task Group

9. **Nomination for AASHTO Monitor**

Tamara Haas, New Mexico DOT

10. **Potentially Interested AASHTO Councils and/or Committees**

- Committee on Funding and Finance
- Committee on Planning
- Committee on Maintenance
- Committee on Communications

11. **Submitted By**
NCHRP Review of B-11

Reviewed By:
Lawrence D. Goldstein
lgoldstein@nas.edu

Comments:

Asset management frameworks and implementation of asset management programs is an ongoing research topic for NCHRP and other CRP programs. The challenge for this study will be to make sure that the research builds on previously completed and ongoing studies, adding to the state-of-the-art rather than repeating other work. For example, two current studies are 02-26 on Implementation of Programmatic Life Cycle Cost Analysis in a Transportation Asset Management Framework; and 08-118: Risk Assessment Tools and Techniques for Transportation Asset Management. If the proposed study can include an evaluation of what has already been prepared and is under preparation, and can integrate that research into an expanded system level guide, the result would be significant. Other current studies will also be important, including 19-14 on Right-Sizing Transportation Investments. This is a complicated process that will need to bring together a variety of techniques to enhance system-level asset management procedures. The problem statement needs careful editing and rewriting.

Review Date:
12/4/2018

FHWA Evaluation of B-11

Pete Stephanos, HISM-1 and S. Gaj, HISM-30 - This research is highly supported as methods to value assets are lacking and needed. Also, for consideration, Good project that is needed. The problem statement should include a statement that a goal is that the value of a State's network should be that the value of the network (pavements, bridges and other assets) don't lose value. Also, it is stated that asset valuation does not relate to performance management, it could be argued that it is a performance metric. Is a
product of this study a guide, "how to use asset valuation in managing a network" or "asset valuation as a tool in managing a network".

AASHTO Committee Evaluation for B-11

Submitted By:
Matthew Hardy
AASHTO staff
Performance-Based Management

Comments:
First priority by the Committee on Performance-Based Management

Submitted By:
Elizabeth Robbins
Chair
Planning

Comments:
COP's 3# priority: This research should think broadly about "value" to include the concept of economic value of the asset in its context.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline

Problem No: 2020-B-12

1. Problem Title
   Emerging Issues: Impact of New Disruptive Technologies on the Performance of DOTs

2. Background
   The transportation of people and goods is one of the most important components of our everyday lives. The arrival of the 4th Industrial Revolution and the rapid development and fusion of multiple disruptive and innovative technologies, such as artificial intelligence, big data and digitization, the Internet of Things (IoT), fifth (and even sixth) generation wireless technologies (5G/6G), connected and autonomous vehicle (CAV) technologies, on-demand ride sharing services, Mobility as a Service (MaaS), 3D printing, the sharing economy, and others are changing not only the behavior but also the expectations of our customers and stakeholders, not only here in the United States but all over the world.

   The fusion of these technologies is bringing a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation is moving at a pace that governmental entities are not readily prepared to respond to.

   Mobility as we know it, is also transforming as new technologies disrupt traditional ways people and goods move throughout our transportation systems. The rapid introduction of mobile internet is upending the traditional approaches with new customer-centric business models based on the sharing economy such as online car hailing, bike sharing, time sharing, customized shuttle bus, parking sharing, etc. And while the new business models bring more convenience and efficiency to the users and to the national and local economies, they have also created new problems, needs, and challenges that we must face as decision makers.

   Today during the 4th Industrial Revolution as technology previously foreign to transportation rapidly enters old ways of doing business – e.g., solely road infrastructure related – performance is affected across all modes and aspects of transportation agencies’ responsibilities. Institutional processes may be knocked down to make room for updated or more effective methods to improve performance outcomes. Unfortunately, all agencies lag behind to at least some extent as they struggle to define meaningful measures, manage data collection, maintain accountability, and streamline reporting.

   These disruptive technologies are forcing global changes that are capturing the attention of transportation agency leaders within AASHTO as well as transportation researchers worldwide, including the World Road Association (PIARC) that has recently announced a call for papers on the “Impact of Disruptive Technologies to the Performance of Transport Administrations” as part of the World Road Congress in Abu Dhabi in 2019.

3. Literature Search Summary
   A review of the literature at the intersection of emerging transportation technologies and transportation performance measures and management reveals three things. First, there exists a wealth of research, development, and guidance on high level performance measures for transportation agencies, e.g., fatality counts. This is also played out with the
current federal performance reporting requirements for safety, infrastructure condition, and mobility. These generally include highly aggregated lag measures that may not be influenceable or attributable to policy, strategy, or resource decisions. Second, the literature is appropriately rich with disruptive technologies, and the opportunities and challenges thereof. For instance, prominent among the expected impacts of disruptive technologies on transportation agencies are CAVs and cooperative and automated transportation (CAT). These are actively generating a large body of literature, including several reports from NCHRP Project 20-102. In addition to the disruptors noted in the opening paragraph, another current example is the proliferation of operations decision support systems (DSS). These are increasingly real-time and empowered by big data, digitization, and machine learning. While still emerging, DSS are increasingly adopted for highway operations, and are actively in development for arterial operations. As with CAV/CAT, technologies like DSS are expected to improve agency performance outcomes. For assessing the impact of disruptive technologies on the performance of DOTs, researchers must increasingly refer to literature from the electrical, communications, and automotive disciplines.

Third, there is far less at the intersection of performance management and disruptive technology with regard to transportation agencies, which is the central motivation for this research. For performance impacts from new technologies, estimated or predicted benefits to safety and mobility are getting a lot of attention. But what is lacking in the literature and in practice, is the careful consideration of evidence and whether transportation agencies are measuring the right things for tracking the impacts on outcome. On one hand, high level measures like number of fatalities help understand general trends, but with so many variables, a link to a specific disruptive technology is infeasible. On the other hand, tracking basic activity outputs is easy but not quality performance measures, nor are milestones for implementing a DSS or enacting enabling legislation for CAV. Agency missions and strategic goals are generally not disputed, but work remains to identify the most relevant quantification of evidence for performance results clearly impacted by disruption and linked to agency goals.

4. Research Objective
The objective of this research is to advance the state of understanding of the impacts that innovative and disruptive technologies, including the sharing economy, will have on the overall performance of DOTs and MPOs. The research will seek to identify leading performance indicators that transportation agencies can implement to better understand the impact of these evolving technologies to the overall performance of DOTs and MPOs, and how that ultimately affects their strategic planning and delivery of services.

5. Implementation Planning
The final phase of this project shall include the development of an implementation package that will provide the instruction necessary for a transportation agency to adopt the methodology developed during this project.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $250,000

Research Period: 24 months. The research team will develop the detailed tasks and work plan for this project.
Literature review. Granted, technology has been changing transportation for millennia, so a lot of thought has been put into the topic. But performance management as we currently know it is much more recent. While the literature review should capture key new, emerging, and future transportation technologies, it must focus on transportation performance management and how it has or should be adapted. Related topics include the performance management guidance coming out of the Second Strategic Highway Research Program (SHRP2), the current federal performance reporting requirements, and best practices among transportation agencies within the United States and worldwide.

Address and analyze issues, effects, and opportunities at the intersection of transportation technology and performance management. These may include:

- Categories of technology disruptors, e.g., data, digitization, information; vehicle technologies; shared mobility; evolving modes, especially for shorter urban trips
- New business or partnership models involving the private sector, as well as impacts to how agencies execute long-range planning and prioritize investments in expansion, maintenance, and operations
- Agency responsibility for evaluation, approval, and regulation of new ways of getting around, and the potential trade-off between performance improvement and changes in risk
- Measuring performance for new goals related to privacy, resiliency, security, and cybersecurity
- Workforce adaptation needed to better enable agency preparedness for measuring performance in more impactful and actionable ways as technology continuously affects outcomes
- Customer service, effects on users of the transportation system, and improved access and mobility for historically underserved populations
- Gap identification. Define the key gaps between current performance management practice and evolution required to implement or maintain meaningful performance management programs. Sources for this should include, at a minimum, the SHRP2 capability maturity model and frameworks, and performance management best practices from outside of transportation and government

Framework for performance management. Bringing best practices in performance management to bear on transportation agencies is doubly important as technology and data proliferates. This framework must address technology impacts without being rigidly tied to specifics, and it shall include strategies for advancing agency culture and environment; avoiding common errors and pitfalls; deliberately defining outcome-based measures that are strongly tied to the agency’s goals; and monitoring and reporting results in more automated and impactful ways

7. Urgency and Potential Benefits

Agencies that adopt new processes and methodologies developed through this research project will benefit by:

- Understanding the impacts of technology on the DOTs/MPOs performance and incorporating this important context when communicating with the public, decision-makers, and other stakeholders.
- Having a defensible framework for incorporating into their business of performance management; defining performance measures by desired outcomes, independent of specific technologies; explicitly tying those measures to goals of the transportation agency.
• Identifying the workforce skills needed for performance management that is continually disrupted by technology advances; leveraging the types of performance data that are important as technology plays a deeper, more meaningful role.
• Being proactive in adapting business models and processes for a sharing economy, for evolving private sector roles, and for changes in how people and goods utilize transportation systems.
• Improving access, mobility, confidence in new technology and safety for all users, including underserved populations.

8. **Person(s) Developing the Problem Statement**
   AASHTO Committee on Performance Based Management
   TRB Standing Committee on Performance Measurement, ABC30
   World Road Association’s Technical Committee TC A.1 Performance of Transport Administrations

9. **Nomination for AASHTO Monitor**
   Christos Xenophontos, Assistant Director
   Rhode Island Department of Transportation
   Two Capitol Hill
   Providence, Rhode Island 02903
   401-222-2495, Ext 4400
   christos.xenophontos@dot.ri.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
    Committee on Performance Based Management
    Chair: Russell McMurry, Georgia DOT
    Vice Chair: Christos Xenophontos, Rhode Island DOT

    ***NOTE: This project was ranked number 2 of 3 submitted by the Committee on Performance-Based Management

11. **Submitted By**
    Committee on Performance Based Management
    Chair: Russell McMurry, Georgia DOT
    Vice Chair: Christos Xenophontos, Rhode Island DOT

    ***NOTE: This project was ranked number 3 of 3 submitted by the Committee on Performance-Based Management

---

**NCHRP Review of B-12**

Reviewed By:
B. Ray Derr
rderr@nas.edu
The proposed research is appropriate for the NCHRP and likely to be useful if the scope can be appropriately and tightly defined.

As noted in the literature search summary, there are numerous resources available on performance measures and management and on emerging technologies and more on the technologies are becoming available weekly. The intersection of the two has not been explored as much, except for safety measures. The project scope will need to be limited to that intersection and the deliverables will need to be structured to retain value as the technologies continue to be deployed and evolve. Of the work described under Item 6, "Estimate of Problem Funding and Research Period," the second bolded sentence should be addressed through a very high level review of existing resources and those under development (there are too many efforts to list). The framework described in the third bolded item will be the main deliverable, exploring the linkages between the effects of the various technologies to agency goals and leading performance indicators.

Review Date:
12/7/2018

AASHTO Committee Evaluation for B-12

Submitted By:
Matthew Hardy
AASHTO staff
Performance-Based Management

Comments:
Second priority by the Committee on Performance-Based Management
Problem No: 2020-B-13

1. Problem Title
   Guidebook for Identifying and Implementing Forecasting Techniques for Effective Target Setting

2. Background
   In the Transportation Performance Management (TPM) framework, forecasting of performance is a key element in effective setting of performance targets. In the seven national performance goals defined by MAP-21 and its successive legislation, the established performance measures capture several dimensions of performance, reflect distinct and varied underlying processes that relate actions to outcomes, and are subject to varying degrees of influence by, and interaction with, factors and covariates affecting or driving performance. The forecasting of performance in this diverse context would benefit from techniques that are tailored to each particular context and business process designed to impact outcomes. Whereas asset management systems may be adept and sufficiently developed to predicting performance for pavements and bridges, other performance dimensions such as highway safety and system reliability may require different approaches. Consequently, there is a need to provide guidance to the performance manager in selecting a reasonable and effective approach for forecasting performance that is well suited to the specific performance dimension that is being managed. This need extends beyond specific national performance measures to all performance measures used by transportation agencies to monitor and positively impact outcomes in their sphere of influence.

   Forecasting techniques have been developed in a variety of areas of human activity, in economics, social and natural science, and the technical and engineering fields, and there is an opportunity to draw on general principles to apply an appropriate forecasting methodology to transportation performance measures. The need and opportunity align with Goal 2 of the AASHTO Committee on Performance-Based Management, “Provide Innovative Performance Management Technical Products and Professional Services,” and would be a timely contribution to the second stage of TPM implementation as identified in Government Accountability Office (GAO) Report GAO-17-638; in that report, the second stage is defined as “setting and tracking performance targets (p. 19)” This research need has been developed by the TRB Standing Committee on Performance Management (ABC30) through review of its Triennial Strategic Plan and a solicitation and vetting process finalized at its 2018 mid-year meeting.

3. Literature Search Summary
A review of ongoing transportation research reveals that forecasting is ubiquitous, but each forecasting application is embedded in each transportation research topic. There is no shortage of predictive models, statistical forecasting techniques, and approaches to forecasting. However, there is no comprehensive guide in the field for aligning the variety of forecasting methods to the transportation problems at hand. The forecasting application topic has concerned the science, technology, and management fields for a long time (an example can be found in a Harvard Business Review article, “How To Choose The Right Forecasting Technique, July 1971 available at https://hbr.org/1971/07/how-to-choose-the-right-forecasting-technique). An example of a textbook treating the subject of forecasting science is “Forecasting science in the abstract is treated in textbooks and research papers, such as “Principles of Forecasting – A Handbook for Researchers and Practitioners (Armstrong, J.S. (Ed.), 2001).”

Nevertheless, the research objective of matching forecasting techniques to transportation performance measures (or transportation problems) is not readily available. A guidebook, building on this body of knowledge and including an analysis of the methods used in specific transportation research problems and that are applicable to performance management, would be a significant addition to the set of tools that performance managers could use to effectively set targets for measures that are intrinsically different from one another.

4. Research Objective

The objective of this research is to develop a guidebook for transportation performance managers to identify, select, and implement forecasting techniques that are appropriate for each performance measure. The guidebook should enable performance managers to identify general types of performance measures and pair them with the most promising methodologies for forecasting performance that will help achieve the goal of effective target setting. The guidebook should also treat the subject of secular changes in the phenomena being measured and how to address the impact of these unforeseen changes on the estimation of future outcomes using each of the forecasting techniques.

5. Implementation Planning

Implementation of the guidebook at a state DOT is likely to require start-up assistance in terms of training in categorizing performance measure features in a way that allows selection of appropriate forecasting methodology application. Knowledge transfer vehicles such as peer exchanges, a TRB or other workshop associated with a performance-management or asset-management conference, and interactive or immersive online learning tools could all be considered for this purpose. The guidebook should also contain a step-by-step procedure that can be applied to any performance measure. It would be useful to include an actual forecasting example as a case study so that state DOTs have information about what kind of work is necessary after the guidebook has been used. For this purpose, existing national performance measures could be examined in the latter part of the research.
6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**
   $500,000. This includes two professional staff for the proposed research period, with the remainder envisioned for development of training or knowledge materials, and delivery of the knowledge transfer.

   If the problem statement is selected, the level of funding provided may be adjusted by the AASHTO Special Committee on Research and Innovation.

   **Research Period:**
   24 months

7. **Urgency and Potential Benefits**

   This section should describe the anticipated product and the potential benefits of the research and successful deployment of the results. Explain how your agency as well as other agencies could use and benefit from the research results. Discuss the potential negative impacts if the research described in this problem statement is not funded.

   Appropriate performance forecasting is expected to accelerate the evolution and integration of the TPM framework in the business processes of state DOTs as well as the Federal Highway Administration. Linking outcomes to actions is at the core of performance management. Given that there is a significant body of work in forecasting science, albeit not applied to transportation performance measures, there is an apparent ability to achieve a useful, practical product from this research. State DOTs will be able to prioritize implementation of forecasting techniques as resources and capabilities align.

8. **Person(s) Developing the Problem Statement**

   The following individuals contributed to the development of this problem statement:
   - Edgardo D. Block, Research and Performance Management, Connecticut Department of Transportation, tel (860) 594-2495, edgardo.block@ct.gov.
   - William Johnson, Colorado DOT, will.johnson@state.co.us

   This problem statement was developed based on research needs identified in the AASHTO Transportation Performance Management Research Roadmap, and through regular member feedback on the need to develop greater consistency across the transportation industry with respect to forecasting performance targets.

9. **Nomination for AASHTO Monitor**

   Not assigned

10. **Potentially Interested AASHTO Councils and/or Committees**
NCHRP Review of B-13

Reviewed By:
Lawrence D. Goldstein
lgoldstein@nas.edu

Comments:

The process of establishing performance measures coupled with techniques forecasting performance to meet those measures is a potentially daunting task. The way this research proposal is written is to encompass an extraordinary range of issues for an extensive range of performance forecasting issues. It might be useful if the proposed research could be defined or limited in some way to initiate the process and apply it to test cases that might be more broadly applied in future, additional research. With respect to specific forecasting methods applied to specific classes of assets, considerable work has been done, including detailed studies of traffic forecasting models in the changing context of demands for accuracy, reliability, and reproducibility. A recent NCHRP example is 08-94: Guidelines for Selecting Travel Forecasting Methods and Techniques. This study should be of use if targeted to achievable examples in a more directed and limited application.

Review Date:
12/4/2018

FHWA Evaluation of B-13

Pete Stephanos, HISM-1 - This research is highly supported as transportation organizations need more tools and guidance on forecasting different investment scenarios in order to effectively establish targets. However, recommend that the
objective of the research be rewritten to focus on considerations needed to accurately forecast performance or how to test investment scenarios vs. tying forecasting techniques to a specific performance measure. Nadarajah Sivaneswaran/ HRDI-20 - There is a new 2018 NCHRP 02-27 project "Making Targets Matter: Managing Performance to Enhance Decision-Making" that is in the RFP/source selection phase. There is overlap and synergy between this proposed effort and 02-27 and we suggest this be delayed or combined with 02-27.

AASHTO Committee Evaluation for B-13

Submitted By:
Matthew Hardy
AASHTO staff
Performance-Based Management

Comments:
Third priority by the Committee on Performance-Based Management

Submitted By:
Elizabeth Robbins
Chair
Planning

Comments:
COP's #6 priority: This research should specifically relate to forecasting techniques relevant to measures required by recent federal mandates and consider data issues that have been identified by the state DOTs.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Comments: This request is the top research priority for the Committee on Planning for this research cycle

Problem No: 2020-B-14

1. **Problem Title**

   Snapshots of Planning Practices

2. **Background**

   NCHRP Project 08-36 was established to provide a flexible, ongoing program of quick-response research and development capabilities for states to address near-term improvements in statewide and metropolitan transportation planning, as well as project development processes. NCHRP Project 08-36 completed 138 individual tasks that provided new and/or enhanced technical and policy tools to support planning processes and decision-making systems for the transportation community. In relation to this research statement, the AASHTO Committee on Planning will focus on Task 120’s deliverable.

   Task 120 produced “Snapshots” of planning practices of existing and/or innovative transportation planning practices in the United States. Each Snapshot featured innovative ideas, best practices, links to resources, and contacts for agency use to improve their transportation planning practices and results. Although Task 120 was originally commissioned to produce 4 Snapshots, their value to practitioners was significant to warrant increased funding to the Committee on Planning for more Snapshots within NCHRP Project 08-36. The project and all tasks were completed and finalized in March 2018.

   The Committee on Planning submits *Snapshots of Planning Practices* to continue this proven and valued work as demonstrated in the increased funding award for research under Task 120. This request is the top research priority for the Committee on Planning for this research cycle.

3. **Literature Search Summary**

   The proposed research is intended to build upon published Snapshots completed under Task 120 which are as follows:

   - **Snapshot #1 Freight Planning Today** – Addressed the state of freight planning within agencies. Survey respondents included 29 state DOTs, 31 MPOs, and 20 regional planning organizations.
   - **Snapshot #2 Innovations in Long-range Planning** – Focused on the state of long-range planning in transportation communities. Survey respondents included 20 state DOTs, 37 MPOs.
• **Snapshot #3 Scenario Planning Applications** – Targeted the state of scenario-based transportation planning and future directions. Survey respondents included 16 state DOTs and 2 MPOs.

• **Snapshot #4 Bicycle and Pedestrian Planning** – Featured the state of active transportation planning within agencies. Survey respondents included 31 state DOTs and 99 MPOs.

• **Snapshot #5 Incorporating Transportation Operations with Planning** – Highlighted how agencies are integrating planning and operations functions and how they influence each other. Survey respondents included 22 state DOTs and 58 MPOs.

• **Snapshot #6 Complete Street** – Showcased how agencies address and implement Complete Streets. Survey respondents included 22 state DOTs, 17 MPOs, and 1 COG.

• **Snapshot #7 Crash Data** – Described how crash data is collected, analyzed, and applied in planning from the viewpoint of transportation planners and crash data managers. Survey respondents included 33 state agencies and 27 regional organizations.

• **Snapshot #8 Integrated Planning** – Targeted how transportation, land use, economic development and other planning processes are coordinated between agencies and at different levels of government. Survey respondents included 15 state agencies and 21 regional organizations.

• **Snapshot #9 Lessons from HOV/HOT Conversions** – Featured impacts, lessons, and outcomes of converting existing high occupancy vehicle (HOV) facilities to high occupancy tolled (HOT) lanes. Survey respondents included 13 state transportation agencies and 2 state tolling authorities.

• **Snapshot #10 Risk and Resiliency Planning** – Explored how agencies account for changing weather patterns and associated risks through the planning process. Eighty-five responses were collected from 35 state DOTs and 1 MPO with some agencies submitting multiple responses.

• **Snapshot #11 Connected and Automated Vehicles** – Showcased how agencies are planning for connected and autonomous vehicles. Eighty responses were received from state DOTs, MPOs, and other regional agencies with some agencies submitting multiple responses.

• **Snapshot #12 Complete Street and Multimodal Implementation** – Focused on how agencies address and implement Complete Streets. Survey respondents included 26 DOTs, 31 MPOs, 5 regional planning agencies, and 2 tribal governments.

The Snapshot Database can be accessed via: [http://www.planningsnapshots.camsys.com/](http://www.planningsnapshots.camsys.com/)

4. **Research Objective**

The objective of this research is to produce Snapshots of planning practices to present relevant information in the form of concise summaries of current and/or innovative transportation planning practices currently in use in the United States. Transportation agencies will use Snapshots to help improve their own practices and results. The Snapshot topics chosen will represent a variety of topical subjects including practical solutions to current technical challenges,
responses to legislation or administrative rules, organizational designs used by agencies to accomplish their work, means of influencing agency decision-making, etc. To accomplish this objective, the proposed project will:

- Identify relevant topics for research.
- Determine set of survey techniques, tools, and content that can be used to analyze the topic.
- Distribute survey to planning practitioners within transportation agencies.
- Analyze results and summarize data into Snapshots.
- Publish Snapshots to the Snapshot Database for dissemination to survey respondents and partner organizations.

5. **Implementation Planning**

   The specific target audience of this research project will be State DOTs, MPOs, COGs, regional planning organizations, tribal governments and other agencies. The Snapshots will be published online and distributed to the survey respondents and partner organizations. Additional implementation activities for consideration are printed pamphlets, Snapshot specific peer exchanges, and webinars.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding**: $300,000
   
   - The requested funding will support 12 Snapshots with $25,000 dedicated for each Snapshot.

   **Research Period**: 42 months
   
   - Snapshots will be produced quarterly over a 3-year period. An additional 6 months is budgeted for reviews.

7. **Urgency and Potential Benefits**

   **Benefit**: The proposed research will be of immediate value to transportation agencies because it will yield actionable practices that planning stakeholders can immediately use to enhance the development of programs. Snapshots will identify and fill knowledge gaps, share creative and innovative ideas, enable better decision-making, boost agency efficiency and create a collaborative culture amongst the transportation community nationwide.

   **Negative**: The lack of knowledge sharing between planning practitioners can hinder innovation and program enhancements. Furthermore, planning practitioners will lack the opportunity to submit quick-response research whose results affect near-term challenges.

8. **Person(s) Developing the Problem Statement**

   Elizabeth Robbins, Manager, Planning Policy Innovations and Partnerships
   Washington State Department of Transportation
   Chair – Subcommittee on Research
   360.705.7371
9. Nomination for AASHTO Monitor
   Elizabeth Robbins, Washington State Department of Transportation

10. Potentially Interested AASHTO Councils and/or Committees
    - Committee on Planning

11. Submitted By
    AASHTO Committee on Planning
        Chair: Scott Bennett, Arkansas DOT
        Vice-Chair: Tim Henkel, Minnesota DOT
        Research Subcommittee Chair: Elizabeth Robbins, Washington State DOT

    ***NOTE: This project is ranked number 1 of 2 submitted by the Committee on Planning.

NCHRP Review of B-14

Reviewed By:
Lawrence D. Goldstein
lgoldstein@nas.edu

Comments:

This proposed research effort is a follow-on to the earlier 08-36 Task 120 studies that proved popular in the industry. Extending the research appears to be a desirable addition to that previous work. The danger that needs to be avoided is to provide more than a shallow summary of an existing issue, adding something unique to the planning process that has some longevity and value.

Review Date:
12/4/2018

AASHTO Committee Evaluation for B-14

Submitted By:
Elizabeth Robbins
Chair
Planning
Comments:
COP's highest priority.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline  
Problem No:  2020-B-15

1. Problem Title  
Incorporating Resilience Concepts and Strategies in Transportation Planning Efforts

2. Background

This problem statement reflects research gaps identified as part of the NCHRP 20-117 project as well as findings from the RISE Summit held in October 2018. Most resilience efforts on the part of state departments of transportation (DOTs) are found in emergency response and to some extent in project design (for example, design exceptions when the context makes a different design appropriate). However, several presentations at the RISE Summit showed the importance of considering resilience efforts in planning efforts in order to set the overall direction of how resilience can be considered throughout the project development process. Corridor studies from Oregon, Colorado and Utah illustrated how corridor-based resilience planning provided direction to potential designs, operations and maintenance. In addition, other state DOTs, such as the Michigan DOT, are examining how resilience concepts could be included in statewide transportation planning. And yet a few others, such as Caltrans, are conducting resilience studies through its planning division. The purpose of this research is to provide more in-depth research on the topic of resilience and transportation planning that can be included in the Resilience Guidebook that is being produced by the NCHRP 20-117 project.

3. Literature Search Summary

A TRIS/TRID literature review was conducted on the topic of resilience and transportation planning. Very few publications and on-going research projects were found. Several publications were found that related to network modeling and how resilience could be represented in demand modeling efforts.\(^1\) The focus of these articles and publications was on the technical aspects of planning; very little attention was given to how resilience could be integrated into the overall transportation planning process, and how higher levels of transportation planning

---

(e.g., statewide planning) could be linked to planning at smaller scales (e.g., corridor planning).

A similar result was found when examining research in progress. The NCHRP Project, Transportation System Resilience: CEO Primer & Engagement, 2017 (ongoing) includes some aspects of what CEOs should be considered throughout the decision-making process, including the transportation planning process. However, the level of detail associated with the Primer is not sufficient for inclusion in the Resilience Guide. Caltrans has sponsored "Introducing Resilience into the State Transportation Network," that has examined transportation decision making, but again this examination has been at a fairly high level.

Information Systems Audit and the Control Association and other sources that can be used to create cyber resilience metrics.

Many of the studies that have been conducted on system resilience to natural disasters, extreme weather events and climate change have focused on conducting separate vulnerability assessments and/or identifying strategies for protecting or at least mitigating the negative effects of system disruptions due to such causes. Very little effort has examined the linkage between the different components of transportation planning and system resilience factors….and there are many different aspects of the transportation planning and programming process where resilience factors could be considered.

If one considers the many different aspects of how resilience into transportation planning (see figure 1), there is no research that has examined these different components of the planning process.

![Figure 1: Different Levels of Commitment for Incorporating Resilience into Transportation Planning](image)

The FHWA has sponsored several efforts that examine the relationship between resilience and transportation planning. These efforts have been at a very high level and not specific enough to include in the Resilience Guidebook. There is a need to provide very detailed and specific advice to state DOTs on how resilience can be integrated into different aspects of transportation planning.
4. **Research Objective**
   The purpose of this project is to develop specific guidance on how resilience concepts can be incorporated into transportation planning efforts at all scales of application. The intent is to integrate the research results into the Resilience Guidebook being developed by the NCHRP 20-117 project. It is expected that the research will look at different types of state DOT planning efforts, such as statewide planning, modal planning and corridor planning, and how resilience could be integrated into such efforts.

5. **Implementation Planning**
   The incorporation of the research results will be included in the Research Guidebook, and thus the results will be implemented via the outreach efforts as part of the Guidebook rollout.

6. **Estimate of Problem Funding and Research Period**
   **Recommended Funding:** $120,000
   **Dissemination Funding:**
   **Research Period:** 1 Year

7. **Urgency and Potential Benefits**
   It was clear from the RISE Summit that some of the most comprehensive efforts at considering resilience at a systems level occurs in state DOT planning efforts.

8. **Person(s) Developing the Problem Statement**
   Kim Avery
   Bureau of Field Services Director
   Michigan Department of Transportation
   269-337-3910
   Averyk@michigan.gov
   Timothy Sexton
   Chief Sustainability Officer
   Minnesota Department of Transportation
   651-366-3622
   Timothy.sexton@state.mn.us

9. **Nomination for AASHTO Monitor**
   Timothy Sexton
   Chief Sustainability Officer
10. **Potentially Interested AASHTO Councils and/or Committees**
   Committees on Planning and Performance Based Management

11. **Submitted By**

    Michael P. Lewis
    Executive Officer
    Colorado Department of Transportation
    303-757-9201
    michael.p.lewis@state.co.us

---

**NCHRP Review of B-15**

Reviewed By:
Stephan A. Parker
saparker@nas.edu

Comments:

As noted in the FHWA evaluation, "FHWA is finalizing case studies and a handbook on Integrating Resilience into the Transportation Planning Process, both of which should be available in early 2019. These new FHWA resources target both State DOTs and Metropolitan Planning Organizations."

The panel has not yet received a draft of the Resilience Guide being developed under NCHRP 20-117. It may be worth having resources already reserved for follow-on work before the Guide is evaluated by the panel.

Review Date:
12/12/2018

---

**FHWA Evaluation of B-15**

Heather Holsinger/HEPN - Incorporating resilience into the transportation planning process is an important emerging issue, and existing research into the topic is somewhat limited. The proposed research would look at different types of State DOT planning efforts, such as statewide planning, modal planning and corridor planning, and
how resilience could be integrated into such efforts. If this research does generate very
detailed and specific advice to State DOTs, it would be a welcome addition to the
literature overall, and more specifically to the Resilience Guidebook that is being
produced by the NCHRP 20-117 project. It is important to note that FHWA has
developed a white paper that provides a baseline level of understanding of how DOTs
and MPOs are already beginning to integrate resilience into their long-range plans and
programming documents. In addition, FHWA is finalizing case studies and a handbook
on Integrating Resilience into the Transportation Planning Process, both of which
should be available in early 2019. These new FHWA resources target both State DOTs
and Metropolitan Planning Organizations.

AASHTO Committee Evaluation for B-15

Submitted By:
Eric Kopinski
AASHTO Staff
Committee on Transportation System Security and Resilience (TSSR)

Comments:
This problem statement rated the highest for AASHTO's Committee on Transportation
System Security and Resilience.

Submitted By:
Matthew Hardy
AASHTO staff
Performance-Based Management

Comments:
This submission is supported.

Submitted By:
Elizabeth Robbins
Chair
Planning

Comments:
COP's #2 priority: This research should incorporate the results of NCHRP 08-36 Task
146.
1. Problem Title
Synthesis of Recent Active Transportation Related Research and Creation of Research Roadmap for Council on Active Transportation (NCHRP 20-123)

2. Background
In November 2016, the AASHTO Board of Directors adopted a new committee structure for the organization that included creating the new Council on Active Transportation (Council) in the Transportation Policy Forum model area. Active transportation includes bicycle and pedestrian travel modes and the formation of the new Council shows the importance of including these non-motorized users throughout future AASHTO documents as the organization moves forward. The new Council has since met twice and adopted a strategic plan for 2018-2021 and an action plan for 2018-2019 that includes many start-up type activities, coordination efforts, and deliverables necessary for a successful AASHTO Council.

Research is a key component for the Council’s action plan and strategic plan. Many aspects of multi-modal transportation have rapidly progressed in recent years and the Council is looking for more focused guidance on research needs and priorities to investigate in the form of a Research Roadmap. However before the Council can do that, a white paper (or Literature Review) of recently published research on active transportation (pedestrian, bicycle and related transportation connections) is necessary to define a starting point for the Research Roadmap. This problem statement aims to combine those two efforts to set the Council up for success in the coming years.

3. Literature Search Summary
Authors searched the Transportation Research Information Database (TRID), Research in Progress Database (RIP), as well as TRB Snap Searches for the following topics: Pedestrian & Bicycle (7/9/18); Planning & Forecasting (5/22/18). The Council anticipates these sources will be thoroughly used during the research synthesis effort.

4. Objective
- A White paper (or Literature Review) should summarize relevant recent research (latest 3 years) of active transportation topics. The topics should include, but are not limited to: safety, data, equity, quantifying the benefits of active transportation, communication, policy, network analysis, accommodating all users within the Rights-of-Way, design, and traffic.
Gaps in research would be identified to develop the next deliverable: the Research Roadmap for the Council.

- The Research Roadmap would provide focused research recommendations for the Council to prioritize related to implementing active transportation elements into AASHTO publications and Departments of Transportation policies, practices, and infrastructure for the coming years. The work will align with the Council’s Strategic Plan as well as compliment conclusions arising from the White Paper discussed above. The Roadmap would include a timeline of recommended research activities (new research, existing research needing further study, research ready for implementation, and research to monitor) for the Council to include in the following action plan. The Roadmap may involve coordinating with other AASHTO committees on subjects and recommendations to limit overlap or redundancies.

5. Implementation Planning
Presentation(s) via webinars would be an efficient way to disseminate the results and recommendations. Reports for web posting and referencing are also necessary.

6. Estimate of Problem Funding and Research Period
Recommended Funding:
$350,000 ($250,000 for 12 months of 1 professional staff; $50,000 for reporting and dissemination, $50,000 for meetings)

Research Period:
12 months (8 months of investigation and report writing, 2 months for review, 2 months for interim report reviews and meetings)

7. Urgency and Potential Benefits
This research is necessary to guide the new Council for all research related activities including submissions, review of new AASHTO publications, and review of other committee reports/submittals. The Council requires this effort to advance 3 out of 6 goals in the adopted Strategic Plan.

8. Person(s) Developing the Problem Statement
Anna Bosin, AASHTO Fellow/AK DOT&PF
444 N. Capitol Ave NW
Washington, DC 20001
(202) 624-7800

9. Nomination for AASHTO Monitor
Anna Bosin, AASHTO non-voting member of Council on Active Transportation

10. Potentially Interested AASHTO Councils and/or Committees
11. Submitted By

Provide contact information for individuals submitting or supporting this problem statement. If an organization, e.g., an AASHTO committee, is listed, include the name and contact information for an individual associated with the organization.

Council on Active Transportation
Shannon Eggleston, AASHTO Liaison
444 N. Capitol Ave NW
Washington, DC 20001
(202) 624-3649

NCHRP Review of B-16

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The problem statement describes activities and objectives that fit well with the charge to the 20-123 panel, which will make funding allocation decisions for proposed activities to support AASHTO Councils and Committees.

The approach should produce a well-considered set of recommendations for the research, as well as provide an opportunity for the Council on Active Transportation to strengthen their connections with other AASHTO Committees and Councils. This will be particularly relevant to improve coordination within AASHTO for efforts to develop and maintain guidance documents.

The White Paper will be an important element in informing the roadmap and other Council activities. There may be value in not strictly limiting the review to the latest 3 years of research as there are likely seminal papers that continue to have value for a current roadmap. A mechanical approach to searching the literature by a narrow publication date range may artificially constrain the roadmap to 'hot topics' that have limited value over time or may lead to recommendations that will replicate older existing studies.

Review Date:
11/19/2018
FHWA Evaluation of B-16

Gary Jensen/Shari Schaftlein/HEPH - Research updates are provided during the FHWA liaison portion of the CAT meetings. Despite updates to AASHTO Bike and Ped Guides, all parties recognize there are still gaps associated planning and design gaps. For the literature review, the proposal should consider recent and ongoing FHWA resources (See https://www.fhwa.dot.gov/environment/bicycle_pedestrian/resources/trb_summaries/) For the White Paper, recommend considering connectivity/accessibility, performance management, the importance of active transportation in complete trips and the impacts of automation on active transportation. Coordination of the Roadmap with other organizations performing research on active transportation will be essential to avoid duplication, and the proposal should include a coordination/collaboration task.

AASHTO Committee Evaluation for B-16

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This submission has strong support and is the highest ranked submission from Council on Active Transportation Members surveyed.

Submitter Response for 2020-B-16

From: [email: seggleston@aashto.org] Anna Bosin (Abosin@aashto.org)

Comments: AASHTO has reviewed the comments received by NCHRP and FHWA related to the proposed research needs statement 2020-B-16 and discussed it with Council on Active Transportation Steering Committee members. Thank you for the input and we agree to include the recommended additional FHWA resources as listed as well as include topic areas: 1) connectivity/accessibility, 2) performance management, 3) the importance of active transportation in complete trips and 4) the impacts of automation on active transportation into the White Paper developed as part of this project. We will coordinate as much as possible with other organizations performing similar research by reviewing TRID for active projects in the topics areas as well as
communicating throughout the project with other AASHTO committees/councils and non-AASHTO affiliated organizations we conduct business with during the timeline. As a new Council, we recognize it is important to not duplicate research efforts by reaching as far and wide as possible (and can include beyond the initial 3-year window of published research) to complete a well thought out roadmap for future work. At the same time, we want to be cognizant that this effort needs to be completed as soon as practical to keep our strong initial momentum as a new Council moving forward. The AASHTO panel member assigned to this project will stay actively engaged to keep the Council apprised of the project's milestones.

AASHTO will revise the NCHRP problem statement to reflect these changes requested.

Contact Info:
Shannon Eggleston,
seggleston@aashto.org
202-624-3649

Anna Bosin, P.E.
AASHTO Fellow-Alaska DOT&PF
202.624.7800

Review Date: 11/19/18
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Problem No:  2020-B-17

Problem Title:  Best Practices in determining rural transit fleet size – How to provide service for changing demographics of rural ridership (Right-sizing of rural transit fleets).

Statement of the Research Problem

Finding the right size of a rural public transit fleet is a significant challenge for rural public transit agencies. These providers must accommodate riders with varying needs at different hours during the day and in varying quantities. For example, Medicaid’s integrated setting rule helped move persons with disabilities out of sheltered workshops and into employment settings and integrated throughout the community. Many rural public transit agencies offer employment or medical shuttles from one community to another.

As a result, the need of more varied vehicle sizes is becoming more prevalent. Rather than the typical 18 passenger light duty bus, a standard transit bus size among rural transit providers, these transit agencies must consider vans with less capacity or medium-sized buses with higher seating counts. The decision over which size bus to purchase is agonizing for small, rural transit agencies since funding for replacement vehicles is so limited. And when replacement vehicle funding is available from the Federal Transit Administration, the decision remains difficult since local matching funds are required. Another factor weighing into this decision is the length of time a vehicle will be a part of a rural transit agency’s fleet. Many of the vehicles procured by rural public transit agencies are kept two to three times past their federal useful life before replacement funds are available, meaning the size vehicle chosen has to be useful well into the future.

It is vital for rural transit agencies to know how to “right-size” their transit fleets giving changing demographics of rural ridership. State departments of transportation, the funding sources for many of these rural transit agencies, would benefit from understanding what the best practices are from other states about determining rural transit fleet size, to help assist its own transit providers.

Literature Search Summary

During this literature search, the following three citations with summaries were discovered in relation to determining rural transit fleet size:

- Research for the AASHTO Standing Committee on Public Transportation. Task 73. Best Practices and Marketing to Increase Rural Transit Ridership and Investment.
The objective of this research is to produce a Best Practices Guide that will cover the interconnected topics of practices to: (1) increase rural transit ridership; (2) practices for measuring the Return-On-Investment (ROI) of rural transit investment and (3) practices to communicate (market) the importance of rural transit investment.

- **Ngo, Huan Hoang; Shah, Rohan; Mishra, Sabyasachee.** Multicriteria Mixed Transit Fleet Resource Allocation. Transportation Research Board 97th Annual Meeting, 2018, 6p Summary: Agencies and policymakers are often challenged with equitable and optimal allocation of funds among transit agencies for not just regular operations and maintenance, but also for active fleet management including purchase of new buses and rehabilitation of aging fleet. The paper models a hierarchical structure of resource allocation where federal support for such fleet management is routed through the state, and ultimately to local transit agencies.

- **Tang, Li; Gan, Albert; Cevallos, Fabian; Alluri, Priyanka.** Characteristics of Bus Transit Vehicles in the United States: A 30-Year National Trend Analysis. Transportation Research Record: Journal of the Transportation Research Board, Transportation Research Board, 2018, 11p. Summary: In 2015, transit agencies in the United States spent over 60% of their bus transit capital funds on their revenue vehicles. Using 30 years of data from the National Transit Database (NTD), this paper examines the national trends of seven major characteristics associated specifically with bus revenue vehicles. These trends can provide important information on where the market might be heading and aid in planning decisions on transit investments. The characteristics examined include the number of vehicles, spare ratio, average age, average capacity, Americans with Disabilities Act (ADA) accessibility, vehicle reliability, and vehicle operations and maintenance expenses.

This research, previously mentioned, is truly valued by the rural transit community. However, this proposal would complement the previously mentioned research and move it a step further by addressing the issue of changing demographics and the difficulty transit providers are faced with to procure the appropriate sized vehicles, to provide current level of service and to anticipate additional or declines in ridership in the future.

**Research Objective**

The objective of this research is to determine the best practices from the perspective of state departments of transportation and transit providers about how changing demographics and policies (federal public transportation and health care-related policies) are affecting decisions to procure vehicles and what vehicles (size and capacity) are eventually purchased by rural public transit systems to meet these ever-changing needs. And more importantly, what are the costs associated with these decisions.

**Implementation Planning**
Some of the specific Tasks that could be a part of this work include (but not limited to):

1. Collecting and analyzing data from the 2010 Census and the Household Travel Survey to determine demographic changes in rural communities.
2. Survey state departments of transportation and FTA Section 5311 transit providers about procurement practices for vehicles.
3. Selectively interviewing stakeholders and developing case studies based on interviews.
4. Developing recommendations for best practices for state departments of transportation and rural transit providers.

**Estimate of Problem Funding and Research Period**

**Recommended Funding:** $250,000

**Research Period:** 18 months

**Urgency and Potential Benefits**

This research provides significant benefits for transit offices of state departments of transportation and their transit providers and will help answer these pressing industry questions:

1. How demographic changes are affecting vehicle procurement decisions;
2. How policy (federal public transportation and health care-related policies) changes are affecting vehicle procurement decisions;
3. What types of vehicles are procured and the reasons for those procurements;
4. What are the costs associated with those procurements; and
5. What lessons are learned from this process?

**Person(s) Developing the Problem Statement**

Kristin Haar, Compliance and Training Officer, Office of Public Transit, Iowa Department of Transportation

**Nomination for AASHTO Monitor**

**Potentially Interested AASHTO Councils and/or Committees**

- Standing Committee on Performance-Based Management

**Submitted By:** Council on Public Transportation

Contact(s):
NCHRP Review of B-17

Reviewed By:
Stephan A. Parker
saparker@nas.edu

Comments:

There are several research problems posed in this candidate problem statement, including selecting the appropriate sizes for individual vehicles, identifying the appropriate size of an overall fleet, and optimizing the fleet mix. Many of the topics are covered in discrete reports such as TCRP Synthesis 41, The Use of Small Buses in Transit Service (2002) http://onlinepubs.trb.org/onlinepubs/txrp/tsyn41.pdf and in more comprehensive reports such as the "Fleet Mix Characteristics" chapter in the Texas Transportation Institute-authored Texas DOT Guidebook: Managing Operating Costs for Rural and Small Urban Public Transit Systems (2014) https://groups.tti.tamu.edu/transport-mobility/files/2014/05/GUIDEBOOK-REVISED-0415-Final.pdf. The "guidebook is a resource for rural and small urban transit agency managers to use in better understanding, predicting, and managing operational costs. Doing so can improve the efficiency, effectiveness, and sustainability of public transit in the community served.

The guide is a framework for assessing current transit agency operating costs and tools to predict future costs and is presented in three parts. Part 1 introduces the fundamentals of transit operating costs and discusses what drives them. Using real-world examples, part 2 looks at the impact of component costs on an agency’s bottom line to help managers prioritize where to optimize spending to get the biggest bang for their buck. Part 3 provides practical tools to help managers allocate costs by service type and conduct market analyses to improve services offered consumers."

Related work includes TCRP Report 161: Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation.

Getting to the details in the candidate problem statement, though, the focus might be more on small bus procurement policies and practices. That is work that would be very timely and relevant, perhaps appropriate for off-cycle funding as the climate is
Conducive to identifying potential policy alternatives for changing small bus procurement requirements.

Review Date:
12/12/2018

Submitter Response for 2020-B-17

From: Richard Price on behalf of Kristin Haar, Iowa DOT

Comments:
The reviewer seems to think we want a study of small bus procurement practices. That is not the case. Procurement procedures is not the issue. Also, operational costs is not the issue. Knowing how to select the appropriately sized vehicle to be utilized for many years into the future is the problem. Select something too large and you risk running it nearly empty with the public seeing an empty bus driving around and criticizing the transit system's efficiency. Select something too small and you may need to send multiple vehicles and drivers to a single stop to accommodate all passengers. Having guidance or a tool on how best to select the right size vehicle with limited funding is what is needed.

Contact Info:
Kristin Haar
Compliance and Training Officer, Office of Public Transit
Iowa Department of Transportation
Kristin.Haar@iowadot.us

Review Date: 1/21/2019
Problem No:  2020-B-18

Problem Title:  Best Practices on Transit Options for Discharged Patients from Healthcare Providers

Statement of the Research Problem

Health care providers are pressured to discharge patients expeditiously and patients are released from hospitals and other medical facilities at all hours of the day and night. For transit-dependent population groups (e.g. low income, seniors and disabled), it can be difficult to provide timely trips home when they are discharged. This is especially challenging when discharges occur at night or weekends in more rural communities when conventional public transit service may not be available.

Private transportation such as taxis or transportation network companies (e.g. Uber or Lyft) may be options but they do not always have accessible vehicles available for individuals who use wheelchairs. Moreover, the matter of who pays for the service is an issue.

Literature Search Summary

During this literature search, the following citations with summaries were discovered in relation to best practices on transit options for discharged patients from healthcare providers:

- **Guidebook and Research Plan to Help Communities Improve Transportation to Health Care Services.** [Project]. Transit Cooperative Research Program, Federal Transit Administration. Start Date: Oct. 01, 2017. Summary - The objectives of this research are to: (1) Develop a guidebook to help communities improve transportation to health care. The guidebook should serve three important audiences—the healthcare sector, the transportation sector, and other stakeholders—and help them lay the foundation for building effective relationships to improve customer-focused mobility services.

- **Improving the Safety, Health, and Productivity of Transit Operators Through Adequate Restroom Access.** [Project]. Transit Cooperative Research Program, Federal Transit Administration. Start date: 2 Feb. 2017. **Summary** - The objective of this research is to develop resources that include implementable strategies that address how to improve restroom access for transit operators.

- **Transportation to Dialysis Centers: Health/Transportation Policy Intersection.** [Project]. Transit Cooperative Research Program, Federal Transit Administration. Start date: 3 Dec. 2016. **Summary** - The objectives of this research is to quantify
the current and projected demand and associated costs of transportation for kidney dialysis in the United States and identify current effective practices and new strategies for funding and providing transportation for dialysis.

- Papaioannou, Dimitrios; Nicolas, Wagner. Measuring Access to Healthcare and Education by Car and Public Transport in 18 Cities Across the World. Transportation Research Board 97th Annual Meeting, 2018, 14p Summary - This paper showcases an approach to measure accessibility to healthcare and education amenities by public transport and car in 18 cities from all over the world.
- Lee, Jinhyung; Miller, Harvey J. Measuring the Impacts of New Public Transit Services on Space-Time Accessibility. Transportation Research Board 97th Annual Meeting, 2018, 21p Summary – This study analyzes whether these new public transit services will change residents’ accessibility to job and healthcare in an underserved neighborhood of Columbus.

This research, while successful at addressing a unique problem, does not address the research included in this proposal. In this research proposal, the focal point is specifically on public transportation availability and options for discharging patients and determining payment responsibility, an often overlooked aspect of non-emergency medical transportation or NEMT.

Research Objective

The objective of this research is to analyze the factors contributing to this issue, assess the prevalence and identify best practices from across the country. Other factors to consider include payment responsibility and determine who is responsible for payment – the health care providers, the transit system, an assisted living facility, the individual or perhaps a combination of the parties. Research efforts could include case studies of transportation – healthcare provider relationships that successfully manage this situation.

Implementation Planning

Aside from the final report, state DOTs would benefit from example agreements or language that could be shared with local communities. This could be in the form of written templates of agreements between transportation operators, healthcare providers, managed care providers and long-term care organizations. The intent would be to have a model(s) that could be easily disseminated and adopted in different locations across the country.

Estimate of Problem Funding and Research Period

Recommended Funding: $250,000

Research Period: 18 months.

Urgency and Potential Benefits
Transportation for discharged patients is an emerging issue and will continue to grow as the population continues to age. More and more individuals will be moving to assisted living facilities and these organizations are often not prepared to handle return trips for their clients. However, the issue is not limited to the elderly as low-income individuals and those who have limited mobility due to a long or short-term disability may struggle to use existing transit services or may not yet be qualified for paratransit service.

Benefit exists for state DOTs and transportation systems that are expected to address these transportation needs but are not readily equipped to do so. Community leaders, advocacy groups and other entities look to transit operators to address the issue but the solutions may not be apparent.

Person(s) Developing the Problem Statement

Ian Ritz, Transit Section Chief, Wisconsin Department of Transportation, 608-266-0189, ian.ritz@dot.wi.gov

Nomination for AASHTO Monitor

Potentially Interested AASHTO Councils and/or Committees

- Standing Committee on Environment
- Standing Committee on Human Resources

Submitted By: Council on Public Transportation

Contact(s):

Shayne Gill, Program Director for Multimodal Transportation
Council on Public Transportation
Phone#: (202) 624-3630
Email: sgill@aashto.org

Richard Price, Program Specialist
Multi-State Transit Technical Assistance Program (MTAP)
Phone #: (202) 624-5813
Email: rprice@aashto.org

NCHRP Review of B-18
Reviewed By:
Gwen Chisholm-Smith
gsmith@nas.edu

Comments:

Dianne Schwager:

This problem merits additional research to (1) illuminate the nature and complexity of challenges associated with providing transportation to patients from healthcare providers and (2) identify possible strategies for providing appropriate mobility options for discharged patients and paying for them. There is interest in at least 2/3 of the DOTs since all states face these challenges which effect the most disadvantaged residents in all states (i.e., people who are low income, elderly, and/ or disabled.) The objective (and title) could be improved by broadening the focus to address a range of on transportation options for discharged clients from healthcare providers. Not all healthcare trips can or should be served by public transit and there are a variety of options merit consideration. The scope should be modified as suggested above; the budget is adequate. Additionally this research should address relationships between funding and requirements for transportation and those of Medicare and Medicaid, promulgated by DHHS. TCRP B-45, Dialysis Transportation: The Intersection of Transportation and Healthcare (completed) and TCRP H-55, Guidebook and Research Plan to Help Communities Improve Transportation to Health Care (underway) address a range of issues pertaining to transportation for clients of healthcare . Both would be excellent resources for the proposed project. This is a problem that has not been adequately addressed and is likely to increase in importance. This is a worthy topic that deserves more research.

Review Date:
12/12/2018

FHWA Evaluation of B-18

Wesley Blount/HEPH, Victoria Martinez/HEPN - The proposal may want to consider how automation may play into this effort If this was to move forward, FTA would need to be involved. This is a complicated issue with multiple players (DOT, VA, HHS, State and local agencies, etc.) that are currently trying to address this problem that has multiple perspectives (e.g., filling perscriptions on the way home).

Submitter Response for 2020-B-18

From: Richard Price on behalf of Ian Ritz, Wisconsin DOT
Comments:
Thank you for the feedback about the 2020-B-18 Best Practices on Transit Options for Discharged Patients from Healthcare Providers problem statement. The comments about broadening the scope of the project to include more stakeholders and address the range transportation options available for discharged patients are valid. Public transit systems are not always the most appropriate option but communities often expect transit to provide this service and individuals may not be aware of other options. At the federal, state and local levels transportation, healthcare (i.e. Medicaid and Medicare) and veterans programs often are implemented independently of each other despite commonalities in the types of individuals who participate in the programs. For example, transit dependent populations such as low income or disabled individuals may also participate in Medicaid or Medicare programs. Coordination among stakeholders has been promoted but further analysis of the funding, purpose and eligibility requirements of these programs is a natural extension under this research topic. Further, apart from existing public entities, it is necessary to explore how private transportation options and emerging technology may be utilized to fill in the service gaps

Contact Info:
Ian Ritz
Transit Section Chief
Wisconsin Department of Transportation
608-266-0189
ian.ritz@dot.wi.gov

Review Date: 1/21/2019
Statement of the Research Problem

Public transportation has long been the mobility alternative to single occupancy vehicles, offering a consistent and reliable method of ridesharing. However with the rise of private sector ridesharing companies and multimodal transportation options increasing, the interplay between traditional models and innovative approaches is critical to research, address, and engage with, in order to create a seamless transportation network that meets the mobility needs for all riders.

Online and phone mobility apps are becoming increasingly available in small urban and rural communities to help people find the best commuting option to shopping, appointments, recreation, employment, and other destinations. These apps make it easy to find the best transit route, locate a park and ride lot, map your trip, or even find a commuting partner based on your work schedule or neighborhood.

However, many small urban and rural communities lack these online tools, leaving commuters, especially those without automobiles, to navigate the complexities of the transit systems in these areas, highlighting the needs to research solutions to the existing gap in transportation coordination amongst the growing options.

Literature Search Summary

During this literature search, the following five citations with summaries were discovered in relation to best practices in coordination of public transit and ride sharing:

- Research for the AASHTO Standing Committee on Public Transportation. Task 76. Opportunities for State DOTs (and Others) to Encourage Shared Use Mobility Practices in Rural Areas. [Project]. National Cooperative Highway Research Program, AASHTO, Federal Highway Administration. Start date: 23 Apr. 2018. Summary - The research objective is to generate information that State DOTs and others, including rural transit, planning and/or economic development agencies, could make use of to advance selected shared use mobility practices as a method to extend the reach or capacity of small urban and rural transit services, with a significant focus on rural areas.

- Collaborations and Partnerships between Public Transportation and Transportation Network Companies (TNCs). [Project]. Transit Cooperative Research Program, Federal Transit Administration. Start date: 28 Sep. 2017. Summary - This research should provide a thorough and objective assessment,
with practical, relevant examples, to enhance understanding and to facilitate informed decision making on whether, when, and how collaborations and partnerships between public transportation and TNCs should be considered and pursued.

- Feigon, Sharon; Murphy, Colin. Broadening Understanding of the Interplay Among Public Transit, Shared Mobility, and Personal Automobiles. TCRP Research Report, Issue 195, 2018, 94p. Summary - This report extends the research presented in TCRP Research Report 188. It broadens understanding of the interplay between emerging and established modes of transportation by further exploring how shared modes, particularly transportation network companies, are being incorporated into the mix of transportation options.

- Feigon, Sharon; Murphy, Colin; McAdam, Taylor. Private Transit: Existing Services and Emerging Directions. TCRP Research Report, Issue 196, 2018, 71p. Summary - This report provides an overview and taxonomy of private transit services in the United States, reviews their present scope and operating characteristics, presents three case studies, and discusses ways private transit services may affect the communities in which they operate.

- Alemi, Farzad; Rodier, Caroline. Simulation of Ridesourcing Using Agent-Based Demand and Supply Models Regional: Potential Market Demand for First Mile Transit Travel and Reduction in Vehicle Miles Traveled in the San Francisco Bay Area. Transportation Research Board 97th Annual Meeting, 2018, 3p. Summary - Authors used existing modeling tools and data from the San Francisco Bay Area (California) to understand the potential market demand for a “first” mile transit access service and possible reductions in vehicle miles traveled (and thus GHGs) at both the regional and station level.

**Research Objective**

The objective of this research is to document the available online apps to help ease commuter access to public transit and allow for improved mobility in their communities. In order to advance this area of transportation knowledge, it is important to identify what existing resources are currently available and if/how the private industry is interacting and partnering with the public sector in coordinating mobility services.

**Implementation Planning**

The support needed to successfully implement this research project include a thorough report out of the findings and areas of opportunity that exist between ridesharing companies and public transportation. Brochures and marketing materials would enhance the ability to implement the findings to multiple stakeholders, from the private industries, public transit companies, to legislatures and decision makers. Examples and case studies will be very beneficial in demonstrating the potential effectiveness of duplicating mobility models that have been successful in other rural areas.

**Estimate of Problem Funding and Research Period**

Recommended Funding: $250,000
Research Period: 18 months

Urgency and Potential Benefits
As one of the Idaho Transportation Department’s (ITD’s) core mission statements, “Your Mobility”, researching and understanding the opportunities to coordinate public transportation with other ridesharing mobility options directly ties back to the focus areas in this state.

The research timeframe and funding amount are adequate to meet the intended outcomes, and there are no existing barriers to having this accomplished.

ITD, along with other state DOTs around the country, are eager to take the results of this study and look for opportunities for increased coordination amongst private ridesharing companies and the public transportation systems. As the mobility needs are changing, and the gap in design between rural transportation and urban transportation increasing, we are at a critical juncture in need to innovative solutions. The outcomes that this project will offer will be able to be implemented in the form of marketing efforts, outreach strategies, and provide data and analysis to bring together multiple stakeholders with a common goal.

Person(s) Developing the Problem Statement

➢ Kim McGourty, Public Transportation Manager, Idaho Transportation Department

Nomination for AASHTO Monitor

Potentially Interested AASHTO Councils and/or Committees

• Standing Committee on Transportation System Operations

Submitted By: Council on Public Transportation

Contact(s):

Shayne Gill, Program Director for Multimodal Transportation
Council on Public Transportation
Phone #: (202) 624-3630
Email: sgill@aashto.org

Richard Price, Program Specialist
Multi-State Transit Technical Assistance Program (MTAP)
Phone #: (202) 624-5813
Email: rprice@aashto.org

NCHRP Review of B-19
Dianne Schwager:

This problem is solvable through research and is a worthy topic for NCHRP. On-line mobility apps are important for better connecting people to mobility options. To date, these apps have been most widely used in larger urban areas. However, there is increasing interest in small urban and rural communities to pursue apps as a means to improve mobility. There is interest in at least 2/3 of the DOTs since this is a relatively inexpensive method to improve mobility and a technology that has already tested and viable. While the objective is reasonably clear it would be improved if it clarified whether the intent of this research is to focus on small urban and rural communities, as suggested on the second paragraph of the background. While the research should address the experiences of communities of all sizes (i.e., the use and benefits of apps as well as market penetration), I believe this research may have greater value if it focuses on the application and potential in small urban and rural areas. The scope is reasonable and the budget is adequate. Three of five research projects included under the Literature Search Summary in the problem statement are TCRP J-11 Projects that I have managed. The two completed projects have been very popular as measured by downloads and webinar attendance. The project on Collaboration and Partnerships will be completed and recommended for publication soon. These projects address a range of issues pertaining to shared mobility options and public transportation. Each report states that this is a nascent and dynamic field where much is still to be learned and many changes will continue to occur as the field evolves. To date, by in large, the research has focused on large and mid-sized communities since this is where shared mobility started. Interest in smaller communities is emerging. This is a worthy topic that deserves more research.

Review Date:
12/12/2018

FHWA Evaluation of B-19

Jasmy Methipara (HPTS) - We support this problem statement.
From: Richard Price on behalf of Jeff Marker, Idaho Transportation Department  
Comments: Inputs were provided by FHWA and NCHRP with both supporting this problem statement. NCHRP recommended modifying the objective statement to clarify this research is for small urban and rural communities. I concur with that recommendation.

Contact Info:
Jeff Marker  
Public Transportation Manager  
Idaho Transportation Department  
P: (208) 334-4475  
E-Mail: jeffrey.marker@itd.idaho.gov

Review Date: 1/21/2019
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Problem No: 2020-B-20

Problem Title: Access to Jobs, Economic Opportunities and Education in Rural Areas

Statement of the Research Problem

Population across the country is shifting, creating a need for stronger connections to rural areas. These connections might be rural to rural or rural to urban. This population shift has created challenges for employers in rural areas and their ability to recruit new employees. Moreover, jobs in our urban areas are not paying adequately and increasing access for populations in rural areas to jobs in rural communities is important to their success.

Transit plays a vital role – in traditional and non-traditional models – to solving this employment shortage.

Literature Search Summary

During this literature search, the following citations with summaries were discovered in relation to access to jobs, economic opportunities and education in rural areas:

- Papaioannou, Dimitrios; Nicolas, Wagner. Measuring Access to Healthcare and Education by Car and Public Transport in 18 Cities Across the World. Transportation Research Board 97th Annual Meeting, 2018, 14p. Summary - This paper showcases an approach to measure accessibility to healthcare and education amenities by public transport and car in 18 cities from all over the world.
- Mikaelian, Levon. Assessing the Jobs Accessibility Impacts of MARTA Service in Clayton County, Georgia and Their Possible Income Segregation Implications. Transportation Research Board 97th Annual Meeting, 2018, 18p. Summary - A cumulative opportunities transit accessibility measure was calculated for census tracts using up-to-date Google Maps data. Additionally, a multi-group measure of income segregation was computed at the census tract scale. Equity implications of the recent MARTA service are discussed. Of interest in this paper are the effects that MARTA initiation had on accessibility to jobs and any relationship that accessibility may have with income segregation in Clayton County.
- Hibberd, Robert E; Nelson, Arthur C. Longitudinal Cluster Analysis of Jobs–Housing Balance in Transit Neighborhoods. Transportation Research Board 97th Annual Meeting, 2018, 15p. Summary - This paper presents a longitudinal study of spatial association of jobs, housing, and transit systems in Chicago before, during, and after the Great Recession. As workforce-housing balance is more indicative of internal capture, workers and jobs are classified by income level and analyzed for degrees of global and local spatial autocorrelation over time. The results show that
LE transit neighborhoods are populated in large part by high-income jobs and workers, and this trend has continued in Chicago since the recession and during the years of recovery.

- Smart, Michael J; Klein, Nicholas J. Disentangling the Role of Cars and Transit in Employment and Earnings. Transportation Research Board 97th Annual Meeting, 2018, 17p. Summary - The authors examine the relationship between transportation access and improved economic outcomes for individuals.


Research Objective

The objective of this research is to identify ‘hot spots’ of needs in rural communities, including employment, education and transportation and explore the new relationships and partnerships needed to ensure success. While many jobs, education institutions and medical facilities will be located in metropolitan regions, major employers supporting economic prosperity will also be located in suburban and rural areas. Commuting patterns will become increasingly regional requiring transit agencies to develop new services to connect employees across jurisdictional boundaries. New local routes, regional commuter services and rural employment routes will support regional and statewide economies. This is a paradigm shift away from looking at jurisdictional based planning but instead looking at larger geographic area needs or travel sheds to meet those needs. An example is a cluster of employers in rural areas unable to recruit employees. By gathering data from one of the many travel data tools (Longitudinal Employment Household (LEHD) Data, Streetlight Data, Regional Integrated Transportation Information System (RITIS), HERE Data), what are the triggers to identify transit opportunities?

Implementation Planning

In order to implement the findings of this study, state DOTs will need a step by step guide to define ‘hotspots’, the best data to use and then identifying the services needed for each solution type.

Estimate of Problem Funding and Research Period

Recommended Funding: $250,000

Research Period: 18 months

Urgency and Potential Benefits
Rural areas of the country are suffering as employers, education opportunities and medical facilities are closing. The vitality of rural areas is dependent on our investments of time and resources to address these needs.

**Person(s) Developing the Problem Statement**

- Debbie Collins, Public Transportation Director, North Carolina Department of Transportation

**Nomination for AASHTO Monitor**

**Potentially Interested AASHTO Councils and/or Committees**

- Standing Committee on Transportation System Operations

**Submitted By:** Council on Public Transportation

**Contact(s):**

Shayne Gill, Program Director for Multimodal Transportation  
Council on Public Transportation  
Phone#: (202) 624-3630  
Email: sgill@aashto.org

Richard Price, Program Specialist  
Multi-State Transit Technical Assistance Program (MTAP)  
Phone #: (202) 624-5813  
Email: rprice@aashto.org

**NCHRP Review of B-20**

**Reviewed By:**
Stephan A. Parker  
saparker@nas.edu

**Comments:**

Access in rural areas is an important topic. Techniques for measuring the problem in order to match appropriate services would be useful. The problem statement can be incorporated into the Rural Transportation Issues: Research Roadmap.

**Review Date:**
12/12/2018
FHWA Evaluation of B-20

Harlan Miller/Stefan Natzke/HEPH - I think this line of research has merit, though I don't fully understand the research objective of identifying "hot spots." The problem statement correctly understands that there are a number of drivers to the loss of economic vitality and well being in rural areas. Successful economic development planning seeks to address underlying needs with appropriate and varying support including-as hinted at in the problem statement-education, employment training, and transportation. They also include things like provision of utilities and other infrastructure, tax subsidies, etc. Well performing transportation such as the Interstate Highway System or various other proposed transportation networks (e.g., the Belt and Road Initiative) can support a system of winners and losers, with those closer to these networks succeeding in the modern economy and others being left behind. Building off the proposed title, I'd suggest that this research would be of higher value if it looked at the conditions that create conditions that lead to rural abandonment and disinvestment, and examined creative ways of linking such rural areas better to locations of high economic activity (e.g., metropolitan areas, the global economy, etc.). Jasmy Methipara (HPTS) - We support this problem statement.

Submitter Response for 2020-B-20

From: Richard Price on behalf of Debbie Collins, North Carolina DOT

Comments:
This is a systems approach to creating a model supporting the economic vitality of our rural areas. 'hot spots are defined as areas needing access in our rural communities. It might be employment centers based on commuting and employment data or educational institutions. Understanding what they are and how to use the data to identify them will maintain the economic health of citizens and their communities.

Contact Info:
Debbie Collins
Public Transportation Director
North Carolina Department of Transportation
dgcollins1@ncdot.gov
919-707-4684

Review Date: 1/21/2019
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Comments: This problem statement was developed by the NCHRP 20-122 Rural Transportation Issues: Research Roadmap project team per panel direction. It is being submitted by the AASHTO Special Committee on Research and Innovation per action taken at their meeting on October 29-30, 2018. R&I suggests that the scope should reflect other rural travel generators and attractors such as theme parks. If selected, that guidance will be shared with the technical panel overseeing the project.

Problem No: 2020-B-21

1. Problem Title
   Trade-Off Analysis: A Multi-Modal Guide for Rural Transportation Investment Analysis

2. Background
   Resource-constrained rural communities such as counties and small municipalities face a crucial dilemma when making transportation investments: they can’t afford to pass up opportunities that will help grow the local economy, and they can’t afford to put money into something that doesn’t work. As a result, rural transportation investments can become contentious. Local newspapers document numerous controversies over roadway widenings, airport upgrades, transit service expansions, bike paths, and more. These disagreements sometimes become quite emotional. For example, an airport expansion in south-central Iowa has been hotly debated for more than 5 years, while a similar project in north-central Wisconsin continues to affect local politics decades after its completion.

   The use of objective analytical tools can sometimes help avoid contentious debates by helping local decision makers understand which public investments provide the greatest overall benefit to the community. Nevertheless, most rural counties and small municipalities lack the resources to hire an economic analysis expert: to the extent that analysis is performed, it needs to be done by an engineer, planner, administrator, or accountant whose primary duties are to support other agency operations.

   A common feature of transportation investments in rural communities is that high-stakes decisions often must be made without the use of tools that urban analysts take for granted, such as travel demand forecasting models. There is frequently a shortage of reliable data to assess facility use or ridership. Decision makers and staff often have limited experience evaluating non-highway modes. Many projects include both utilitarian and recreational elements, introducing the possibility of under-weighting some benefits and double-counting others.

   Major trade-offs can occur when local revenue is scarce. For example, in a rural county separate community groups might simultaneously advocate four projects that all compete for the same local revenue: lengthening a runway to accommodate larger aircraft, building a railroad siding to support industrial park expansion, replacing a deficient highway bridge, or building a bike path. Each
project might have substantial benefits, yet the county might not have enough money to do everything.

Broadly speaking, transportation investment decisions fall into two categories. Case I is the selection of projects within the predefined eligibility criteria of a state or federal program. Case II the selection of projects using unrestricted funds such as local property tax revenue. In Case I, the limitations of analytical methods and assumptions generally have limited impact on the overall rating or ranking of candidate projects: the analytical shortcomings usually affect all candidates more or less equally.

The importance of cross-modal consistency arises in Case II since the funding has no eligibility restrictions. For example, objectively analyzing the airport vs rail vs bridge vs bikeway decision requires a very consistent set of analytical assumptions and parameters.

Most of the existing transportation investment analysis guidance is oriented toward Case I, and nearly all is mode-specific (e.g., analytical methods intended for airport projects are often completely inapplicable to rail projects). As discussed below, the few existing tools that are suitable for analyzing Case II are generally very complicated, putting them beyond the technical capacity of most rural communities.

3. Literature Search Summary

Most of the available guidance on transportation investment analysis has a mode-specific focus, and most is oriented toward major projects. For example, AASHTO’s 2010 User and Non-User Benefit Analysis for Highways manual is written primarily for expert-level state DOT analysts working to establish the business case for major highway projects. Similarly, the Federal Transit Administration and Federal Aviation Administration have each issued detailed, mode-specific (and often program-specific) analytical guidance, focused mainly on analyzing development of new transportation systems or major expansions of existing facilities.

In metropolitan areas, a frequently-used approach is to produce project-level economic analysis based on data exported from a regional travel demand model, as discussed in NCHRP Report 765. While this overcomes some of the modal limitations of the AASHTO and FTA methodologies, it requires prior development and calibration of a travel demand forecasting model. Due to the time, complexity, cost, and specialized technical expertise required to build and maintain such models, they typically exist only for metropolitan areas. Thus, this approach is beyond the grasp of most rural transportation agencies.

The British Department for Transport’s WebTAG project represents perhaps the most ambitious attempt to establish a multi-modal transportation investment framework. It is intended to allow side-by-side comparison of competing corridor-level technical solutions, such as passenger rail expansion vs. freeway expansion along an intercity route. Since the process combines economic analysis with environmental assessment, its complexity is suited mainly for major projects. The WebTAG approach is extraordinarily thorough, but it is not intended to solve the dilemma facing most rural transportation agencies, namely the comparison of
dissimilar projects that are competing for unrestricted funds. Like the travel
demand modeling based approach, WebTAG’s technical requirements are well
beyond the capabilities of most rural transportation agencies.
A number of key principles for investment analysis are highlighted in the World
Bank’s 2010 guidance, *Cost-Benefit Analysis in World Bank Projects*. It adopts a
mode-neutral framework and recognizes the need for scalability: the sophistication
of the analysis should match the complexity of the project. Although focused
primarily on investments in less-developed countries, the principles are largely
applicable to rural transportation agencies in the U.S. Nevertheless, it is not a
stand-alone analytical guidebook or toolkit.

4. Research Objective
The objective of this research is to develop a rural transportation analysis guide
that facilitates decision-making for unrestricted funds (including local funds used
as match for state/federal aid projects). Specifically, the guide would allow
economic analysis to be performed consistently for individual projects within one
transportation mode, as well as across two or more modes.

To address this objective the project will:
- Develop a consistent set of economic analysis methods that can be used with
  all modes.
- Provide resources for estimating the costs of new facilities and services
  consistently across modes, including sources of unbiased information to
  support independent estimates of capital, operating, and maintenance costs.
- Provide resources for evaluating project benefits consistently across modes
  by offering proven, simplified techniques. This includes estimating facility
  use/ridership consistently across modes.
- Providing information about how to factor in non-economic externalities such
  as social, health, equity, and environmental benefits (and disbenefits) of
  transportation projects.
- Providing links to sources for keeping analysis parameters and assumptions
  up to date.
- Discussing technical issues such as handling non-linear growth in facility
  utilization.
- Acknowledging the uncertainties inherent in rural transportation investment
  analysis and providing simplified risk analysis techniques to allow analysts to
  develop high, low, and most-likely-outcome scenarios that bracket the range
  of possible outcomes.
- Offering information on how to present the results of transportation analysis in
  a manner that is easy for elected officials and the public to understand and
  apply.
- Providing worked examples illustrating the use of modal and cross-modal
  analysis.
- Discussing case examples of applications of the methodology.
- Validating the recommended methodology using realistic examples reviewed
  by an interdisciplinary expert task group.
5. Implementation Planning
The end product of this research will be a guidebook and analysis templates to assist rural transportation agencies in conducting simplified modal and cross-modal investment analysis. The guidebook will also include information sources for analytical data, with emphasis on publicly-available sources that are updated regularly. Strategies to support ongoing use of the guidebook, such as training through LTAP centers or universities, should also be considered as part of the guidebook development process.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $500,000  Recommended Research Period: 30 months

7. Urgency and Potential Benefits
Benefits: Improving the technical capacity for modal and cross-modal project analysis is vital to the efficient use of scarce rural transportation funding resources.

Negative impacts if not funded:
- In the absence of user-friendly analytical guidance, decision outcomes are less likely to maximize public benefits.
- Lack of objective analysis to guide decision-making is a frequent source of tension between agency staff and elected officials. Politically-driven projects that are not cost-effective are funded with some regularity, even as basic needs often go unmet.

8. Person(s) Developing the Problem Statement
NCHRP 20-122 Rural Transportation Issues: Research Roadmap project team per panel direction.

9. Nomination for AASHTO Monitor
TBD

10. Potentially Interested AASHTO Councils and/or Committees
Committee on Performance-Based Management
Fiscal Management and Accounting Task Force
Committee on Data Management and Analytics
Special Committee on Intermodal Transportation and Economic Expansion
Public Transportation Council
Special Committee on Research and Innovation

11. Submitted By
AASHTO Special Committee on Research and Innovation

NCHRP Review of B-21
Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The problem statement outlines a challenging issue and an equally challenging research question. The search for simplified methods that are valid for a wide range of cases (including many modes and many contexts) and with a high level of transparency for elected officials and the public, is a demanding task, and doubly so when data are sparse.

The Literature Search Summary does not mention the previous work for SHRP 2 CO3 and C11 published as EconWorks (previously TPICS; see NCHRP Report 786). While focused on highway projects, this work may provide an important foundation for proposed study. Note that the EconWorks database of projects was designed to be expanded over time. Additionally mode-neutral and cross-modal accounting of costs and benefits (economic and otherwise) are an important element of research and practice in performance management. This topic area may provide a rich source of information for the proposed study.

If the project is to include multiple case examples of applying the method, the budget and research period should be increased on the order of $50K to $100K per applied case.

Review Date:
11/19/2018

FHWA Evaluation of B-21

Jasmy Methipara (HPTS) - We support this problem statement.
Comments: This problem statement was developed by the TRB Committee on Transportation Needs of National Parks and Public Lands. It was included in the NCHRP 20-122 Rural Transportation Issues: Research Roadmap project interim report and presented by the research team to R&I per panel direction. It is being submitted by the AASHTO Special Committee on Research and Innovation per action taken at their meeting on October 29-30, 2018. R&I suggests that the scope should reflect other rural travel generators and attractors such as theme parks. If selected, that guidance will be shared with the technical panel overseeing the project.

Problem No: 2020-B-22

1. Problem Title

Accessing America’s Great Outdoors: Understanding Recreational Travel Patterns, Demand, and Future Investment Needs for Transportation Systems.

2. Background

Each year, there are an estimated 870 million visits to federal lands (Leggit et al 2017). This recreational and tourism travel, driven by demand for access to parks and public lands, continues to increase in urban and rural areas throughout the country, placing new and changing demands (traffic congestion, air pollution, etc.) on transportation systems. Managing this travel demand has been increasingly challenging and has added congestion and operational stresses on not only the public lands themselves, but also on the gateway communities that provide access to them. For example, many National Parks have seen substantial and rapid changes in visitation rates over the last five years (as high as 40% and 60% at some units) and looking ahead, the growth rate for international visitation to the US is higher than the forecast growth for domestic travel (according to the US Travel Association). This growth in visitation has resulted in congested roads, intersections, and entry gates for many parks as well as gateway communities (c.f. Yellowstone Transportation and Visitor Mobility Study 2016; Acadia Transportation Plan / DEIS 2017).

In many places we are seeing tourism expand at record breaking numbers. For example, tourism to Utah grew 12 percent from 2011 to 2015, with visitors spending a record of nearly $8.2 billion and generating approximately $1.15 billion in total state and local tax revenue. This visitation expansion is happening both in total visitation numbers, but also in traditionally low use seasons. For example, NPS visitation grew 9% in September 2018 when compared to the same month last year. Outdoor recreation contributed $373.7 billion to the US economy (or 2%) in 2016, exceeding the economic contributions of other industries that access similar lands (e.g., mining, oil, and gas extraction at 1.4% of total GDP) (BEA ORSA). The outdoor recreation economy grew 3.8 percent in 2016, compared with the overall U.S. economy’s 2.8 percent growth that year. Many local
communities in rural areas are largely dependent on the recreation travel economy.

Therefore, there is a great need for increased research in understanding recreational travel demand, patterns and demographics. Without this information, land managers, states and gateway communities have limited and inconsistent resources by which to make transportation decisions about access, quality and asset management within a single jurisdiction, let alone across multiple jurisdictions within a region.

3. Literature Search Summary

This project builds on efforts by the TRB Committee on Transportation Needs of National Parks and Public Lands (ADA40) to enhance coordination and cooperation among federal land management agencies (FLMAs) and transportation and recreation agencies at the federal, state, regional and local levels. It leverages the data collected by the FLMAs in surveys and interviews, creating new knowledge of value in transportation planning and policy making. The project expands on other NCHRP 8-36 projects, including Innovative Transportation Planning Partnerships to Enhance National Parks and Gateway Communities.

Currently, most FLMAs, states, and counties have very limited information by which to project recreational travel demand and therefore are limited in their ability to make informed decisions about transportation and tourism planning and development. The best models available for projecting this use is developed by tourism markets, but these are poor analogies to recreational travel demand as these travelers do not always translate neatly to transportation road volumes, and these models report at such gross scales that most local entities cannot use the information generated from these models (c.f. US Travel Association Travel Forecasts). Often times, transportation planners are using historical visitation (c.f. Ziesler 2017) and historic use trends (c.f. White et al 2016) to inform decision making, however, these sources are limited in that they do not address cumulative or mediating factors that might change future use and these historic trend analyses do not address the underlying “why” and “what” is driving trend changes.

Sources Cited:
- Bureau of Economic Analysis Outdoor Recreation Satellite Account
- Interactive Travel Data Analytics: https://www.ustravel.org/research/interactive-travel-analytics
- Statewide Tourism Travel Demand Forecasting: A Behavior-Based Modeling Framework for the State of Florida: TRB 2017 Conference


Other Related References:


4. Research Objective

Commuter and freight travel patterns and needs have been extensively studied over the past 50 years. These studies, and the resulting operational and management changes to Interstates, state highways, arterials and local roads have maximized transportation investments, improved safety and allowed communities to improve long-term access and quality of life investments. Given state and regional tourism marketing campaigns, advantageous economic conditions, population growth, national development patterns, baby boomer retirements and global tourism trends, recreational travel to federal and state public lands will continue to increase based on current trends, resulting in new and more challenges for state and federal transportation managers and the possibility that these activities will require a greater share of national transportation investments.

Recreational travel patterns have not received this type of attention from the transportation industry. As this sector of the economy grows, transportation impacts from recreation travel are also growing, and the impacts to quality of life are being felt by local community residents and businesses, along with millions of visitors. Investments in recreation-related multimodal transportation infrastructure, operations and management are difficult without some ability to understand, document and plan effectively for future system performance. This project has three objectives:

- The first is to document and describe recreational and tourism travel demand and the related data gap within key states of interest (focus states TBD). This would create the baseline needed to account for both the recreational travel demand on federal and state roads and the contribution recreational travel makes to the overall use of transportation assets and the economic development and sustainability of these regions and local communities. It should be noted that this study is not about evaluating the capacity in these locations, the ability to accommodate visitation (currently or into the future), or strategies to address concerns about demand. Rather it is about filing a critical gap in knowledge about recreation travel demand and what factors influence this demand profile.
• The second is to identify and begin to explore which factors (economic, demographic, geographical, etc.) drive recreational travel volumes and patterns (both within and between public lands). Outcomes of this study should clearly describe which factors are correlated with recreation visitation vs which factors drive changes in recreational travel. Greater understanding of these factors will allow both states and federal entities to proactively plan for and manage travel routes to accommodate both volumes and user types in a way that provides for high quality transportation experience and informs fiscal decisions on transportation infrastructure to meet recreational traveler needs.

• The third would be to develop a model to project recreational travel demand on state and country roads to allow those jurisdictions to make better informed decisions about investments in economic development, transportation and other issues that may affect quality of life for residents and experience for visitors.

Tasks:
There are three primary tasks associated with this need.

Phase 1
1. Document and describe recreational and tourism travel demand within the study state. This should describe the dominant trends in recreational travel demand and its current impacts to related transportation systems. This should include both a literature review and gap analysis.
2. Explore and document which factors (economic, demographic, geographic, etc.) drive recreational travel volumes and patterns and describe how these factors may or may not impact recreational travel demand.

Phase 2
3. Develop a model to understand and potentially predict recreational travel demands on transportation systems at local, regional, and/or state levels. This includes testing the model in a variety of settings (including but not limited to NPS sites, state sites, FWS sites, and USFS sites). The model will be updated based on beta tests and will be subject to peer review.

5. Implementation Planning
A regional travel demand model that is specific to recreational travel demand, patterns, and demographics would provide land managers, states, and gateway communities with a reliable and valid tool to leverage when making transportation decisions about access, quality, and asset management.

6. Estimate of Problem Funding and Research Period
Phase 1: Tasks 1 & 2: $150K (12 months)

Phase 2: Task 3: $300K (12 months)

This research is relevant for xxx and xxx funding sources. This research could be appropriate for academic and PhD research for students and candidates who are interested in recreational use of transportation systems and who have experience with travel demand modeling. This research will also be relevant to state DOTs, FLMA recreation and transportation planners, state and regional tourism bureaus and officials, other professionals, researchers and planners in visitor use management on public lands.

7. Urgency and Potential Benefits

A goal among several Federal departments to enhance the recreation and tourism (e.g., DOI SO 3366, USDA Call to Action #5) means that these agencies need to find sustainable solutions to managing recreational travel demand generated by public land visitation. Proactive and strategic investment in the assessment and planning for visitor use management along recreational travel routes is needed to support both federal and state efforts to successfully manage changing visitation, connect visitors to public spaces, protect resources, support local economies and provide for high quality travel experiences.

However, most (if not all) travel demand models use tools and assumptions that do not account for the unique needs, uses and patterns of recreation-based travel. Most transportation planning and related data collection efforts have focused primarily on travel related to work (commuting and commerce), which limits the ability to fully use these results to understand and proactively manage recreational travel demand.

Ultimately this research will help federal agencies and states 1) clearly understand future recreational demand on transportation systems, 2) understand relationships between and within recreation sites and 3) forecast needs associated with future projected recreational travel demand.

8. Person(s) Developing the Problem Statement

- Rachel H Collins, Ph.D., Visitor Use Management Specialist, National Park Service Denver Service Center, (303-987-6852; rachel_collins@nps.gov)
- Linda MacIntyre, Congestion Management Program Manager, National Park Service.
- Ben Rasmussen, Public Lands Team Lead, US DOT Volpe Center
- Steve Suder, ADA40 Chair & Multimodal Program Lead, National Park Service

9. Nomination for AASHTO Monitor

- Carol Zoff, Minnesota DOT
10. Potentially Interested AASHTO Councils and/or Committees
   - Committee on Planning

11. Submitted By
AASHTO Committee on Planning
   Chair: Scott Bennett, Arkansas DOT
   Vice-Chair: Tim Henkel, Minnesota DOT

***NOTE: This project is ranked number 2 of 2 submitted by the Committee on Planning.

Submitted by AASHTO Special Committee on Research and Innovation, Committee on Planning and Tennessee DOT

NCHRP Review of B-22

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
The problem statement describes a study to develop a travel demand model for trips to recreational trips to National Parks and similar outdoor areas. The problem statement alludes to using data from one or more focus states to develop the model, which would likely require access to detailed travel survey data or cordon studies. If such data are available for a representative set of destinations, the study is feasible for the estimated budget. The model and estimates from a representative set of cases will likely have limitations for generalization to other locations given the highly particular features of National Parks and their gateway communities, the range of tourism marketing campaigns, and unique visitor group types.

Review Date:
11/19/2018

FHWA Evaluation of B-22

Christopher Douwes/HEPH - The proposal should include the new NPS Active Transportation Guidebook as a resource. The proposal should specifically mention bicycling and walking as possible mitigation for road congestion if there is a modal shift
to bicycling and walking, bicycle and walking tourism, and bicycling and walking as reasons that people visit locations. The proposal should consider: 1) unique factors of why people travel to specific locations, such as specific recreational activities that draw people (mountain biking, skiing), or unique scenic or geologic draws (canyons, geysers, wildlife). Economics, demographics, or geographics may be minor factors compared to other factors that draw people; and, 2) Impact of local travel; how much tourism traffic really is local traffic.

AASHTO Committee Evaluation for B-22

Submitted By: Elizabeth Robbins
Chair Planning

Comments: COP#7 priority: Strengthen the modeling/forecasting approach for applying methods (v. academic discussions) and basic data collection. Include concepts such as Big Data and Internet of Things.
Problem No: 2020-B-23

1. Problem Title
Development and Implementation of the National Intercity Bus Atlas

2. Background

The purpose of this research project is to develop a national atlas of intercity bus services that utilizes General Transit Feed Specification (GTFS) data, is publicly available, can be maintained to a high level of currency, and is complementary to the National Transit Map.

Although the network of intercity bus services represents the most comprehensive national coverage provided by any of the intercity modes, there has not been any comprehensive, complete, and up-to-date inventory of these services until recently. Such an inventory has been needed by policy-makers, planners, operators of complementary services, and the industry itself to understand and depict the current state of the intercity bus network, its role, its connections with local transit, and its role with regard to Amtrak and commercial air service.

This mode has gone unrecognized for its critical role in connecting America’s rural areas, small and large cities—in part because of lack of information about the national network it provides, and in part because most of this network is operated without federal or state subsidies. At a number of times in the past such a tool would have been extremely useful for policy analysis, for research and for planning for improved connectivity. For example, it could have been used to determine the impacts on service levels, connectivity and mobility of such events as the Greyhound restructuring of 2004-2005, or the growth of curbside services such as (Megabus, Flixbus, etc.) that have developed over the past decade.

The major federal program of assistance for intercity bus service has been the Section 5311(f) program, providing federal funding to support intercity bus services serving rural areas. This program provides for a 15% set-aside of each state’s allocation of Section 5311 funding, unless the state certifies that there are no unmet rural intercity needs. The 15% set-aside amounts to nearly $100 million per year, yet there is no map that can be used to help evaluate unmet needs, or to show which routes are funded by this program. Decisions are being made regarding Amtrak services, and there is no publicly-available national map that shows how intercity bus services relate to Amtrak, whether as part of the Amtrak
network (Amtrak Thruway), complementary connecting service, or even directly competitive service. Policy issues regarding the Essential Air Service program could also benefit from the existence of a current atlas in intercity bus services that would show how rural areas are connected to the national airline system.

By using GTFS, which includes not only the routes (assigned to the highway network), but exact latitude and longitude of stops and terminals, and the schedules/frequency of service, this network can be linked to other data such as the National Transit Map to assess connectivity and to Census or health data, allowing assessments of the degree to which mobility and access exist from rural areas. The ability to know exactly where the stops are located allows for assessment of connections to transit, as it will be possible to finally know the proximity of intercity bus and transit stops. If such a tool exists and is maintained, by saving each update it will be possible to monitor trends in coverage or service levels over time. Finally, a major potential benefit is that by promoting the development of GTFS data for inclusion in this map, the industry may also see that this data can be used for trip-planning purposes if made available to information providers such as Google Transit—allowing potential travelers to know the all the connecting services needed to make multi-modal trips.

Potential users of this tool include state departments of transportation, state, regional and local planning agencies; policy researchers; the academic community; trade associations; and the industry itself.

3. Literature Search Summary

Prior to deregulation of the intercity bus industry by the Bus Regulatory Reform Act (BRRA) of 1982, the Interstate Commerce Commission (ICC) and state regulatory agencies controlled the routes and fares of virtually all carriers. Although these agencies had this information, it was not publicly available, though the overwhelming majority of intercity bus carriers made their schedules and routes known through a publicly-available, industry-wide schedule book, the National Motorcoach Guide, published by Russell’s (commonly known as Russell’s Guide or just Russell’s). This monthly publication was not generally used by individuals, but was in the hands of virtually every ticket agent in the country, and could be used by knowledgeable researchers to analyze services and monitor changes. However, it was not easy, because the Guide was not searchable, had no comprehensive maps, and was constructed of individual timetables for each company. Since deregulation there has been a lack of information about this mode and its role, with occasional and sporadic efforts to develop a map for industry promotion, or to attempt to address the impact of deregulation and industry changes. This includes two studies of rural access by the U.S. Department of Transportation’s Bureau of Transportation Statistics, the last of which took place nearly a decade ago.

However, Michael Buiting, an individual interested in providing the public information that could be used to plan trips that involved multiple carriers voluntarily developed a national intercity bus map. The independent and unbiased map is available from the American Intercity Bus Riders Association’s (AIBRA)
website (http://www.kfhgroup.com/aibra/pdf/usmap.pdf). He keeps the map up to
date through his carefully developed network of industry contacts and by
constantly reviewing published timetables. The AIBRA map is in a CAD
(Computer Aided Drafting) format, and stops are shown as cities with no
identification of terminal addresses. Despite these limitations, this map slowly
became recognized as the only consistent, comprehensive and up-to-date
depiction of the national intercity bus network. The industry and planners use the
map to identify gaps in service and potential connections.

4. **Research Objective**

This project is intended to support the development and implementation of the
NIBA as an ongoing, comprehensive and publicly-available inventory of intercity
bus services. While BTS has developed the structure and platform to house and
maintain the NIBA, research is needed to populate the NIBA with GTFS data. The
research team will need to work closely with BTS and its working group to
accomplish this project. Key task elements of this research project include:

- Development of standards for inclusion—whether based on service type (fixed-
  route, fixed-schedule), minimum frequency, route length, connectivity or other
  factors. This effort will need to consider such aspects as the degree to which
  transit commuter routes are included, how to include services that are marketed
  as parts of several networks (many Amtrak Thruway bus routes are operated by
  intercity carriers who also sell seats on the same bus), etc.

- Identification of the universe of firms that should be included and contacting them
to elicit participation.

- Clarification of the difference between provision of data for this research tool, as
  compared to potential issues with carrier provision of GTFS to trip-planning
  developers, etc.

- Activities to promote the need to develop and supply GTFS data to the industry
  itself, including coordination with industry trade associations including the
  American Bus Association (ABA) and the United Motorcoach Association (UMA).
The goal is to have carriers sign the MOU, agree to provide data (generally
easily developed by their ticketing system) on an ongoing basis.

- Identify and work with ticketing firms to make GTFS data generation a routine
  part of ticketing system updates.

- Development of potential applications for NIBA data, such as defining routes
  funded with Section 5311(f), routes funded with other sources, the Amtrak
  Thruway network, routes operated without subsidy, mobility analysis, equity
  analysis, service gaps and unmet needs. This effort includes identification of
  additional data to be joined with the NIBA, as well as potential analyses.

- Identification of potential additional layers for inclusion such as airport ground
  transportation providers, or bus companies serving particular ethnic communities
  that are open to public, etc.

- Work with industry efforts to develop and include GTFS Flex data so that the
  many rural transit operations that are demand-response can be included (both as
  part of NIBA and the National Transit Map), showing their potential role in a
  connected national network.

- Identify a permanent method for maintaining the NIBA map and associated
timetables, such a public agency, industry group, or open source community.
• This effort may include initial conversion of timetable data into GTFS to demonstrate to carriers and their ticketing contractors what this entails, and to encourage them to sign the MOU and commit to maintenance of their data. Any GTFS data developed or collected will be provided to BTS for inclusion in the NIBA.

5. Implementation Planning
The end product of this research will be the populated and functioning NIBA, and a technical report addressing the activities, results, issues and future directions of this effort. It will include a base map of the national intercity bus network, as defined in this process, current as of the conclusion of this inventory, a functioning process for maintaining the map, and potential additional uses and research that can be conducted using this tool. It will also include a plan for future development of the NIBA, and the resources needed to maintain and improve it.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $600,000  Recommended Research Period: 18 months

7. Urgency and Potential Benefits
Benefits:
• Help rural residents meet their transportation needs
• Increase utilization of available resources
Negative impacts if not funded:
• Transportation challenges for rural residents persist
• Because it is an individual and purely volunteer effort, the sustainability and continued availability of the AIBRA map is unlikely.

8. Person(s) Developing the Problem Statement
Fred Fravel & Derald Dudley

9. Nomination for AASHTO Monitor
TBD

10. Potentially Interested AASHTO Councils and/or Committees
Public Transportation Council
Planning

11. Submitted By
AASHTO Special Committee on Research and Innovation

NCHRP Review of B-23
This is an important topic for rural America. Significant implementable results can be shown in a short time under the proposed research effort. The USDOT Volpe Center is already resourced to house the National Intercity Bus Atlas. This effort would educate and provide technical assistance to populate the Atlas, and would fill in the map with available services (to inform the potential riders) and allow analysis of the map to identify gaps in services (to inform business opportunities for potential service providers).

This problem statement was developed by the NCHRP20-122 Rural Transportation Issues: Research Roadmap project team per panel direction after the Denver, Colorado workshop in September 2018.

Review Date:
12/12/2018

FHWA Evaluation of B-23

Tianjia Tang/HPL - This is research the Policy Office attempted before with some limited result. The proposed project is logical and sound. It will offer great value to the transportation community and the general public.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Comments: This problem statement was developed by research teams involved in open source software projects funded under the Transit Cooperative Research Program, the National Rural Transit Assistance Program, and the Federal Transit Administration's Mobility On Demand Sandbox grant program. It was included in the NCHRP 20-122 Rural Transportation Issues: Research Roadmap project interim report and presented by the research team to R&I per panel direction. It is being submitted by the AASHTO Special Committee on Research and Innovation per action taken at their meeting on October 29-30, 2018.

Problem No: 2020-B-24

1. Problem Title
Enabling On-demand, Multi-modal Trips to be Booked in Real-time in Rural America

2. Background
Technology has changed how we arrange travel, from Expedia or Orbitz to Uber or Lyft. Technology can identify where service is available and enable us to reserve a seat or purchase a ticket. Mapping software enables us to choose directions for driving, transit, trains or walking.

Much of the development of transit-related technology to date has been for urban areas, with a focus on fixed-route transit. In rural areas, however, a large portion of transit services are flexible or demand responsive, and these are not addressed by most existing trip planning tools. Developing and implementing technology that addresses demand responsive transportation as well as fixed-route transit would enable integration of human service transportation, taxis, and transportation network companies (TNCs). This also would enable riders to use less expensive fixed-route services for long stretches and use demand response, taxis, and TNCs for the first- and last-miles of their trips.

A comprehensive research, development, and implementation approach is needed to expand current transportation planning tools to accommodate demand response services with a goal of enabling individuals or agencies to discover all available services and service constraints as well as to plan, schedule, and pay for trips. It is important to include all transportation options – fixed and flexible transit services, taxis, human service transportation, and transportation network companies.

3. Literature Search Summary
The prior literature on data standards in this area, Transit IDEA Project 50, TCRP Web-Only Document 62, and the forthcoming TCRP G-16 (Development of Transactional Data Specifications for Demand-Responsive Transportation), have focused primarily on transactional data. NCHRP Report 832 examines the non-technical components of one-call/one-click implementations.
Broadly speaking, open data formats and open source software, while often not described in academic literature, lend themselves very well to research. The ability to share software development and have a broad community build on one another’s efforts and experimentation is particularly valuable in the context of the rapid pace of change in the transportation sector. What follows is a brief overview of the formats and tools which the research objectives seek to advance.

**GTFS-Flex** originated with the 2013 “GTFS for the Rest of Us” initiative by the World Bank, development researchers, and Google to more accurately model the flexible nature of much of the world’s transit services. It is capable of describing the full range of deviated-fixed-route and demand-responsive service models.

**General Transit Feed Specification (GTFS) data**, which GTFS-Flex is an extension of, was the result of a 2005 collaborative effort by Google and TriMet (Portland, OR) to describe fixed-route transit services. The GTFS is now the most widely used of all transit data standards and is still under active development.

**OpenTripPlanner** was first created in 2009 by TriMet as an open source multi-modal transit journey planner. Its use has now grown to over 20 production deployments in the US and Europe, including very large transit systems. In 2017, the FTA MOD Sandbox grant program funded two major expansions to the OTP, adding shared use mobility modes in Portland (TriMet), and flex services in Vermont. The latter is the first system to consume the GTFS-Flex data format for demand-response and deviated-fixed route services.

**1-Click** was first developed in 2013 through the Veterans Transportation and Coordinated Living Initiative as a travel options aggregator specifically designed to robustly describe eligibility-constrained demand-responsive human service transportation. In addition to service discovery, it allows for customer profiles and booking of trips if the service provider furnishes a web API for that purpose. It is currently deployed in six metropolitan areas across the US.

### 4. Research Objective

To build upon existing work to enable on-demand, multi-modal trips to be booked in real-time. The project will expand and implement information technology infrastructure described above in the “Literature Search Summary” in a fashion that is suitable for rural services, can be deployed on a statewide basis, uses open source software and open data tools, and can include all available services.

The research objectives will be accomplished through a combination of working with a State-level advisory committee and a technical team doing software development.

- Work with one state to advance development of GTFS-Flex, OpenTripPlanner, 1-Click, and booking integration.
It is recommended that any location selected be one that already has a foundation in place. Candidate states might include Vermont, Colorado, Pennsylvania, Florida, California, Utah, Oregon. In some states only a region might be covered.

Technical elements for the selected location would include:
- Creation of GTFS-Flex network as needed in individual areas
- Further refinement of OTPs use of GTFS-Flex
- Integration of new OTP/GTFS-Flex capabilities in 1-Click

Work with an advisory panel representing a broader group of states to identify the potential role of states, issues related to adoption such as ongoing resource requirements or need for a governance structure to manage open source software, and different pathways to adoption.

5. Implementation Planning
State DOTs serve the vital role of ensuring for consistency and ease of connection through their jurisdiction. Promoting data standardization among transit providers is the most important statewide planning activity to be led by DOTs pertaining to the research objectives of this project. Additional planning includes promoting technical expertise to manage modular technology systems at the local agency level.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $700,000  Recommended Research Period: 24 months

Funding needed would depend upon infrastructure currently existing in participating state, and scope of region being covered. The following scope and budget estimate are based on projects encompassing Vermont statewide, or Colorado in the Northeast quarter of the state (including Denver).

- 1-Click merge with OTP-flex ($425,000)
  - Change 1-Click search algorithm to include OTP-flex routing
  - Integrate 1-Click booking with local scheduling software
  - Integrate real-time feed from scheduling software with routing algorithm
  - (in Colorado) build GTFS-flex data

- User interface development ($150,000)
  - Include GTFS-flex visualization concepts in new OTP user interface
  - Integrate OTP user interface with 1-Click accounts and booking engine

- Agency and advisory panel outreach and coordination ($75,000)
- Demonstration, testing, evaluation, and final report ($50,000)

Research Period:
- Months 1-6 – incorporate GTFS-Flex routing into 1-Click, develop GTFS-Flex data
- Months 7-12 – incorporate TCRP G16 standards into 1-Click, booking system, and set up booking integration
- Months 13-24 – demonstration, testing, evaluation, and final report
- Months 1-24 – work with additional states committee to evaluate implementation paths

7. **Urgency and Potential Benefits**

   **Benefits:**
   - Help rural residents meet their transportation needs
   - Help residents find more efficient itineraries with fixed route / DRT combos
   - Increase utilization of available resources
   - Reduce load on DRT call center staff
   - Open source solutions to reduce agency cost and increase agency influence over design and development of tools

   **Negative impacts if not funded:**
   - Transportation challenges for rural residents persist

8. **Person(s) Developing the Problem Statement**

   Thomas Craig (thomas@trilliumtransit.com | 503-567-8422 ext. 4) of Trillium Solutions, Inc.;
   Aaron Antrim (aaron@trilliumtransit.com | 503-567-8422 ext. 3) of Trillium Solutions, Inc.;
   Suzanne O’Neill (suzanne.oneill@transitplus.biz | 303-646-4319) of TransitPlus, Inc.;
   Paul Sorenson (PSorensen@camsys.com | 213-372-3030) of Cambridge Systematics;
   Roger Teal (Roger.Teal@demandtrans.com | 847-256-8866) of DemandTrans Solutions;
   Kevin Chambers (kc@fullpath.io | 503-236-7864) of Full Path Consulting.

9. **Nomination for AASHTO Monitor**

   TBD

10. **Potentially Interested AASHTO Councils and/or Committees**

    Public Transportation Council
    Planning
    Transportation System Operations

11. **Submitted By**

    AASHTO Special Committee on Research and Innovation

---

**NCHRP Review of B-24**
This is an important topic for rural America. Significant implementable results can be shown in a short time under the proposed research effort. The project extends work funded under the Federal Transit Administration's Mobility On Demand Sandbox grants. This effort would provide research and development to mature draft standards and technical assistance to implement them. It is complementary to B-23, which makes services discoverable through the national Atlas, by making the information actionable. Where the B-23 Atlas will fill in the map with available services (to inform the potential riders) and allow analysis of the map to identify gaps in services (to inform business opportunities for potential service providers), B-24 will allow riders to actually book and pay for multimodal rides with transfers (including rides connecting to Greyhound, Peter Pan, and other intercity bus services from services like Uber and Lyft and local public dial-a-ride services).

This problem statement was developed by the NCHRP20-122 Rural Transportation Issues: Research Roadmap project team per panel direction after the Denver, Colorado workshop in September 2018.

Review Date:
12/12/2018

FHWA Evaluation of B-24

Brian Gardner/HEP, Tianjia Tang/HPL - This research addresses a challenging issue for rural communities. The technical solution and approaches will be very valuable for all communities. From a practical standpoint, the implementation of such system will be challenging.
1. Problem Number: 2020-B-25

2. Problem Title:

Guidebook on Integrating Freight Movement into 21st Century Communities’ Land Use, Design, and Transportation Systems

3. Background / Description:

Each day, about 60 million tons of freight valued at $40 billion moves through the US transportation system. These enormous volumes evidence how essential logistics and goods movement are to our economy and communities. The markets for travel and for freight movement are both changing and the importance of integration of freight needs with other partners in the evolving more complex communities is changing the ways freight needs to be planned within livable communities. Changing land uses, customer/shipper and freight demands indicate the need for a broader partnering with city planners, architects and traffic engineers including those with a focus on livable communities. What strategies work for all and which are in conflict? Technology advances, shifting land uses markets offer opportunities as well as challenges.

Communities rely on efficient and reliable freight systems. As cities and communities seek to encourage and implement mixed-use and human-scale development, it is important to consider the needs for commercial and residential goods movement, access, and mobility. For example, the City of Seattle instituted a flexible approach to implementing Complete Streets based on the unique qualities of the street, including freight mobility needs. New York City adopted the Off-hour Deliveries program which supports deliveries in Manhattan between 7 PM and 6 AM to facilitate decreasing congestion and truck emissions. The Florida Department of Transportation’s Freight Roadway Design Considerations manual balances freight movement with community livability to provide context-appropriate planning and design guidance.

In contrast, however, many cities and regions that have adopted Complete Streets initiatives do not consider the unique needs of trucks and goods movement. This lack of consideration may lead to delivery trucks double-parking, blocking bike lanes, mounting curbs and sidewalks while driving, and other high-risk behavior when serving businesses and homes. Cities and suburbs will also need street design and parking regulations that ensure trucks can efficiently access dense pick-up and delivery locations without creating roadway safety or maintenance concerns, incurring costly parking fines, or interfering with local vehicle, bike, transit, and pedestrian traffic. The
same applies to the noise and other environmental impacts trucks deliver at a higher relative rate than smaller vehicles.

It is clear that research and planning activities continue to underscore the significant disconnect between land use decision-making and the freight movement-related traffic associated with various land uses. Planners and policy-makers at the local, metropolitan, and state levels often make decisions on transportation system development, management, and investment with only a limited grasp of how, where, and why freight moves on that system, both currently and according to forecasts of the future. At least two dynamics drive this disconnect. First, freight movement is mainly a private-sector activity with significantly different planning timeframes and objectives than the public sector, resulting in difficulties achieving useful public-private communication and collaboration. Second, useful commodity flow and volume information and data can be very difficult and costly for the public sector to acquire and apply in planning activities, resulting in transportation system plans and priorities that can under- or overestimate freight movement demand. State, regional, and local decision-making based on incomplete information and comprehension can lead to land use, economic development, and transportation plans, policies, project priorities, and funding choices that do not address long-term mobility needs for people and freight.

There is a need for a guidebook to help public sector officials, with diverse backgrounds and program responsibilities, understand and integrate freight movement trends, dynamics, and forecasts more effectively into decision-making on topics that directly affect communities’ economic vitality, sustainability, and quality of life. This guidebook would do more than simply explain how freight moves; rather, it would provide insights, planning and decision-making methods, and examples of effective approaches to harmonize freight movement an integral part of the 21st century community fabric that reinforces community livability and economic activity.

4. Research Objective

Develop a guidebook for transportation planners and policy-makers that provides a clear description of the myriad interactions between land use policy, development regulations, environmental preservation, planning, and freight movement, and how and why economically vital and sustainable communities need to integrate freight movement considerations into their development visions and plans. This guidebook would leverage and build on the various prior research and planning products identified in Section 6 below. Guidebook elements would include:

- Overview of how freight shipments support communities’ economies and livability needs, and how those shipments need to be considered in community visioning and equity efforts
- Overview of freight movement behavior, decision-making and operations
  - Importance of travel time reliability for most freight trips
  - Differences in how and why time of day of travel differs from general traffic
identification and description of special freight movement issues and considerations in the urban environment

- Challenges in forecasting freight movement and applying forecasts at the state, regional, and local level
  - Challenges in freight data collection and the application of big data in freight analytics
- Identification of key stakeholders and partners and their relationships to freight facility planning
- Overview of different freight vehicle types, technologies, and infrastructure (current, emerging, future)
  - Operating space required around different freight vehicles (e.g., operating space buffers for loading/unloading)
  - Building code opportunities, including parcel receiving rooms
  - Guidelines for accommodation of on-street loading
- Case studies of noteworthy practices (“success stories”) in coordinated land use planning and freight trip management/forecasting that summarize key findings for planners and policy-makers
  - Include visualizations to extent possible and applicable
- Guidelines and model freight friendly plans/approaches for planners, engineers and architects
  - Incorporating freight in Smart City plans; considerations and challenges
  - A look to the future – how freight planning may change with the emergence of CAVs

5. Potential Benefits:

In the coming decades, urban areas will continue to grow, morph, and densify. Demand for freight movement is forecast to grow by an even greater proportion in these urban areas over this same period. This guidebook will help researchers and practitioners address this challenge by providing the following benefits:

- Provide planners and decision-makers with a more informed and reliable understanding of the relationship between urban and regional land uses and freight movement
- Assist architects, urban planners and traffic engineers to design freight friendly facilities
- Help researchers and practitioners develop and employ more robust and reliable models and forecasts of freight movements associated with land use plans and decisions
- Improve transportation system performance by enabling planners and decision-makers to more effectively match land use decisions with freight movement
capacity, thereby enhancing community economic vitality, sustainability, and climate change resiliency

6. **Related Background Research:**

**Freight Planning and Operations**
- NCFRP Report 14: Guidebook for Understanding Urban Goods Movement
- NCFRP Report 33: Improving Freight System Performance in Metropolitan Areas: A Planning Guide
- (Forthcoming – in final review) NCHRP Report 897: Tools to Facilitate Implementation of Effective Metropolitan Freight Transportation Strategies
- The Role of Transportation Investment in Private Firm Site Selection Decisions: A Primer for Transportation Planners and Decision-makers (FHWA 2018, forthcoming)
- Understanding Big Data in Freight Transportation – TRB Task Force, 2017

**Freight-related Land Use and Policy**
- FHWA Freight and Land Use Handbook
- NCFRP Report 19/NCHR Report 739: Freight Trip Generation and Land Use
- NCFRP Report 24: Smart Growth and Urban Goods Movement
- NCFRP Report 37: Using Commodity Flow Survey Microdata and Other Establishment Data to Estimate the Generation of Freight, Freight Trips, and Service Trips: Guidebook
- NCHR Report 844 Guide for Integrating Goods and Service Commercial Vehicles in Smart Growth Environments
- NCHR 08-111 (ongoing) Effective Decision-Making Methods for Freight-Efficient Land Use

7. **Estimate of Problem Funding and Research Period**
- Recommended Funding: $500,000
- Research Period: 18 months
8. RNS Developers

Peter Plumeau, Vice President (Lead)
EDR Group
pplumeau@edrgroup.com

Manali Sheth
Arup
Manali.Sheth@arup.com

Peter Martin
CDM Smith
martinpc@cdmsmith.com

Makarand Gawade
HDR Inc.
Makarand.Gawade@hdrinc.com

Jose Holguin-Veras
Rensselaer Polytechnic Institute
jhv@rpi.edu

Casey Wells
TXDOT
Casey.Wells@txdot.gov

Yatman Kwan
CalTrans
yatman.kwan@dot.ca.gov

Alissa Barber Torres
Orange County, Florida
Alissa.Torres@ocfl.net

Chip Millard
FHWA
chip.millard@dot.gov

9. Sponsoring Committee (required):
   ● AT025 - Standing Committee on Urban Freight Transportation

Also Submitted by Minnesota DOT

NCHRP Review of B-25
This is a well-written, detailed research proposal that would build on NCFRP and NCHRP projects that are nearing completion. It should be combined with B-31. The funding should be increased to $750,000.

Review Date: 11/30/2018

AASHTO Committee Evaluation for B-25

Submitted By: Elizabeth Robbins
Chair
Planning

Comments:
COP's #4 priority: Goods movement is evolving as changes in technology affect travel and delivery patterns, as well as land use patterns. Clarify and strengthen the focus on this for forecasting purposes, especially in how Vehicle Miles Traveled (VMT) might change. The research should also consider context sensitive design tailored to goods movement, land use practices and policies such as siting of micro-warehouseing.

Submitted By: Susan Howard
AASHTO Staff
Special Committee on Freight

Comments:
This problem statement assumes the need to balance freight movement with community livability. If we change the problem statement to assume that community livability is a desirable outcome and freight movement is one of many means to achieve that outcome, results will be significantly different. The statement presumes that freight movement is a static thing (big trucks) and community design must be compromised to accommodate this "reality." Freight delivery means and methods are dynamic, and any guidebook should recognize this. As written, the guidebook would result in a one size fits approach to our public spaces.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2020-B-26

II. PROBLEM TITLE

Reliability and Quality of Service Evaluation Methods for Rural Highways

III. RESEARCH PROBLEM STATEMENT

Rural roads are a major part of the highway system. According to FHWA (2016), rural roads are around 70% of all highway mileage; of which 98% correspond to two-lane and multi-lane highways. Often times, a rural highway goes through small communities with a variety of conditions, including adjacent land use context (e.g., agriculture farm land, light development), roadway characteristics (e.g., number of lanes, access point density, free flow speed, terrain), and traffic control (e.g., isolated signalized intersections, roundabouts). The same facility can serve multiple purposes, such as through movement or local traffic, and users, like motorists or bicyclists. The perception of quality of service of a rural highway can also vary, depending on the user and purpose. In this regard, providing a multimodal, facility-based evaluation methodology that currently does not exist is of interest to state DOTs.

A significant gap in the Highway Capacity Manual (HCM), Sixth Edition (Transportation Research Board, 2016), is the facility analysis of rural roads. The HCM contains procedural analysis techniques for uninterrupted flow two-lane and multiline segments, but it does not contain a technique to analyze the capacity and level of service for rural highways with different segment types at the facility level. The HCM also contains facility analysis techniques for other roadway types (i.e., interrupted flow urban streets and freeways), but not for rural highway facilities. Work with two-lane highways should build upon the work completed in NCHRP 17-65, “Improved Analysis of Two-Lane Highway Capacity and Operational Performance”. Currently, facility level analysis for rural highways in Germany is addressed in German HCM, however not in the United States. Given that the HCM is nationally accepted as the primary source on highway capacity and quality of service, not having a technical approach to address many of the nation’s highways is a major limitation.

Another limitation of the current HCM methodology for rural highways is the analysis horizon, which is limited to a single study period. Recently, the HCM incorporated a methodology to evaluate travel time reliability for freeways and urban
streets (Chapters 36 and 37), through the work of SHRP 2 Project L08, “Incorporating Travel Time Reliability into the Highway Capacity Manual”. With this approach, the analysis horizon is expanded to an extended time horizon of several weeks or months to evaluate the variability and the quality of service the facility provides to its users. Using a distribution of level of service values mimics the variability of traffic conditions on the facility and provides a better understanding of the quality of service across time. By having more appropriate level of service measures for these types of facilities, states can better allocate their scarce resources.

In parallel, the AASHTO Policy on Geometric Design of Highways and Streets (commonly known as the Green Book), 7th Edition, has introduced the consideration of context classifications as an element of the geometric design process. The two new context classes supplement, but do not replace, the functional classification system. The rural class applies to roads in rural areas that are not within a developed community, while the rural town class applies to roads located in developed communities. The classification results from the NCHRP 855 Project, “An Expanded Functional Classification System for Highways and Streets”. Given the known relationship between geometric design features and traffic operations, incorporating the Green Book’s context classification into the HCM for highway capacity analyses and design is needed.

IV. LITERATURE SEARCH SUMMARY

Most of the operational research conducted on two-lane and multilane uninterrupted flow segments were conducted in homogeneous segments in rural context (Al-Kaisy and Durbin, 2008; Al-Kaisy and Karjala, 2010; Oregon Department of Transportation, 2010; Bessa et al., 2017; Moreno et al., 2016; Al-Kaisy et al., 2016, Washburn, 2018). However, capacity and driver experience is typically controlled by some isolated signalized intersections and other control conditions related rural town contexts. A common example is a rural highway that passes through a small community or hamlet where 55-mph speeds are not suitable for the environment they are entering. Changing the character of the highway by gradual speed reductions are encouraged over the length of the transition zone and maintained through the community (Torbic et al, 2012; Moreno and Garcia, 2013; Maryland DOT, 2001; Oregon DOT, 1999). Common treatments comprise roundabouts and traffic calming techniques, as well as signalized intersections. To address access needs, two-way left turn lanes are often used. The current HCM analysis procedure does not entail control conditions nor multiple segment contexts. Therefore, facility-based analyses herein should be approached with alternative procedures.

Despite the fact that rural highways operations have been widely studied in an uninterrupted flow context, only a handful of studies that started considering rural highways facilities as a whole were identified. Yu and Washburn (2009) developed a methodology for the operational analysis of a two-lane highway that includes occasional isolated signalized intersections. They determined the effective influence
area of the signalized intersection and the effect on the facility quality of service. In a follow-up study, Li and Washburn (2014) implemented the methodology in CORSIM and provided additional guidance for facility segmentation and thresholds. The methodology could be amenable to the incorporation of a variety of segment types, such as multi-lane highways, intersections, roundabouts or passing through small communities.

Further, some transportation agencies have continuous data that could be used to calibrate the HCM procedure to local conditions. However, preferred performance measures for rural highways, such as percent followers or follower density, present a considerable dispersion for similar traffic and geometric conditions (Moreno et al., 2016; Bessa et al., 2017). In this sense, reliability on percent followers or follower density for the same facility could better assess the level of service expected by drivers. Nevertheless, the implications of reliability have been unexplored for two-lane highways.

Recreational bicycling has grown, including long-distance bicycle travel in rural areas. There is a sparse literature on bicyclists behavior on rural highways. Torres et al. (2017) argue that several factors attribute to cyclists speed selection, being highway alignment the most important. In some downhills, the speed of cyclists was even higher than motorists. Alignment also influenced cyclists platoon size, which had direct impact on how motorists overtake cyclists. In this regard, the presence of bicyclists along the highway reduced the speed of motorists (Llorca et al., 2017). However, there is a lack of research in determining how actual drivers and cyclists perceive the quality of service provided by these highways; and how the presence of cyclist influence motorists. Level of service thresholds have been set by knowledgeable professionals without actually being based on user perceptions.

V. RESEARCH OBJECTIVE

The objective of this research is to develop nationally accepted capacity and quality of service reliability techniques for rural road facilities accounting for the new context and functional classifications of the Green Book, 7th edition. The intent is that the research would lead to development of a new chapter in the HCM.

The following tasks are proposed in order to achieve this goal:

Task 1. General Work Plan. The objective of this task is to develop a general work plan that target the objectives of the study and validate the project objectives, desired deliverables and project schedule.

Task 2. Literature Review and Current Practice. The objective of this task is to review relevant literature, but not limited to the HCM, state procedures, Federal Highway Administration source materials and international input.

Task 3. Draft Methodologies. The objective of this task is to develop draft methodologies on proposed analysis for rural facilities, describing the expected
inputs, outputs, strengths and limitations. The most appropriate service measure(s) or a way of combining multiple service measures encompassing various segments (e.g., two-lane segment, multilane segment, signalized intersection influence area, roundabout) and their reliability will be determined. The AASHTO Green Book new functional and context classifications must be explicitly incorporated. Methodologies for calculating reliability in rural highways must be developed. Motorized and non-motorized modes must be included.

**Task 4. Data Collection Plan.** This task aims to develop plans to guide the collection of data for rural and rural town contexts. The research agency is expected to develop a comprehensive list of study locations in a manner that the data reflects different traffic scenarios throughout the country, as well as the key parameters to be collected and which approaches or sources will be adopted to collect data.

**Task 5. Data Collection and Preliminary Results.** The objective of this task is to implement the approved data collection plan developed in Task 4. The task also includes the preliminary analysis of the data against the proposed draft methodology from Task 3, indicating needs for method review, additional validation, as others.

**Task 6. Validation and Methodology Refinement.** The objective of this task is to comprehensively analyze and validate the data collected in Task 5, and perform any methodology refinement needs previously identified.

**Task 7. Report.** The Report shall summarize the work performed on the previous tasks, along with significant conclusions and recommendations for implementation. The report shall include a guide that addresses rural facilities and should be suitable for potential inclusion in a future update of the HCM.

### VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$400,000

**Research Period:**

24 months

### VII. URGENCY, POTENTIAL BENEFITS AND IMPLEMENTATION

In using existing uninterrupted flow two-lane highway segment techniques, states get poor or even failing level of service results in rural and rural town context. This often leads to costly roadway expansions and excessive highway widening in small communities in order to meet level of service standards, especially when the
analysis is for a single time horizon and does not include reliability on the performance measure. By having more appropriate level of service measures for rural highways and their consideration as a whole facility, states can better allocate their scarce resources.

Additionally, HCM and Green Book provide different highway classifications. Updates to the HCM shall incorporate new Green Book’s functional and context classifications for consistency between the two major references of designing and operating rural highways at national level.

The vision is that this research will lead to a new chapter in the HCM. Any changes or updates to the HCM will need to be formally adopted by the TRB Highway Capacity and Quality of Service (HCQS) Committee (AHB40).

IX. REFERENCES

• Maryland Department of Transportation (2001). When Main Street is a State Highway - Blending Function, Beauty and Identity: a Handbook for Communities and Designers.

- Oregon Department of Transportation (1999). Main Street... When a Highway Runs Through It: A Handbook for Oregon Communities.
- Oregon Department of Transportation (2010). Modeling Performance Indicators on Two-Lane Rural Highways: The Oregon Experience.

X. PERSON(S) DEVELOPING THE PROBLEM

- Ana Moreno, Senior Research Associate, Technical University of Munich, Arcisstr. 21, 80333 Munich, Germany, ana.moreno@tum.de, (0049) 89-289-22879

XI. PROJECT MONITOR

Jessie X. Jones, P.E.
Division Engineer
Transportation Planning and Policy Division
Arkansas Department of Transportation
10324 Interstate 30, Little Rock, AR 72203-2261

Bill Knowles, P.E.
State Traffic Analysis Engineer
Transportation Planning and Programming Division
Texas Department of Transportation
125 E. 11th St., Austin, TX 78701-2483

John R. Engle, P.E.
Michigan DOT - Congestion and Mobility Unit
Operations Field Services
XII. SUBMITTED BY

Provide contact information for individuals submitting or supporting this problem statement. If an organization, e.g., an AASHTO committee, is listed, include the name and contact information for an individual associated with the organization.

NCHRP Review of B-26

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
The proposed research is appropriate for the NCHRP. It would develop new capabilities within the HCM by allowing the aggregation of performance measures along a roadway that does not qualify as a freeway or an urban street--the majority of roadway miles operated by state DOTs.

The results will be important for planning and design decisions, such as roadway expansions, improvements for multimodal facilities, intersection improvements, and new facilities (along with roadsides and medians).

Review Date:
11/20/2018

AASHTO Committee Evaluation for B-26

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This submission is supported by Council on Active Transportation based on survey results.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement  
Problem No: 2020-B-27

1. **Problem Title**  
Handbook for Sustainable Roadside Stormwater Infrastructure

2. **Background**  
The challenges of climate change intensify the focus on the need for resilient and sustainable transportation systems. More intense storm events associated with changing weather can cause flooding and undermine the safety and integrity of the roadway. Sustainable practices for roadside stormwater management have a dual purpose of protecting the roadsides that support infrastructure functionality, while lessening the burden on traditional drainage infrastructure. Departments of Transportation (DOTs) are in a unique position to make a significant impact in sustainability because of the acreage of land associated with highway systems. Consolidation of design and maintenance strategies used on roadsides, research documentation, and dissemination of those strategies will advance the state of the practice enabling DOTs to better meet the growing demands of stormwater management along the roadsides, protecting both transportation assets and the environment.

Sustainable practices for roadside stormwater management is often referred to as "Green Infrastructure," however there is not yet a consistent definition for that term. The intent of this problem statement is to narrow the focus on roadside stormwater management using "green" alternatives instead of conventional piped drainage and water treatment systems. Specifications, details, trends, innovation, and industry practices and advances can be consolidated and made available to DOT practitioners as described in the Resilient and Sustainable Transportation Systems Steering Committee Action Plan, thus furthering the use of green infrastructure in the transportation arena.

3. **Literature Search Summary**  
A literature search was performed using the TRID database to locate a standard or guideline for green stormwater infrastructure as it applies specifically to roadsides. A vast number of case studies and reports were identified, but there is a need to glean the findings to isolate design strategies that are most appropriate for use on highway systems and distill the findings into a practical, usable format. A comprehensive search of State DOT documents will complement this effort.  
*The following are some examples of the literature available:*

AASHTO Practitioner's Handbook 13
Developing and Implementing a Stormwater Management Program in a Transportation Agency
Center for Environmental Excellence by AASHTO (American Association of State Highway and Transportation Officials), 2009
This document provides a background briefing, key issues to consider and practical tips for achieving compliance, but does not offer details and specifications at a construction contract level of detail.

ACRP Research Report 174; 2017
Green Stormwater Infrastructure; Volume 1: Primer
James W. Jolley, Mary Ellen Tuccillo, Michelle L. Young, Michael Barrett, Anna Lantin
Airport Cooperative Research Program; The National Academies Press; http://nap.edu/24817
This publication describes Green Stormwater Infrastructure (GSI) as it applies to airports.

ACRP Research Report 174; 2017
Green Stormwater Infrastructure; Volume 2: Guidebook
James W. Jolley, Mary Ellen Tuccillo, Michelle L. Young, Michael Barrett, Anna Lantin
The National Academies Press; http://nap.edu/24816
This publication is the companion to volume 1 and discusses BMPs in more detail.

NCHRP 20-68A Domestic Scan 16-02
Leading Landscape Design Practices for Cost-Effective Roadside Water Management
This scan was initiated by Caltrans.

NCHRP 565
Evaluation of Best Management Practices for Highway Runoff Control
Oregon State University, GeoSyntec Consultants, University of Florida, The Low Impact Development Center, Inc.
Transportation Research Board, 2006
This provides guidance for the selection of BMPs.

Proceedings of the 2015 International Low Impact Development Conference
LID: It Works in All Climates and Soils
Michael Barrett, Editor
ASCE, American Society of Civil Engineers; ascelibrary.org
This collection of technical papers addresses a wide range of topics that are relevant to sustainable stormwater management, some of which may be appropriate for roadside applications.

Washington State Department of Transportation
This manual is specific to the state of Washington.

https://www.epa.gov/green-infrastructure/green-infrastructure-design-and-implementation#Design%20Manuals
This link leads to a collection of links to various States’ literature.

State of California, Department of Transportation
Division of Research, Innovation and System Information
State of the Practice on Design Guidance for Green Infrastructure
This Preliminary Investigation (literature search) is currently underway.

4. Research Objective
The research objective is to identify research literature and existing "Green Stormwater Infrastructure" (GSI) best practices for roadside implementation. In addition to compiling State DOTs and other transportation organizations' research findings and applications, the goal is to provide a compendium of best practices for transportation agencies' use—a handbook for GSI on roadsides that includes the following for each of the BMPs selected for inclusion in the final report:

1. Need analysis and site appropriate BMP selection
2. Design (including specifications and details)
3. Construction
4. Maintenance
5. Costs (of construction and maintenance listed separately)

This is not intended to be an overview of low impact development, but a practical handbook to assist landscape architects and engineers preparing construction contract documents for transportation agencies.

5. Implementation Planning
Once the handbook is finalized, it should be made available free of charge as an ebook. An online outreach to Departments of Transportation, academic and professional societies, and other interested parties will facilitate dissemination of the research product.

Deployment is a key aspect of this research, and for that reason, it is suggested that a second phase be considered to develop and execute dissemination. Print copies of the handbook should be considered. A learning module may be developed for use at presentations and workshops offered by employers to equip staff with these tools. Other means of deployment may be considered.

6. Estimate of Problem Funding and Research Period
Recommended Funding:
It is estimated that conducting the proposed research will require $300,000. If successful, a second phase will be proposed under separate funding to deploy the findings as described under Section 5, "Implementation Planning."

Research Period:
It is estimated that the proposed research will require 24 months to accomplish, including two interim reports and the final review.

7. **Urgency and Potential Benefits**
The availability of an authoritative compendium of highway green stormwater infrastructure design, implementation, and maintenance practices will bring the state of the practice one step closer to making sustainable design choices the industry norm. While these innovative practices have been developing over the years, honing these techniques and disseminating the information will give practitioners the ready tools needed to secure these practices as accepted conventions. The handbook produced and distributed as a result of this proposal will improve the efficacy of GSI becoming an established practice in highway design and construction, moving our transportation systems nearer to the goal of sustainability. This will open new doors for further innovation. Without it, implementation of sustainable practices will continue to develop at the current rate, risking damage to transportation assets and the environment as climate change continues.

8. **Person(s) Developing the Problem Statement**
Jack Broadbent
Supervising Landscape Architect
State of California Department of Transportation
Landscape Architecture Program, Mail Station 28
1120 N Street
Sacramento, CA  95814
Phone:  916-653-3170
Email:  Jack.Broadbent@dot.ca.gov

9. **Nomination for AASHTO Monitor**
Leona Burk
Senior Landscape Architect
State of California Department of Transportation
Landscape Architecture Program, Mail Station 28
1120 N Street
Sacramento, CA  95814
Phone:  916-654-5996
Email:  Leona.Burk@dot.ca.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
Supported by:
- AFB 40 Landscape and Environmental Design
- AHD 50 Roadside Maintenance Operations

Others that may be interested:
- The Resilient and Sustainable Transportation System Steering Committee
- Committee on Environment and Sustainability (ETAP) Environmental Technical Assistance Program

11. Submitted By
Joe Horton
State of California Department of Transportation
Division of Research Innovation & System Information (DRISI)
1727 30th Street, 3rd floor
Sacramento, CA 95816

NCHRP Review of B-27

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
This problem statement proposes to develop practitioner-focused guidance on stormwater BMPs. Updated information on roadside designs that can be integrated with watershed or regional and off-site approaches could support DOTs in their efforts at compliance and stewardship in this important environmental area. NCHRP has invested in several complementary projects in recent years. For example, NCHRP Report 840 (2017) addresses off-site BMP applications; NCHRP 25-53 (forthcoming) will address watershed- and regional-scale TMDL programs; NCHRP 25-25/Task 101 (2017) outlines the design of monitoring programs; and considerable information on costs of BMPs is provided in NCHRP Report 792 (2014). A resource focused on "green" roadside BMPs from a perspective of resilience could both complement and update existing research.

Review Date:
11/19/2018

FHWA Evaluation of B-27
Damaris Santiago/HEP - This seems like another effort of having a stormwater BMP handbook. There are many such handbooks out there that don't just focus on "conventional piped drainage and water treatment systems."

---

**AASHTO Committee Evaluation for B-27**

*Submitted By:*  
Eric Kopinski  
AASHTO Staff  
Committee on Environmental and Sustainability (CES)

*Comments:*  
Selected by AASHTO CES as third highest ranked problem statement.

---

*Submitted By:*  
Patricia Bush  
AASHTO staff  
Committee on Design

*Comments:*  
The Committee on Design's Technical Committee on Hydrology and Hydraulics is supportive of this research. Please include a TCHH member on the panel.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement
Problem No: 2020-B-28

1. Problem Title
Application of Carbon Capture, Utilization, and Sequestration Technologies to Transportation Infrastructure Construction Materials

2. Background
Carbon capture Utilization, and sequestration (CCUS) technologies have the potential to be applied in production of industrial materials (e.g., PCC and asphalt concrete, aggregate) used in the construction of transportation infrastructure such as roads and bridges. CCUS materials have been proposed to be used in number of ways. For example, for one potential application, the CCUS material can be used as a coating for aggregates which can in turn be used in embankments, retaining wall fill, or as the aggregate constituent in portland cement and asphalt concrete materials. However, there is a lack of information on the state of maturity, feasibility, and environmental benefits of CCUS technologies in industrial materials regarding their potential to reduce greenhouse gasses (GHG) emissions related to transportation infrastructure construction activities.

3. Literature Search Summary
A literature review and product status survey was conducted as part of a preliminary investigation process. The preliminary investigation was completed on July 2018. During this process, private sector CCUS-based companies and research groups were consulted and research papers on CCUS technologies were reviewed. A survey of state departments of transportation (DOTs) to identify agencies that have experience with construction materials produced using CCUS technologies was also conducted. The summary of the findings from this effort indicate that no reported applications of CCUS-based construction materials on large-scale transportation projects are yet available.

One of the CCUS-based companies consulted, Blue Planet Ltd., combines captured CO\textsubscript{2} with metal oxide(s) like calcium oxide sourced from industrial/construction waste material(s) to form carbonate minerals (limestone). A substrate is then coated with this limestone to produce a CO\textsubscript{2}-sequestered construction aggregate for use in concrete. Blue Planet’s technology can produce a range of ASTM-compliant products, including lightweight, standard weight and high-strength limestone-coated aggregates; supplementary cementitious materials; and remediated recycled concrete aggregates. Small batches of material are being produced in the company’s lab-based pilot line. Blue Planet is developing a larger production facility but it is not yet completed.
The other CCUS-based company, CarbonCure Technologies Inc., uses CO₂ captured from emissions that has been purified and liquefied, and delivered to partner concrete producer plants in pressurized tanks. CarbonCure technology injects the recycled CO₂ into wet concrete while it is being mixed. The company’s primary products are masonry blocks and ready-mixed materials. The ready-mixed product is a poured—not precast—concrete. CarbonCure is currently working with two concrete producers—Central Concrete Supply Company Inc. and Outback Materials—to retrofit production facilities that can provide CarbonCure ready-mixed materials. This company is in the process of scaling up its process to provide for larger-scale projects.

The third CCUS-based company that was consulted is Mineral Carbonation International. Mineral Carbonation International has developed a process that reacts captured CO₂ with quarried low-grade minerals in a continuous industrial process. The company is primarily focused on developing carbonate-based products using CO₂ and low-grade minerals and wastes as feedstock. Mineral Carbonation International has a plan to move towards industrial demonstration.

Two research groups are currently working to further advance CCUS-based technologies. *Carbon Upcycling UCLA, a University of California, Los Angeles research group, uses carbon upcycling to fabricate CO₂NCRETE, a near CO₂-neutral construction material. The process uses flue gas exhausted from power plants or cement plants “by efficiently recovering waste heat and enriching CO₂ present in the gas stream. A novel binder system based on calcium hydroxide (hydrated lime) is mixed with aggregates and admixtures to form a shape-stabilized CO₂NCRETE building element. The final and key step lies in combining the captured CO₂ with CO₂NCRETE element via a carbonation reaction (i.e., CO₂-mineralization) to form a solid building component.” The project team at UCLA is seeking funds to support the lab-scale proof of concept. After completing the proof of concept, the technology could be commercialized over the following five to seven years.*

The second research group is out of University of Aberdeen in Scotland. This group known as Carbon Capture Machine uses a technology that dissolves combustion CO₂ from any source in dilute alkali, converting it to carbonate ions with efficiency approaching 100%. The carbonate solution is reacted with readily and abundantly available calcium (Ca++) and magnesium (Mg++) brines to selectively precipitate CaCO₃ (Precipitated Calcium Carbonate, PCC) and MgCO₃·3H₂O (Precipitated Magnesium Carbonate, PMC).” A multistage precipitation technology is used to separate and produce nearly insoluble Ca and Mg carbonate minerals that have useful properties. The resulting conversion products are “carbon negative, high value feedstocks that are in demand across many industries, and are currently used in papermaking, plastics, paints and adhesives; future applications in cement and concrete are under development.
The state DOTs survey was distributed through AASHTO Committee on Construction and 13 state DOTs responded to the survey but none of the state DOTs reported on experience with CCUS-based construction materials.

4. **Research Objective**

The literature search and preliminary investigation has shown that CCUS-based technologies have some potential to help reduce GHG emissions and achieve emission targets but the following key questions need to be fully addressed before testing and implementing these technologies on large-scale projects:

- To what extent have CCUS material production processes been studied and documented to date?
- What commercial options currently exist to use CCUS-based construction materials (e.g., concrete, aggregates) on projects?
- Can CCUS-based construction materials currently be produced in quantities to support large-scale transportation infrastructure projects? Do industrial-scale manufacturing processes exist at this time? Are there well-documented case studies available?
- Have the environmental benefits of CCUS-based construction materials been quantified using Life Cycle Analysis (LCA) or techniques used in an Environmental Product Declaration (EPD) as defined by ASTM?
- Does the existing body of research substantiate claims that CCUS-based construction materials produce a net savings in environmental impacts?
- How do the additional costs of producing CCUS-based construction materials compare with conventional construction materials? Are equivalent or greater environmental benefits achievable at the same scale with other (less costly) mitigation strategies?
- Do CCUS-based construction materials impact the durability, longevity, maintenance, constructability, or performance in infrastructure-specific applications (e.g., structural concrete)? Are there environmental conditions (e.g., weather, moisture, etc.) that require special consideration? Are there maintenance-related activities (e.g., concrete surface grinding, material disposal, chemical de-icing treatments, etc.) that require special consideration?
- What are the implementation barriers that will potentially prevent from deploying these technologies?

5. **Implementation Planning**

For those CCUS technologies that are proven to answer the aforementioned key questions, a field testing will be planned and conducted. The field testing will generate new process documents, specifications, and implementation plans on how to use CCUS technologies as one of the tools to reduce GHGs in transportation infrastructure construction activities.

6. **Estimate of Problem Funding and Research Period**
**Recommended Funding:** $500,000

**Research Period:** 30 months would be needed to accomplish the objective.

7. **Urgency and Potential Benefits**
CCUS-based technologies have the potential to reduce GHG emissions and contribute to sustainable transportation infrastructure development. State DOT's actively work to reduce their carbon foot print that arise from transportation construction activities. For instance, California Department of Transportation (Caltrans) is legislatively mandated to achieve GHG emission goals and failing to fund this project will preclude Caltrans from using this cutting-edge technology to achieve its emmision goals and contribute to conservation of the environment.

8. **Person(s) Developing the Problem Statement**
Daniel Speer, Deputy Division Chief (Principal Transpiration Engineer)
Caltrans Division of Engineering Services
5900 Folsom Blvd., Sacramento, CA 95819
(916) 227-7254; daniel.speer@dot.ca.gov

9. **Nomination for AASHTO Monitor**
Jacquelyn Wong, Senior Transportation Engineer
Caltrans Office of Structural Materials
5900 Folsom Blvd., Sacramento, CA 95819
(916) 227-7205; Jacquelyn.Wong@dot.ca.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
Jointly submitted by the AASHTO Committee on Construction, the TRB Standing Committee on Construction (AFH 00), and the California Department of Transportation.

11. **Submitted By**
Joe Horton, California DOT
DRISI
1727 30th Street, 3rd Floor
Sacramento, CA 95816

---

**NCHRP Review of B-28**

Reviewed By:
Amir N. Hanna
ahanna@nas.edu
Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem is unlikely solvable through the proposed research. Carbon Capture, Utilization, and Sequestration is a new technology driven by industry interests, its applicability to construction materials has not been established, and involves proprietary products. Feasibility of this technology and its potential for use in producing construction materials that provide the desired levels of strength and durability need to be investigated and documented—a role that appears to belong to the interested industry and promoters of the technology. The findings from such investigations are needed to determine the viability of this technology and its applicability to highway infrastructure, and if research under the NCHRP is warranted.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

Considering the lack of documented information to support applicability of the proposed technology to highway construction materials, it is unlikely that many state DOTs will have interest in the topic; it is expected that very few state DOTs will have a limited interest in this technology.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, lists many issues that need to be addressed, but does not provide a clear/specific intent of the research.

D. Is the scope of the research reasonable?

The scope as derived from the stated objective is extensive. It covers a large number of issues that require substantial resources to address.

E. Can the research be done in 2-3 years at the most?

Recognizing the many issues that need to be addressed, the not well-defined project objective, the proprietary nature of the proposed technology, and lack of documented information to support the research, its is unlikely that usable findings can be accomplished within a 3-year time frame.

F. Is the budget adequate?

Considering the many issues associated with this new technology and the lack of documented information to support its applicability to highway construction materials, it is unlikely that practical findings can be achieved with the proposed budget.

G. Comments on current or past research on the topic.
As noted in the problem statement, limited research has been performed on the topic that can be used as the basis for developing a good research plan and achieving implementable results.

Review Date:
12/6/2018

FHWA Evaluation of B-28

Sivaneswaran Nadarajah/HRDI; H.Dylla/HIF; Mike Culp/HEPN - There are other related national R&D efforts, including at DOE’s NETL.? If this project is selected, having someone from DOE’s NETL in the panel would be beneficial.? Also, the effort is strictly a review and documentation of literature and ongoing efforts in CCUS - given that, recommended funding is high.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  
FY2020 NCHRP Problem Statement Outline

Problem No: 2020-B-29

1. **Problem Title**
   Analytic approaches to understand how freight transportation is influenced by land use context and transportation conditions.

2. **Background**
   The SHRP2 C20 Freight Demand Modeling and Data Improvement program (SHRP2 C20) recommended strategies provide the strategic framework for continuous improvement and innovative breakthroughs in freight transportation forecasting, planning, and data.\(^1\) While SHRP2 C20 completed many advancements to the state of the art, not all research needs could be completed. One research area that was identified by the expert panel, but not implemented, was to establish analytic approaches that describe how elements of the freight transportation system operate and perform and how it is affected by the overall transportation system. In addition, some of the SHRP2 C20 research efforts that were completed highlighted the need for additional research on how freight activity and land use interact at the system level, based upon the spatial distribution and context of land use.\(^3\) This research proposal draws from and builds on these previous initiatives.

This research would build on the work conducted with SHRP2 C20 to enhance methods for estimating Freight Trip Generation (FTG) for transportation and land use planning by gaining insight into how freight transportation is affected by transportation system conditions and land use context. It will also evaluate how transportation system conditions and land use context influence key characteristics of freight movement to better support freight transportation planning.

The first aspect, transportation system conditions, would be framed based upon traffic operations, congestion, and transportation infrastructure, including capacity, congestion, connectivity, context sensitive design, Transportation System Management and Operations (TSMO) strategies, and constraints related to competing transportation needs. The second aspect, land use context, would consider population/employment density, land use patterns/diversity/mix of land uses, design, location (urban core to exurban/rural), and relationship to larger regional centers. This would examine how these variables affect FTG factors for mode choice, vehicle size, frequency of trips, timing of trips, and truck touring characteristics under different scenarios. The research will need to consider these variables for both long-haul shipping and local deliveries.

3. **Literature Search Summary**

\(^1\) Freight Demand Modeling and Data Improvement, SHRP2 Report S2-C20-RR-1, TRB, 2013.
\(^3\) Freight and Land Use Travel Demand Evaluation: Final Report, SHRP2 C20, FHWA, 2018.
This research will build upon the work done through SHRP2 C20. This along with other related research includes:

- **SHRP2 C20– Freight Demand Modeling and Data Improvement, 2013.** The SHRP2 C20 initiative assesses the state of the practice of freight demand modeling and freight data as related to highway capacity planning and programming. SHRP2 C20 included many Implementation Assistance Pilot (IAP) projects, many of which can serve as a source of information for the proposed research. The research noted that one of the challenges is identifying how freight operations are affected by passenger travel and land uses that potentially conflict with freight activity. This research proposal builds on these initiatives.

- **SHRP2 C20– Freight/Land Use Travel Demand Evaluation, 2018.** This report identifies and documents noteworthy practices and tools for analyzing how land use, local economic development, and demographic factors drive freight movement, trip generation, and freight demand. The report recommends models include a set of options suitable to diverse scales and contexts, and not a "one-size-fits-all" approach. This report serves as a strategic action plan to improve the integration of land use with freight demand analysis. The proposal builds on this prior research.

- **FHWA Freight and Land Use Handbook, 2012.** This handbook provides tools and resources to assess the impacts of land use decisions on freight movements, as well as the impacts of freight development and growth on land use planning goals. However, this handbook focuses more on policy and planning than on quantitative tools to forecast FTG.

- **FHWA, Quick Response Freight Manual (QRFM), 2007.** The QRFM provides information on the freight transportation system and factors affecting freight demand, helps locate available data and freight-related forecasts, and provides guides for developing freight forecasts. It describes several types of models and addresses how the transportation forecasting process is used to forecast goods movement. FHWA is currently updating this manual.

- **NCFRP Report 8: Freight-Demand Modeling to Support Public-Sector Decision Making, 2010.** This report evaluates possible improvements in freight demand models and other analysis tools and provides a guidebook to assist model developers in implementing these improvements.

- **NCFRP Report 24: Smart Growth and Urban Goods Movement, 2013.** This report summarizes literature on the impacts of smart growth on goods movement and identifies areas for further research. It identified limitations of current modeling for addressing smart growth and urban goods movement. This included needed research for conflicts between trucks and non-motorized modes, trip reduction, and innovative distribution methods in smart-growth environments. The proposed research will address these questions.

- **NCFRP Report 37: Using Commodity Flow Survey Microdata and Other Establishment Data to Estimate the Generation of Freight, Freight Trips, and Service Trips: Guidebook, 2017.** This report provides methodologies for estimating FTG using commodity flow data and establishment characteristics for type of economic activity performed. The models provide Freight Generation (FG), Freight Trip Generation (FTG), and Service Trip Generation (STG) rates.
per employee for each classification of commercial establishment based upon NAICS codes. The proposed research will build on these models by providing additional parameters for transportation system conditions and land use context.

- NCHRP Synthesis 384, *Forecasting Metropolitan and Commercial Freight Travel*, 2008. This synthesis identifies methods of freight and commercial vehicle forecasting. Methods are described in relation to data collection, model estimation, and model validation. Some of the limitations identified by this report were examined by SHRP2 C20 and the proposed research would build on those efforts.

- NCHRP Synthesis 406, *Advance Practices in Travel Forecasting*, 2010. This synthesis evaluates the use of travel modeling and forecasting tools, including: activity-based demand, dynamic network, land use, freight, and statewide. The proposed research would provide additional methodologies that could be incorporated into these models.

- NCHRP Report 739: *Freight Trip Generation and Land Use*, 2012. This report discussed important elements of FG, FTG, and STG. This was superseded by NCFRP Report 37.

- NCHRP Report 758, *Trip Generation Rates for Transportation Impact Analysis of Infill Developments*, 2013. This report provides a process for estimating vehicular trip generation in built-up urban areas, incorporating the effects of site-specific land use and transportation characteristics for infill development. This report covered all types of trips and adjustments to truck trip generation rates still requires additional research.

- NCHRP Report 844 Guide for Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments, 2017. This report summarizes a range of strategies for accommodating demand for goods movement and operations given the context-sensitivity of particularly freight-sensitive land uses. It did not provide models for FG.


### 4. Research Objective

The outcomes for this research will enhance tools and techniques for freight travel demand analysis and planning. It will provide an understanding of how freight activity is influenced by land use context. In addition, it will allow for an understanding of how freight movement will adapt within the context of transportation system design and operations. This will support the further integration of land use and transportation planning. The tasks will include:

1. Establishment of an expert panel who will be able to provide input on the research process, selection of MPO areas to analyze, and evaluation of results.
2. Detailed review of literature on freight travel demand models, and techniques.
3. Selection of MPO areas to analyze with established freight travel demand models. These may include MPOs that were part of the SHRP2 C20 IAP for behavior-based freight models.
4. Evaluate data from select MPO areas to identify the relationship between FTG factors for mode choice, vehicle size, frequency of trips, timing of trips, and
truck touring against variables for land use context and transportation system conditions. These will be defined during the process, but will likely include variables such as:

- Congestion and travel time reliability.
- Network connectivity, context sensitive design, and other transportation modes.
- Local regulatory constraints on delivery times or parking restrictions.
- Implementation of TSMO strategies.
- Interaction and conflict between trucks and non-motorized modes in urban environments.
- Population and employment density.
- Land use patterns/diversity, design, and location (urban core to exurban/rural).

5. Implementation Planning
The final products will be improved analytic methods, models and tools that MPOs and State DOTs can utilize. Upon completion, the results will be incorporated into an update to the QRFM, published on the FHWA Freight Demand Modeling and Data Improvement webpage at https://ops.fhwa.dot.gov/freight/freight_analysis/fdmdi/index.htm, as well as other guidance from FHWA on freight planning, and integration of land use and transportation. Presentations will also be made for the Travel Model Improvement Portal (TMIP) https://tmip.org/.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $ 400,000.
Research Period: The research period for this project will be 2 years.

7. Urgency and Potential Benefits
The final products will be improved analytic tools and methods for understanding freight movement and forecasting FTG under different land use scenarios and transportation conditions.

- It will provide an understanding of how freight activity is influenced by land use context. This will also support the further integration of land use and transportation planning.
- It will highlight how freight movement adapts to the context of transportation system design and operations. This will provide a better understanding of the effect TSMO has on truck movements and decisions for mode, route, and time of day. It will also provide insight on the relationship between travel time reliability and freight performance.
- It will develop improved analytic tools to enhance long-range transportation plans that meaningfully consider goods movement. This will provide improved methods to evaluate of long-term freight transportation needs and investment alternatives to support state and regional economic development.

8. Person(s) Developing the Problem Statement
Jeff Purdy, AICP, PTP
9. **Nomination for AASHTO Monitor**
The AASHTO Monitor will be assigned by NCHRP staff.

10. **Potentially Interested AASHTO Councils and/or Committees**
- AASHTO Special Committee on Freight
- AASHTO Committee on Planning
- AASHTO Committee on Transportation System Operations-Working Group on Freight Operations

11. **Submitted By**
Jeff Purdy, AICP, PTP
Federal Highway Administration
Office of Freight Management and Operations
1200 New Jersey Avenue, SE
Washington, DC 20590
202-366-6993
Jeffrey.Purdy@dot.gov

---

**NCHRP Review of B-29**

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:

The freight trip generation (FTG) aspect was done in NCFRP-25(01) (Estimating Freight Generation Using Commodity Flow Survey Microdata), and the land use aspect is being addressed by NCHRP 08-111 (Effective Decision-Making Methods for Freight-Efficient Land Use), which will be completed in April 2019. However, the second aspect of the Background statement implies that the research should investigate how receivers decide which mode and vehicle to use in conjunction with the number of orders needed and shipment sizes, and this would be worthwhile to research. To do so, will require interviews, not internet surveys, which are expensive, but probably doable for $400,000.

Review Date:
11/30/2018
AASHTO Committee Evaluation for B-29

Submitted By:
Susan Howard
AASHTO Staff
Special Committee on Freight

Comments:
This research might better inform how freight delivery and transportation infrastructure interact. Once this relationship is better understood we can work on solutions such as those envisioned in B-25.
NCHRP Problem Statement

1. **Problem No:** 2020-B-30

2. **Title:** A Comprehensive Evaluation of the Benefits and Costs of Railroad Quiet Zones

3. **BACKGROUND**

In response to a statutory mandate, the Federal Railroad Administration (FRA) developed rules governing the sounding of locomotive horns at highway-railroad grade crossings. The resulting rules were implemented in 2005 and made final in August of 2006. These rules included guidelines for establishing Quiet Zones, segments of railroad where locomotive engineers are not required to routinely sound locomotive horns at grade crossings. In order to implement quiet zones, applicant communities must usually implement engineering measures intended to guard against degraded safety outcomes.\(^1\) In response to this opportunity, local communities have successfully applied for and created several hundred quiet zones throughout the United States.\(^2\) Since implementing the rules that allow for the establishment of quiet zones, the FRA has twice evaluated the effects of quiet zones on safety outcomes and found that their implantation has not reduced safety performance over what might have been expected had trains continued to sound their horns. In October of 2017, the Government Accountability Office (GAO) delivered a relatively critical assessment of the FRA’s monitoring and evaluation of quiet zones. Specifically, the GAO report questions the validity of the FRA’s safety assessment and notes that neither the FRA nor anyone else has attempted to measure the benefits attributable to establishing quiet zones.

4. **Literature Search Summary**

The TRB database shows 36 entries of research related to quiet zones, the majority of this work was completed before 2007, shortly after quiet zones were introduced. These reports speak to noise annoyance, pilot studies and community planning efforts, but none of these reports assess the cost benefit of proposed projects. Four reports have been completed in the past two years, one is in German, one compares the rider experience in Australia. In 2018 Nebraska completed a study looking at prediction models but did not focus solely on the benefit cost of quiet zones. This problem statement was developed specifically to address the concerns a 2017 GAO report makes clear, stating that there is a paucity of research regarding the benefits attributable to railroad quiet zones. The GAO report notes that the FRA has not undertaken this sort of analysis, nor is there robust academic research that can be

---

\(^1\) These measures include but are not limited to channelizing motor vehicle traffic through by installing curbs and medians or the installation of four-quadrant gates. While rare, there are cases where existing safety measures are sufficient, so that it is possible to implement quiet zones without modifications to the subject crossings.

\(^2\) There is no routinely published and timely information describing the total number of quiet zones. However, this total stood at 203 in 2011, including 81 zones that were grandfathered under the 2005 FRA rules. By 2017, the number of post-rules, new quiet zones had grown to 570 across 42 states.
applied. The GAO assessment identified two academic papers that are somewhat relevant – one that examines the disamenities associated with proximity to railroad tracks and a second that focuses on noise disamenities from various sources, but neither paper is directly applicable to the evaluation of quiet zones; both are relatively dated; and both focus on narrow geographic areas. In preparing this Research Needs Statement, the Committee identified a third paper that does specifically value noise from train horns. Unfortunately, it also relies on extremely narrow geographic data and is also not particularly current.

5. RESEARCH OBJECTIVES
The proposed research would remedy the GAO’s criticisms by producing a benefit-cost analysis (BCA) for the establishment of quiet zones that:

- Accurately accounts for the variability in mitigation costs encountered in establishing quiet zones;
- More defensibly evaluates safety outcomes and their associated benefits or costs; and
- Measures aggregate quiet zone benefits, based variations in commercial and residential property values.

6. IMPLEMENTATION PLANNING
Based on the Research Objectives outlined above, the proposed research entails the execution of five specific tasks. These include:

- Design a set of hedonic (or similar) pricing models for both residential and commercial models with sufficient geographic and demographic variations to be broadly applicable in their results.
- Based on model design acquire the necessary data and estimate hedonic (or similar) pricing models that isolate the effects of quiet zones.
- Acquire and reconcile data that account for the implementation costs of existing quiet zones.
- Re-evaluate the FRA quiet zone safety outcomes based on the modeling suggested proffered within the GAO report and monetize those outcomes based on current U.S. DOT guidelines.
- Combine the analytical results in the development of a benefit-cost analysis specific to the implementation of quiet zones under current FRA guidance.

Certainly, we would expect the research to be made available through traditional outlets. However, given the pervasive and persistent interest in quiet zones, we expect that robust results would be quickly received and implemented.

7. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
This research is anticipated to be completed within 18 months, with a final report detailing the, results and policy recommendations. The estimated funding requirement for the requested research is approximately $400,000.

8. URGENCY AND POTENTIAL BENEFITS

The proposed research would certainly be of benefit to the FRA as it continues to evaluate and modify its rules regarding the establishment of quiet zones. The analysis would also be of value to state-level stakeholders who are routinely asked to evaluate and fund the remedial efforts necessary to quiet zone establishment. Most importantly, however, the results of the proposed research would provide communities with hugely useful information as they determine whether or not quiet zone designations are in the public interest.

9. Person Developing the Problem Statement

Mark Burton, Director Transportation Economics, Research Associate Professor, Center for Transportation Research, The University of Tennessee, 865-974-4358 mburton3@utk.edu
Libby Ogard, President Prime Focus LLC 920-217-7222 logard@new.rr.com
Tom Burns ORDC Project Development Manager 614-644-0293 Thomas.Burns@dot.ohio.gov

10. Nomination for AASHTO Monitor

Phillip Meraz, Rail Regulation and Analysis, Iowa DOT 515-239-1420 phillip.meraz@iowadot.us.

11. Potentially interested AASHTO councils or Committee

This statement was brainstormed at the AASHTO CORT (Committee on Rail Transportation) in Miami, FL held September 2018. Twenty four states were present.

12. Submitted by

- Iowa DOT – Phil Meraz, 515-239-1420
- Ohio Rail Development Commission - Tom Burns 614-644-0293
- Illinois Commerce Commission - Stephen Laffey 217-785-9026
- Wisconsin DOT – Lisa Stern 608-266-1010

NCHRP Review of B-30
The process of measuring costs and benefits attributed to establishing quiet zones pits safety issues against alleviating community disruption in terms of changes in asset valuation. When noise control measures are introduced, residential asset values generally increase. Noise control measures can also reduce the need for noise attenuation construction techniques, which translate into cost savings. Whether this is an NCHRP topic is somewhat questionable, except with a close tie-in to safety impacts and "costs" at highway grade crossings. Measuring the benefits of reduced noise on residential and commercial properties would require extensive literature search on previously documented experience on the cost of noise exposure, across a broad range of potentially relevant applications--airport noise and residential valuation, for example. Alternative means of valuation would require extensive surveys in environments affected by noise, which could add significantly to the cost of the study. Coupling this effort with the need to measure potential costs in relation to safety concerns is not an easy step, but may be tied to providing structural grade-crossing solutions where not previously available.
American Association of State Highway and Transportation Officials
FY2020 NCHRP Problem Statement Outline

Comments: This research problem was submitted by urban freight transportation committee and has support from the Tennessee Department of Transportation, Dan Pallme, TDOT

I. Problem Number: 2020-B-31

II. Problem Title
Engaging the “Right” Players to Expand the Playbook of Workable Urban Freight Solutions

III. Research Problem Statement
According to the US Department of Transportation’s Report, Beyond Traffic: 2045, U.S. freight volumes are expected to increase by more than 40% by 2045. Yet even today, our freight system faces multiple challenges, including but not limited to aging facilities, institutional fragmentation, increased congestion, and lack of public understanding and support. These issues are particularly acute in urban areas where freight faces additional challenges of competing with passenger transportation and pedestrians for space for delivering, parking, and loading/unloading, not to mention navigating a myriad of financial, regulatory and permitting issues.

Solutions are needed, but given the fragmented nature of the system and the close proximity of freight operations with neighborhoods in urban areas, getting the “right” players to the table for discussions and determining how to best leverage relationships among them is imperative. One important example is provided by The New York City Off-Hour Delivery Project (NYCOHDP). Begun as a research project that brought together a number of stakeholders – most notably, the shippers, carriers, and receivers – the effort was eventually transitioned to a pilot through a partnership among private, public, and academic stakeholders.1 By involving the private stakeholders directly, the project leads were able to understand the constraints and expectations and where synergies might exist. It also enabled them to explore areas of support and antagonism to identify means for fostering the former and mitigating the latter.

As important as this work has been, further work is needed so that public sector practitioners can understand the full breadth of concerns and constraints, and critically examine levers for addressing them. To do this successfully, additional stakeholders that have not yet been engaged need to be invited to the table. For example, vehicle manufacturers and fleet providers consider a number of factors when they design and purchase vehicles, but these criteria may not dovetail well with street design and space requirements in urban areas. Rather than designing, purchasing, and deploying freight vehicles that are tailored to urban delivery, some vehicle manufacturers and carriers may use a “one-size-fits-all” approach, whether for reasons of cost-reduction, lack of

awareness, or lack of perceived demand for urban delivery-optimized vehicles. Some cities (Seattle and New Orleans, for example) have over time established restrictions on vehicle width and length in constrained downtown areas. More typically, however, public entities respond by providing accommodations, exceptions, or waivers even if these solutions are not as efficient as aiming for smaller and/or more maneuverable vehicles. Having vehicle manufacturers and fleet providers at the table with public entities and academics, along with carriers and drivers, could spur broader thinking and problem solving around vehicle selection much as the NYCOHDP did with respect to delivery timing.

Similarly, engaging the companies exploring automated vehicle technology in these discussions is also important, whether on the roads, rails, or in the air or waterways. Public policy processes and laws need to be rethought to make best use of these technologies. Further, technologies developed for one type of vehicle or mode may have implications or use cases for others. For example, as platooning has been discussed, much of the focus has been on intercity highways and trucks. However, there may be applications within cities as well, either on trucks directly or perhaps on buses. While the latter would aid passenger travel directly, there could be an indirect affect for urban freight as roadway capacity is freed up.

Hearing from these entities and engaging them in discussions has the potential to foster deeper and more well-rounded understanding of both public and private needs and constraints. Further, having public and private entities working together with these and other stakeholders not often included could lead to additional pilots and ultimately policy and process changes.

IV. Literature Search Summary
As noted earlier, The New York City Off-Hour Delivery Project offers an important example of how engaging stakeholders who are not typically included can lead to new and impactful solutions for urban areas. This particular project has been well discussed in the literature, with a number of papers and articles dating back to the earliest research on the matter that describe both the process and the outcomes. There has also been some literature regarding methods for engaging more stakeholders in freight discussions, though they typically revolve around how the public entity should

---


restructure or focus its efforts rather than on the types of stakeholders that should be sought.  

Critical examination of urban freight vehicle design and selection as a constraining input to public entities that oversee street design, construction, and freight operations has been limited in the literature. However, a number of recent reports and analyses have offered initial perspectives on the opportunity and means of doing so. Among them are:

- US Department of Transportation, Federal Highway Administration’s *Urban Freight Operations, Logistics, and Technology Primer*, which includes discussion on New Orleans’ truck length restrictions, London’s Safer Lorry Scheme and guidance on broadening stakeholder inclusion.  
- Transport for London’s “Direct Vision Standard”, which is part of the Safer Lorry Scheme to limit access based on the size of vehicles’ blind spots  
- National Association of City Transportation Officials Webinar – Fire Trucks and Vision Zero, that examines trade-offs between freight vehicle payload and maneuverability on city streets. 

V. Research Objective
The objective of this research is to identify and engage additional stakeholders beyond shippers, receivers, and carriers, who are critical for thinking differently about freight and finding new solutions. The work envisioned would involve the following tasks:

- Identify the full breadth of stakeholders who should be part of discussions on urban freight, reasons for their inclusion, and level of engagement in prior discussions and/or pilots.
- Through literature review and discussions, determine the key challenges these stakeholders face with respect to urban freight, and potential solutions they have considered or for which their technologies or businesses could prove helpful.
- Exploring the public aspects of these issues and potential solutions, determine the areas of synergy or friction that need to be addressed among various private and public entities.
- Hold sessions that bring these voices directly to the table in order to progress research and solution-finding and implementation.
- Develop a report which details the issues and potential solutions and provides a map for potential implementation.
- Should funds allow, identify at least one pilot effort, along with a potential location and supporting stakeholders.

VI. Estimate of Problem Funding and Research Period
Recommended Fung: $450k

---

7 USDOT, FHWA, *Primer for Improved Urban Freight Mobility and Delivery.*  
Research Period: 2 years

VII. Urgency, Payoff Potential, and Implementation
As noted earlier, over the next 25 years, freight is expected to grow significantly even as communities are further concentrating in urban areas. The need for solutions that step beyond what is to what could be is imperative but key voices are still missing from discussion – in particular, key stakeholders and champions. Finding was to bring these voices to the table, engaging them, and working together to leverage public and private entities to develop pilots and implement workable solutions is critical and yet, very few examples of this exist to date.

With respect to implementation, the research effort here will not only develop the roadmap needed to move forward, but will begin the process of engaging the stakeholders and developing and identifying locations for potential pilots.

VIII. Person(s) Developing the Problem
Allison L. C. de Cerreño, Ph.D.
Deputy General Manager, Port Authority Bus Terminal
Port Authority of NY & NJ
625 Eighth Avenue
New York, NY 10018
T: 212-502-2203; M: 917-301-5650; E: acdecerreno@panynj.gov

Alexander K. Epstein, Ph.D.
General Engineer, Volpe National Transportation Systems Center
U.S. Department of Transportation
55 Broadway, Kendall Square
Cambridge, MA 02142
T: 617-494-2539; E: Alexander.Epstein@dot.gov

IX. Problem Monitor
Allison L. C. de Cerreño, Ph.D.
Deputy General Manager, Port Authority Bus Terminal
Port Authority of NY & NJ
625 Eighth Avenue
New York, NY 10018
T: 212-502-2203; M: 917-301-5650; E: acdecerreno@panynj.gov

X. Date and Submitted by
AASHTO Urban Freight Committee, Minnesota DOT

NCHRP Review of B-31
This proposal would engage stakeholders who, thus far, have not been included in research or projects to improve urban goods delivery. It should be combined with B-25.

Review Date:
11/30/2018

AASHTO Committee Evaluation for B-31

Submitted By:
Susan Howard
AASHTO Staff
Special Committee on Freight

Comments:
Like with B-29, this work needs to be done before we can shift to preparing guidebooks.
AASHTO STANDING COMMITTEE ON RESEARCH
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
National Cooperative Highway Research Program (NCHRP) Problem Statement

Problem No: 2020-B-32

PROBLEM TITLE

Land-Use Development Guide for Hazardous Materials Transportation

RESEARCH PROBLEM STATEMENT

Hazardous materials are transported every day in huge quantities through pipelines, on ships and barges, on trains, and by motor vehicles throughout the United States. While many of these materials are ubiquitous to everyday life, such as cosmetics, household products and other personal-use items, many present significant risks in transportation. Facilities that produce, use, or transport hazardous materials are often located near transportation infrastructure, such as highways, ports and railways to facilitate efficiency. Risk assessments are often conducted to determine optimal transportation routes and methods to minimize exposure to population centers, sensitive populations and environments (e.g. protected Federal lands including Tribal lands, etc.), and critical infrastructure. Appropriately, many of these facilities were initially located far from population centers. But today there are numerous instances where land use planners and zoning administrators are allowing or even encouraging encroachment on hazardous material transportation corridors and facilities with inappropriate development. This encroachment greatly elevates the risk from hazardous material release events and short- and long-term exposure associated with routine hazardous materials facility and transport operations (i.e. air and water discharges, airborne dusts, and site contamination).

The elevated risk centers on time and distance relative to the consequences of a release. When a release event occurs, populations that may be impacted have two protective options available to them, shelter-in-place or evacuation. Both options take time to complete and includes time for local responders to arrive at the scene, assess the situation, determine an effective course of action, communicate with the public, and then implement the best response and protection option. In many scenarios, the event will be well underway or sometimes even over before local responders arrive and have any opportunity to act, causing some populations to act on their own discretion. Even where a population has been trained on discretionary protective actions, they may not have time to act. Evacuation through an active toxic gas plume will have dire outcomes and sheltering for some distance out from the source will not be protective because the impacts immediately overwhelm the protective capacity of most any building. Due to these facts, there is a distance surrounding hazardous material facilities and transportation corridors where development needs to be limited simply because it is too close to the worst of the impacts of a potential event, regardless of what protective choices are made.
Several examples will help reinforce the concern:

1) April 2013: West Texas explosion of ammonium nitrate with 12 dead and where among other damages, the explosion destroyed a middle school, a nursing home and apartment complex that were built effectively next door.

2) July 2013: Rail disaster in Lac-Mégantic, Quebec, Canada with 42 dead and five missing, were a crude oil explosion was caused by a derailed unit train of crude oil and subsequent fire on a rail line in the heart of the historic village. The 0.6-mile radius explosion and fire destroyed 30 buildings outright, and 36 more had to be demolished. Of 69 buildings, only three survived.

3) July 2012: Near miss in Wake Forrest, North Carolina where a charter school was surrounded by a cloud of 100% nitrogen gas from a nearby air separation plant. Had the event occurred on a weekday, there likely would have been 90 fatalities of students, teachers, and administrators of the school. The facility was built in an agricultural area in the 1980s and successive development has surrounded the facility with 8 schools, an assisted living facility, and high-density residential apartments.

Land-use planning officials in most communities throughout the United States have no effective means of identifying the distance from high risk hazardous materials corridors or facilities within which it would be unsafe for some types of development, particularly those involving high-intensity land uses, dense or sensitive populations, or critical infrastructure. What is needed is a planning tool that would identify the zone surrounding hazardous materials transportation corridors and facilities that would trigger a review of the existing hazards and risks and subsequent increases in risk from proposed land-use decisions.

Guidance for local governments on hazardous materials risk assessment and land-use decision making is sparse or absent all together. The Department of Transportation’s North American Emergency Response Guidebook (ERG) is often referred to as it contains protective action and isolation distances for hazardous materials in the event of an active transportation spill, but the list of chemicals on table 1 is far too brief, and the guide pages are far too general. The ERG does not include hazard identification (i.e. a commodity flow), risk assessment, and other guidance pertinent to a process to determine a recommendation relevant to land use planning. Therefore, national guidance is needed to help aid in community land-use decision-making where hazardous materials are ever-present.

OBJECTIVE
Develop a hazardous materials guidebook for local land use planners and zoning administrators to aid in decision making. The guidebook would be used when evaluating community and transportation development plans and zoning/re-zoning proposals for land uses near transportation corridors and facilities where hazardous materials are often in transportation, use, or production. The guidebook would detail a process that communities could use to determine land-use recommendations (i.e. appropriate buffer) based on the risk and proximity to fixed chemical facilities and
hazardous materials transportation corridors. The process would inform land-use decisions at the local level and enable voluntary choices to avoid or mitigate risk. The process could also be used to aid in decision-making for transportation projects near protected Federal lands including Tribal lands.

RESEARCH PROPOSED
Task 1 – Conduct a literature search and contact relevant stakeholders to identify best practices for land use planning as it relates to hazardous materials transportation and fixed facilities.

Task 2 – Develop a methodology for assigning recommended distances for zoning based on the proximity of transportation corridors and fixed facilities involved with hazardous materials. The methodology will take into account local hazard identification, environmental site assessments, risk assessments, and existing development, when applicable. The methodology will also be specific to the physical and chemical hazards likely to be transported, used, or produced in the community.

Task 3 – Validate methodology developed in Task 2 with relevant stakeholders including federal agencies such as Center for Disease Control and Prevention’s Agency for Toxic Substances and Disease Registry (CDC/ATSDR), the Federal Motor Carrier Safety Administration (FMCSA), the Pipeline and Hazardous Materials Safety Administration (PHMSA), and the American Planning Association (APA).

Task 4 – Develop comprehensive guidebook for land use planning as it relates to hazardous material transportation and fixed facilities. The guidebook will include detailed instruction on hazard identification (i.e. commodity flow), risk assessment techniques, and hazardous material specific guidance for land use planning.

Task 5 – Create a plan for peer review including the identification of relevant stakeholders and construction of a peer review group to facilitate acceptance and implementation of the guidebook developed in Task 4.

Task 6 – Develop a final report detailing the research effort. The final report will also include the comprehensive guidebook as an attachment.

ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding: $500,000
Research Period: 24 months

URGENCY AND PAYOFF POTENTIAL
As existing communities continue to grow, land use planning decisions will play a greater role in influencing the consequence factor of the risk equation for hazardous materials transportation. Overnight (boom town) communities such as Williston, North Dakota would have an immediate and urgent need for additional guidance on land use as it relates to hazardous materials obtained through mining and fracking activities (oil, natural gas). Established communities are also making critical land use planning
decisions everyday that could impact transportation safety in both the short term and long term.

**RELATED RESEARCH**

Recently the Center for Disease Control and Prevention’s Agency for Toxic Substances and Disease Registry (CDC/ATSDR) launched the Choose Safe Places for Early Care and Education Program (CSPECE) [https://www.atsdr.cdc.gov/safeplacesforece/index.html](https://www.atsdr.cdc.gov/safeplacesforece/index.html). The purpose of this program is to provide guidance to community planners on where to locate daycares, schools, and other early education facilities to reduce risk of exposure to hazardous materials and chemicals. It provides a very good framework for developing and managing a CSPECE program within a community. However, the scope and guidance are limited. It does not fully address transportation corridors, nor does it give specific guidance and recommendations on siting distances or criteria based on specific hazardous chemical properties.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) also maintains information and recommendations on land-use in relation to pipelines as part of the Pipeline and Informed Planning Alliance (PIPA) program. Again, this guidance is limited in scope and this proposed research would help bring together these recommendations into a single approach that would be relevant for all types of transportation corridors, facility types, and community contexts.

There are also numerous transportation and community planning guides developed by TRB and other organizations related to developing smart and efficient transportation to facilitate the movement of people and goods, however, in most instances, this guidance does not include detailed considerations related to protection of the community as it relates to the transportation of hazardous materials.

**PERSON(S) DEVELOPING THE PROBLEM**

Richard Bornhorst, Chair AT040
FACTOR, Inc.
rbornhorst@essentialfactor.com

John Steinauer
IEM
John.steinauer@iem.com

**ENDORSEMENTS**

Endorsed by the TRB Committee on the Transportation of Hazardous Materials (AT040) in consultation with Center for Disease Control (CDC), the Federal Motor Carrier Safety Administration (FMCSA), the American Planning Association (APA), the North Carolina Department of Environmental Quality, and the Wake County, North Carolina, Local Emergency Planning Committee.
NCHRP Review of B-32

Reviewed By:  
William C. Rogers  
wrogers@nas.edu

Comments:

The recent examples cited in the problem statement emphasize the consequences of ignoring hazardous materials, both in-transit and stored, in land use decisions. With the demise of the Hazardous Materials Cooperative Research Program, there is no venue to vet new hazardous materials transportation research topics. The research could be accomplished for $400,000.

Review Date:  
11/30/2018

FHWA Evaluation of B-32

Vince Mantero/HOFM, Connie Hill/HEPN - The case is adequately made for the need for the hazardous materials guidebook that would be the product of this study. Such a guidebook and the analyses conducted through the proposed work could be valuable planning and economic development tools for states and local communities. The general discussion about "high risk hazardous materials corridors" is of some concern, given that the three examples used were either rail or facility disasters. Hazardous material transportation on roadways pose as much, if not more, of an issue. Local and state governments have a great deal of control over designating, or restricting, HazMat on the roadways. Any discussion of a land use guidebook would need to include the need for identifying HazMat routes, connectivity amongst jurisdictions, etc. De-designation of HazMat routes due to encroachment of non-industrial land uses can pose a problem that has largely been left unanswered. This guidebook can help address some of those issues.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Problem No: 2020-B-33

1. Capturing Low-Incidence/High-Impact Travel in Household Travel Surveys

2. Background

“Low-incidence” travel behavior is difficult to capture in a traditional household travel study (where typically one day of travel is collected from a representative sample of households in a region). Behaviors or travel choices that do not occur frequently may fall into different categories:

- Behaviors that a small number of people participate in or consider in their travel choice set. This might include travel modes that are used frequently by a small number of people (bicycling, vanpool, etc.) or new or emerging travel modes that may not be widely used yet (carshare, rideshare, e-bikes, automated vehicles, etc.)
- Travel behavior in the context of complex analytical structures (complicated tour patterns, decisions that are related to household interactions)
- Behaviors that a large number of people may participate in, but may not engage in frequently enough to be captured in a one-day travel diary (long-distance travel, trip replacement behavior such as home delivery of goods and services, etc.)

As discussed in a recent Travel Model Improvement Program (TMIP) post, a sufficient number of surveys need to be captured for that travel class to be estimated correctly in a travel demand model: around 1,000. It is important to be able to collect enough observations of these behaviors to better analyze the current and future demand for different types of travel; to better understand how these rare or new types of behaviors affect the overall demand for transportation resources; and to understand how these emerging alternatives may affect “traditional” transportation behavior. Because these behaviors are rare, alternative methods for sampling enough observations in a regional travel study need to be identified and tested. Despite their low-incidence, many of these alternatives have outsize effects on the transportation system. (E.g. Long-distance travel accounts for a large segment of the VMT, even though it is a small percent of trips).

This proposal was developed from a Research Needs Statement from the Travel Survey Methods Committee (ABJ40). As seen in the Literature Review below, a number of research projects have concluded that this topic needs further research and has thus led to this submission.
3. Literature Search Summary


Schiffer, R. *National Cooperative Highway Research Program Report 735: Long-Distance and Rural Travel Transferable Parameters for Statewide Travel Forecasting Models*. Transportation Research Board. 2012. – This report notes that “trips of more than 100 miles account for less than 1 percent of all vehicle trips but 15.5 percent of all household-based vehicle miles.” It also notes that most surveys are not adequately capturing this travel and only national survey and two statewide long-distance surveys and 2 other statewide surveys were able to be used for that project.


Berliner, R., Aultman-Hall, Lisa, and Circella, Giovanni. *Exploring the self-reported long distance travel frequency of millennials and generation X in California*. Transportation Research Board. 2018. The report notes that “The patterns of infrequent long-distance trips are poorly understood especially compared to the better studied (and understood) local daily travel patterns and calls out limitations of MPO surveys and the NHTS.

In-Progress or Proposed

Kockelman, K. *The Rise of Long-Distance Trips, in a World of Self-Driving Cars: Anticipating Trip Counts and Evolving Travel Patterns Across the Texas Triangle Megaregion*. Project for DOT – Current project to predict VMT long-distance trips by CAVs and other impacts.

Rauch, E. *Optimizing Technology for Collecting Long-Distance Travel Data*. Project for Arizona DOT. – Project notes that “the long-distance component of the FHWA’s National Household Travel Survey (NHTS), has not been updated since 2002 and even then had an insufficient sample size for the Southwest. Better data for current travel behavior is needed.” This project is only looking at the technology to capture LD trips.
Aultman-Hall, L. *Long Distance Travel in the United States*. Project for National Center for Sustainable Transportation – This project is producing a synthesis white paper that includes the research needs in this area.

Goulias, K. and K. Janowicz. *Long Distance Travel in the California Household Travel Survey (CHTS) and Social Media Augmentation*. Project for University of California Center on Economic Competitiveness in Transportation – This paper is looking at the CA LD survey and the possibilities of integrating travel with social media and other data sources.

4. **Research Objective**

Research objectives are to identify and analyze methods for sampling people or households and incidences of rare or emerging travel behaviors, including how to incorporate new methods into household travel survey data collection. This may involve looking at non-traditional sampling methods or survey designs and overcoming the practical and logistical barriers to finding and collecting samples of rare behaviors. Research objectives should also consider how the data can be weighted and analyzed on its own and within the context of a traditional “representative” household travel survey dataset.

Potential research tasks may include:

- Identification of the types of behaviors that cannot be easily captured in a traditional travel survey
- Determination of which behaviors have sufficient impacts on the transportation system or on transportation model systems as to warrant changes in survey methods.
- Synthesis of non-traditional or non-representative sampling methods to capture low-incidence travel behaviors, and/or supplemental or special generator survey methods
- Analysis of non-traditional sampling methods (data quality, cost-effectiveness, integration of data with traditional household travel survey data)
- Comparison of traditional survey methods with the resulting data fused with Big-Data (e.g. StreetLight or AirSage)
- Analysis or recommendations for how sampling methods can be applied across different modes or different regions

A variety of datasets are available for this analysis including the NHTS and the Ohio 1-year long-distance dataset, 1-7 day regular HTS and StreetLight data, and the Minneapolis/St. Paul MN regional HTS datasets. The California survey may also be made available.

5. **Implementation Planning**

The next National Household Travel Survey (NHTS) is being developed and fielded in the coming five years. It is anticipated that the upcoming NHTS will be able to implement some of the methods resulting from this project in order to capture the full range of travel behavior. Additionally, States and MPOs conduct their own surveys, and it is anticipated that these methods will be implemented in those efforts as well. The results from this study will be presented at the TRB Annual Meeting at the ABJ40 committee meeting and will be added to the travel survey manual wiki. It is also possible to give presentations at the TRB Transportation Planning Applications Conference and as a TMIP presentation.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**
   
   $300,000
   
   It is estimated that this project could take a senior and a junior staff member one full year.

   **Research Period:**
   
   24 months, including reviews

7. **Urgency and Potential Benefits**

   As mentioned earlier, 65% of states have statewide models that need accurate long-distance travel, and the upcoming NHTS is imminent. Emerging, low-incidence travel modes are becoming critical policy issues in regional and statewide long-range plans that need quality data to analyze and forecast. Ideally, results from this study will be able to support the development of the NHTS sample frame and instrument as well as the rest of the state DOTs and MPOs. Ohio DOT is spending upwards of $8 million for HTS data collection. This project will help with targeting the low-incidence travel needed to make both the statewide and regional models accurate in predicting those trips.

8. **Person(s) Developing the Problem Statement**

   Provide name, title, organization, telephone number, and email address for each contributor.

   Rebekah Straub Anderson, P.E., Transportation Engineer, Ohio Department of Transportation, 614-752-5735, rebekah.anderson@dot.ohio.gov

   Jonathan Ehrlich, P.E. (MN), Manager: Transportation Research and Modeling, Metropolitan Council, 651-602-1408, jonathan.ehrlich@metc.state.mn.us

9. **Nomination for AASHTO Monitor**

   The AASHTO Monitor may be assigned by NCHRP staff.

   FHWA Liaison – Daniel Jenkins, P.E., Senior Transportation Specialist, FHWA Office of Highway Policy Information, 202-366-1067, daniel.jenkins@dot.gov
10. Potentially Interested AASHTO Councils and/or Committees
   SCOP

11. Submitted By
   Provide contact information for individuals submitting or supporting this problem statement. If an organization, e.g., an AASHTO committee, is listed, include the name and contact information for an individual associated with the organization.

   Rebekah Straub Anderson, P.E., Transportation Engineer, Ohio Department of Transportation, 614-752-5735, rebekah.anderson@dot.ohio.gov

   Tae-Gyu Kim, Ph.D., Model Research and Development Group Supervisor, North Carolina Department of Transportation, 919-707-5735, tae-gyukim@ncdot.gov

   Jonathan Ehrlich, P.E. (MN), Manager: Transportation Research and Modeling, Metropolitan Council, 651-602-1408, jonathan.ehrlich@metc.state.mn.us

   ABJ40 – Travel Survey Methods Committee

NCHRP Review of B-33

Reviewed By:
Lawrence D. Goldstein
lgoldstein@nas.edu

Comments:

Adding this component to improve effectiveness of travel surveys reflects the growing diversity of alternative travel modes, especially in congested urban environments. Defining what is meant by "high impact" will be important in defining the scope of this effort. This study should also take into account recent applications of innovative survey methods, including consumer preferences surveys and data available from the ever-expanding cell-phone information resources. These newer approaches are detailed in recent NCHRP studies as well as in other CRP efforts.

Review Date:
12/4/2018

FHWA Evaluation of B-33
Tianjia Tang/HPL - This area indeed needs to be addressed. And it has been a historical weak point household survey was trying to overcome. Both the data and methods have significant practical implications as related to safety and behaviour. Should move forward.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline  
Problem No: 2020-B-34  

1. Problem Title  
Incorporating the Demand, Capacity, and Operational Impacts of Incidents and Safety Treatments in the HCM Freeway Facilities Methodology  

2. Background  
The HCM 6th Edition procedures for Freeway Facilities incorporate incidents in the Reliability Analysis. Incident rates are either manually entered or estimated using an expansion factor from crash rates. Crash rates may be manually entered or estimated using the Highway Safety Manual’s freeway crash rate estimation equation. This equation is primarily sensitive to the Annual Average Daily Traffic on the freeway segment; however, the method does not take into account potential safety treatments that may affect operations on freeway facilities. Currently, there is no method of incorporating crash modification factors (CMFs) or crash reduction factors (CRFs) due to safety countermeasures in the HCM freeway reliability analysis.

With the advent of Advanced Traveler Information Systems, both public and private, traveler information on incidents (either planned or unplanned) may potentially impact the resulting demand in the incident influence area as drivers divert from their current route to avoid incident related congestion. The diversion due to incidents is potentially a function to both pre-trip and en-route travel information, as well as the characteristics of the facility and the adjacent surface transportation network. The current reliability method does not adjust the demands of any segment on a facility when an incident is present. Data are needed in order to develop estimated incident-induced demand diversion and the methodology must be updated to incorporate this demand reduction along the facility.

Another issue arises in how incidents are assigned at the facility level. Currently, the reliability methodology aggregates expected number of incidents for the entire facility and then randomly assigns locations to incident scenarios. This method will need to be modified to take into account the changes in segment level crash rates.

3. Literature Search Summary  
The literature contains a broad range of research into the topic areas of crash modification factors included in the CMF Clearinghouse, incident impacts on freeway operations including capacity and speed, as well as the benefits of incident management systems. Less research is available on the changes in demand due to the presence of incidents. Below is a list of relevant sources:
4. **Research Objective**

Enhance the HCM 6th Edition's freeway facilities methodology in order to better incorporate incidents and strategies deployed to impact the frequency or duration of incidents.
of incidents at a segment level. This includes making the methodology compatible with research contained in the CMF Clearinghouse.

5. Implementation Planning
As this research will result in new and/or improved Highway Capacity Manual methodologies, the target audience includes transportation engineers and planner, freeway management personnel, and educators.

6. Estimate of Problem Funding and Research Period

Recommended Funding:
$400,000
If the problem statement is selected, the level of funding provided may be adjusted by the AASHTO Special Committee on Research and Innovation.

Research Period:
24 months
If the problem statement is selected, this estimate may be adjusted by the project panel.

7. Urgency and Potential Benefits
High. This research will produce new analytical methodologies and tools for improving the Highway Capacity Manual freeway facilities and reliability methodologies. The proposed research will address several limitations of the current methodologies, and will address the interdependency between demand, incidents, and operations. Failure to fund this problem statement will result in cost-prohibitive use of microsimulation.

8. Person(s) Developing the Problem Statement
R. Thomas Chase, Institute for Transportation Research and Education (ITRE), North Carolina State University, (919) 515-8625, rtchase@ncsu.edu
Alexandra Kondyli, Ph.D., University of Kansas, (785) 864-6521, akondyli@ku.edu

9. Nomination for AASHTO Monitor

10. Potentially Interested AASHTO Councils and/or Committees
TRB Standing Committee on Highway Capacity and Quality of Service Committee
Chair: Tom Creasey, Tom@caliper.com, (617) 775-5759.

11. Submitted By
Bill Knowles, P.E.
State Traffic Analysis Engineer
Transportation Planning and Programming Division
Texas Department of Transportation
(512) 517-6404
bill.knowles@txdot.gov

Brian G. Dunn, P.E.
Oregon Department of Transportation
Transportation Planning Analysis Manager
Mill Creek Office Building
555 13th St. NE, Suite 2
Salem, Oregon 97301-4178
brian.g.dunn@odot.state.or.us
(503) 986-4103

NCHRP Review of B-34

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:
The scope of the research is reasonable within the time period and estimated budget with a clear objective to be potentially solvable. The problem statement is of likely interest on a national level as it will aid agencies in implementing and updating future potential editions of the Highway Capacity Manual.

Review Date:
12/10/2018
1. Problem Title
Regulatory and Policy Actions to Facilitate Truck Automation Technology

2. Background
Today, connected and automated vehicle technology developments are accelerating at a rate that transportation planners and regulatory agencies are challenged to keep pace with. An important subset of these developments is truck automation technology. The proposed research will identify the critical governmental policy and regulatory actions necessary to enable trucking automation as a common practice. This research will use information developed by, and will also inform, current and planned research, including the recent United States Department of Transportation (USDOT) Broad Agency Announcement to assess various aspects of in-service truck platoons. It is also anticipated this research will help inform reauthorization of federal transportation legislation.

Much of the drive towards trucking automation technology will come from the private sector recognizing the possibilities in terms of cost savings as shown in a willingness to adopt the technologies. Before this can happen, significant government action will be required to create an operational, infrastructure, and regulatory environment conducive to realizing the potential benefits of trucking automation technology. To guide these actions, a number of questions need to be answered. At a minimum, this research will explore:

1. What laws and regulations need to be enacted or modified to enable trucking automation technology?
2. How and where should governments (national, state, and local levels) prioritize investment resources and why?
3. What are the major factors for benefit cost assessments for public sector and what kind of readily available data can support quantitative analyses to support investment decisions?
4. What criteria should governments (national, state, and local levels) and public sectors consider identifying long distance freight corridors for trucking automation technology?

In addition to the above key research questions, within the guidance of its NCHRP sponsors and project technical panel, this research will also consider the below listed questions:

1. In what ways can autonomous trucking provide roadway information critical to enhanced operations?
2. How should trucking automation technology be deployed in different operating environments such as metropolitan areas or less congested intercity routes, varying times of day, traffic conditions, or dynamic weather conditions?
3. What is the procedure for handling incidents and crashes involving autonomous trucks?
4. How are public sector activities best coordinated to coincide with evolutionary progress in truck automation technologies?
5. How would truck platoons and autonomous trucks operate across state lines?
6. What infrastructure improvements or uses of existing infrastructure should be considered, such as dynamic signage to indicate truck platoon only use of off-peak HOV lanes, or construction of dedicated truck lanes?
7. What are going to be the allowed, safe, minimal spacing distances between platooned trucks or autonomous trucks?
8. What is the maximum allowable platoon size?
9. How should weight, safety, or traffic enforcement best interact with truck platoons?
10. Should platoons and autonomous trucks be operated with escorts?
11. Should platooned and autonomous trucks be limited to operate in specific lanes or on certain roadways?
12. Should platooned trucks have a feature to allow other drivers to easily identify them (perhaps electronically) as being in platoon or autonomous?
13. Should platooned and autonomous trucks have a feature to allow state law enforcement personnel to easily identify them (perhaps electronically) as being in platoon or autonomous?
14. What effects, if any, do platooned trucks have on bridge condition (e.g. due to closer spacing) as compared to traditional, low-technology trucks?

While completely autonomous trucks on the road may not become acceptable for many years, lesser degrees of automation may become practical in the near-term. Truck platoons, with a “pilot driver” in a lead truck, followed by two or three “driverless trucks,” may be a development deployed in the 2020s on certain long-haul routes and/or dedicated truck lanes.

These technologies hold promise for improving the safety and operational efficiencies of truck-based freight movements, reducing roadway congestion, and reducing fuel consumption and associated emissions. On long-haul freeway routes between major cities and dedicated truck freeways in major metropolitan regions, truck automation technologies, if utilized on a large scale, have the ability to increase truck and overall traffic throughput on a freeway. Autonomous truck technologies can alleviate labor and hours-of-service issues through reductions in driver time at the wheel and improvements in safe truck operation that can reduce or mitigate accidents and associated fatalities and vehicle damage.

This research will focus on what immediate changes to regulations are needed, what operational processes need to be introduced or modified, and how efforts and investments should be prioritized to facilitate truck automation technologies.
3. Literature Search Summary

This project is expected to build on existing work in the areas of autonomous and connected vehicle research, focusing on truck-based freight movement or autonomous trucking applications, policies, and regulations. The authors of this project statement have conducted a review of TRB-based literature, most notably, “Challenges to CV and AV Applications in Truck Freight Operations,” NCHRP Project 20-102(03). It was found that, while government roles in CV/AV applications have been studied, and guidance is available, there is limited information focused on the research questions listed above. Much of the past and current research has been focused on technology applications, existing relevant policies and regulations across the country, and potential benefits that could be realized by widespread deployment of CV and AV. What is missing, and is to be covered by this research, are topic areas identified as additional needs in much of the TRB-based literature, in particular the need for additional planning, establishing a regulatory environment, and fostering CV/AV application testing to facilitate the deployment of truck automated technology.

4. Research Objective

Complete a comprehensive review of governmental, operational, regulatory, and policy barriers to autonomous trucking and potential countermeasures. The proposed research will examine the questions posed in the Problem Statement from a federal, state, and local municipality standpoint and will include a review of existing regulations that may create barriers to autonomous trucking and operational constraints, and a survey of current and planned infrastructure improvements necessary for autonomous trucking and, where appropriate, documentation of best practices in preparing for CV/AV, including model legislative language. The final product will be a report detailing the findings of this research.

The research will be conducted through the following tasks:
1. Perform a literature review of regulations, statutes, other rule makings, relevant benefit cost evaluation processes, and criteria for autonomous truck corridors that would impact autonomous trucking applications.
2. Identify subject matter experts, including CV/AV operators in the private sector, policy makers in the public sector (e.g., Departments of Transportation, Departments of Public Safety), and autonomous transportation technology and software developers, and conduct in-depth phone interviews with them to identify operational and regulatory barriers to autonomous trucking.
3. Develop Interim Report on findings of Tasks 1 and 2, and allow one month for panel review time.
4. Present initial findings to broader stakeholder groups at appropriate venues and incorporate comments and suggestions into the project documentation.
5. Document research results in final report and allow three months for panel review.
6. Disseminate the information to the transportation community (scholars,
transportation agencies, OEMs and freight movers) in the form of a written
document and other press releases.

5. Implementation Planning

Results from this proposed research will be shared with CV/AV operators in the
private and public sectors, as well as information technology and software
developers to determine the best applications of these technologies in the trucking
industry.

6. Estimate of Problem Funding and Research Period

Recommended Funding:
$350,000.00

Research Period:
2 years

If the problem statement is selected, this estimate may be adjusted by the project
panel.

7. Urgency and Potential Benefits

High. The stand-alone benefits of autonomous trucking technologies can be
significant in terms of reducing congestion, fuel consumption, diesel emissions,
truck-related crashes, and potentially lowering the cost of freight shipments. The
timing of this research is critical to transportation stakeholder and public agencies
planning for autonomous trucking due to the pace of technology developments in
the applications of CV/AV, the opportunity to bolster ongoing or planned research,
and the probability of informing state and federal transportation legislation.

8. Person(s) Developing the Problem Statement

Caroline Mays
Freight Planning and International Trade Section Director
Transportation Planning and Programming Division
Texas Department of Transportation
caroline.mays@txdot.gov
(512) 936-0904

9. Nomination for AASHTO Monitor

10. Potentially Interested AASHTO Councils and/or Committees

11. Submitted By

Caroline Mays
Freight Planning and International Trade Section Director
NCHRP Review of B-35

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:

NCHRP Project 20-102(22), State and Local Impacts of Automated Freight Transportation Systems, (https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4678) was recently approved and a panel is currently being formed. This problem statement will be provided to that panel and I expect that they will choose to address many of the issues raised. I recommend retracting this problem statement until the scope of NCHRP Project 20-102(22) has been set.

Review Date:
12/7/2018

FHWA Evaluation of B-35

John Corbin/HOTM - The problem statement should be refined to better distinguish between issues associated with truck platooning, and broader policy and regulatory issues of truck automation. Coordination with related USDOT initiatives through the FHWA Office of Research and Development for Safety & Operations (HRDSO) is advisable. The problem statement may be more appropriately considered within the NCHRP 20-102 and the second iteration research roadmap for that initiative, which is under development.

AASHTO Committee Evaluation for B-35

Submitted By:
Susan Howard
AASHTO Staff
Special Committee on Freight

Comments:
It would be helpful to include labor disruption/evolution in this research.
Research Field C

Design
AASHTO STANDING COMMITTEE ON RESEARCH
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

NCHRP Problem Statement

Comments: This was the No. 1 priority from AASHTO Committee on Bridges and Structures (COBS)

2018 Research Needs Statement

Problem Number: 2020-C-01

1. TITLE: Bridge Deck Overhangs with MASH-Compliant Railings

2. DESCRIPTION/BACKGROUND:

State Highway Agencies across the country are upgrading standards, policies, and processes to satisfy the 2016 AASHTO/FHWA Joint Implementation Agreement for Manual for Assessing Safety Hardware (MASH). Many existing bridge deck overhangs were designed to accommodate a barrier with a 10-kip collision design load while the current TL-3 and TL-4 test railing call for a 54k-load. When a barrier upgrade is required, the bridge deck overhang must often be assumed to have adequate over-strength or retrofitted in order to accommodate the new requirements. The latter is costly and the traveling public is inconvenienced by the construction. In many cases, limitation of work space and strength of existing reinforced concrete make retrofit of overhang impractical to satisfy the new higher collision load requirements.

FHWA mandated use of the AASHTO LRFD Bridge Design Specifications (LRFD) in 2007. These Specifications include higher design loads than the previous AASHTO Standard Specifications for different test levels (TL) of bridge railings. The deck overhang design is specified in LRFD Section A13; three design load cases are given including the over-turning moment caused by the collision load and portion of the vehicle on the overhang. California, New Jersey, and other states have gone even further in requiring 20% additional strength in the overhang.

In 2009, AASHTO Manual for Assessing Safety Hardware (MASH), 1st Edition, was published followed by the 2nd Edition in 2016. Crash-testing of various safety shapes for the new requirements has taken place, but the test surface to which the shape is anchored is often over-designed in order to verify performance of the barrier. Anecdotal evidence of crashes supports the premise that bridge deck overhangs perform well during collision events.

New technologies exist to analyze and enhance the strength of bridge deck overhangs. Refined analysis may be able to quantify energy dissipation via crushing of the concrete and elongation of the bar reinforcement in the barrier, deformation of the barrier or post connection, and potentially the overhang itself. Alternatively, some bridge owners have used composite strips and other new technologies to enhance the strength of bridge
deck overhangs. The latter can have less impact to the traveling public—and be cost competitive.

3. LITERATURE SEARCH:

A literature search was conducted by NJDOT’s Research Librarian, and a review of the identified documents indicates that this topic has been very rarely researched previously. The limited recent research associated with this topic has shown that the force effect in the overhang/barrier connection due to a lateral static load may be less than the resistance required by the current AASHTO LRFD Bridge Specifications (LRFD), Section A13. In a study by Purdue University the collision load distribution length for two solid concrete parapet-type barriers was shown to be much greater than that specified in LRFD. Furthermore, for various amounts of bridge deck overhang reinforcement the failure mode in the overhang was shown to be shear under the barrier.

4. RESEARCH OBJECTIVE:

The primary objective of this research is to recommend changes to the current LRFD bridge deck overhang design specifications for both solid and “see-through” post-beam barriers subjected to TL4 and TL5 collision loads. The changes may be based on refined or nonlinear analysis methods but lead to a practical and quickly performed flexural design. Current methods may be acceptable with development and justification of an increased the load distribution, alternative concrete strengths for existing bridges, or revised barrier-deck connections. Potential shear failure and detailing recommendations for the bridge deck overhang must also be provided. The deck overhang must also be able to carry the vertical load of the vehicle.

The research is to survey past as well as present practice of existing deck overhang designs and details, and barrier connection details. Recommendations from this research must be applicable to the broadest cross-section of practice possible for both new and existing structures in terms of configuration, strength, and barrier anchorage. Experimental testing of prototype overhang-barrier systems may be determined based on literature survey and analytical study.

Another objective is to develop design guidance on when to retrofit an overhang, methods for doing so, and design examples. The goal is to keep both bridge and vehicle safe in a cost-effective way.

5. IMPLEMENTATION PLANNING

The Implementation Plan will include but not be limited to the following:

(1) Presentation to the AASHTO Committee on Bridges and Structures for adoption and inclusion into the AASHTO LRFD Bridge Design Specifications;
(2) Provide a final report documenting the entire project, incorporating all other specified deliverables of the research;
(3) Provide an electronic presentation on the proposed guidance and design examples that can be tailored for specific audiences;
(4) Deliver a webinar to inform practitioners of the proposed guidance and design examples;
(5) Presentations at TRB, International Bridge Conference, and other practitioner related meetings and conferences; and
(6) Recommendations on needs and priorities for additional research.

6. ESTIMATED PROJECT FUNDING & RESEARCH PERIOD:

Project Estimate: $500,000 (if involving experimental study, maybe more $$)

Research Period: 24 Months  (if involving experimental study maybe 30 months)

7. URGENCY, PAYOFF POTENTIAL AND IMPLEMENTATION:

The research is of urgent need to ensure public safety and satisfy the AASHTO MASH and LRFD requirements in cost-effective way. State DOTs across the country are striving to upgrade standards, policies, and processes to meet the 2016 AASHTO/FHWA Joint Implementation Agreement for MASH (MASH), where it is stated that for contracts on National Highway System with a letting date after December 31. 2019, only safety hardware evaluated using the 2016 edition of MASH criteria will be allowed for the new permanent installations and full replacements.

During the implementation of the AASHTO/FHWA agreement, MASH compliant bridge rails and concrete deck overhang should be considered as a system for design to keep both motorists safety and sufficient bridge capacity. Reliable determination of existing bridge overhang/barrier connection performance and strength under vehicle impact loads will ensure sufficient safety and avoid overhang replacements i.e. save time, labor cost, and work zone safety for construction.

The successful research will meet AASHTO Strategic Plan for Bridges and Structures in following aspects:
- Maintain and Enhance AASHTO Specifications for Improved Structural Performance;
- Enhance and Optimize Structural System;
- Enhance National Policy;

The research outcomes will potentially be valuable not only for MASH barrier upgrades on existing bridges, but also for new bridge design and construction. The new policy and process based on successful research will be aligned with AASHTO and FHWA requirements for roadway safety and bridge structural safety. The implementation may start with a pilot study or studies, identification of a “champion” affiliated with the AASHTO
Committee on Bridges and Structures, and dissemination of the research recommendations at conferences attended by practicing bridge design engineers.

8. PERSON DEVELOPING THE PROBLEM STATEMENT:

This problem statement is submitted by the TRB General Structures Committee AFF10 in collaboration with the TRB Committee on Bridge Preservation AHD37 and the TRB Committee on Structures Maintenance AHD30.

POC: Richard Dunne, PE
Chair, General Structures Committee (AFF10)
609-807-9670
Richard.dunne@mbakerintl.com

9. NOMINATION FOR AASHTO MONITOR

I would suggest it be Tim Keller, Arielle Ehrlich, Hannah Cheng and/or Sue Hida.

10. POTENTIALLY INTERESTED AASHTO COMMITTEE

AASHTO Committee on Bridges and Structures. Endorsed by the following Technical Committees: T-7 Guardrail and Bridge Rail, T-9 Bridge Preservation, T-10 Concrete Design & T-14 Steel Design.

11. SUBMITTED BY:

AASHTO Committee on Bridges and Structures & TRB Committee on General Structures (AFF10).

NCHRP Review of C-01

Reviewed By:
Waseem Dekelbab
wdekelbab@nas.edu

Comments:

The problem is suitable for funding in the FY 2020 NCHRP. The AASHTO CBS ranked this problem as the 1st in a group of 4 high-priority problems from the problem statements reviewed this year.

Review Date:
12/10/2018
AASHTO Committee Evaluation for C-01

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This is the #1 priority of the Committee on Bridges & Structures. Please include a member of T-7 on the panel.
I. PROBLEM NUMBER
2020-C-02

II. PROBLEM TITLE

Virtual and Augmented Reality for Integration and Effective Use of Heterogeneous Data from Visual Inspection, Nondestructive Testing/Evaluation, and Structural Health Monitoring

III. RESEARCH PROBLEM STATEMENT

To ensure safety and longevity of infrastructure, on-site Visual Inspection (VI), Nondestructive Evaluation (NDE), and Structural Health Monitoring (SHM) are used to assess performance and condition, and quantify the deterioration. Nevertheless, these actions generate large amounts of data (e.g., condition data of various components, crack locations and crack size, section loss information, internal force, vibration, load ratings, FEM results, etc.) and metadata (e.g., plans with locations of sensors, type/specification of sensors, etc.), which is challenging to access and visualize. These data often are hard to manage and relate with each other in a seamless fashion in a quick timeframe. This may lead to underutilization of the available information to make more informed decisions. This, in turn, may also lead to less than optimal decision making, and in some cases wrong or costly decisions. Main challenges with how the data and metadata records are managed are the following:

1. The heterogeneous nature of the data and metadata (condition data of various components, crack locations and crack size, section loss information, internal force, vibration, load rating data, FEM results, etc.) makes it difficult to access and visualize in a combined yet meaningful manner.

2. The size and geometry of infrastructure components (e.g., bridges, pipelines, etc.) are large and complex, which presents a challenge to directly correlate the data with metadata (e.g., sensor readings with their position, results of data analysis with the location of the damage, etc.), which in turn is crucial to understand the data, and decide and perform subsequent actions.

3. A diverse audience consults of the infrastructural data and metadata; the inspector, evaluation engineer, planners, maintenance engineer, designer, and decision maker are frequently not the same person, and they may have different backgrounds and needs in terms of access and visualization.
Therefore, there is a need for a novel and robust method of managing data and metadata that can offer a new strategy for successful structural assessment where data is not separated from their environment (infrastructure), but becomes part of it. Combining virtual tours (VT), informational modeling (IM), and augmented reality (AR) may be a suitable way to address the above challenges. Development of such a platform also has a great potential to integrate data from new technologies with visual inspection data in a seamless fashion, leading to stakeholders adopting new and innovative technologies.

IV. LITERATURE SEARCH SUMMARY

In general, there are two main typologies of data visualization for VI, NDE, and SHM: two-dimensional (2D) and three-dimensional (3D). 2D documentation includes Computer-Aided Design (CAD) programs. Additionally, many NDE and SHM systems have their own proprietary 2D visualization software [1-4]. While 2D methods can be valuable for a project since they are less costly in terms of time and money than their 3D counterparts, these methods do not always capture the full details and do not guarantee a comprehensive or intuitive understanding of a structure, sensing system, or data and results of data analysis. Future development and implementation of advanced sensors will make it even more complicated to use [5-14].

3D methods could be more advantageous for depicting complicated topologies of structures and networks. 3D methods for documenting structure include technologies such as LiDAR, Bridge/Building Information Modeling (BRIM/BIM), and Model View Definition Summary (MVDS) [15-16]. A currently funded project on TRID is “Implementation of Aerial LiDAR Technology to Update Highway Feature Inventory” [17]. There are currently nine different projects on BIM ranging in structural applications from bridges to airports [18-26]. Virtual Reality (VR) BIM models have also been used by many major companies including LERA and AECOM to facilitate the understanding of a complex space [27]. Yet, while these methods are well-suited for depicting 3D concepts about a structure, these 3D methods can be costly for a project in terms of time, money, and management.

Hence, there is a need for a method of data access and visualization that enables 3D understanding yet does not necessitate building a 3D digital model. Virtual tours (VT) have been implemented for tourism and educational purposes to communicate 3D space to a broad audience in a simple and intuitive manner [28-29]. Previously, scholars have suggested that a combination of Virtual Reality (VR) and Informational Modeling (IM) could document a building [30-33]. A VT/IM based method for SHM was preliminary developed to fill the gap in methods for SHM data access and visualization [33-34]. Augmented Reality (AR) refers to an enriched real world with a complementing virtual world. In the case of Virtual Reality (VR), the real world is replaced by virtual objects and systems. In contrast, AR enhances the real world by anchoring virtual information into it. Recent achievements have shown promise for collecting measurements [35]. While there are many studies of the applications of AR [36], there is very little on the interaction between human cognition, information overlays, and motion.
controllers. Hence in addition to points (1)-(3) identified above, there is a need to (4) build a theory of AR cognition (ARC), using the built-environments as the foundation for studying how to complement human cognition with visual representations and motor actions from wearable AR devices.

V. RESEARCH OBJECTIVE

The desired research outcome of this work is a novel methodology for documenting, organizing, and visualizing (i.e., managing) data and metadata for visual inspection (VI), nondestructive evaluation (NDE), and structural health monitoring (SHM). The main two approaches will combine both virtual reality (VR) and augmented reality (AR) to implement human-centered assessment of decaying infrastructure.

The final product of this work will be a software application which applies this methodology. Hence, the methodology and software to be developed must encompass the best cognitive practices. This will guarantee human-centered features of the final product. This research will be applied to the needs of industry. Through the duration of this research AR will be benchmarked both in laboratory settings, and on-site with traditional VI, NDE, and SHM tools chosen by users. It is expected that the regular interaction of users with both AR and VR will inform them of the potential and direction towards the use of this technology in field decisions and applications.

Time, cost, and safety indexes will be measured to compare the ability of the new system to improve current inspection practices, management operations for infrastructure, and ultimately in providing safer and more effective results.

The main application of this technology will be transportation infrastructure, including bridges and tunnels. This tool would also be applicable to includes aviation, dams, energy, inland waterways, ports, rail, schools, solid waste, drinking water, hazardous waste, levees, public parks, roads, transit, and waste water.

To facilitate the implementation of the research products across these many types of infrastructure, researchers should disseminate the results to practitioners through presentations and publications at the venues participated by owners, AASHTO bridge and maintenance meetings. They should also organize workshops and short courses to instruct others on how to use the new technology.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

The estimated budget for this project will be $500,000 for a duration of two years. This estimated budget includes salaries, supplies, travels, laboratory experiments, field experiments, report preparation, presentations, and organization of workshops.

We estimate that this work will take a maximum of two years to complete. Specific tasks include generating architectures and capabilities, accessing and adding information off site and on-site, workshop and reporting, and conference presentation of the results. A final report is expected to summarize the results obtained as well as the benchmarking
of this technology with current techniques and methods, as well as recommendations for future developments.

VII. URGENCY AND POTENTIAL BENEFITS

Potential value of research results and negative impacts if this problem is not funded
The proposed product will facilitate integration, organization, visualization, and interpretation of heterogeneous data and metadata, and thus:

(i) Simplify and ease the access to, and interpretation of data, and thus incite and sustain more widespread use of technologies, such as SHM and NDE;
(ii) Enable involved diverse parties (inspector, technician, engineer, manager, owner, etc.) to access, visualize, and use the data and metadata, with aim to infer actionable information regarding the health and performance of infrastructure;
(iii) Make data collection and documentation simple and efficient, and thus lower the cost of these components related to maintenance and preservation of infrastructure;
(iv) Augment the ability of humans to collect and quantify data in the field;

A 2016 ASCE study estimates that if the current deterioration trends related to infrastructure continue, by 2025 there will be $3.9 trillion in losses to the U.S. GDP, $7 trillion in lost businesses, and 2.5 million lost American jobs [37]. Therefore, it is imperative to research methods of preserving and maintaining existing infrastructure to stymie deterioration.

Non-funding this project will practically maintain the current status on how the infrastructure is managed and preserved, which is proven to be inefficient given the available funds.

Utilization of proposed technologies on a routine basis in infrastructure management also has a great potential to attract new generation of engineers to this field - a crucial added benefit.

Likelihood of implementation-ready products
By the end of the proposed project term, the end goal is to have a software application prototype that is ready to be implemented in diverse sets of structures. Testing stages should be built into the proposed implementation plan to ensure that as the product develops it is efficient and effective.

VIII. IMPLEMENTATION PLANNING

Target audience
The target audience of this project is wide in scope and includes:

(i) Inspectors, technicians, engineers, planners, decision makers, and other professionals dealing with VI, NDE, and SHM;
(ii) Construction and infrastructure managers, owners, and other stakeholders in the following fields: bridges, buildings, aviation, dams, energy, inland waterways,
ports, rails, schools, solid waste, drinking water, hazardous waste, levees, public parks, roads, transit, and waste water;

(iii) Government officials, state and county engineers, military, and other entities in charge of the safety and protection of our nation’s infrastructure and the wellbeing and prosperity of society;

(iv) Academics – researchers, students, and teachers whose field of work is related to maintenance and preservation of infrastructure.

Key decision makers who can approve, influence, or champion implementation of the research products
AASHTO (see the next subsection), but also Federal Highway Administration (FHWA) could approve, influence, and champion the implementation (FHWA’s new website of regarding NDE technologies is developed, and study for similar website regarding SHM is being carried out).

AASHTO committee with likely responsibility for adoption of the results
AASHTO committee T-18 Bridge Management, Evaluation, and Rehabilitation and/or AASHTO committee T-9 Bridge Preservation would likely take responsibility for adoption of the results.

Early adopters
Early adopters would be state transportation agencies such as DOTs and/or fragments of it, local owners, bridge authorities, counties, cities, small and medium railroads, transportation districts, etc.

Institutional or political barriers to implementation
We do not expect to encounter any institutional or political barrier. On the contrary, the political discussions on infrastructure are expected to support innovation of new approaches to quantify and better assess the condition of our existing infrastructure.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Branko Glisic, Ph.D.
Associate Professor, Princeton University Tel: 609-258-8278
E-mail: bglisic@princeton.edu

Fernando Moreu, Ph.D.
Assistant Professor
The University of New Mexico Tel: 505-277-1784
E-mail: fmoreu@unm.edu
Sreenivas Alampalli, Ph.D., P.E.,
MBA Director, Structure
Management Bureau
New York State Department of
Transportation Tel: 518-457-4544
E-mail: sreenivas.alampalli@dot.ny.gov

X. AASHTO MONITOR

Sreenivas Alampalli, Ph.D., P.E.,
MBA Director, Structure
Management Bureau
New York State Department of
Transportation Tel: 518-457-4544
E-mail: sreenivas.alampalli@dot.ny.gov

James M. Long, P.E.
Section Chief, Bridge Inspection Section
Bureau of Maintenance and Operations/Asset Management
Division Pennsylvania Department of Transportation
Tel: 717-783-7616
E-mail: jamelong@pa.gov

Bruce Johnson,
P.E. State Bridge
Engineer
Oregon DOT, Bridge Engineering
Section Tel: 503-986-3344
E-mail: Bruce.V.Johnson@odot.state.or.us

XI. SUBMITTED BY

Sreenivas Alampalli, Ph.D., P.E., MBA
(Chair, TRB Standing Committee AFF40 “Testing and Evaluation of Transportation Structures”) Director, Structures Evaluation Services Bureau
New York State Department of
Transportation 50 Wolf Road, Albany,
NY 12232
Tel: 518-457-4544
E-mail: sreenivas.alampalli@dot.ny.gov

AASHTO COBS (Bridges and Structures) and New York DOT

References


[16] Boshce, F.; Haas, C.; Akinci, B. Automated recognition of 3D CAD objects in site laser scans for


[34] Napolitano, A.; Blyth, A; Glisic, B. Virtual environments for visualizing structural


---

**NCHRP Review of C-02**

Reviewed By:
Waseem Dekelbab
wdekelbab@nas.edu

Comments:

The problem statement is well written, and the research objective is well-defined. However, the problem statement did not discuss how the developed software will be maintained/updated and be supported. Without addressing these issues, the benefit of the final product will be very limited.

Review Date:
12/10/2018

---

**FHWA Evaluation of C-02**

Hoda Azari/ HRDI-20 - Using AR for visualization and integration of NDE, SHM and VI would be very valuable and the end product would be very useful for owners to better understand the data and extract useful information. The inspection notes can be shared among different inspectors as well. $500k might not be enough to cover all the proposed tasks and develop a software package. FHWA's NDE program has a relevant ongoing project looking at different NDE data fusion, visualization and interpretation techniques.
AASHTO Committee Evaluation for C-02

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This research is may be necessary but the statement and body of the report RNS is complicated and leads to believe the outcome will be difficult to achieve. Suggest smaller scope.

Submitter Response for 2020-C-02

From: [email: Sreenivas.Alampalli@dot.ny.gov;Bruce.V.Johnson@odot.state.or.us;]

Comments:
It should be noted that the AR software is not bought or purchased but it is rather programmed using Unity and Visual Studio. It is like a Matlab code that is coded by the programmers (either owners' staff or consultants) and will always be available to be run, even in the future with newer versions of the software. Thus, for AR applications, the software is programmed and thus does not get outdated.
The AR software has already been developed in the last two years at laboratory settings for sensor data collection, data visualization, field data acquisition, and 3D hologram sharing at small scale. The goal of this project will be to develop the AR software, as a proof of concept, that can be used by State DOTs. At the end of the project, selected consultant can work with FHWA and AASHTO for further implementation by interested owners.

Contact Info:
Sreenivas Alampalli, Ph.D., PE, MBA
Director, Structure Management Bureau
New York State Department of Transportation
Tel: (518) 457-4544
email: Sreenivas.Alampalli@dot.ny.gov

Review Date: January 21, 2019
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  
FY2020 NCHRP Problem Statement  

Comments: Committee on Bridges and Structures #5 priority for 2020. Endorsed by COBS T-9, Oregon DOT, Florida DOT

Problem Number: 2020-C-03

1. Problem Title
Best Practices for Steel Bridge Coating and Recoating Warranty Contract Requirements

2. Background
The Desk Scan Summary Report for NCHRP Domestic Scan 15-03 “Successful Preservation Practices for Steel Coatings” concluded that Warranties were a good practice for improving the quality of bridge coating projects, by increasing the contractor’s interest in providing a long lasting durable product. The Scan identified several State DOTs and Agency Owners who have successfully employed the use of Warranties on steel bridge coating and recoating projects: Maryland, Michigan, Oregon, Virginia, and the Golden Gate Bridge, Highway and Transportation District. Developing proven and effective guidance on how to prepare contract language and administer Warranties for steel bridge coating and recoating projects, would improve the quality and durability of steel bridge coatings, help lengthen the service life of steel bridges, lower the cost of bridge maintenance, and encourage the use of this contracting method nationwide.

The proposed work is part of a sequence of research activities promoted by AASHTO COBS, Technical Committee T-9 to extend the life of steel bridges by focusing on coatings. The domestic Scan was part of the sequence of research and this project is the next step to develop AASHTO adopted recommendations for warranties of steel bridge coatings. This sequence of research supports the COBS Strategic Plan Priority 1: Extend Bridge Service Life and Priority 2: Maintain and Enhance the AASHTO Specifications.

3. Literature Search Summary
A TRID search was conducted to identify previous research in the area of coating warranties for steel bridges. Four references were identified, three journal articles and one research report. The articles described specific practices in Michigan (1998), a specific project example in Maryland on the Chesapeake Bay Bridge (1998), and the general lack of the use of warranties by State DOT’s in 2000. The research report was conducted by Purdue University for Indiana DOT to provide a comprehensive assessment of methods to improve quality of steel coatings, including a section on the benefits and problems with warranties and how to specify them for improved effectiveness.
No references were found describing current practice within the last 17 years. Although not in the TRID database yet, a Domestic Scan 15-03 “Successful Preservation Practices for Steel Coatings” was recently completed by NCHRP. Recommendations from that Scan led to this proposal. None of the previous efforts contained a comprehensive nationwide summary of state DOT best practices. The proposed research will fill that need and provide critical information on the successful use of warranties and specifications to make their use more effective and promote the use of best practices in administering warranty contracts.

4. Research Objective
The objective of the proposed project is to develop draft contract language for steel bridge coating and recoating warranty contracts that will improve the quality and durability of steel bridge coatings. Determine contract performance measures that will fairly and accurately evaluate the longevity of coating systems. Recommend a warranty period based on structure size that will protect the owner’s investment and optimize the cost of bonding. Include the following proposed work tasks:

a. Perform a nationwide survey to determine the most successful steel bridge coating and recoating warranty contract requirements.

b. Summarize best practices to determine optimum bonding period and amount to assure coating durability, while minimizing bonding costs, and determine other methods of ensuring the quality of work without bonding, if possible.

c. Prepare generic contract performance measures that could be used with any coating system to establish premature coating system failure.

d. Determine specific contract penalties based on failure, which could include: remove and replace or leave in place with financial penalty.

e. Develop a generic electronic warranty contract specification for steel bridge coating and recoating projects, incorporating the above with contract options utilizing a drop-down menu, as appropriate.

5. Implementation Planning
Implementation of this research is expected to begin with adoption of the research guidance into the AASHTO LRFD Bridge Construction Specifications. The process of adopting this guidance by the AASHTO Technical Committees can be facilitated by the Research team presenting the research and explaining and justifying the proposed specifications at mid-year and annual meetings of the technical committees. Since the Scan identified some states unfamiliar with the benefits of using warranty clauses and the most effective term for the warranty, and many state use consultants for design and development of construction specifications, webinars are planned to explain these issues to a larger group than those attending AASHTO Meetings.

6. Estimate of Problem Funding and Research Period
Recommended Funding:
It is estimated that this research will require $150,000.

Research Period:
It is estimated that this research will take 12 months.

7. Urgency and Potential Benefits
Bridge owners spend hundreds of millions of dollars every year coating and recoating steel bridges. These projects have historically failed to reach their expected service lives, which is generally not discovered until many years after the projects are completed. Encouraging the contracting community to strictly adhere to specification requirements will result in longer lasting, better quality coatings, which will reduce future bridge maintenance costs, and help preserve the nation’s steel bridge infrastructure.

8. Person(s) Developing the Problem Statement
Jeffrey A. Pouliotte, FDOT
AASHTO Committee on Bridges and Structures, Member
(850) 410-5691
Jeffrey.pouliotte@dot.state.fl.us

9. Nomination for AASHTO Monitor
Bruce Johnson, PE
State Bridge Engineer, Oregon DOT
Chair, AASHTO COBS Technical Committee T-9
(503) 986-3344
Bruce.V.Johnson@odot.state.or.us

10. Potentially Interested AASHTO Councils and/or Committees
AASHTO Committee on Bridges and Structures
AASHTO Committee on Maintenance
AASHTO Committee on Materials

11. Submitted By
Bruce Johnson, PE
State Bridge Engineer, Oregon DOT
Chair, AASHTO COBS Technical Committee T-9
(503) 986-3344
Bruce.V.Johnson@odot.state.or.us

NCHRP Review of C-03
The problem statement is well written, and the research objective is well-defined. However, the problem statement is more suitable for NCHRP Synthesis and the budget shall be reduced accordingly.

Review Date:
12/10/2018

FHWA Evaluation of C-03

Becker/ HRDI-10 - This project sounds like it will touch on, or seek out, similar information that was covered under a recent NCHRP Synthesis, Number 517, Corrosion Prevention for Extending the Service Life of Steel Bridges. It seems like there is likely some overlap, although this proposed topic will be specific to warranties. It sounds like this task's information will be done mainly through surveys of best-practices. This, along with the examples of necessary contract wording, seems like a useful guide. The cost, $150k, seems a bit high, since this will mainly be performed through surveys and conversations. The time to complete seems reasonable. Raj Ailaney/HIBS-30 - Recommended for funding. The project will develop much needed generic warranty contract specifications for steel bridge coatings and recoating projects that states can use. It is one of the recommendations from the NCHRP Domestic Scan that was recently completed on "Successful Preservation Practices for Steel Coatings". The project is supported and submitted by AASHTO SCOBS' Technical Committee on Bridge Preservation.

AASHTO Committee Evaluation for C-03

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This was reviewed by T-11 as a synthesis, but has been rewritten as a full project. The Committee believes this has value, and would like to have a member of the Committee on the panel.
Problem Number: 2020-C-04

1. Problem Title
Rational Tolerances for Fabrication of Steel Bridge Members.

2. Background
Tolerances are required in fabrication of steel bridges so the designers can be assured the real structure does not deviate too far from the design, and fabricators need some leeway during fabrication because bridges are heavy weldments from steel plates that themselves have natural waviness and variation in thickness. AASHTO publishes tolerances for steel bridges mostly in three locations; 1) the AASHTO LFRD Bridge Construction Specifications, 2) the AASHTO/AWS D1.5/D1.5M Bridge Welding Code and to a lesser extent, 3) the AASHTO LRFD Bridge Design Specifications. For instance, the Bridge Welding Code contains dimensional tolerances for weldments including warpage and tilt of flanges, web out-of-flatness, camber, acceptable levels of undercut. The LFRD Bridge Construction Specifications mostly reference back to the Bridge Welding Code but does have specific requirements such as allowable pre-welding gaps between rib and deck plates for orthotropic steel decks. Similar tolerances exist in the LRFD Bridge Design Specifications for orthotropic decks.

Published tolerances are generally based on best practices or workmanship criteria, not necessarily based in performance of the structure. To compound upon this further, designers sometimes arbitrarily impose more restrictive tolerances resulting in added costs that have no bearing on the performance of the member. There is an urgent need to review all tolerance criteria published in AASHTO specifications for use in the fabrication of steel bridges and understand the basis for its existence and if it is needed for structural performance, or merely an aesthetic requirement. Rational criteria should be used to define new tolerances if the existing are proven too restrictive based on structural performance requirements, and additional restrictions provided if aesthetics must govern. The research should identify how fabrication practices used to achieve the specified tolerances, including fit up, distortion control, temporary welding, and imposed restraints, affect structural performance. Additionally, the cost associated with restrictive tolerances should be documented.

This research problem statement contributes directly to the Committee on Bridges and Structures 2014 Strategic Plan Prioritized Objective 4: Maintain and Enhance
3. Literature Search Summary

Literature search on TRID was performed using the following search criteria:

- Searching the keywords “bridge tolerance” yielded only one possible relevant hit. The on-going NCHRP 12-99 project entitled “Recommended Guidelines for Prefabricated Bridge Elements and Systems Tolerances and Dynamic Effects of Bridge Moves,” however this project is addressing tolerances between prefabricated elements, the concern of this RNS is the tolerances within the prefabricated element itself.
- Searching keywords “tolerance OR fabrication” with “bridge” in the title resulted in no relevant hits.
- Searching keywords “bridge OR tolerance” with “performance” in the title resulted in no relevant hits.
- Searching just keywords “tolerance OR fabrication” itself resulted in two hits relevant to steel bridges:
- The National Technical Reports Library was searched and no additional references could be found pertaining to steel bridges, however numerous references could be found pertaining to steel ship structure fabrication. This indicated that likely other industries beyond bridges have some published literature that can be used for the project. One example would be:

4. Research Objective

The objective of this research is to develop performance based dimensional tolerances for fabrication and erection of steel bridge decks and superstructures, both in shop and field applications. Supplemental tolerances based on visual aesthetics shall also be provided along with estimated costs to achieve them.

5. Implementation Planning

The full implementation of this research is to develop code language that would be adopted by AASHTO COBS in the AASHTO Metals Fabrication Specifications that are currently under development by T-17 Technical Committee on Metals Fabrication. As part of this specification development, it is anticipated that presentations will be given to T-17, the National Steel Bridge Alliance Task Group 2, Fabrication, and to the Joint AASHTO-AWS D1.5 Bridge Welding
Subcommittee in order to disseminate the findings and to develop support for the anticipated code provisions.

6. **Estimate of Problem Funding and Research Period**

**Recommended Funding:** $600,000

**Research Period:** 30 months

7. **Urgency and Potential Benefits**

There is an urgent need to develop rational tolerances for fabricating bridge members that are based on a realistic assessment of the structure's performance rather than on best practices or workmanship criteria. This is especially the case when designers sometimes arbitrarily impose more restrictive tolerances resulting in added costs that have no bearing on the performance of the member or overall structure. Having realistic tolerance criteria will allow fabricators to produce bridge members more efficiently and economically, since these new tolerances will be consistent from project to project and will not require fabricators to meet tolerance limits that are too stringent. Without these realistic fabrication tolerances, fabricators will have to continue to meet the current ones by special attention to the fabrication process or having to re-work the member at a great expense, all of which may be unnecessary for the actual field assembly or structural performance.

This research is especially timely since the AASHTO T-17 Technical Committee for Metals Fabrication is starting to develop an AASHTO Metals Fabrication Specification. The results of this research would be incorporated into this new specification. Incorporating these tolerances specifications into a national AASHTO specification would assure that state DOTs would have the confidence to adopt them for their projects.

8. **Person(s) Developing the Problem Statement**

John Fisher, PhD, PE
Professor Emeritus
Lehigh University
117 ATLSS Drive
Bethlehem, PA 18015
jwf2@lehigh.edu

Sougata Roy, PhD
Principal
Sougata Roy, LLC
4211 Campbell Drive
Bethlehem, PA 18020
sougata.r@gmail.com

Justin Ocel, PhD, PE
Structural Steel Research Program Manager
Federal Highway Administration
6300 Georgetown Pike
McLean, VA 22101
justin.ocel@dot.gov

9. **Nomination for AASHTO Monitor**
   To be assigned by NCHRP staff.

10. **Potentially Interested AASHTO Councils and/or Committees**
    AASHTO Committee on Bridges and Structures

11. **Submitted By**
    This problem statement was developed in the TRB AFH70 committee and is being submitted by Alexander K. Bardow, Chair of AASHTO T-17 “Technical Committee for Metals Fabrication”

    The problem statement was endorsed by the AASHTO T-17 “Technical Committee for Metals Fabrication” and AASHTO T-14 “Technical Committee for Structural Steel Design”.
    At its June 2018 Annual Meeting, AASHTO COBS rated this as its 3rd research priority.

---

**NCHRP Review of C-04**

Reviewed By: Waseem Dekelbab
wdekelbab@nas.edu

Comments:

The AASHTO CBS ranked this problem as the 3rd in a group of 4 high-priority problems from the problem statements reviewed this year. However, the requested funding appears to be extremely high given that there is no lab or field testing included. Also, the problem statement is missing the research approach/tasks.

Review Date:
12/10/2018

---

**AASHTO Committee Evaluation for C-04**
Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This is the #3 priority of the Committee on Bridges & Structures.

Submitter Response for 2020-C-04

From: [email: alexander.bardow@state.ma.us]

Comments:
One of the comments was that the problem statement was missing the research approach/task. The problem statement should be amended by adding the following task to part 4 Research Objective of the problem statement:

Rational Tolerances for Fabrication of Steel Bridge Members Research Approach/Tasks:
Following research approach/tasks are anticipated for accomplishing the project objectives.

Phase I
Task 1. Collect and review relevant domestic and foreign literature, research findings, information and existing specifications regarding tolerance requirements for fabrication of steel bridge members and their influence on member performance. This information may be obtained from published and unpublished reports, and contacts with transportation agencies and other public and private organizations.

Task 2. Synthesize the literature review to identify (1) the key parameters that affect the performance of fabricated steel members, (2) the tolerance requirements for steel member fabrication, and (3) the relevant sections of the existing fabrication specifications that need to be revised for addressing the arbitrariness in the specifications.

Task 3. Assess the relevance of the fabrication parameters and tolerances identified in Task 2 and identify those most relevant to fabrication of structural steel bridge members for further consideration in this research.

Task 4. Based on the findings of Task 3, develop a proposed plan that includes both computational and experimental investigations, to be executed in Phase II, for determining rational tolerances for fabrication of structural steel members for highway bridges.
Task 5. Prepare an interim report that documents the research performed in Tasks 1 through 4 for review and approval by NCHRP.
Phase II
Task 6. Perform research as per plan developed in Task 4 and approved in Task 5.

Task 7. Based on the research performed, develop rational tolerance for fabrication of steel bridge members.

Task 8. Develop recommendations for revisions to the relevant specifications for rational fabrication tolerances for steel bridge members.
Task 9. Prepare a final report that documents the entire research effort.

Another comment was that the requested funding appears to be extremely high. The response is that some laboratory/field testing is anticipated, as noted in Research Task 4 above. Since the task were missing from the original problem statement, this might have resulted in the comment.

Finally, the preparers of the problem statement would like to amend the problem statement by increasing the research duration to 36 months from the originally submitted 30 months

Contact Info:
Alexander Bardow
State Bridge Engineer
Chair, AASHTO T-17 Technical Committee
MassDOT
10 Park Plaza,
Boston, MA 02116

Review Date: January 18, 2019
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Comments: Committee on Bridges and Structures #2 Priority for 2020 Funding. Endorsed by AASHTO T-9 Bridge Preservation and T-10 Concrete Bridge

Problem Number: 2020-C-05

1. Problem Title
   Developing High Strength Corrosion Resistant Steel Strands for Prestressing

2. Background
   Prestressed concrete elements such as beams, girders, piles, and decks are an essential part of the vast majority of bridges built in the US. Bridges built using prestressed concrete components use black steel strands that are susceptible to corrosion leading to structure deterioration. Corrosion is the first mode of deterioration for all bridges and the 7-wire strands are the most sensitive steel to corrosion. Delaying the onset of corrosion will reduce maintenance needs, extend the bridge service life and enhance the safety overall.

   There is a need to develop corrosion resistant metallic strands. Georgia, Florida and Virginia have worked to develop and produce stainless strands meeting the requirements of ASTM A276, UNS S31803 or S32205 (Type 2205), however these strands have a lower strength and lower elongation or ductility compared to black steel strands.

   The objective of this research is to develop guidance and AASHTO specifications for the use of high strength stainless steel strands for prestressing concrete structures and components. This guidance and specifications should include all bridge structure applications including pre-tensioning, post-tensioning and cable stay applications.

   This research statement meets the strategic plan of the AASHTO subcommittee on Bridges and Structures Items:
   1- Extend Bridge Service Life,
   4- Maintain and Enhance the AASHTO Specifications,
   6- Optimize Structural Systems,

3. Literature Search Summary
The literature search produced numerous research in Florida, Georgia and Virginia that developed and produced stainless steel strands. However, this effort is to cast a wider search for all available stainless steel strands and develop guidance and specifications for the use of these strands.

4. **Research Objective**

The objective of this research is to develop guidance and AASHTO specifications for the use of high strength stainless steel strand for prestressing concrete structures and components. This guidance and specifications should include all bridge structures applications including pre-tensioning, post-tensioning and cable stay applications.

The research may involve at least the following tasks:

1. Literature review: Review of national and international literature for available material specifications, guidance and manufacturer information of stainless steel prestressing strands and any governing design specifications for these strands.
2. Identify the AASHTO LRFD Bridge Design Specifications Provisions that will have to be modified to incorporate the stainless steel strands.
3. Develop work plans to develop these specifications including material and full scale testing.
4. Conduct the work plans.
5. Based on the testing and analytical work Develop the following:
   a. Material specifications for specifying the selected strands.
   b. Design guidance for the use of the selected strands.
   c. AASHTO LRFD Bridge Design Specification revisions to incorporate the selected strands into the specifications.

5. **Implementation Planning**

The implementation of research begins with adoption of the research guidance into the AASHTO LRFD Bridge Design Specifications. The process of adopting this guidance by the AASHTO Technical Committees can be facilitated by the Research team presenting the research and explaining and justifying the proposed specifications.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:** $600,000

   **Research Period:**

   36 Months

7. **Urgency and Potential Benefits**
This statement addresses a critical need to transition toward more corrosion resistant alloys for use in the infrastructure. Stainless steel offers a viable corrosion resistant material for prestressing strands which will extend the bridge service life, reduce potential maintenance and future rehabilitation work.

8. **Person(s) Developing the Problem Statement**

Sam Fallaha, P. E.  
Assistant State Structures Design Engineer  
Florida Department of Transportation  
605 Suwannee Street, MS 33  
Tallahassee, FL 32399  
Off: 850-414-4296  
Cell: 850-459-3455  
Sam.fallaha@dot.state.fl.us

9. **Nomination for AASHTO Monitor**

Matt Chynoweth, P. E.  
Bridge Field Services Engineer  
Michigan Department of Transportation  
425 West Ottawa St  
Lansing, MI 48933  
Off: 248-483-5102  
chynowethm@michigan.gov

10. **Potentially Interested AASHTO Councils and/or Committees**

This problem statement was supported by AASHTO Committee on Bridges and Structures.  
The AASHTO Committee on Maintenance is interested.

11. **Submitted By**

This problem statement was the #2 Priority of the AASHTO Committee on Bridges and Structures.

Bruce Johnson, P. E.  
State Bridge Engineer  
Oregon Department of Transportation  
4040 Fairview Industrial Dr SE, MS #4  
Salem, OR 97302  
Off: 503-986-3344  
Cell: 503-986-3407  
bruce.v.johnson@odot.state.or.us
NCHRP Review of C-05

Reviewed By:
Waseem Dekelbab
wdekelbab@nas.edu

Comments:

The problem is suitable for funding in the FY 2020 NCHRP. The AASHTO CBS ranked this problem as the 2nd in a group of 4 high-priority problems from the problem statements reviewed this year. The objective of this project is consistent with the 2013 CBS Strategic Plan.

Review Date:
12/10/2018

FHWA Evaluation of C-05

Becker/ HRDI-10 - This task addresses a critical need in terms of corrosion prevent and mitigation for prestressed and post tensioned structures. Work in this area is urgently needed. In addition to stainless steel, there are other materials that may want to be examined as replacements for ‘black-bar’ cable. Besides the strand material, other related areas that need to be examined include the grouts used (for PT tendons) and the design and construction methods. This project would likely be a good start, but given the amount of test and validation work to be done, in addition to the modifying the specifications, the cost and time frame may be too low.

AASHTO Committee Evaluation for C-05

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This is the #2 priority of the Committee on Bridges & Structures.
Problem No: 2020-C-06

Title: Evaluating the Completeness and Accuracy of Existing Utility Records

Background/Description:
There is substantial anecdotal evidence suggesting that records do not exist for many underground utilities; or at least not to the degree with which they can be accurately located. In some instances, this scenario can also occur for overhead utilities where identifying the current utility owner proves challenging. Additional anecdotal evidence suggests that when as-built or location records are available for existing utilities, their actual, precise location may vary significantly from what is presented in these records. There is a need to understand these anecdotes and quantify the results such that improvements can be planned and substantiated.

Evidence for the lack of quality utility records comes in the form of “unknowns” that are found during construction or as unanticipated discoveries during subsurface utility engineering (SUE) investigations. Quantifying the amount of these non-recorded utilities presents additional challenges that is not as simple as counting the number of unknown utilities versus recorded utilities. The unknown quantity should likely be a comparison of the total length of non-recorded utilities versus total length of recorded utilities. Some quantities may be relatively easy to collect when they involve utilities that while they do not have records may not be true unknowns due to the ability to field trace them between known structures. Other quantifications may be more complicated, such as numerous non-recorded direct-buried cables in a single trench. Quantifying the risk is even more difficult due to factors such as abandoned or unknown utilities.

Another factor to consider is record accuracy. Here, the anecdotal evidence suggests that existing underground utilities with available records from utility owners cannot be designated accurately from plans without some diligent fieldwork. In these cases, while the One Call system may result in the utilities being marked, there is evidence from a Virginia Department of Transportation study in 2011 that many surface marks are often incorrect. Quantifying the amount of miss-marked utilities by some arbitrary distance is difficult, since not all projects are 100% excavated in the areas of utility markings. While the use of SUE has the potential to find inaccurately marked utilities, this is not a role of the One Call system. It is also often difficult to determine when One Call marks are established through use of geophysical methods or simply marked from records.

Because of this and other concerns, ASCE 38 has standardized the practice of assuming a One Call mark is designated only though notations from the utility records. However, One Call utility markings are still often relied upon by excavators.

Additionally, many departments of transportation are using utility records as true indicators of facility locations. The concerns and anecdotal evidence above suggest a large risk to utility facilities and excavator safety, yet there is currently not a quantifiable determination to support a change of practice. These factors need further investigation.

Objective (Required):
The object of this study is to collect quantifiable measures regarding incomplete or inaccurate utility records within highway projects. While an exhaustive study of these measures is impossible, evidence to provide relative ranges of incompleteness or inaccuracy would establish a benchmark from which improvements could be measured and guidance could be developed.

**Potential Benefits:**
The potential benefits of this study are the determination of support for the anecdotal evidence regarding the quantity of unknown utilities and the accuracy of utility records. These determinations will allow the measured return on investment of applied utility coordination and location approaches such as the use of SUE or other best practices. This study will establish the needed baseline in order to quantify returns on best practices and further develop guidance on best application of these practices.

**Related Research:**

**Tasks:**
The following tasks are not comprehensive. They are intended as a guide to successfully complete the research:

- Conduct an analysis of the Common Ground Alliance DIRT report and interactive website for review of damages relative to unknown or inaccurately marked utilities.
- Conduct three (3) side-by-side utility field investigations comparing One Call Marks and SUE providers regarding the discovery of unknown and inaccurate utility records.
- Conduct a survey of the 50 DOTs to inquire about known documentation regarding estimates of incomplete or inaccurate utility records and to determine possible cases for detailed study.
- The results of the previous tasks should be summarized and presented to the research panel along with a list of potential state DOTs for case study. Present the research panel with a detailed study plan for estimating the quantity of incomplete utility records and the range of inaccuracy in utility records.
- Complete case studies and required work for estimating the quantity of incomplete utility records and the range of inaccuracy in utility records. Case studies should be completed for at least 10 state DOTs (as approved by the panel).
- Develop a framework and implementation guide for estimating the quantity of incomplete utility records and the range of inaccuracy in utility records with
associated guidance for the application of best practices to maximize the return on their investment.

- Compile the collected and developed materials into final project deliverables including a report (Word Document) and PowerPoint presentation.

**Implementation:**
The implementation of this project could be facilitated through presentation at the AASHTO Committee on ROW, Utilities, and Outdoor Advertising Control Annual Conference and webinars. The guidance developed would then be implemented at the state level.

**Funding:**
The estimated project cost for this project is $300,000.

**Research Period:**
It is estimated that this project would require 24 months for completion.

**Research Priority:**
This study presents a needed benchmark from which improvements in utility data completeness and accuracy can be determined. The completion of this study would mark the beginning of much needed guidance concerning available utility data.

**Relevance:**
State departments of transportation as well as other agencies lack evidence of support to rely upon when considering the completeness or accuracy of utility provided data. This study would allow the determination of the extent of potential issues with utility provided as-built data and plans.

**Source Information:**
Southeastern/Eastern Utility Summit, Contact: Anthony Carovillano WVDOT

**RNS Developer:**
Rob Martindale, Colorado Department of Transportation
Technical Committee on Utility Mapping, GIS & Data Management
email: rob.martindale@state.co.us

**Sponsoring Committee (Required):**
AASHTO Committee on ROW, Utilities, and Outdoor Advertising Control

**Subject Categories (Required):**
Utilities
Permitting
Communication
Coordination
Records research
NCHRP Review of C-06

Reviewed By:
Camille Crichton-Sumners
crichton-sumners@nas.edu

Comments:

It would be helpful for state transportation agencies to have benchmarks and suggested ranges for accuracy to compare the quality of utility records, although, it will be difficult to obtain data from the states. Budget and timeframe seem reasonable.

Review Date:
2/10/2018

FHWA Evaluation of C-06

Julie Johnston, HICP-10 - We support this NCHRP problem statement as it addresses one of our findings in the National Utility Program Review: Lack of accurate utility location information on plans. Corrigan/ HRDI-20 - Potential to combine with Problem No: 2020-C-08. It is unclear how the deliverables will be used and benefit the current state of practice (including a framework and implementation guide for estimating the quantity of incomplete utility records (and range of inaccuracy) with "associated guidance for application of best practices to maximize the return on their investment")? We know there are inaccuracies between the documented locations and actual field locations of many subsurface items; how will estimating or quantifying the inaccuracy help improve locating them? Additional details are needed. If the goal is to determine and provide guidance on available utility data as cited in the Research Priority section, it is unclear how the scope and task support the goal.

Submitter Response for 2020-C-06

From:
Jennifer McCleve (jennifer.mccleve@ky.gov) Vice Chair of Utilities Subcommittee
On behalf of Nelson Smith (nsmith@sha.state.md.us) Chair of Utilities Subcommittee

Comments:  
**FHWA Comments** - Julie Johnston, HICP-10 - We support this NCHRP problem statement as it addresses one of our findings in the National Utility Program Review: Lack of accurate utility location information on plans. Corrigan/ HRDI-20 - Potential to
combine with Problem No: 2020-C-08. It is unclear how the deliverables will be used and benefit the current state of practice (including a framework and implementation guide for estimating the quantity of incomplete utility records (and range of inaccuracy) with "associated guidance for application of best practices to maximize the return on their investment")? We know there are inaccuracies between the documented locations and actual field locations of many subsurface items; how will estimating or quantifying the inaccuracy help improve locating them? Additional details are needed. If the goal is to determine and provide guidance on available utility data as cited in the Research Priority section, it is unclear how the scope and task support the goal.

Response – We agree that it has been well documented that utility locations (both documented and field) are frequently inaccurate. Increasing data accuracy is a costly endeavor, so it becomes prudent to document the existing condition to help identify if the additional cost needed to increase accuracy is a valuable endeavor. We seek to understand the relative level of accuracy one should expect from utility records, One Call marks, and SUE. Through this understanding, we are better equipped to determine the appropriate level of accuracy needed. This research is particularly valuable when considered during the most costly portion of the project process: construction. Construction largely relies on One Call marks, which may be more unreliable than we currently understand. The developed implementation guide may be especially useful during construction to define extra steps to mitigate the risk inherent to relying solely on One Call marks.

NCHRP Comments - It would be helpful for state transportation agencies to have benchmarks and suggested ranges for accuracy to compare the quality of utility records, although, it will be difficult to obtain data from the states. Budget and timeframe seem reasonable.

Response – We agree that the collection of data for analysis will be a critical element of this research and likely the most difficult element of the research. We agree the funding level and timeframe requested is sufficient to achieve the goals set.

Contact Info:
Nelson Smith
nsmith@sha.state.md.us

Review Date:
1/18/19
Problem Number:  2020-C-07
Title:

Evaluation of Tools and Methods to Mitigate and Manage Utility-Related Risks on State Department of Transportation Projects

Background/Description:

Risk is the exposure to the chance of injury or loss; a hazard or dangerous chance. The probability of risk is typically proportional to the resulting impact (i.e. the greater the potential risk, the greater potential impact to financial, schedule, safety, etc.). Utility-related risks on projects differs greatly site-to-site, utility-to-utility, and proposed project to proposed project. Utility risk is also handled differently owner-to-owner. For example, the risk associated with utility impacts and relocation costs may be minimal on a mill and pave project, whereas the risks could be significant for a proposed drainage improvement project. There are several dimensions to utility risk management during project development and delivery. Examples include risks due to uncertainties in utility location (X, Y, and Z); operational characteristics (e.g., pressure, capacity, and operational status); structural characteristics and performance (e.g., soil and bedding characteristics, strength, resilience); work schedule (e.g., utility conflict management, coordination, constructability, construction phasing, traffic control, damage prevention, worker safety, cost management, and billing); and costs (e.g., preliminary estimates, local participation, funding availability). Each of these risk dimensions can affect a transportation agency’s ability to deliver projects on time and within budget.

Some approaches to manage and mitigate utility-related risk have been developed, such as Subsurface Utility Engineering (SUE), the use of Utility Conflict Management (UCM), Utility Impact Analysis (UIA) and mobile construction technology. However, these technologies and procedures are not consistently managed or implemented state-to-state. States who implement these technologies have seen varying levels of success in mitigating their utility-related risks while still other states are not even aware of these technologies. There is a significant need for states to identify and share the successful implementation of these and other utility-related risk mitigation approaches.

Objective (Required):

The objective of this study is to evaluate the management and implementation of Utility Impact Analysis (UIA), Utility Conflict Management (UCM), and Subsurface Utility Engineering (SUE) as a means in mitigating utility-related risks on state department of transportation projects.

Potential Benefits:
The potential benefits of the research include a best practice implementation framework and guidance for the management and implementation of Utility Impact Analysis (UIA), Utility Conflict Management (UCM), and Subsurface Utility Engineering (SUE) in mitigating utility-related risk on a state department of transportation projects.

Related Research:

There are existing and ongoing efforts related to location and conflict tracking and management systems including NCHRP Synthesis 405, ACRP Synthesis 34, SHRP2 R01, SHRP2 R15A, SHRP2 R15B, FHWA-HRT-16-019, TxDOT research projects 0-5475 and 0-6756, and Kentucky Transportation Center report KTC-14-15/SPR460-13-1F involving guidance on best practices applied according to a utility risk metric.

Tasks:

The following tasks are not comprehensive. They are intended as a guide to successfully complete the research:

- Review existing literature and identify current utility risk quantitative or qualitative performance metrics.
- Conduct a 50 state DOT survey to identify utility coordination programs conducting performance evaluation, risk management, and collecting data such that quantitative risk analysis may be performed. Identify and document their approach in implementing Subsurface Utility Engineering (SUE), Utility Conflict Management (UCM), and Utility Impact Analysis (UIA).
- Identify state DOT’s for case study to capture details regarding the benefits and costs in implementation of Subsurface Utility Engineering (SUE), Utility Conflict Management (UCM), and Utility Impact Analysis (UIA) for mitigating and managing utility-related risks.
- Meet with the research panel and present a research plan for developing a best practice implementation framework and guidance for the management and implementation of Utility Impact Analysis (UIA), Utility Conflict Management (UCM), and Subsurface Utility Engineering (SUE) in mitigating utility-related risk on a state department of transportation projects.
- Conduct the research and case studies as approved by the research panel.
- Review current technology advancements of in-real time management of SUE data.

Implementation:

The implementation of this project could be facilitated through presentation at the AASHTO Committee on ROW, Utilities, and Outdoor Advertising Control Annual Conference and webinars. The guidance developed would then be implemented at the state level.

Funding:
The estimated project cost for this project is $400,000.

**Research Period:**

It is estimated that this project would require 24 months for completion.

**Research Priority:**

Utility-related risks on transportation construction projects continually contribute to cost overruns, schedule delays, and litigation because some DOTs lack the understanding or knowledge about successful and proven technologies created to manage those risks. This research would assemble these best practices and guidance documents into a single source that can be shared with all state DOTs.

**Relevance:**

State departments of transportation are faced with the increasingly challenging task of mitigating and managing utility-related risks within their highway construction projects. There exists methods to assist in those processes but there is minimal guidance in their successful application. This research would develop guidance that could lead to reductions in cost overruns, schedule delays, and litigation related to utility interactions with highway construction projects.

**Source Information:**

Southeastern/Eastern Utility Summit, Contact: Anthony Carovillano WVDOT

**RNS Developer:**

Larry Ditty – Pennsylvania Department of Transportation  
Technical Committee on Utility Project Scoping & Coordination  
litty@pa.gov  
Rob Martindale, Colorado Department of Transportation  
Technical Committee on Utility Mapping, GIS & Data Management  
email: rob.martindale@state.co.us  
Kenneth C. Kerr, P.E.  
Regional Director / Chief Engineer  
InfraMap Corp.  
92 North Main St., Building 19E  
Windsor, New Jersey 08561  
(609) 371-5420 x405  
kkerr@inframap.net
**Sponsoring Committee (Required):**
AASHTO Committee on ROW, Utilities, and Outdoor Advertising Control

**Subject Categories (Required):**
Utilities
Permitting
Risk Management
Best Practices
Communication
Technology

---

**NCHRP Review of C-07**

**Reviewed By:**
Camille Crichton-Sumners
crichton-sumners@nas.edu

**Comments:**
State transportation agencies would benefit from additional tools to aid in utility relocation risk mitigation to reduce delays, claims, and costs. This would be a suitable topic for a highway synthesis study. Budget and timeframe are feasible.

**Review Date:**
12/10/2018

---

**FHWA Evaluation of C-07**

Julie Johnston, HICP-10 - This also supports the findings from our National Program Review in that Utility Coordination is a risk to the Federal Aid Program. The problem statement doesn’t seem to coincide with the objective however. What is the intended outcome? To promote SUE, UCM, etc? To show DOTs how to lower their risk?
AASHTO Committee Evaluation for C-07

Submitted By:
Eric Kopinski
AASHTO Staff
Committe of Right-of-Way, Utility and Outdoor Advertising Control (CRUO)

Comments:
This topic has importance and value for almost EVERY road project. As utility installations increase in the RW and varying laws allow for old utilities to be abandoned in place, the RW is becoming ever more crowded. Additionally the costs to relocate many utilities can quickly affect project budgets and can sometimes make projects cost prohibitive, denying the public the benefit of the project. Identification of tools that can mitigate issues before they have to be dealt with during construction can yield positive benefits to project outcomes.

Submitter Response for 2020-C-07

From:
Jennifer McCleve (jennifer.mccleve@ky.gov) Vice Chair of Utilities Subcommittee
On behalf of Nelson Smith (nsmith@sha.state.md.us) Chair of Utilities Subcommittee

Comments:
FHWA Comments - Julie Johnston, HICP-10 - This also supports the findings from our National Program Review in that Utility Coordination is a risk to the Federal Aid Program. The problem statement doesn't seem to coincide with the objective however. What is the intended outcome? To promote SUE, UCM, etc? To show DOTs how to lower their risk?
Response – We believe the problem statement lacks a single element to tie it to the objective: There are likely many reasons that DOT’s do not leverage these tools to their advantage. This research addresses what we believe are fundamental reasons for a lack of use or misuse of these risk reduction tools. By defining the cost / benefit of use, what projects typically benefit from use, and how to implement these risk reduction tools, we believe that DOTs will be better equipped to selectively apply these risk reduction tools in their projects. Since the national review has confirmed utility impacts are a notable risk to projects, fostering use of these risk reduction tools is a worthy endeavor.

NCHRP Comments - State transportation agencies would benefit from additional tools to aid in utility relocation risk mitigation to reduce delays, claims, and costs. This would be a suitable topic for a highway synthesis study. Budget and timeframe are feasible.
Response – We agree that utility risk reduction is a key element of project development and delivery. While this project does not intend to identify additional tools, it will absolutely add clarity to existing utility risk reduction tools so users understand how beneficial they can be when used correctly and on the right types of projects.
NCHRP Problem Statement

Problem No: 2020-C-08

Title: Utility Conflict Impacts During Highway Construction

Background
A 2001 survey of State departments of transportation (DOTs), highway contractors, design consultants, and other user groups shed light on the most frequent causes of delays in highway projects. Across all categories of respondents, the top five causes of delay mentioned were delays in utility relocations, differing site conditions (DSCs) related to utility conflicts, environmental planning delays, permitting issues, and insufficient work effort by the contractor. Overall, delays in utility relocations and differing site conditions related to utility conflicts were ranked first or second by all groups.

A 2018 Federal Highway Administration (FHWA) report identified utility issues as one of the top causes of project delays, confirming that inefficiencies in the utility process remain one of the main reasons that highway projects experience delays and cost overruns. This conclusion is consistent with anecdotal evidence that project managers and engineers frequently provide. In certain areas, things may be getting worse. For example, the annual Damage Information Reporting Tool (DIRT) report, which used to show decreases in damages to underground utility infrastructure during construction every year, has started to show increases since 2014.

FHWA and the American Association of State Highway and Transportation Officials (AASHTO) are implementing projects R01A, R01B, R15B, which emerged from the Second Strategic Highway Research Program (SHRP2). The focus of these projects was the identification and resolution of utility conflicts and more effective management of utility data, primarily during the pre-construction phase. Lessons learned are beginning to emerge from the implementation of these products at close to 20 State DOTs nationwide. A recent report from FHWA also highlighted specific strategies to address utility process inefficiencies during the pre-construction phase.

A substantial gap in this research and implementation effort has been how to manage the impact of utility conflicts during the construction phase. It is known that utility process inefficiencies can result in multiple problems, such as disruptions when utility installations are encountered unexpectedly during construction, damage to utility installations, delays that can extend the period of project delivery and increase total project costs, frustration for travelers, unnecessary utility relocations, and negative public perception about the project. However, a number of utility risk areas have not been addressed yet, including, but are not limited to, the following:

- Uncertainties during construction associated with existing utility location (X, Y, and Z)
- Structural characteristics and performance (e.g., soil and bedding characteristics, material properties, strength, resilience)
- Interaction among utilities that occupy a common, confined footprint
- Coordinated infrastructure project phasing with utility work schedules
- Constructability, traffic control, damage prevention, worker safety, and other construction factors
- Field inspection, verification, and production of as-built records.

Objective
The purpose of the research is to (a) quantify the impact of utility conflicts during construction; (b) prepare a catalog of best practices for managing utility conflicts during the construction phase; (c) develop and test prototype procedures for point-of-delivery utility inspections, i.e., in-place inspections and location data capturing in ways that maximize real-time data collection and processing; and (d) develop training materials.

Potential Benefits
Developing a catalog of effective practices for managing utility conflicts during construction would translate into multiple benefits including, but not limited to, the following:
- Time and cost savings during construction and throughout the lifetime of transportation and utility facilities.
- Improved utility location data collection practices during construction, resulting in reduced risk of damage to utility infrastructure and improved worker safety during construction.
- Improvements in the quality of utility inspections leading to benefits, such as higher performance levels by the utility contractors and tighter contract requirements and specifications.
- Fewer and less costly construction project change order and utility-related claims.

Relationships to the Existing Body of Knowledge
- The Virginia DOT (VDOT) has piloted the use of radio frequency identification (RFID) markers as a damage prevention tool and as a strategy to increase the accuracy, reliability, and completeness of utility location and attribute data.
- The Michigan DOT (MDOT) has implemented a program to collect real-time 3D utility facility data while the trench is still open.
- A 2018 FHWA report identified sources of utility-related risks and inefficiencies that extend to the construction phase.
- SHRP2 R01A, R01B, and R15B research reports and lessons learned from the FHWA-sponsored implementation.
- DIRT reports highlighting increases in damages to underground utility infrastructure during construction.

Tasks
The following tasks are not comprehensive. They are intended as a guide to what might be necessary to successfully complete the research:
- Survey state DOTs, municipalities, and other jurisdictions to examine issues, examples of innovative and best practices, required inspection data to be collected and identification of critical improvement areas.
• Conduct a review of utility conflict impacts during construction, including a compilation of examples and tabulation of related change orders and claims.
• Prepare a catalog of best practices for managing utility conflicts during construction.
• Develop and test prototype procedures for point-of-delivery utility inspections, i.e., in-place inspections and location data capturing.
• Develop training materials and conduct pilot training.

Follow-On and Implementation Activities
• Provide web-based training opportunities nationwide
• Publish a self-guided training tool that can be shared electronically
• Publish an e-book documenting commonly used practices, point of delivery examples, and innovative inspection example cases.

Estimated Funding Requirements
$400,000.

Research Period
This project would require 24 months for completion.

Research Priority
Inefficiencies in the utility process remain one of the top reasons that highway projects experience delays and cost overruns. After years of decreases, damages to underground utility infrastructure during construction are now consistently increasing. Inefficiencies in the management of utility issues result in multiple problems, such as disruptions when utility installations are encountered unexpectedly during construction, damage to utility installations, delays that can extend the period of project delivery and increase total project costs, frustration for travelers, unnecessary utility relocations, and negative public perception about the project. It is urgent to address these sources of delay and cost overruns.

Relevance
After years of considering utility issues as a lower priority item, FHWA and State DOTs are now recognizing that utility topics should be considered a key integral component of project delivery both during the pre-construction and construction phases. Contractors have long recognized that utility inefficiencies are a source of risk that can increase their cost and the probability of project delays. Addressing how utility conflicts are managed during construction would assist in reducing this level of risk and improve project delivery practices.

Contact Person
Larry Ditty
Chief Utility Relocation Administrator
Pennsylvania Department of Transportation (PennDOT)
Phone: (717) 214-8762
Email: lditty@pa.gov
Nelson Smith
Statewide Utility Engineer, Office of Construction
Maryland State Highway Administration (MDSHA)
Phone: (443) 572-5267
Email: nsmith@sha.state.md.us

Sponsoring Committee (Required)
AASHTO Committee on Right of Way, Utilities, and Outdoor Advertising Control

Subject Categories
Utilities
Construction
Design

NCHRP Review of C-08

Reviewed By:
Camille Crichton-Sumners
ccrichton-sumners@nas.edu

Comments:
It will require significant effort to obtain data (some potentially sensitive due to claims), but states will benefit from being able to determine quantifiable impacts due to construction related utility conflicts. A best practices catalog for managing utility conflicts and procedures for point-of-delivery utility inspections will also be helpful. The scope will likely require 36 months and a larger budget-450K.

Review Date:
12/10/2018

FHWA Evaluation of C-08

Julie Johnston, HICP-10 - This study supports the findings of our National Utility Program review. There is a substantial lack of information and resources out there to help states manage and track construction related impacts due to utilities. I would rate this of high importance, if not the most important of the utility related studies. Corrigan/HRDI-20 - Potential to combine with Problem No: 2020-C-06. Developing a catalog of best practices for managing utility conflicts during construction by including and leveraging usage of emerging technologies (RFID, location data capturing, and BIM/CIM data) would provide value to the construction industry.
AASHTO Committee Evaluation for C-08

Submitted By:
Eric Kopinski
AASHTO Staff
Committee of Right-of-Way, Utility and Outdoor Advertising Control (CRUO)

Comments:
Road RW are becoming ever more crowded with utilities, new and abandoned ones. While State DOTs are making efforts to reduce, mitigate, or avoid utility issues/conflicts/delays prior to construction, inevitably some will still exist. Providing best practices to State DOTs could reap significant benefits, such as decreased project overrun costs and increased reliability for opening projects on-time. Such results will yield benefits to the travelling public and the attendant economies.

Submitter Response for 2020-C-08

From:
Jennifer McCleve (jennifer.mcbleve@ky.gov) Vice Chair of Utilities Subcommittee
On behalf of Nelson Smith (nsmith@sha.state.md.us) Chair of Utilities Subcommittee

Comments:

**FHWA Comments** - Julie Johnston, HICP-10 - This study supports the findings of our National Utility Program review. There is a substantial lack of information and resources out there to help states manage and track construction related impacts due to utilities. I would rate this of high importance, if not the most important of the utility related studies.
**Corrigan/ HRDI-20** - Potential to combine with Problem No: 2020-C-06. Developing a catalog of best practices for managing utility conflicts during construction by including and leveraging usage of emerging technologies (RFID, location data capturing, and BIM/CIM data) would provide value to the construction industry.

**Response** – We concur with these comments and believe this is the most important of the utility related studies. It would be possible to incorporate Problem No: 2020-C-06 into this proposal, provided the funding and schedule is extended somewhat. The arena of utility impacts during project construction remains largely uninvestigated. Over the years there have been many tools developed to help effectively manage the utility coordination process during project development and before project construction. As these tools are further leveraged in real life applications, we can and should focus more on the ramifications of utility impacts to the construction project itself, where we still see significant negative effect.

**NCHRP Comments** - It will require significant effort to obtain data (some potentially sensitive due to claims), but states will benefit from being able to determine quantifiable impacts due to construction related utility conflicts. A best practices catalog for
managing utility conflicts and procedures for point-of-delivery utility inspections will also be helpful. The scope will likely require 36 months and a larger budget-450K.

Response – We concur with these comments, it will be challenging to derive the data necessary to analyze utility impacts to project construction. The resulting catalog will be valuable to all DOTs to varying degrees. The funding and schedule may be expandable if both this and the 2020-C-06 proposal were merged. The scope increase would be relatively small, and we do not expect the entirety of the 2020-C-06 budget would need to be included since much of these proposals would involve overlapping research and case study. We would recommend increasing the schedule to 36 months of the topics are merged.

Contact Info:
Nelson Smith
nsmith@sha.state.md.us

Review Date:
1/18/19
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline
Problem No: 2020-C-09

1. Problem Title
Outdoor Advertising Control Program Reference Manual for State Departments of Transportation

2. Background
State OAC Programs are a federally mandated program under 23 USC 131 and 23 CFR Part 750. The federal program was established in the late 1960s with minimal significant amendments. State Department of Transportation (State DOTs) have since passed state legislation to address new trends and innovations in advertising technology without any uniformity in the context of the national application. Federal law provides that each State DOT develop, under a State/Federal Agreement, an OAC program which is at least as stringent as the federal laws and regulations. Each state has fulfilled this Congressional unfunded mandated by creating a State OAC program which is unique to each state with differing legal criteria which meet the federal requirement of being at least as stringent as the baseline federal provisions set forth in the State/Federal Agreements.

Although each state is governed by the baseline federal provisions, there are significant differences in the application of those provisions. Such differences have resulted in different approaches to similar OAC situations and issues. The different approaches between the states have created an inconsistent federal OAC program among the states with varying degrees of enforcement on similar OAC issues. These programmatic differences create a number of challenges in administering and managing the state OAC program. These challenges include the following:
• Lack of understanding and application of federal OAC terms
• Lack of understanding of federal OAC guidance
• Inconsistency in the meaning to terms implemented by state regulations
• Inconsistency in understanding of federal baseline provisions

To overcome such challenges, State DOTs need an OAC Reference Manual to provide guidance and consistency to the State OAC programs. The Reference Manual will consist of federal and state OAC terminology as well as federal and state baseline criteria extrapolated from the Florida Research Project entitled “Establishment of Effective Control Factors to Achieve Federal Enforcement Consistency with the Highway Beautification Act”; Agreement No.: BE288; Fin. Project I.D.: 4194971B201; Procurement No.: RFP-DOT-16/17-9016-GH; http://nahba.org/libraryresources/research/floridareserachproject.pdf.
The proposed project will build on this previous research to develop guidance for State DOTs to ensure consistency in the federal program. The guidance can also serve as a training tool for new staff, easing staff transitions and workforce turnover. In addition, the research project will include synthesizing the NHI on-line Training Modules into a working manual for day-to-day instruction on how to handle OAC issues. It will also include model rules on base line program criteria. State DOTs are in significant need and can benefit from a consolidated source of information and guidance on OAC program management.

3. Literature Search Summary

2017 – Florida Research Project. Prior research on this matter never resulted in a Procedures Manual but will be used as a source to create the manual. The Florida Research Project is entitled "Establishment of Effective Control Factors to Achieve Federal Enforcement Consistency with the Highway Beautification Act"; Agreement No.: BE288; Fin. Project I.D.: 4194971B201; Procurement No.: RFP-DOT-16/17-9016-GH; [http://nahba.org/libraryresources/research/floridareserarchproject.pdf](http://nahba.org/libraryresources/research/floridareserarchproject.pdf). It identified various effective control measures. Baseline Standard 5 of the report provided that procedures should be developed to comply with all existing OAC rules and regulations. This research project will be an extension and continue where the Florida Research Project ended.

2000 – National Study – Outdoor Advertising Control. The Federal Highway Administration's (FHWA's) Office of Real Estate Services (ORES) sponsored, in coordination with the National Alliance of Highway Beautification Agencies (NAHBA), a national survey of all states in an effort to determine the types of outdoor advertising (ODA) data each state collects, how it is collected and how that data is maintained and used. The survey was conducted over a five-month period utilizing the World Wide Web and achieved an 81 percent response rate. The study culminated in a recommendation for further research to assist the states with their program needs.

There has been no other comprehensive research or duplication of research to develop an OAC Procedural Manual on a national level. The proposed research differs from, and will build upon, the existing body of research found in the literature review.

4. Research Objective

The primary objective of this Project is to create a Reference Manual as a programmatic resource for use by state DOTs in the implementation of the OAC Program. The OAC Reference Manual will be a resource available to the state DOTs to provide guidance and consistence in the application of this federal program. An OAC Reference Manual is essential as a necessary state strategic plan initiative to assist State DOTs with workforce and succession planning and retention management.
5. **Implementation Planning**

The work tasks anticipated in this project include the following:

- Collect and develop OAC terms, conditions, procedures, policies and guidelines from each state DOT and compare with FHWA regulatory definitions;
- Collect written guidance, letter, memoranda and documentation from FHWA establishing OAC policies and procedures;
- Develop a list of baseline OAC extrapolated from (1) the Florida Research Project *Effective Control Factors to Achieve Federal Enforcement Consistency with the Highway Beautification Act*; (2) assimilation of the state DOT data collected; and (3) FHWA law, regulations, policies and procedures.
- Develop a list of model rules which capture the base line effective control features of the federal program; and
- Provide a narrative report with well-organized tables presenting the research results.

6. **Estimate of Problem Funding and Research Period**

It is estimated that this research will take 14-18 months to complete and will required $200,000.00 funding.

7. **Urgency and Potential Benefits**

AASHTO leadership and State Departments of Transportation continually strive to reduce administrative costs associated with the management of the OAC program. Consistent application and understanding of the program will help minimize administration of programmatic functions which may result in a more efficient and less costly program.

(a) This research is of significant value to State DOTs critical need to provide programs that are cost effective as well as benefiting the State DOTs strategic objectives of workforce succession planning and retention in the OAC program.

(b) This research project builds off of the Florida Research Project which identified several baseline effective control measures. The State DOTs now need an OAC Procedures Manual which can consolidate the information into a useful medium to enhance and streamline their programs. As such it can be successfully achieved within the constraints of time and funding proposed.

(c) The research project will produce implementation-ready OAC Procedures Manual.

(d) The research project will consist of baseline national OAC requirements which each state is mandated to adhere in order to meet their
State/Federal requirements and as such will be a very useful and necessary tool for the State DOTs.

8. **Person(s) Developing the Problem Statement**
   Barbara M. Wessinger, South Carolina Department of Transportation  
   Co-Chair, OAC, AASHTO CRUO  
   955 Park Street  
   Columbia, SC 29202  
   Tel: (803) 737-1348  
   Fax: (803) 737-2071  
   wessingebm@scdot.org

   Jim Spalla, Florida Department of Transportation  
   Co-Chair, OAC, AASHTO CRUO  
   605 Suwannee Street, MS 22  
   Tallahassee, FL 32399-0450  
   Tel: (850) 414-4600  
   Fax: (850) 414-4850  
   Jim.Spalla@dot.state.fl.us

9. **Nomination for AASHTO Monitor**
   Barbara M. Wessinger, South Carolina Department of Transportation  
   Co-Chair, OAC, AASHTO CRUO  
   955 Park Street  
   Columbia, SC 29202  
   Tel: (803) 737-1348  
   Fax: (803) 737-2071  
   wessingebm@scdot.org

10. **Potentially Interested AASHTO Councils and/or Committees**
    The OAC Reference Manual is a primary research initiative of and supported by the AASHTO Right of Way, Utilities, and Outdoor Advertising Control’s Technical Subcommittee on OAC Policy.

11. **Submitted By**
    Randall R. Park, P.E. – Utah Department of Transportation  
    Project Development Director  
    Committee Chairman, AASHTO CRUO  
    Tel: (801)633-6267  
    rpark@utah.gov

---

NCHRP Review of C-09
Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The problem statement describes a project to help states implement and comply with FHWA OAC program. States are increasingly struggling to recruit, train, and retain staff to support their OAC programs (especially appraisers), so a reference resource on the requirements of the federal program would be of use. Information on how states are addressing their OAC workforce challenges could be important to identify the most effective ways to implement the guidance.

The scope suggests developing a OAC program that could be consistently adopted by all state DOTs. It is unclear whether such a program would be widely accepted as states may have different needs and state-level legal and regulatory environments.

Review Date:
11/20/2018

FHWA Evaluation of C-09

Joi Singh/HEPR - The problem, as drafted, appears to have significant merit. It proposes to meet an as yet unmet need and would stand to promote greater program consistency. However, the problem proposes to catalog all of the OAC terms used at SDOTs nationally. This task seems moot, if the goal is to align SDOT definitions with federal definitions.

AASHTO Committee Evaluation for C-09

Submitted By:
Eric Kopinski
AASHTO Staff
Committee of Right-of-Way, Utility and Outdoor Advertising Control (CRUO)

Comments:
The proposed Reference Manual would be helpful across the country. The information currently available is scattered and largely outdated. A Reference Manual on these topics could help to educate staff, could identify common issues facing state DOTs in OAC enforcement, and would provide a valuable benchmark for OAC rules and policy.
Submitter Response for 2020-C-09

From: [email: wessingebm@scedot.org]

Comments:

FHWA COMMENTS:
The problem, as drafted, appears to have significant merit. It proposes to meet an as yet unmet need and would stand to promote greater program consistency. However, the problem proposes to catalog all of the OAC terms used at SDOTs nationally. This task seems moot, if the goal is to align SDOT definitions with federal definitions.

Implementation Planning
The work tasks anticipated in this project include the following:
- Collect and develop OAC terms, conditions, procedures, policies and guidelines from each state DOT and compare with FHWA regulatory definitions;
- Collect written guidance, letter, memoranda and documentation from FHWA establishing OAC policies and procedures;
- Develop a list of baseline OAC extrapolated from (1) the Florida Research Project Effective Control Factors to Achieve Federal Enforcement Consistency with the Highway Beautification Act; (2) assimilation of the state DOT data collected; and (3) FHWA law, regulations, policies and procedures.
- Develop a list of model rules which capture the base line effective control features of the federal program; and
- Provide a narrative report with well-organized tables presenting the research results.

RESPONSE: The 1965 HBA and subsequent provisions in the Code of Regulations contain a relatively small list of OAC definitions. Since that time frame, SDOT’s have expanded the regulatory vocabulary to handle a variety of new developments in the OAC industry, to included, electronic signs and levels of comprehensive zoning. The goal is to identify the different terms and establish the fundamental federal policies which apply to them so that SDOTs will have a reference manual of how to handle those terms.

NCHRP REVIEW OF C-09
Comments: The problem statement describes a project to help states implement and comply with FHWA OAC program. States are increasingly struggling to recruit, train, and retain staff to support their OAC programs (especially appraisers), so a reference resource on the requirements of the federal program would be of use. Information on how states are addressing their OAC workforce challenges could be important to identify the most effective ways to implement the guidance. The scope suggests
developing a OAC program that could be consistently adopted by all state DOTs. It is unclear whether such a program would be widely accepted as states may have different needs and state-level legal and regulatory environments.

**Urgency and Potential Benefits**

AASHTO leadership and State Departments of Transportation continually strive to reduce administrative costs associated with the management of the OAC program. Consistent application and understanding of the program will help minimize administration of programmatic functions which may result in a more efficient and less costly program.

(a) This research is of significant value to State DOTs critical need to provide programs that are cost effective as well as benefiting the State DOTs strategic objectives of workforce succession planning and retention in the OAC program.

(b) This research project builds off of the Florida Research Project which identified several baseline effective control measures. The State DOTs now need an OAC Procedures Manual which can consolidate the information into a useful medium to enhance and streamline their programs. As such it can be successfully achieved within the constraints of time and funding proposed.

(c) The research project will produce implementation-ready OAC Procedures Manual.

(d) The research project will describe examples of how SDOT’s have implemented each baseline provision in the HBA and CFR to demonstrate how SDOT’s can meet state and federal requirements. Consist of baseline national OAC requirements which each state is mandated to adhere in order to meet their State/Federal requirements and as such will be a very useful and necessary tool for the State DOT

RESPONSE: The project is not to develop an “OAC program that could be consistently adopted by all state DOTs.” I believe the confusion could be in section (d) which is not intended to mean that the project will create new requirements for the SDOTs to adhere to, rather, is to identify the existing FHWA requirements that are mandated by the current HBA and CFR and how those requirements assimilate in today’s vernacular of current OAC terms and conditions.
Contact Info:

*Barbara M. Wessinger*
Assistant Chief Counsel
SCDOT
PO Box 191
Columbia, SC 29202
(803) 737-1348
wessingebm@scdot.org

Review Date:  January 21, 2019
NCHRP Problem Statement

Problem No: 2020-C-10

Title (Required): Valuation of Permitting Utility and Communications Installations in Public ROW

Background/Description (Required):
State Departments of Transportation (DOTs) permit the use of highway right-of-way (ROW) for the installation of utility and communication facilities with varying approaches to the accommodation. For example, ROW along roadways without access control may provide for utility and communications accommodation at no cost while accommodation along limited access routes may be more complex. These complex accommodations may involve numerous agreement structures, ranges of fees, if any (or potentially other means of compensation) and involve varying legislation addressing these arrangements. The details of these accommodations are often not easily comprehended or communicated. Further, they vary from state to state, as there is no single national standard.

This issue becomes further complicated when specifically addressing communications facilities. In these instances, the owner of dark fiber optic facilities may be charging or leasing carrier companies for the use of their facility. In this arrangement, the facility owner, who may have been located on public ROW at no cost, is in essence profiting from the lease of their facility to telecommunications providers as third parties. While the accommodation of utilities and communications facilities in public ROW is generally considered a public benefit, there may be instances where DOTs should be compensated for accommodations that are currently accommodated in ROW at no cost.

Some DOTs have navigated or enacted legislation to allow for placing fees or leasing accommodation on ROW for communications and other utility company facilities. These approaches entail varying fee schedules and can often be found to be revenue neutral or operating at a loss, while still others could be generating revenue to supplement highway funds. With the rapidly expanding networks of broadband fiber optic networks and microcellular technology, investigating these approaches is necessary for determining effective practices and guidance in these accommodations.

There is a need to capture the approaches used by DOTs to evaluate and potentially charge for the permitted use or accommodation on ROW. As mentioned these charges may include fees, leasing, in-kind trading (such as allowing DOTs to use or share facilities), or other compensation means. A comparison of these approaches, the associated agreements, the fee structures, and related legislation is needed along various variables and scenarios. These varying characteristics include the types of utilities or communications facilities accommodated, the location of these accommodations (urban or rural), and the access control of the roadways where these accommodations occur.
Objective (Required):
The objective of this research is to prepare guidance and a collection of approaches used to evaluate and charge for the accommodation of utility and communication installations on public ROW. The guidance is to include a comparison of fees, leasing, and in kind trading along the various approaches used nationally. This collection of national rates and standards should be analyzed to identify variations among approaches and determine possible reasons for these variations, such as legislation, property values, etc. When presented, the approaches should be standardized, normalized, and converted such that the comparisons are evaluated in like terms. The guidance should provide DOTs the means and approaches necessary to execute a fee or leasing schedule for occupancy for general utilities or isolated to strictly telecommunications facilities.

Potential Benefits:
This project will produce a clear guidance document, which can be used by DOTs to assess their accommodation policies of utilities and communication facilities in ROW. This ability to assess existing DOT policies using clearly documented policies of other DOTs with the corresponding legislation will provide DOTs will a clear course for executing changes if necessary. These changes may result in better legislation, expanded DOT communication networks, fiscally net neutral accommodation, or potentially net positive accommodation for the DOTs.

Related Research:
Upcoming Research: NCHRP 26-06 (Legal Problems Arising out of Highway Programs) Topic 24-04, “The Legal Issues Concerning the Use of Transportation Facilities to Generate Revenue for State DOTs”—this topic is strictly a legislation review and would serve as background to the project stated here.

Tasks:
The following tasks are not comprehensive. They are intended as a guide to what might be necessary to successfully complete the research:

- Analyze the legislation and permitting documentation readily available for all 50 states and at the federal level to determine the statutory and regulatory standards for utility and communications accommodation and associated fees
- Summarize and compare legislation and fee structures collected through the previous review and highlight potential legislative pitfalls to be further analyzed in the following survey or potential case studies
- Conduct a survey of the 50 DOTs to determine varying approaches to permitting accommodation of utilities and communications, any associated fees or leasing and how these fees may be affected by variables such as access limitations, route types, urbanization, etc. Further, any information available regarding the accommodation value assessments and determination of fees should be collected and summarized. The survey should also be used to determine state
DOTs to serve as case studies in the development of the guidance to be developed in later tasks of this study.

- The results of the previous tasks should be summarized and presented to the project panel along with a list of potential state DOTs for case study. The varying approaches identified should be presented to the panel at this stage.
- Complete case studies to detail the approaches used by selected state DOTs for valuation and permitting utility and communications installations on public ROW. Case studies should be completed for at least 10 state DOTs (as approved by the panel) and should include Utah, West Virginia, Louisiana, Colorado, and California. The details from the case studies should include as a baseline fee schedules or leasing details, variables affecting the accommodations, legislation requirements and associated necessary legislative changes.
- Develop a framework and implementation guide for each of the approaches recommended by the research panel for valuation of permitted utility and communications installations. This guidance should at least detail the methods for determination of fee schedules and value assessments, the impact of location and route variables, and any legislative requirements or pitfalls associated with the approach.
- Prepare a final guidance document highlighting the approaches for valuation of permitted utility and communications installations and the known benefits and drawbacks of each approach.
- Compile the collected and developed materials into final project deliverables including a report and presentation.

**Implementation:**
The implementation of this project could be facilitated through presentation at the AASHTO Committee on ROW, Utilities, and Outdoor Advertising Control Annual Conference and webinars. The guidance developed would then be implemented at the state level.

**Funding:**
The estimated project cost for this project is $350,000.

**Research Period:**
It is estimated that this project would require 24 months for completion.

**Research Priority:**
The accommodation of utilities and communications facilities in public ROW is on the rise in most states. It is critical that DOTs be provided the data necessary to assess these accommodations and this guidance will be such a tool for assessment.

**Relevance:**
Currently state DOTs are dealing with an abundance of accommodation requests for multiple utilities but specifically relating to microcellular and broadband fiber optic
facilities. These accommodations could be much more standardized on the national level for mutual benefit to the state DOT and the utility companies involved.

**Source Information:**
Western States Utility Summit, Contact: Alana Spendlove UDOT
Southeastern/Eastern Utility Summit, Contact: Anthony Carovillano WVDOT

**RNS Developer:**
AASHTO Technical Subcommittee on Utility Accommodation and Safety
Eric Cimo DelDOT
Eric.Cimo@state.de.us

**Sponsoring Committee (Required):**
AASHTO Committee on ROW, Utilities, and Outdoor Advertising Control

**Subject Categories (Required):**
Utilities
Communication
Permitting

---

**NCHRP Review of C-10**

**Reviewed By:**
Camille Crichton-Sumners
crichton-sumners@nas.edu

**Comments:**

State transportation agencies would love to be able to evaluate and charge for the accommodation of utility and communications appurtenances within their public ROW. Coordination and communication with state legal or Right-of-Way staff at state agencies will require a significant effort and cooperation. It’s not likely that a national standard will be achieved, but it would be helpful to have examples of successful contractual arrangements in other states. This was beyond the scope of 20-07 Task 407, but there was some interest in exploration.
FHWA Evaluation of C-10

Maggie Duncan-Augustt/HEPR - Based on the information provided, the proposed research effort will likely compile current State utility and communication accommodation practices into a resource reference document. The potential benefit of this type of documentation could facilitate greater consistency and efficiency in utility/communication accommodation and management of public rights-of-way nationwide. Julie Johnston/HICP-10 - Project may impact some of the effects going on with the WH Broadband initiatives. This also lines up with the current FCC rules that are having an impact on 23 CFR 645.

AASHTO Committee Evaluation for C-10

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This submission is supported by Council on Active Transportation members based on survey results

Submitted By:
Eric Kopinski
AASHTO Staff
Committee of Right-of-Way, Utility and Outdoor Advertising Control (CRUO)

Comments:
This is perhaps one of the hottest topics facing DOTs across the country. The need for fiber backhaul is growing nationwide and State DOT RW is an obvious solution to provide unobstructed, unbroken corridors to facilitate this installation. The economic and technological advantages that may develop from such installations are limitless. The question of valuation is a requirement under Federal Law and the various state laws and policies create an even more diverse landscape. This study will provide vital information and guidance.
Submitter Response for 2020-C-10

From:
Jennifer McCleve (jennifer.mccleve@ky.gov) Vice Chair of Utilities Subcommittee
On behalf of Nelson Smith (nsmith@sha.state.md.us) Chair of Utilities Subcommittee

Comments:
FHWA Comments - Maggie Duncan-Augustt/HEPR - Based on the information provided, the proposed research effort will likely compile current State utility and communication accommodation practices into a resource reference document. The potential benefit of this type of documentation could facilitate greater consistency and efficiency in utility/communication accommodation and management of public rights-of-way nationwide. Julie Johnston/HICP-10 - Project may impact some of the effects going on with the WH Broadband initiatives. This also lines up with the current FCC rules that are having an impact on 23 CFR 645.

Response – We agree that this research proposal is particularly timely and valuable, allowing for a national compilation of practices. Through early proposal drafting, we discovered that there is a wide range of practices in regard to the permitting communication facilities in public right of way and the valuing of access. There is a lot of activity nationally in terms of communications and data installations, both physically and in rulemaking. Now seems the best time to collect facts of practice to help all during implementation.

NCHRP Comments - State transportation agencies would love to be able to evaluate and charge for the accommodation of utility and communications appurtenances within their public ROW. Coordination and communication with state legal or Right-of-Way staff at state agencies will require a significant effort and cooperation. It's not likely that a national standard will be achieved, but it would be helpful to have examples of successful contractual arrangements in other states. This was beyond the scope of 20-07 Task 407, but there was some interest in exploration.

Response – We agree that a national standard is not necessarily viable and a compilation of practices is valuable by itself. We expect states will use a compilation of practices to identify a baseline of fair and reasonable fees, streamline practices and understand the steps permitted providers must take in neighboring states. We expect this understanding will lead to a more consistent process for permittees nationally.

Contact Info:
Nelson Smith
nsmith@sha.state.md.us

Review Date:
1/18/19
Problem No: 2020-C-11

1. **Problem Title:** Methodology for Addressing Project Constraints in Early Construction Cost Estimates.

2. **Background**
   
   • *Early project cost estimates (Planning, Conceptual, and Preliminary Estimates) are used to develop and support the budget for the transportation project. Establishing accurate estimates at this stage are increasingly challenging as the primary cost drivers for the project (such as pavements, bridges, etc.) are heavily influenced by constraints to minimize disruptions to motorists and environmental constraints. These constraints can include schedule constraints (such as impacts of season restrictions, accelerated construction, restrictions for traffic control during night work only), phased construction (to maintain essential traffic), as well as tight project constraints such as limited access as in urban areas.*

   • *Establishing research based adjustment factors and methodology will increase the accuracy and reliability of early project estimates which will allow for delivery of the project on budget, thus reducing the need for adjustments of project scope to meet the programmed budget or adjustment of the overall program to address the actual project costs.*

   • *This project is aligned with the Committee on Design’s Strategic Goals. Specifically, this project will provide tools to better estimate the cost of construction projects while meeting the expectations of the end user and meet environmental commitment (reference Goal # 2” Develop design solutions that meet the purpose and need of a project, address its context, and protect the natural and human environment”). It will advance the state of practice of Cost Estimating (Goal #5) and Improve the Cost Effectiveness of our projects (Goal #3).*

3. **Literature Search Summary**

   A Literature search on the TRID webpage for the parameters of “cost estimate contingency”. The

   *Most relevant result was the 2011 report by the American Society of Civil Engineer’s report entitled “New Approach to Developing Conceptual Cost Estimates for Major Highway Projects.” Although this project was focused on*
using final project costs to establish contingency/adjustment factors for use with Conceptual Estimates, there is a need to expand this to specific type of constraints seen in transportation projects today and in simplified format.

4. **Research Objective**

   1. Establishment of national adjustment/contingency factors (or ranges) for constraints including:
      - Construction schedule constraints, including:
        - Construction / MOT Restrictions
      - Physical constraints (access based, such as in constricted urban setting)
      - Environmental Restrictions (such as stream, tree cutting)

   2. Establishment of framework/methodology for states to establish and maintain state specific adjustment/contingency factors

5. **Implementation Planning**

   - Review of state procedures related to Preliminary estimates to adopt means of addressing new adjustment factors
     - Web conferences to roll-out training on results
   - Methodology to establish state specific adjustment factors for constraints
     - Webinars and peer exchange

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**

<table>
<thead>
<tr>
<th>Task</th>
<th># of states/factors</th>
<th>hours each</th>
<th>hours total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background Research</td>
<td>4</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>State Data</td>
<td>8</td>
<td>40</td>
<td>320</td>
</tr>
<tr>
<td>Analysis of Data</td>
<td></td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>Establish Contingency Factors</td>
<td>10</td>
<td>40</td>
<td>400</td>
</tr>
<tr>
<td>Draft Report</td>
<td></td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>Solicit/address comments</td>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Final Report</td>
<td></td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Webinar Development</td>
<td></td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Training Sessions</td>
<td></td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

   Estimated Cost: $128,000
Potential Peer Exchange  $50,000

Range: $130-$180k

Research Period:  
12-18 months

7. **Urgency and Potential Benefits**

The delivery of transportation projects requires adaptations to environmental, construction, and physical site constraints. Without the tools and guidance for how to account for the impacts that these constraints have on the cost of the project in the conceptual and preliminary stages projects may be significantly under budgeted. Under budgeted projects may result in the need to either revise the scope of the project at a future date or make significant adjustments in the agency’s program to identify additional funding for the increased project costs.

8. **Person(s) Developing the Problem Statement**

*Melissa Batula, Vice Chair of the Technical Committee on Cost Estimating (TCCE).*
*Terry Knouse, Research subgroup member of the TCCE*
*Christa Siegenthaler, Research subgroup member of the TCCE*
*Elijah Gansen, Research subgroup member of the TCCE*

9. **Nomination for AASHTO Monitor**

TBD

10. **Potentially Interested AASHTO Councils and/or Committees**

Endorsed by the Committee on Design

11. **Submitted By**

*Melissa Batula, Vice-Chair of the Technical Committee on Cost Estimating.*

---

**NCHRP Review of C-11**

Reviewed By:  
Edward T. Harrigan  
eharriga@nas.edu

Comments:
· Is the problem potentially solvable through research? If not, why?

The problem is of high priority and is potentially solvable through an NCHRP research project.

· Is it likely of interest to at least 2/3s of the DOTS? If not, why?

Yes, as developing accurate cost estimates for transportation projects is key to their delivery on time and on budget.

· Is there a reasonably clear objective? If not, can you suggest a brief improvement?

The objectives are clear and well-stated.

· Is the scope of the research reasonable? Please recommend changes if needed.

○ Can the research be done in 2-3 years at the most? If not, why?

○ Is the budget adequate? If not, why?

The scope and schedule are reasonable, but an increase in the budget to $250,000 is urged.

Review Date:
12/4/2018

AASHTO Committee Evaluation for C-11

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is endorsed by the Committee on Design.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement
Problem No: 2020-C-12

1. Problem Title
Methodology to Define New AASHTO Green Book 7.0 Context Classification Settings Implementation as Related to Active Transportation Infrastructure

2. Background
In 2018, the National Cooperative Highway Research Program (NCHRP) published Report 855 titled *An Expanded Functional Classification System for Highways and Streets*. This document served as a key reference informing the recently published AASHTO Green Book 7.0 (Green Book). The new Green Book introduces a change in guidance for State transportation officials by introducing a broader set of land use context categories that combined with functional class are intended to guide design decision making. By introducing a more refined land use classification breakdown (including rural, rural town, suburban, urban and urban core) the guidance provides a mechanism for better targeting design solutions to specific contexts, while providing needed flexibility to address planning and design needs. The existing research and guidance, however, does not point to specific methodologies or parameters by which these land use contexts would be defined and operationalized to implement the Expanded Functional Classification System (FCS).

The proposed research would entail exploring available data sources and methodologies to provide more specific guidance on the process and parameters by which the newly proposed contexts would be defined. It would fill a key gap in the existing guidance by outlining more specific metrics for quantifying the proposed contexts, and by recommending more specific approaches for weighting the inputs and identifying appropriate ranges of values to inform their stratification. To advance this discussion, the work would include identifying and analyzing comparative land use data across a range of state or regional contexts and building from best practices and case studies to help inform state-specific methodologies for implementing the new guidance. Particular attention will be required to advance methodologies for estimating future land use impacts, which will usefully include analysis of protocols associated with trip generation rates and access management, to help strengthen the consideration of modal integration in a given roadway network.

In addition, the research should include preliminary analysis of key demonstration projects – as case studies to inform how the classification system – and the specific processes or treatments associated with it, are to be evaluated. This component of the research is a critical component to ensure that application of
these methods are rigorously tested, and to inform the systematic evaluation and refinement of the proposed approach. The case studies should include a range of project types as well as classifications, to help illustrate the utility and limitations of the new methods and guidance.

3. Literature Search Summary
Authors searched the Transportation Research Information Database (TRID), Research in Progress Database (RIP), as well as TRB Snap Searches for the following topics: Pedestrian & Bicycle (7/9/18); Planning & Forecasting (5/22/18). The relevant reports related to this problem statement are:

- NCHRP Report 855: An Expanded Functional Classification System for Highways and Streets
- AASHTO Green Book 7.0 (Draft reviewed by Council on Active Transportation)
- NCHRP Web-Only Document 230: Developing an Expanded Functional Classification System for More Flexibility in Geometric Design
- NCHRP Report 880: Design Guide for Low-Speed Multimodal Roadways

The above research and guidance documents do not provide specificity regarding the metrics and methodologies for defining and implementing the Expanded Functional Classification System. This study advances further research needs identified in the studies listed above and will be critical to inform their implementation.

4. Research Objective
While this guidance includes all of the roadways and contexts currently in place, additional guidance is needed to assist practitioners in selecting which of the existing guidance is most pertinent to the new categories, such as suburban and rural town contexts. In the long term, the increased resolution of the context categories and documentation of that in operational databases, such as the HPMS, will allow for more refined research and guidance that addresses the specific and unique needs of the new categories being proposed.

- Expand upon Report 855 and the Green Book guidance to ensure consistent implementation of the new functional class system within DOTs and local governments.
- Define more objective criteria, proposed modeling, and a validation process that can be used when considering each mode of transportation for each new functional class category that takes into account access management and projected traffic impacts and desired operational speed.
- “How-to” manual or implementation guide is a desired deliverable for DOTs to best incorporate these changes in planning and design.

5. Implementation Planning
Presentations and webinars would be an efficient way to disseminate the results and recommendations. Sample guidelines for DOTs to adopt may be useful to ensure consistent implementation and demonstrate the recommendations.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**
   $300,000 ($200,000 for 12 months of 1 professional staff; $50,000 for data collection and modeling; $50,000 for reporting and dissemination)

   **Research Period:**
   20 months (12 months of research, 4 months for review, 4 months for interim report reviews and meetings)

   Research to be conducted in 2 overlapping phases:

   1) Identification of potential land use metrics and provisional stratification; and
   2) Evaluation of categories through identification and testing of case studies.

7. **Urgency and Potential Benefits**

   The research will present a much needed and timely addition to existing research and provide a forum for addressing many questions that are likely to arise with the issuance of the new Green Book guidelines. It will improve the capacity of state DOTs to adopt and implement the approach reflected in the Extended Functional Classification System.

8. **Person(s) Developing the Problem Statement**

   Marty Baker, Ph.D., AICP,
   Deputy Director of Bicycle and Pedestrian Access
   Office of Planning and Capital Programming,
   Maryland Department of Transportation.
   Ph: 410-865-1294; E-mail: mbaker1@mdot.state.md.us

   April Renard, P.E., PTOE
   Louisiana Department of Transportation and Development
   Transportation Safety and Complete Streets
   1201 Capitol Access Road
   Baton Rouge, Louisiana 70802
   Phone: (225)379-1919
   Email: april.renard@la.gov

   Anna Bosin, AASHTO Fellow/AK DOT&PF
   444 N. Capitol Ave NW
   Washington, DC 20001
   (202) 624-7800

9. **Nomination for AASHTO Monitor**
10. **Potentially Interested AASHTO Councils and/or Committees**
   - Council on Highways and Streets
   - Planning Committee
   - Safety Committee

11. **Submitted By**
    Provide contact information for individuals submitting or supporting this problem statement. If an organization, e.g., an AASHTO committee, is listed, include the name and contact information for an individual associated with the organization.

---

**NCHRP Review of C-12**

**Reviewed By:**
B. Ray Derr
rderr@nas.edu

**Comments:**

The proposed research is an excellent extension of the work documented in NCHRP Report 855 which has been incorporated into the 7th Edition of the Green Book. The new context classes appear to be well accepted and the proposed research would provide more concrete guidance on context selection for a particular project. It should be noted that this selection should take into account planned development in addition to historical data.

The proposed research complements that in Problem Statement G-11 that would develop more explicit design guidance based on these context classes.

**Review Date:**
11/28/2018

---

**FHWA Evaluation of C-12**

Fleming El-Amin/HEPH - This statement needs to be coordinated with G-11, which is focused on identifying appropriate applications and ranges of design controls, criteria, and elements across a range of functional classifications, contexts, and modal priorities consistent with the recommendations of Research Report 855. The proposal should consider the range of target audiences; engineers, planners, designers, and environmental specialists. Under Research Objective, consider "Expand understanding
of the relationship between highway design flexibility and the Green Book 7th Edition context classifications." Under Literature Review, consider: Highway Functional Classification Concepts, Criteria and Procedures (FHWA, 2013) - Section 6 talked about defining urban and rural boundaries and perhaps this project could inform an update to this guide if FHWA wants to expand to include the 5 context zones into the official functional classification. There would be ripple effects through many aspects of the Federal-aid program, which is why Report 855 developed a system that could still fit in with our urban/rural coding. E. Hilton, HICP-10 - Overlaps with G-11, but perhaps more from the planning angle.

AASHTO Committee Evaluation for C-12

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This has strong support and was the second highest ranked submission by Council on Active Transportation based on survey results

Submitter Response for 2020-C-12

From: [email: abosin@aashto.org] Contact Info: Anna Bosin, abosin@aashto.org 202-624-7800

AASHTO has reviewed the comments received by NCHRP and FHWA related to the proposed research needs statement 2020-C-12 and discussed it with Council on Active Transportation Steering Committee members. Thank you for the input and review of the research needs statement.

The Council on Active Transportation submitter and needs statement writers are assessing how this research needs statement can be coordinated with the Technical Committee on Geometric Design 2020-G-11 needs statement in order to complement efforts. We will work to address this request prior to the project selection meeting April 9th and 10th.

Comments:
NCHRP Review of C-12

Reviewed By:
B. Ray Derr
rderr@nas.edu
The proposed research is an excellent extension of the work documented in NCHRP Report 855 which has been incorporated into the 7th Edition of the Green Book. The new context classes appear to be well accepted and the proposed research would provide more concrete guidance on context selection for a particular project. It should be noted that this selection should take into account planned development in addition to historical data.

The proposed research complements that in Problem Statement G-11 that would develop more explicit design guidance based on these context classes.

**Review Date:**
11/28/2018

Fleming El-Amin/HEPH - This statement needs to be coordinated with G-11, which is focused on identifying appropriate applications and ranges of design controls, criteria, and elements across a range of functional classifications, contexts, and modal priorities consistent with the recommendations of Research Report 855. The proposal should consider the range of target audiences; engineers, planners, designers, and environmental specialists. Under Research Objective, consider "Expand understanding of the relationship between highway design flexibility and the Green Book 7th Edition context classifications." Under Literature Review, consider: Highway Functional Classification Concepts, Criteria and Procedures (FHWA, 2013) - Section 6 talked about defining urban and rural boundaries and perhaps this project could inform an update to this guide if FHWA wants to expand to include the 5 context zones into the official functional classification. There would be ripple effects through many aspects of the Federal-aid program, which is why Report 855 developed a system that could still fit in with our urban/rural coding. E. Hilton, HICP-10 - Overlaps with G-11, but perhaps more from the planning angle.

Anna Bosin, P.E.
AASHTO Fellow-Alaska DOT&PF
202.624.7800
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Problem No:  2020-C-13

1. Problem Title
Impact Performance Assessment of Barrier Performance at High Speeds

2. Background

Recent data indicates that sixteen (16) states have speed limits of 75 mph or higher. Seven (7) of these states currently have speed limits of 80 mph, with almost all of them adopting this higher speed within the last 5 years.

The AASHTO Manual for Assessing Safety Hardware (MASH) specifies impact speeds for crash testing and evaluation of barrier systems such as guardrails, median barriers, and bridge rails. The highest impact speed defined by MASH for passenger vehicle is 62 mph. This impact speed was derived from analyses of reconstructed crash data that is now nearly 20 years old. Preliminary data from NCHRP Project 17-43, under which a new database of reconstructed run-off-road crashes is being developed, indicates that for highways with a posted speed limit of 70 mph or greater, the 85th percentile impact speed is 77 mph (1). This indicates a need for a higher design impact speed for barriers used on these higher speed roadways.

A recent study of single vehicle run-off-road crashes in Texas found that as the posted speed limit increases from 70 mph to ≥ 75 mph, the rate of severe injuries and fatalities increases (2). With more states adopting higher speed limits and posting an increasing number of miles of roads with speed limits of 75 mph and higher, there is a growing recognition of the need for evaluating barriers for higher impact speeds in order to maintain the level of safety for motorists on these roadways. In one recent project, a bridge rail system developed and tested under MASH was subsequently subjected to supplemental crash testing with passenger vehicles at an impact speed of 75 mph.

Increased impact speeds will place more demand on barrier systems. The performance limits of current barrier systems beyond the MASH design impact speed of 62 mph are not fully understood. There have been observations of guardrail systems developing partial rail tears when tested under MASH impact conditions, indicating that these systems are near their containment capacity (3,4). There is an urgent need to assess performance limits of existing barrier systems for higher impact speeds and to provide user agencies with barrier systems appropriate for use on roadways with higher posted speeds (> 70 mph).
3. Literature Search Summary

The AASHTO MASH document specifies impact speeds that are used for crash testing. The recommended passenger vehicle impact speed of 62 mph was derived from analyses of reconstructed run-off-road crash data collected under NCHRP Project 17-22. This database relied on NASS CDS data from 1997 to 2001 along with supplemental onsite roadway and roadside data collection. The study found that 62 mph was the 85th percentile impact speed (5).

NCHRP Project 17-43 was funded to update the NCHRP Project 17-22 database and develop a long-term crash data collection program to aid in analysis of run-off-road crashes (1). Preliminary data from NCHRP Project 17-43 indicates that highways with a posted speed limit of 70 mph and greater have an 85th percentile impact speed of 77 mph. This indicates a need for evaluation of barriers at higher impact speeds for roadways with higher posted speeds.

NCHRP Project 17-79 was funded to investigate safety effects of raising speed limits to 75 mph and higher, and provide guidance to assist highway agencies in estimating the safety impacts of increasing speed limits (6). However, the NCHRP Project 17-79 scope is limited to studying the effects of increased speed limits on crash frequency and severity through crash data collection and analysis. There is no determination of recommended design impact speeds for evaluation of barrier systems intended for use on roadways with higher speed limits and no direct assessment of barrier performance at these higher impact speeds through computer simulation or full-scale testing.

The Texas Department of Transportation (TxDOT) funded Project 0-6771 to evaluate barriers for use on high speed roadways with posted speed limits up to 85 mph. Based on extrapolation of impacts speeds from the NCHRP Project 17-22 database, the 85th percentile impact speed was estimated to be 68 mph. As noted above, this database relies on crash data collected between 1997 and 2001, which predates the increase in posted speed limits in many states. Computer simulation was used to evaluate the impact performance of selected barrier systems at an impact speed of 68 mph. The predictive results suggest that some current barrier systems have a reasonable chance of acceptable impact performance at this higher speed. No full-scale crash testing was performed to verify impact performance.

References

4. Research Objectives

This project will determine impact conditions and barrier designs appropriate for use on roadways with posted speeds of 75 mph and greater. The objectives include:

- Determine appropriate impact conditions for roadways with higher speed limits (75 mph and greater) through crash data analysis,
- Assess performance limits of existing barrier systems using engineering analysis and finite element simulation, and
- Develop and evaluate new or modified barrier systems capable of accommodating the recommended design impact conditions using finite element simulation and full-scale vehicle crash testing.

5. Implementation Planning

The result of this research project will be crashworthy barrier systems suitable for use on higher speed roadways with posted speed limits of 75 mph and higher. Successfully tested barrier systems will be immediately available for implementation by State DOTs on roadways with higher posted speeds. The barrier systems could be further implemented through an update of the appropriate sections of the AASHTO Roadside Design Guide (RDG). Recommended design impact conditions could be incorporated into a future update of MASH with proper review and consideration by AASHTO Technical Committee on Roadside Safety (TCRS).

Results of this research and the resulting impact conditions and barrier designs will be disseminated to state DOT design engineers, consultants, and practitioners through presentations and webinars at appropriate industry and professional meetings including TRB Roadside Safety Design Committee,
AASHTO TCRS, and Committee on Bridges and Structures Technical Committee T-7 “Guardrails and Bridge Rails.”

6. Estimate of Problem Funding and Research Period
   Recommended Funding:
   $600,000
   Research Period:
   30 months

7. Urgency and Potential Benefits
   Sixteen (16) states have increased permissible speed limits to 75 mph or greater. Seven (7) of these states currently permit posted speed limits of 80 mph, with all but one of these states implementing this change within the last 5 years. Recent research indicates that roadways with higher posted speeds (≥ 75 mph) have a higher rate of severe injury and fatal crashes. Existing barrier systems are designed for impact speeds of 62 mph.

   There is an urgent need to develop barrier systems appropriate for use on these higher speed roadways to help mitigate the severity of run-off-road crashes. In absence of this research, the frequency of severe injury and fatal crashes will likely escalate as more miles of roadway are posted with higher speeds and vehicle miles of travel continue to increase.

8. Persons Developing the Problem Statement
   Alex Price, P.E.
   Senior Transportation Engineer
   Virginia Department of Transportation
   731 Harrison Ave
   Salem, VA 24153
   Tel.: (540) 521-9301
   E-mail: Alex.Price@VDOT.Virginia.gov

   Chiara Silvestri Dobrovolny, Ph.D.
   Associate Research Scientist
   Roadside Safety & Physical Security Division
   Texas A&M Transportation Institute
   Texas A&M University System
   3135 TAMU, College Station, Texas 77843-3135
   Tel.: (979) 845-8971
   Email: c-silvestri@tti.tamu.edu

   Roger P. Bligh, Ph.D., P.E.
Senior Research Engineer  
Manager, Roadside Safety Program  
Roadside Safety & Physical Security Division  
Texas A&M Transportation Institute  
Texas A&M University System  
3135 TAMU, College Station, Texas 77843-3135  
Tel.: (979) 845-4377  
Email: R-Bligh@tti.tamu.edu

9. Nomination for AASHTO Monitor  
Alex Price, P.E.  
Senior Transportation Engineer  
Virginia Department of Transportation  
731 Harrison Ave  
Salem, VA 24153  
Tel.: (540) 521-9301  
E-mail: Alex.Price@VDOT.Virginia.gov

10. Potentially Interested AASHTO Councils and/or Committees  
AASHTO Technical Committee on Roadside Safety (TCRS)  
AASHTO Committee on Design.

11. Submitted By  
September 24, 2018  
Keith A. Cota, P.E.  
Chairman, AASHTO Technical Committee on Roadside Safety  
New Hampshire Department of Transportation  
7 Hazen Drive, PO Box 483  
Concord, NH 03302-0483  
Tel: (603) 271-1615  
Email: kcota@dot.state.nh.us

NCHRP Review of C-13

Reviewed By:  
Mark S. Bush  
mbush@nas.edu

Comments:  
The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective, but also should investigate developing a new MASH
Test Level. The problem statement is of likely interest on a national level as it will aid agencies in implementing MASH hardware and AASHTO MASH compliance. The problem statement is AASHTO TCRS rated number 2 of their top five priority submittal problem areas. Would also like to note, there are two current NCHRP research projects: 17-76, “Guidance for the Setting of Speed Limits,” and, 17-79, "Safety Effects of Raising Speed Limits to 75 MPH and Higher," respectively and currently underway. The potential results will contribute to the scope of this research problem statement. As of currently, sixteen (16) states have increased permissible speed limits to 75 mph or greater. Seven (7) of these states currently permit posted speed limits of 80 mph, with all but one of these stated implementing this change within the last 5 years. Recent research indicates that roadways with higher posted speeds (≥ 75 mph) have a higher rate of severe injury and fatal crashes. Existing barrier systems are designed for impact speeds of 62 mph under the existing MASH; the proposed research problem potentially can result in updating MASH.

Review Date:
12/10/2018

FHWA Evaluation of C-13

Albin/RC-SHD; Arispe/HRDS - The study should concentrate more on creating a new MASH test level, something like a TL-3+ rather than actually developing a barrier.

AASHTO Committee Evaluation for C-13

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is the #3 priority of the Committee on Design.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline  

Problem No: 2020-C-14  

1. Problem Title  
Developing Testing Protocol for a Family of Devices - Signs, Breakaway Poles and Work Zone Devices  

2. Background  
To encourage state departments of transportation (DOTs) and hardware developers to advance hardware designs, the FHWA and AASHTO collaborated to develop a MASH implementation policy that includes sunset dates for various roadside hardware categories. The joint FHWA/AASHTO implementation plan for MASH devices requires highway agencies to evaluate many different designs of permanent signs, breakaway poles, and work-zone devices. The new policy by the FHWA and AASHTO required that sign supports and breakaway hardware, including breakaway poles and temporary work zone devices, installed on federal aid roadways after December 31, 2019 to have been evaluated to MASH 2016.  

In a May 26, 2017 letter from the FHWA, all tests required by MASH for a given device must be performed to get an FHWA eligibility letter. Also, with FHWA’s changing role in determining crashworthiness, highway agencies and manufacturers have been left in a situation where a significant number of systems still need to be evaluated to MASH, including permanent signs, breakaway poles, and work-zone devices. For each device, up to three full-scale crash tests need to be conducted, and these crash tests can be expensive to perform. There are thousands of variations of breakaway sign support systems, luminaire supports, and work-zone traffic control devices that the state DOTs utilize. The costs of these tests will fall directly on to transportation agencies and the public. Thus, it is not feasible to test all possible combinations to MASH.  

A more cost-effective to evaluate the crash worthiness of a “family” of devices and determine which tests, either full scale or using surrogate testing methods, should be conducted in order to evaluate the crashworthiness of the entire family of products. Finding a more cost-effective way to determine the crashworthiness of a “family” of devices will speed implementation of new hardware and save transportation agencies funds.  

3. Literature Search Summary  
There has been some MASH crash tests performed on existing signs:
Schmidt, J.D., Langel, T.J., Asselin, N., Pajouh, M.A., and Faller, R.K.; “MASH 2016 Evaluation of a Non-Proprietary Type III Barricade”, MwRSF TRP-03-394-18; InTrans Project 18-535; MwRSF; 2018


Bligh, Roger, Menges, Wanda, and Kuhn, Darrell; “MASH Evaluation of TXDOT Roadside Safety Features – Phase I”; FHWA/TX-17/0-6946-1; TTI; 2018


Silvestri, Chiara, Bligh, Roger, and Menges, Wanda; “MASH Full-Scale Crash Testing of 4-ft Mounting Height, 24”×30” Chevron Sign Installed on 5.5H:1V Slope Ditch.”; FHWA/TX-13/9-1002-12-6; TTI; 2013.

Williams, William, and Menges, Wanda; “MASH Test 3-11 Of the TXDOT Portable Type 2 PCTB With Sign Support Assembly”; FHWA/TX-11/0-6143-1; TTI; 2011

Bligh, Roger, Arrington, Dusty, and Menges, Wanda; “Temporary Large Guide Signs”; FHWA/TX-13/0-6782-1; TTI; 2014


Faller, Ronald, Sicking, Dean, Lechtenberg, Karla, Holloway, James, and Schmidt, Jennifer; “Safety Investigation and Guidance for Work-Zone Devices in Freight Transportation Systems Subjected to Passenger Car and
The research projects above concentrated on specific devices, and crash tests were performed on these devices. Some of these efforts included devices that were crashworthy according to the crash testing and safety performance criteria in NCHRP Report 350. However, when NCHRP Report 350 work-zone devices were subjected to the new MASH crash testing, several of the work-zone sign stands produced undesirable results, including windshield and floorboard penetration and excessive windshield and roof deformation. This testing indicated that devices tested under previous NCHRP Report 350 safety performance standards may not perform acceptably with the new MASH safety performance standards, and additional analysis may be warranted.

Currently NCHRP Project 03-119 Application of MASH Test Criteria to Breakaway Sign and Luminaire Supports and Crashworthy Work-Zone Traffic Control Devices that is evaluating several systems with computer simulation and testing to MASH standards. However, this project has limited funds, and there will be a significant number of systems that will not be evaluated during this project.

There are still are significant numbers of devices that should be tested to MASH. Permanent signs with wood post supports, for example, can have the following variations:

- Post sizes (e.g. cross section, weakening of posts)
- Post height
- Number of posts
- Panel size
- Panel connections
- Panel materials
- Panel location
- Panel weight
- Auxiliary devices attached to sign (e.g. flags, solar panels, sensors, flashing lights, secondary sign...)
- Soil type

Just with these variations, there could be approximately 300 to 400 or more MASH tests required for the wood-post subset of permanent signs. Additionally, there could be hundreds more tests when including U-channel supports, perforated square steel tube supports, I-beam supports, round aluminum tube supports, and other variations that state DOTs may utilize. Work-zone signs and sign stands have even more variations that need to be evaluated to MASH. During NCHRP Project 03-119, over 553 unique systems were identified, and some of those systems have multiple variations.

4. Research Objective
This project will:

- Determine what critical features a surrogate or bogie vehicle should have to determine crashworthiness
- Review previous literature and research on testing signs, breakaway poles, and work-zone devices
- Define the critical traits that make a “family” of devices.
- A procedure to determine the “Worst Practical Condition” for some devices that have similar designs. For example:
  - Signs that use the same support design, but are installed at different heights or with different mass signs.
  - Poles made of similar materials, but at different heights or devices attached to the top.
  - Traffic control devices that use similar mounting hardware but have different sign substrates for a specific type of work-zone device
- Perform testing to validate the guidance on determining the most critical tests for a family of devices.

5. Implementation Planning

Transportation agencies are in the process of implementing MASH hardware. This research will allow transportation agencies to implement MASH approved signs, breakaway poles, and work zone devices. Without this research, transportation agencies and manufacturers will need to test all of their wide range of products. This large cost will then be transferred to transportation agencies in their implementation MASH approved signs, breakaway poles, and work-zone devices.

6. Estimate of Problem Funding and Research Period

Recommended Funding:
Recommended funding is $500,000.

Research Period:

Proposed research period 3 years

7. Urgency and Potential Benefits

Transportation agencies must start adopting MASH-approved hardware now, as the new MASH implementation policy by the FHWA and AASHTO requires that sign supports and breakaway hardware, including breakaway poles and temporary work zone devices, installed on federal aid roadways after December 31, 2019 to have been evaluated to MASH 2016. This research will aid agencies in implementing MASH hardware and allows development of hardware in a less expensive manner.
8. **Person(s) Developing the Problem Statement**

Erik Emerson  
Wisconsin Department of Transportation  
Member of Technical Committee on Roadside Safety  
Bureau of Project Development  
Room S424.03  
4822 Madison Yards Way  
Madison 53705  
(608) 266-2842  
erik.emerson@wi.gov

Jennifer Schmidt, Ph.D., P.E.  
University of Nebraska-Lincoln  
Midwest Roadside Safety Facility  
Research Assistant Professor  
330D Whittier Research Center  
2200 Vine St.  
Lincoln, NE 68583-0853  
(402) 472-0870  
jennifer.schmidt@unl.edu

James Kovar  
Texas A&M Transportation Institute  
Associate Transportation Researcher  
3135 TAMU  
College Station, TX 77843-3135  
(979) 458-3874  
j-kovar@tti.tamu.edu

9. **Nomination for AASHTO Monitor**

Erik Emerson  
Wisconsin Department of Transportation  
Member of Technical Committee on Roadside Safety  
Bureau of Project Development  
Room S424.03  
4822 Madison Yards Way  
Madison 53705  
(608) 266-2842  
erik.emerson@wi.gov

10. **Potentially Interested AASHTO Councils and/or Committees**

Technical Committee on Roadside Safety  
National Committee on Uniform Traffic Control Devices  
Subcommittee on Traffic Engineering

11. **Submitted By**
NCHRP Review of C-14

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:
The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective. The problem statement is of likely interest on a national level as it will aid agencies in implementing MASH hardware. The problem statement is AASHTO TCRS rated number 1 of their top five priority submittal problem areas. Would also like to note, there is a current NCHRP research project 03-119, “Application of MASH Test Criteria to Breakaway Sign and Luminaire Supports and Crashworthy Work Zone Traffic Devices,” currently underway and the potential results will contribute to the scope of this research problem statement.

Review Date:
12/10/2018

FHWA Evaluation of C-14

Albin/RC-SHD; Arispe/HRDS - The development of surrogate or bogie vehicle, and determining critical tests for the hardware mentioned. We see more importance on the surrogate vehicle but believe that other aspect of the study would have to be looked at differently depending on the States procedure for determining if the hardware meets MASH.
AASHTO Committee Evaluation for C-14

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is the #4 priority of the Committee on Design.

Submitted By:
Jameelah Hayes
AASHTO staff
Traffic Engineering

Comments:
The Committee on Traffic Engineering thinks this is a very high priority topic. It is ranked #2 in their proposals.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  
FY2020 NCHRP Problem Statement Outline

Problem No: 2020-C-15

1. Problem Title  
Development of a Crash Data Collection Tool for MASH In-Service Performance and Application Guidelines

2. Background

The AASHTO/FHWA joint implementation plan called for MASH testing to be required for the development of new hardware beginning January 1, 2011. As these higher performing systems are placed into service, adequately planned and conducted in-service performance evaluations (ISPEs) will allow determination of field performance of roadside safety hardware. A more comprehensive data collection tool and guidelines will provide a ready-to-use mechanism for agencies to collect the ideal data for conducting ISPEs. A single source of data collection guidelines will lead to data which can be readily combined across multiple states and/or agencies and ultimately resulting in a more meaningful, universal data set for ISPE evaluations.

This project would seek to develop an improved, more consistent in-service data collection tool and associated guidelines for the evaluation of roadside safety features. This tool would support first responders and responding DOT maintenance staff at the crash scene to collect needed data with respect to photographic information, hardware characteristics, and others. The developed crash data collection tool would also support State DOT maintenance personnel for a more consistent crash-related and roadside inventory data.

As part of the proposed project, a pilot study should be developed to test the developed tool and associated guidelines as well as to develop plans for disseminating the tool to interested agencies.

3. Literature Search Summary

There are several research projects which are currently underway or recently completed which will directly contribute to this effort in one way or another. A few of the more important projects have been highlighted here, including: TRB and FHWA pilot studies of data collection, NCHRP 22-33 and many past in-service performance evaluations (ISPEs).

A TRB special study is currently under way which includes “… exploratory work in selected states” [TRB14] on collecting data for the in-service performance of w-beam guardrail terminals. It does not appear that any conclusions will be
made relative to field performance from the collected data. The TRB special study committee, however, recently released a report which served to “… advise states on the existing process of conducting in-service evaluations of guardrail end treatments.” [TRB14]

The FHWA office of Safety Research and Development is, in parallel with the TRB special study committee, conducting a pilot data collection program for w-beam terminals to document good practices for real-time crash data collection and interagency communication. The FHWA will not perform analysis or form conclusions from this pilot data collection program. [FHWA17] While each of these studies are limited in scope to only w-beam terminals, these studies will inform the early stages of this effort and serve to update the data collection protocols outlined in NCHRP 490 with recent advances in technology. [Ray03]

Privately funded and state funded ISPEs have been ongoing for more than 40 years. These various studies are too voluminous to list here. Each of these individual ISPEs provides insight into the data limitations and possibilities for improved data collection. In addition to ISPEs, states some states have begun mobile developing data collection apps for the purpose of asset management and/or assessing the field performance of roadside hardware. Examples of these states include: Texas, Iowa, and Minnesota.

NCHRP 22-33, “Multi-State In-Service Performance Evaluations of Roadside Safety Hardware” is currently underway. Among other tasks such as identifying collaborative approaches across state lines for conducting ISPEs, NCHRP 22-33 is also developing a list of idealized database elements for conducting ISPEs. This list will inform this this proposed research effort.

References


4. Research Objective
This project would seek to develop a crash data collection tool and associated guidelines. This tool would support first responders and transportation agency staff at crash scenes to collect needed data with respect to photographic information, hardware characteristics, and other fields identified by the research. The developed crash data collection tool would also support State DOT maintenance personnel for roadside safety inventory data. The following tasks are proposed:

a. Conduct a literature review of documented research to identify best practices of existing tools currently utilized by Agencies for crash data collection tools and methodology;

b. Develop improved recommendations and a tool for first responders and DOT maintenance personnel at crash scene for easy and efficient collection of crash data;

c. Conduct a pilot testing to determine efficiency of the newly developed tool and associated guidelines;

d. Develop plans, including workshops, for disseminating newly developed tool and associated guideline to interested agencies.

5. Implementation Planning

This research would result in improved recommendations and a tool that can use for the efficient collection of in-service performance data for roadside safety features. A portion of the project should be dedicated to pilot testing the developed tool and associated guidelines as well as developing plans for disseminating the tool to interested agencies. It is anticipated that the improved guidelines and tool would better support state DOT personnel charged with maintaining roadside inventory data.

6. Estimate of Problem Funding and Research Period

Recommended Funding: $400,000

Research Period: 24 months

7. Urgency and Potential Benefits

Urgency – MASH was published in 2009. The AASHTO/FHWA joint implementation plan called for MASH testing to be required for the development of new hardware beginning January 1, 2011. Without in-service performance evaluations of roadside safety hardware it will not be possible to determine how well crash test performance translates into field performance. Making informed decisions about MASH implementation requires that in-service performance evaluations be performed to develop policy. A more comprehensive data collection tool and guidelines will provide a ready-to-use mechanism for agencies
to more easily collect the needed data for ISPEs, combine data across multiple states and/or agencies, and extract more meaningful results from ISPEs.

**Potential Payoff** – The primary payoff is a means to collect better, more consistent crash-related and roadside inventory data. This information can be used in making policy decisions about selecting between the range of upcoming MASH tested road safety hardware. The cost of this research is a tiny fraction of what a whole-sale technology replacement would cost if a particular device type proves unacceptable in the field.

8. **Person(s) Developing the Problem Statement**

**Keith A. Cota**, P.E.
Chairman
AASHTO – Technical Committee on Roadside Safety
NH Department of Transportation
7 Hazen Drive, PO Box 483
Concord, NH 03302-0483

Tel: (603) 271-1615
Email: kcota@dot.state.nh.us

**Douglas J. Gabauer**
Associate Professor
Department of Civil and Environmental Engineering
Bucknell University
Lewisburg, PA 17837
(570) 577-2902
doug.gabauer@bucknell.edu

**Christine E. Carrigan**
RoadSafe LLC
Box 312
12 Main Street
Canton, ME 04221
(413)626-1516
Christine@roadsafellc.com

**Chiara Silvestri Dobrovolny**
Associate Research Scientist
Roadside Safety & Physical Security Division
Texas A&M Transportation Institute
Texas A&M University System
3135 TAMU, College Station, Texas 77843-3135
Tel.: (979) 845-8971
Email: c-silvestri@tti.tamu.edu
9. Nomination for AASHTO Monitor

Keith A. Cota, P.E.
Chairman
AASHTO – Technical Committee on Roadside Safety
NH Department of Transportation
7 Hazen Drive, PO Box 483
Concord, NH 03302-0483

Tel: (603) 271-1615
Email: kcota@dot.state.nh.us

10. Potentially Interested AASHTO Councils and/or Committees

Technical Committee Roadside Safety (TCRS).

11. Submitted By

September 24, 2018

AASHTO Technical Committee on Roadside Safety
Chair: Keith A. Cota
New Hampshire Department of Transportation
Bureau of Highway Design
7 Hazen Drive, PO Box 483
Concord, NH 03302-0483
Phone: (603) 271-1615
Fax: (603) 271-7025
Email: kcota@dot.state.nh.us

NCHRP Review of C-15

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective to be potentially solvable. The problem statement is of likely interest on a national level as it will aid agencies in implementing MASH hardware and contribute to updates of the AASHTO MASH and RDG. The problem statement is
AASHTO TCRS rated number 5 of their top five priority submittal problem areas. Would also like to note, there is a current NCHRP research project, 22-33, “Multi-State In-Service Performance Evaluations of Roadside Safety Hardware,” currently underway and the potential preliminary results during the course of the research may also contribute to the scope of this research problem statement.

Review Date:
12/10/2018

______________________________

FHWA Evaluation of C-15
Albin/RC-SHD; Arispe/HRDS - Although we agree that this is important, we feel like this would be covered by the FHWA ISPE study and the ISPE pooled fund group that will be established.

______________________________

AASHTO Committee Evaluation for C-15

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is endorsed by the Committee on Design.
Problem No: 2020-C-16

1. Problem Title
Crashworthiness of Barrier Attachments

2. Background
Concrete median barriers have been used throughout the nation as permanent rigid barriers in medians to separate traffic and on roadsides to shield hazards. Typically, these barriers are crash tested and considered crashworthy according to National Cooperative Highway Research Program (NCHRP) Report 350 or more recently the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessment of Safety Hardware (MASH). Due to space restrictions, hardware such as signs or luminaire poles needs to be attached on top of such barriers. However, when signs or light poles are attached on top of barriers, they potentially reduce the crashworthiness of the barrier and increase the risk to occupants of vehicles impacting the barrier and attachment, or to occupants in other vehicles in vicinity of the impact. There are few research studies on how a barrier with hardware attached on top would perform when impacted by an errant vehicle.

The AASHTO Roadside Design Guide (RDG-2011) currently does not provide guidance for attachment of hardware on top of barriers. Section 4.5.1 does indicate that several state agencies mount luminaires on top of concrete median barriers, a practice that often requires modification to the luminaire support, median barrier, or both. Section 4.5.1 also indicates that a consideration in this design is likelihood of truck impacts, which could snag on the support or bring down the support that might present a risk to opposing traffic.

There is a need for additional design, testing, evaluation, and acceptance of barrier attachment combinations that cover a wide range of barrier and hardware configurations that will be crashworthy when attached on top of concrete barriers in medians and on the roadside including bridges and tunnels. Sign placement on median barriers is becoming more prevalent, especially on multi-lane divided highways adjacent to HOV and HOT lanes, and for evacuation routes where traffic is reversed during hurricanes. Hardware being attached to barriers include small sign supports, large cantilever and overhead sign supports, pedestrian railings, bicycle railings, glare screens, security chain link fence, conventional and high mast luminaire poles, and noise barriers. There is currently minimal design guidance available for selection and attachment of hardware on top of barriers in
medians and on the roadside that will ensure continued crashworthiness of the barrier.

There is also a need for performance evaluations to determine the extent of any safety problems associated with existing installations and to evaluate the relative risks and/or benefit/cost analysis of providing crashworthy barrier attachments versus other options (e.g., no barrier attachments or non-crashworthy barrier attachments).

3. Literature Search Summary

Past and current research and guidance related to barrier attachments has focused primarily on the following areas:

a) State of practice and extent of DOT usage of barrier attachments. NCHRP Synthesis 465 (2014) “Permanent Signs Mounted on Median Barriers” included a comprehensive survey of state DOTs summarizing types of signs and supports being attached to the top of rigid median barriers and level of consideration some practices give to potential safety concerns. The Synthesis was limited to only include permanent signs mounted on concrete median barriers.

b) Establishing Zone of Intrusion (ZOI) envelopes for common barrier types subjected to standardized crash tests. Several studies established ZOI envelopes for a limited number of barrier designs using NCHRP Report 350 impact Test Levels 2 through 4. These ZOI envelopes are summarized in Chapter 5 of the RDG-2011. NCHRP Project 22-34 project is anticipated to establish updated ZOI envelopes using MASH Test Levels (expected completion in 2021).

c) Crash testing of specific barrier/attachment combinations. Though limited, some crash tests have been performed to evaluate the performance and acceptability of specific attachments mounted on concrete barriers, such as fixed small sign supports and luminaire poles.

Past and current research efforts directly related to evaluating crashworthiness of common barrier attachment combinations is limited.

4. Research Objective

The objective of this research is to:

a) Identify the extent of any safety problems associated with existing barrier attachment combinations;

b) Identify existing crashworthy barrier attachments (MASH) and recommend new or modified barrier attachments to Panel for crash testing;

c) Develop risk-based design guidance for selection of crashworthy barrier attachments and non-crashworthy barrier attachments on existing or modified concrete barriers;
d) Crashworthiness of barrier attachments will be evaluated based on MASH Test Level 3 impact which is controlled by the pickup truck test due to its height. However, Test Level 4 should also be evaluated to determine post-impact trajectory hazard of such attachments on median barriers.

The research should identify from a survey of user agencies existing design guidelines and common types of barrier attachments currently being used including any observed operational problems. Assess the performance of the most common barrier attachment combinations that have not been crash tested through nonlinear finite element simulation, and recommend existing or modified attachment/barrier combinations for further evaluation and crash testing.

5. Implementation Planning
The plan to get information sufficient enough to implement in the field such as but not limited to:
   a) Detailed construction drawings and specifications of crashworthy barrier attachments;
   b) Design guidance for risk-based selection of crashworthy and non-crashworthy barrier attachment types and combinations for median and roadside installations for a wide range of design speeds and traffic volumes for future inclusion in the RDG.

6. Estimate of Problem Funding and Research Period
   Recommended Funding: $650,000
   Research Period: 36 months

7. Urgency and Potential Benefits
Currently there are few known barrier attachments that have been successfully crash tested. More and more user agencies are installing hardware on barriers to communicate with drivers including traffic and emergency information. Hence, providing crashworthy barrier attachment combinations is becoming more important to reduce risk to the travelling public. There is also increased use of hardware on barriers on median barriers for HOV and HOT lanes, and for evacuation routes on divided highways where traffic is reversed in advance of hurricanes or other emergencies.

User agencies need risk-based design guidelines with one or more cost effective crashworthy barrier attachments designs available from this research instead of using designs with unknown performance and risk.
8. **Person(s) Developing the Problem Statement**
   Mark Ayton, P.Eng.
   Member, Technical Committee on Roadside Safety
   Ontario Ministry of Transportation, St. Catharines, ON, L2R 7R4
   Phone: (905) 704-2295, Email: Mark.Ayton@ontario.ca

   Eric Lohrey, P.E.
   ECL Engineering, PLLC, Warrensburg, NY
   Email: Eric@ECLengineering.com

   Akram Abu-Odeh, Ph.D.
   Texas A&M Transportation Institute, College Station, TX 77843
   Phone: (979)-862-3379, Email: abu-odeh@tamu.edu

9. **Nomination for AASHTO Monitor**
   Mark Ayton, P.Eng.
   Member, Technical Committee on Roadside Safety
   Ontario Ministry of Transportation, St. Catharines, ON, L2R 7R4
   Phone: (905) 704-2295,
   Email: Mark.Ayton@ontario.ca

10. **Potentially Interested AASHTO Councils and/or Committees**
    AASHTO Technical Committee on Roadside Safety

11. **Submitted By**
    September 24, 2018

    Keith A. Cota, P.E.
    Chairman, AASHTO Technical Committee on Roadside Safety
    New Hampshire Department of Transportation
    7 Hazen Drive, PO Box 483
    Concord, NH 03302-0483
    Tel: (603) 271-1615
    Email: kcota@dot.state.nh.us

---

**NCHRP Review of C-16**
The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective to be potentially solvable. The problem statement is of likely interest on a national level as it will aid agencies in implementing MASH hardware and contribute to updates of the AASHTO MASH and RDG. The problem statement is AASHTO TCRS rated number 3 of their top five priority submittal problem areas.

Review Date:
12/10/2018

AASHTO Committee Evaluation for C-16

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is endorsed by the Committee on Design.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  
FY2020 NCHRP Problem Statement Outline

Problem No: 2020-C-17

1. Problem Title
MASH Performance Evaluation of Safety Grates for Culverts

2. Background
Culverts create numerous roadside hazards along our nation’s highways. Further, these culverts can produce serious accidents when struck by an errant vehicle. Safety treatments for roadside culverts include extending the culvert out of the clear zone, shielding the culvert with guardrail, and making the culvert traversable.

Extending a culvert out of the clear zone often requires large amounts of fill material to reconfigure the roadside slopes adjacent to the roadway. Not only is the extension of the culvert and placement of fill costly, but the reconfigured slopes often produce complicated geometries which can cause errant vehicles to roll over. Using guardrail to shield traffic from culverts also has some disadvantages. Guardrails cannot normally be placed near a culvert because of the steepness of most roadside slopes. As a result, long guardrail installations are usually needed to protect motorists from cross-drainage culverts. This type of installation produces numerous guardrail crashes for every culvert impact that is prevented. Although making a culvert traversable can adversely affect hydraulic efficiency, the cost of this type of treatment is normally modest, and it does not increase the number of crashes by enlarging the hazard.

Not surprisingly, studies of the benefits and costs of safety treatments for cross-drainage structures have indicated that the culvert grates often provide both the least costly and the safest treatment for cross-drainage culverts. However, all of these studies are based upon the basic assumption that grates can make culverts safely traversable when installed on any traversable slope. Although crash testing has been conducted on a number of cross and parallel drainage culverts, only two tests have been conducted to NCHRP 350 on cross-drainage structures and no testing beyond passenger cars at 50 mph has been conducted on parallel drainage structures. Additionally, no testing or modeling has been done on skewed cross-drainage pipe installations. It is necessary that previous research be validated with the latest fleet of vehicles represented in Manual for Assessing Safety Hardware (MASH) in order for the American Association of State Highway Transportation Officials (AASHTO) Technical Committee on Roadside Safety (TCRS) be able to update guidance provided in the Roadside Design Guide and in accordance with the vision statement in their strategic plan, “lead roadside policy development, support safety innovations, and be an information resource to
promote a decline in roadway departure related deaths and incapacitating injuries.” Updating this guidance will benefit highway practitioners in providing cost effective safety treatments and reduce the number of roadside hazards.

3. Literature Search Summary

The most comprehensive study of the safety grates was published in by Ross, et al. in 1982 (1). Unfortunately, this research was conducted under safety performance evaluation guidelines contained in Transportation Research Circular 191. Testing for cross-drainage structures was limited to small and heavy passenger cars and it was limited to roadside slopes of 1v:5h. Although computer simulation modeling indicated that the safety grates could be effective on steeper slopes, no crash testing was conducted to verify performance. Crash testing for parallel drainage structures was limited to small and heavy passenger cars at a top speed of 50 mph. It was found that a passenger car could traverse a berm replicating a cross-road with 1v:6h slopes despite becoming airborne.

Another study was undertaken to examine the effectiveness of cross-drainage culvert grates when installed on slopes as steep as 1v:4h, Bryden, J.E. (2). Unfortunately, this study incorporated the use of 1 inch diameter rebar spaced 12 inches apart. Although this culvert grate was found to provide adequate safety performance, the close spacing of the grating makes it much more likely to snag debris and clog the culvert pipe. As a result of the potential for producing localized flooding and allowing water to flow over the road surface, this culvert grating system has not gained wide spread acceptance.

In recognition of the need to examine the safety performance of cross-drainage culvert grates when installed on roadside slopes as steep as 1v:3h, the Midwest States Pooled Fund funded a study to conduct computer simulation, develop a grate design, and conduct two full scale crash tests under NCHRP 350 (the standard at the time the study was conducted), Sicking, et al., 2008 (3). A grate was designed to cover a simulated 20 ft. by 20 ft. opening using 4 inch diameter schedule 40 pipes spaced at 30 inches and placed on a 1v:3h slope. Two full scale crash tests were conducted, a 4500 lb. pickup at 61 mph and an angle of 25.4 degrees and a 1800 lb. car at 61 mph and an angle of 18.7 degrees. Both vehicles successfully traversed the grate meeting all of the salient criteria under NCHRP 350. Unfortunately, no subsequent crash testing has been conducted on cross-drainage structures to date, either to MASH 2009 or MASH 2016. Parallel drainage structures have only been tested with small and large passenger cars and only at 50 mph or less.

Culvert grating guidelines developed by Ross et al., 1982, (1) were included in first edition of the AASHTO Roadside Design Guide (RDG) published in 1996 and have remained essentially unchanged except for a reference to the research conducted by the Midwest States Pooled Fund in 2008.


4. **Research Objective**

The objective of this research will be to evaluate slopes, vehicle stability with regard to slopes and grate designs using the latest computer models and followed up with full scale crash testing using MASH vehicles. Parallel drainage structures typically used for approach roads have never been evaluated with a vehicle having a higher center of gravity than a passenger car nor at speeds exceeding 50 mph. Cross drainage structures have not been evaluated with the MASH pickup truck which has a higher center of gravity and greater mass than the older NCHRP 350 pickup. The results of this research will be used to update guidance in the AASHTO Roadside Design Guide, the primary resource used by highway practitioners regarding issues of roadside safety. Completion of this research will provide cost effective solutions for mitigating the hazards created by pipe culvert ends along the roadside, thereby improving safety to the traveling public.

5. **Implementation Planning**

The primary product of this research will be an updated section in the AASHTO Roadside Design Guide, the premier resource for highway practitioners for implementing roadside safety strategies. Until that guidance can be updated in the AASHTO Roadside Design Guide, the results of this research can be published by TRB and presented to various meetings of highway practitioners including the TRB Annual Meeting, the summer meeting of the TRB Committee for Roadside Safety Design (AFB20), Task Force 13, etc. Information will be shared with industry so they can manufacturer culvert grates.

6. **Estimate of Problem Funding and Research Period**

**Recommended Funding:**

$600,000

**Duration:**

36 months
7. **Urgency and Potential Benefits**

The final deadline for implementing the joint FHWA/AASHTO MASH Implementation plan is December 2019. Although the proposed research will not meet this deadline, it is reasonable to assume that FHWA would grant an extension for the use of older technology for culvert grates until the results of this study are published. Failure to commence this research could require that culvert ends located within the clear zone would now have to be shielded with long, expensive runs of guardrail. These runs of guardrail must be long enough to shield a culvert end from all reasonable trajectories. Since guardrail itself is a hazard, this results in significantly longer areas of exposure to errant vehicles, thereby increasing the number of crashes. Because this research will provide practitioners a much more cost effective solution for mitigating culvert ends along the roadside, states will be very likely to implement this research.

8. **Person(s) Developing the Problem Statement**

William B. Wilson, P.E.
Technical Committee for Roadside Safety
Standards Engineer, Wyoming Dept. of Transportation
5300 Bishop Blvd.
Cheyenne, WY 82001
307-777-4216
bill.wilson@wyo.gov

Scott King, P.E.
Technical Committee for Roadside Safety
Bureau Chief of Road Design
Kansas Dept. of Transportation
Eisenhower State Office Bldg.
700 SW Harrison Street, 11th Floor
Topeka, KS 66603
785-296-3901
scott.king@ks.gov

9. **Nomination for AASHTO Monitor**

Scott King, P.E.
Technical Committee for Roadside Safety
Bureau Chief of Road Design
Kansas Dept. of Transportation
Eisenhower State Office Bldg.
700 SW Harrison Street, 11th Floor
Topeka, KS 66603
785-296-3901
scott.king@ks.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
This problem statement was recommended by the TRB Committee for Roadside Safety Design (AFB20) and voted one of the top priority problem statements by the AASHTO Technical Committee for Roadside Safety.

11. Submitted By
September 24, 2018

Keith A. Cota, P.E.
Chairman, Technical Committee on Roadside Safety
New Hampshire DOT
7 Hazen Drive, PO Box 483
Concord, NH 03302-0483
Phone: 603-736-8811
Email: kcota@dot.state.nh.us

NCHRP Review of C-17

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective to be potentially solvable. The problem statement is of likely interest on a national level as it will aid agencies in implementing MASH hardware and contribute to updates of the AASHTO MASH and RDG. The problem statement is AASHTO TCRS rated number 4 of their top five priority submittal problem areas.

Review Date:
12/10/2018

FHWA Evaluation of C-17

Albin/RC-SHD; Arispe/HRDS - We believe the issue lies on the slopes and vehicle stability rather than on grate designs. Slopes and vehicle stability is something we have been looking at through our rollover study and maybe this could be a good means of a continuation of that study.

AASHTO Committee Evaluation for C-17
Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This has the potential to reduce impacts and costs.

---------------------------------------------------------------------------------------------------------------------------------------------

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is endorsed by the Committee on Design.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement
Comments: AASHTO Committee on Safety #1 of 5.

Problem No: 2020-C-18

1. Problem Title
Understanding and analyzing the contributing factors to crashes

2. Background
Successful safety management practices require a thorough understanding of the factors contributing to crashes. The successful safety practitioner must know the methods used to analyze and select the most appropriate countermeasures for a given locations characteristics. Further, they must also have an understanding of how these countermeasures will affect all road users (modes) under that given context. The continuous advancements in the science of data-driven safety analysis, as well as the countermeasures and technologies available for addressing crashes, create challenges in maintaining a safety workforce that is always proficient in the state of the practice.

In many cases, agencies continue to use approaches, such as descriptive statistics and anecdotal information to perform this diagnostic assessment without a thorough understanding of what should be expected for a given context or road type. This may result in over- or under-design of a system, which could lead to a lower than expected return on the safety investment made. A secondary issue is that once the nature of the crashes at a location are assessed, choosing an effective countermeasure requires an examination of given the human factors, behavioral factors, future development, prevailing or predicted crash type(s) or mix of road users to determine the most appropriate treatments to apply. Doing so allows the selected countermeasure to reduce crashes to the greatest extent possible. In many cases, practitioners have limited experience and background to assess these contributing factors, reducing the likelihood of success of safety investments. Further, the practitioner may have limited understanding of the potential for a treatment to increase exposure to the more vulnerable road users. For instance, installing a turn lane might also increase vehicle speeds or crossing distance. By having a better understanding of these tradeoff, changes can be made in the design and operations of facilities upfront, rather than waiting for crashes to occur before addressing the less than optimal road design.

Unfortunately, it is far too common that the application of countermeasures often benefits one mode of transportation over another because consideration of the modal priorities, needs, non-road factors and context is not part of the operational or design decision-making. This selection and application can be
improved through approaches and tools to perform crash diagnostics and countermeasure selection that is both modally and context sensitive. The immediate application in safety audits, geometric design and traffic systems operations are apparent.

This research will assess best practices in crash diagnosis across crash types in modal diverse contexts, recognizing that vehicle and mode mix matters in the success of investment strategies. The research will then develop additional diagnostic tools that leverages the availability of crash, roadway, traffic volume, human factors, behavioral, socioeconomic, and demographic data to advance the art of the practice in crash diagnostics that consider both modal priority and facility context.

The research is not intended to be a simple synthesis of current practice as it will develop comprehensive guidance, tools, and case studies on the application of improved crash diagnostics methods. This effort will increase the transportation professional’s knowledge and abilities to leverage crash diagnostics in planning, scoping, design, maintenance, and operations in a manner that they are highly effective in reducing fatal and serious crashes across all modes of transportation.

It is expected the contractor will consider the following activities:

1. Identify the previous research on crash diagnosis and countermeasure selection for various modes of transportation and determine if the necessary research literature is coordinated, not coordinated or contradictory.
2. Outline a process or procedure for identifying what steps are needed to develop enhanced/new comprehensive diagnostic assessment methods for determining crash-contributing factors across modes and in different roadway contexts using crash type, severity, and integrated safety and other data for the system.
3. Identify a technical working group of safety engineers, designers, traffic engineers, planners, behavioral experts, and others to provide input to the project and to review these diagnostic and countermeasure selection tools as they are proposed and developed. Note that the focus of the project is not to capture existing practice but to advance the limited approaches currently deployed.
4. Meet with selected transportation and safety organizations, such as state departments of transportation (DOTs), FHWA, TRB committee(s), and others, to identify needed skills for understanding crash diagnostics and countermeasure selection that is responsive to the needs of mixed modes of traffic across the five contexts used in the AASHTO Green Book.
5. Develop new diagnostic assessment and countermeasure selection tools considering, multiple factors, multimodal needs and multiple contexts, along with draft instructions for users and materials describing the basis for the tools, assumptions, and limitations for application.
6. Plan and conduct two pilot data driven diagnostic assessments and countermeasures selection tools to a) illustrate how multimodal road use safety needs can be addressed using the newly developed tools; b) how other existing safety tools (including the human factors guides and mode specific tools) can be used to supplement these activities. Use the pilots to update and clarify new or existing materials and analysis approaches (e.g., Every Day Counts initiative on Data Driven Safety Approaches, and road safety audits).

7. Update the diagnostic assessment and countermeasure selection tools, accompanying documentation (including the basis for the tools, assumptions, and limitations for application).

8. Coordinate with related AASHTO, FHWA, TRB committees and state DOT staff to determine the most effective method to disseminate and share this information and how to include this research with using these diagnostic and countermeasure selection tools with data driven safety analysis from the development through implementation of safety projects.

The AASHTO Committee on Safety has identified institutionalization of analytical tools to advance the science of safety as one of its goals in the Committee strategic plan, and this research would help practitioners address a range of safety issues. In addition, the Committee has a goal to ensure a knowledgeable and competent safety workforce, and this research would support ensuring practitioners are proficient in analytical methods related to identifying factors contributing to crash and appropriate countermeasures. The Committee has ranked this research problem statement first (of five submitted to NCHRP) for FY 2020.

3. Literature Search Summary

While there are a number of documents on crash diagnostics, human factors, design and countermeasures these documents are at times contradictory and often reflect anecdotal beliefs. Some advances in crash typing for example (Schneider and Stefanish 2016), along with data availability driven by federal requirements for crash and roadway data indicate that significant opportunity exist to advance the art of crash diagnostics.

References related to diagnostic analysis include:


4. Research Objective
This research will review existing published highway related crash diagnostics and countermeasure selection and to expand approaches by considering multimodal factors and multiple contexts. This research will also assess modal mix, geometric design, operations, social economic, demographic, behaviors and human factors to determine appropriate diagnostic assessment and selection of countermeasures treatments given both the positive and negative aspects of the treatment. This research will develop new methods, guidelines, and tools. These methods, guidelines and tools will significantly advance existing tools for crash diagnostics and countermeasure selection that consider all road users. These new methods, guidelines, and tools will incorporate roadway context (such as the five contexts incorporated in the AASHTO Green Book), modal mix, geometric design, operations, and human factors as part of each of the newly developed tool sets, methods, and accompanying guidelines.

5. Implementation Planning
The deliverables of this research would be tested through the proposed pilot effort, which will result in products that are ready to be used by safety practitioners in state DOTs and other organizations. The proposed coordination with national-level partners will help ensure the products are disseminated. Once the products are complete, a joint effort possibly coordinated by FHWA, AASHTO, and TRB, to promote the products in more detail, possibly through workshops at national events or through a lead state effort would help ensure the products are put into use more quickly and more efficiently.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $650,000
Research Period: 36 months

7. Urgency and Potential Benefits
As data driven safety analysis continues to advance, existing crash diagnostic and countermeasure selection approaches are lacking. This has significant
impacts on the quality of design and operational decision making on the roadway system. Therefore, improved methods, guidelines, and tools are needed to help road safety professionals more fully understand each step of the decision-making process as well as potential impacts of the decisions. Most tools related to diagnostic assessment and the selection of countermeasures view safety from a narrow perspective, independent of the multiple modes and contexts under which road facilities operate. While various tools have been developed they are neither coordinated, comprehensive, nor tested for different scenarios and combinations of modal priority and context. In some cases they also lack scientific rigor and are based on perceptions of professional or advocate involved in their development. This proposed research intends to focus and advance methods, guidelines, and tools that consider multiple modes and contexts in order to develop a well-rounded tool that addresses all users of the transportation system for differing contexts. Given the necessity for data driven tools and performance-based systems in order to reduce fatalities and serious injuries, this tool is necessary if multimodal safety performance is to be considered in highway planning, design and operations and will be useful in safety audit, design, operations and management activities.

8. **Person(s) Developing the Problem Statement**

Dr. John Milton, PE
Director, Transportation Safety and Systems Analysis
310 Maple Park Avenue SE
Olympia, WA 98503-1147
P.O. Box 47418
Olympia, WA 98504-7418
Phone: 360-704-6363; 360-791-9242
Fax: 360-704-6367
miltonj@wsdot.wa.gov

Dr. Ida van Schalkwyk
Safety Policy and Innovations Engineer
310 Maple Park Avenue SE
Olympia, WA 98503-1147
P.O. Box 47418
Olympia, WA 98504
Phone: 360-705-7119
vanschl@wsdot.wa.gov

9. **Nomination for AASHTO Monitor**

Dr. John Milton, PE
Director, Transportation Safety and Systems Analysis
310 Maple Park Avenue SE
Olympia, WA 98503-7418
P.O. Box 47418
Phone: 360-704-6363; 360-791-9242
10. Potentially Interested AASHTO Councils and/or Committees
   Committee on Safety

11. Submitted By
   Steven A. Buckley, P.E.
   State Highway Safety Engineer
   Bureau of Transportation Safety & Technology
   700 SW Harrison Street, 6th Floor
   Topeka, KS  66603-3745
   785-296-1148

NCHRP Review of C-18

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective to be potentially solvable. There may be some concern or consideration as to level of study based on the proposed budget. The problem statement is of likely interest on a national level as it will aid agencies in implementing and updating future potential editions of the AASHTO Highway Safety Manual, (HSM). This study will also build on existing completed research which is being updated in the new proposed HSM, Second Edition, under NCHRP research project 17-71. At the time of my review, AASHTO Safety rated the problem statement as their number 7 of their top seven priority submittal problem areas.

Review Date:
12/10/2018

FHWA Evaluation of C-18

Amjadi/HRDS; Scurry/HSA - We think this is a holistic approach to safety for understanding contributing factors to crashes. This research intends to examine best practices in crash diagnosis for all crash types in all road users, recognizing that vehicle
and all road users? interactions will influence the success of selected strategies. This study intends to develop additional diagnostic tools that leverages the availability of crash, roadway, traffic volume, human factors, behavioral, socioeconomic, and demographic data to advance the practice in crash diagnostics for both all road users and facility type. The Recommended Funding of $650,000 is fine if they hire expert statisticians, and period of 36 months is reasonable.

AASHTO Committee Evaluation for C-18

Submitted By: Jameelah Hayes
AASHTO staff
Traffic Engineering

Comments: The Committee on Traffic Engineering thinks this is a high priority topic.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Comments: Committee on Safety priority #2 of 5

Problem No: 2020-C-19

1. **Problem Title**
   Supporting data-driven decision making through an expansion of the Human Factors Guidelines for Road Systems

2. **Background**
   The Human Factors Guidelines for Road Systems (HFG), published as NCHRP Report 600 is a tool for considering road user characteristics into roadway design and operational decisions. The HFG provides guidelines for individual intersection, roadway segment, and other element types and is currently being revised to update existing information and to address additional elements, including bicycle facilities, pedestrian facilities, and roundabouts. This update is nearly completed and will be published as the third edition of the HFG. Additional critical gaps in guidance on considering human factors were identified during the early stages of planning for the first HFG materials, and users have indicated that development of these materials would be beneficial to their efforts to reduce fatalities and serious injuries. Research is needed to develop the additional tools and guidance for a fourth edition of the HFG.

Transportation agencies are seeking to implement performance-based processes (data driven decisions) to improve the planning, design and operations of multimodal transportation systems. Improvements in these project stages require a range of tools to aid understanding of the contributing factors to crashes, identification of relevant countermeasures, implementation of chosen solutions and ensuring that all factors related to crashes are considered during the scoping of projects. This research is an expansion of previous research products related to human factors.

At inception, it was envisioned that the HFG would be a living document where new guidelines would be developed as new human factors needs are identified for enhancing road users’ safety and as new research studies and data become available to serve as the source of guideline materials. It was recognized that some topics could not be developed in the initial HFG publications and future editions would be driven by practitioner needs. For example, the 3rd Edition will add new chapters on bicycles, pedestrians, and roundabouts after responding to a survey of desired HFG changes to increase modal understanding and newer intersections concerns.
Similarly, after receiving user input the 4th edition is proposed to have new chapters on transit, older road users, road diet and complete street topics. The HFG end users also indicated a need for support with application of the HFG in countermeasure selection, road safety audits, roadway signage reviews, determination of crash contributing factors, root cause analysis, human factors training and teaching. The addition of material and tools to support these uses would be highly beneficial.

Transportation agencies have a strong desire for the inclusion of this information to enhance modal and demographic considerations. Further, the research also intends to include updates to existing chapters that could not be updated in the 3rd Edition as other human factors and safety research has continued to evolve rapidly in recent years. The 4th Edition would include new practice-ready content – guidelines, tutorials, tools, etc. that support and illustrate how data-driven safety analysis tools (such as the Highway Safety Manual) and performance based-decisions reflecting road user needs, capabilities, and limitations will enhance highway safety.

The 4th Edition would include the development of new safety audit/analysis practices and guidelines that reflect a focus on all road users in an effort to augment vehicle-focused current practices and tools. It would also add diagnostic tools to aid planners, designers, operations and safety engineers in identifying and communicating to drivers, bicyclist, and pedestrian safety; self-explaining roadway designs; and traffic operations on road segments, intersections, roundabouts, etc. This research will document the best currently available human factors and road-user interaction research and practices in safety analyses and road design to develop comprehensive guidance, tools and case studies to support data-driven decision making.

The objective is to have the next edition (update) of the HFG completed and ready for publication by 2020.

The AASHTO Committee on Safety has identified institutionalization of analytical tools to advance the science of safety as one of its goals in the Committee strategic plan, and this research would help practitioners use research-based information on human factors to make better-informed decisions. The Committee has ranked this research problem statement second (of five submitted to NCHRP) for FY 2020.

3. Literature Search Summary
Guidance on consideration of human factors in roadway design and operations decisions has been limited. The HFG brings this information together into one document in a format suitable for use by practitioners. Additional research has been performed to address knowledge gaps but is not collected in one resource for practitioners. Existing resources that provide human factors guidance for
practitioners and identify additional guidelines needed are presented in these documents:


4. **Research Objective**

To review existing published highway related human factor road-users research literature, update as needed existing guidelines in HFG, Edition 3, and develop new technical chapters with guidelines for inclusion in HFG, Edition 4. All new guidelines will use the format as published in the Edition 3 of the “Human Factors Guidelines for Road Systems,” NCHRP 600. The research also intends that the HFG be a supplement and coordinated document with the AASHTO HSM and other safety tools and processes such as road safety audits, operational reviews, performance planning, data driven design and operations of the road system.

The following activities are suggested:

1. Identify the previous unused reference materials developed for the HFG and determine if the necessary research literature is now available for the development of new human-oriented guidelines that could not be included in the next edition.
2. Develop a process or procedure for identifying what additional technical chapters and associated human oriented guidelines are needed in the update.
3. Develop a process or procedure of identifying how the research for new guidelines will be reviewed and scored for the level of acceptable empirical and other evidence that the research is sound from a human factors perspective relative to geometric design, operation, and control.
4. Identify what guidelines in the current HFG will be adjusted because of the availability of new research since publication.
5. Identify what new technical chapters will be developed, what the specific guidelines will be, and document the justification for why they should be developed.
6. Identify a working group of professional designers, traffic engineers, planners, behavioral experts, and others that will be available for providing input to the project and reviewing guidelines as they are proposed and developed.
7. Meet with selected transportation and safety organizations, such as state departments of transportation, FHWA, TRB, and others, to brief them on the
progress and new technical areas with recommendations as to how the FHWA training course will be impacted by the new material.

8. If in looking for new research for specific candidate guidelines, it is found not to exist or it is not rigorous enough for developing the update, identify what research is needed before such candidate guidelines can be written.

9. Plan and conduct two pilot data driven safety analysis studies to illustrate how multimodal road use safety needs can be addressed using HFG in combination with other available safety tools. Use the pilots to update and clarify new or existing materials and analysis approaches (e.g., DDSA and Road Safety Audits).

10. Coordinate with related AASHTO, TRB, and FHWA committees and staff to determine the most effective information on human factors to include in the Highway Safety Manual, to support consideration of human factors while using both the HSM and HFG while performing data driven safety analysis, using various tools from the development through implementation of safety projects.

5. Implementation Planning

This research will result in practice-ready guidelines for use by state DOTs and practitioners in other organizations. Proposed tasks will help disseminate and pilot test the guidelines. Coordination among national-level entities such as FHWA, AASHTO, TRB, and other professional associations could help expand integration of the updated guidelines into the state of the practice.

6. Estimate of Problem Funding and Research Period

Recommended Funding: $550,000
Research Period: 27 months

7. Urgency and Potential Benefits

The “Human Factors Guidelines for Road Systems (HFG) Edition 2,” was first published in 2012 as NCHRP Report 600, and the 3rd Edition is expected to be published in 2020. The HFG has always been intended to be a living document for use by highway designers, planners, and traffic engineers, to be updated as the user community’s needs change and as available research becomes available and would continue to be coordinated with the HSM and other safety tools to enhance safety knowledge. The 3rd Edition HFG is expected to have 24 chapters and a total of about 105 guidelines. It has been planned that additional chapters and guidelines be added as research and further information becomes available. New guidelines created from this project will use the same format used in the previous editions of the HFG. This HFG updating is timely given the amount of new research on driver behavior and performance that are available to support HFG updates and the value and interest in this resource form the roadway design and safety community. It is urgent this project get started so the
inclusion of users’ needs and limitation can be directly addressed in DDSA projects and other individual safety initiatives.

8. **Person(s) Developing the Problem Statement**
   Dr. John Milton, PE  
   Director, Transportation Safety and Systems Analysis  
   310 Maple Park Avenue SE  
   Olympia, WA 98503-1147  
   P.O. Box 47418  
   Olympia, WA 98504-7418  
   Phone: 360-704-6363; 360-791-9242  
   Fax: 360-704-6367  
   miltonj@wsdot.wa.gov

   Dr. Samuel C. Tignor, PE, ASCE Fellow, ITE Member, and retired Chair of TRB Human Factors Road Design Guides Subcommittee, AND10(2)  
   1706 Fairview Avenue, McLean, VA 22101  
   703-356-1037  
   stignor@aol.com

   Thomas Hicks, PE – Director  
   Century Engineering, Inc.  
   10710 Gilroy Road  
   Hunt Valley, MD 21031  
   443-589-2400x1323  
   thicks@centuryeng.com

9. **Nomination for AASHTO Monitor**
   Dr. John Milton, PE  
   Director, Transportation Safety and Systems Analysis  
   310 Maple Park Avenue SE  
   P.O. Box 47418  
   Olympia, WA 98504-7418  
   Phone: 360-704-6363; 360-791-9242  
   Fax: 360-704-6367  
   miltonj@wsdot.wa.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
   Committee on Safety, Committee on Design, Committee on Traffic Engineering

11. **Submitted By**
   Steven A. Buckley, P.E.  
   State Highway Safety Engineer  
   Bureau of Transportation Safety & Technology  
   700 SW Harrison Street, 6th Floor
NCHRP Review of C-19

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective to be potentially solvable; however, at this time, it may be more beneficial if the problem statement may be considered for next year’s submittal also. The problem statement is of likely interest on a national level as it will aid agencies in implementing and updating future potential editions of the Human Factors Guide for Road Systems. The problem statement is AASHTO Safety top rated number of their top seven priority submittal problem areas. Would also like to note, there is a current NCHRP research project, 17-80, “Expansion of the Human Factors Guidelines for Road Systems, Second Edition,” currently underway but not scheduled for completion until the end of 2019 or potentially early 2020 and the potential preliminary results during the course of the research may also contribute to the scope of this research problem statement. However, by the time the Third edition is published, requirements proposed may have altered considering the projected introduction of new technology into vehicles and the infrastructure which is why it may be advantageous to resubmit this problem statement for next year’s solicitation when more is known under the current research project as well as the dynamics of new autonomous vehicle technology keeps changing and expanding.

Review Date:
12/10/2018

FHWA Evaluation of C-19

Anderson/HSA; Moyer/HRDS - The overall contents of the update to NCHRP Report 600 has not been finalized or completed. The Human Factors Guidelines for Road Systems (NCHRP 600) represents a successful series with a Third Edition due out in 2020. The Fourth Edition proposed suggests new tools and practices across a broad spectrum of issues to include roadway users, infrastructure design and traffic operations. Further, the list of ten suggested activities proposed appears to be a series
of activities to develop processes and procedures, define issues that need addressed, and identify the partners and stakeholders that should contribute to the Fourth Edition. Suggest the Third edition be completed before committing funds to the effort that remains relatively undefined other than to identify what research and products are needed. By the time the Third edition is published, requirements proposed may have altered considering the projected introduction of new technology into vehicles and the infrastructure. We do not support this effort at this time.
Problem No: 2020-C-20

1. Problem Title
Estimating Safety Performance of Infrastructure Improvements Incorporating Consideration of Driver Behavior

2. Background
Driver characteristics are one of the most influential and contributing factors to traffic crashes. However, the advancements in data-driven safety analysis tools available to safety practitioners are focused on infrastructure-related factors affecting crashes. Research is needed to include driver behavior factors in crash prediction models to allow for a more comprehensive assessment of existing and expected safety performance.

Previous research in the field of road safety shows that nearly 95 percent of all traffic crashes are related to human factors (either alone or combined with other contributing factors of traffic crashes) [1,2]. Despite this factor, regression models for expected crash frequency and severity used for development of crash modification factors (CMFs) and estimation of predicted crashes do not incorporate driver characteristics. This creates a problem for those considering safety applications since one of the most important factors is not included. This will lead to safety solutions that do not always work as intended. In the Highway Safety Manual (HSM) the measures of driver characteristics are divided into several categories such as attention and information processing, vision, perception-reaction time, speed choice and so on. But this is provided at a very high level. The driver characteristics such as gender, age, speeding, blood alcohol content, seatbelt use, and distracted driving are usually reported by police officers called to the crash scenes. These factors can be used to assess the impact of driver characteristics on crash frequency, type, and severity. Several studies have evaluated the impact of these factors on crash severity (i.e. fatal and injury crashes). There is, however, a need to incorporate these factors in widely implemented crash prediction models such as Safety Performance Functions (SPF), Severity Distribution Functions (SDF) and other types of crash prediction models implemented by the state Departments of Transportation (DOT) to achieve a better picture of the true potential impacts of safety decisions. Including the driver behavior factors will help improve the prediction accuracy of the aforementioned crash prediction models and will provide the highway safety agencies with a better assessment of the contributing factors of traffic crashes.
Hence, the proposed safety treatments are likely to result in fewer fatal and serious crashes on roadways for all road users.

One of the major challenges of this research is to identify the list of driver behavior variables brought together over a roadway segment, intersection or other spatial unit (e.g., segment, corridor). Although many driver behavior indicators are collected by the police officers, only a few of these variables can be meaningfully brought together (aggregated) over a given spatial area (e.g. alcohol limit, speeding < 5/10/20 mph over the speed limit, number of citations collected, gender, age and household income of the spatial area) for use in design and systems operations decision making. Moreover, since the behavioral coding varies greatly from state to state, the research needs to limit the number of driver behavior variables to account for this factor. Accounting for this factor will also be helpful in transferring and calibrating the results of this study to various states in the future.

Thus, research is needed to develop a methodology to incorporate the aggregate driver characteristics into highway safety prediction models (i.e. SPF, SDF, and so on) for use in design and operational decision-making, as well as incorporation into the HSM and other authoritative safety tools and guidelines. The secondary objective of this research is to identify the list of variables that can be 1) aggregated over a selected spatial area, 2) are common factors in state crash databases, and 3) will be useful in safety planning, design and operational decisions.

The AASHTO Committee on Safety has identified institutionalization of analytical tools to advance the science of safety as one of its goals in the Committee strategic plan, and this research would help practitioners incorporate critical factors that play a significant role in crashes. The Committee has ranked this research problem statement third (of five submitted to NCHRP) for FY 2020.

3. Literature Search Summary

Drivers’ behaviors are complex. Drivers must perceive and interact with the status of their own vehicle and the adjacent vehicles, roadway and weather conditions. Drivers’ personal characteristics such as gender, and age, behavioral characteristics such as speeding, drunk driving, distraction, and other attributes such as demographics (i.e. education level, income), and marital status influence traffic safety and traffic violations and treatment approaches for addressing these problems. For example:

- Speeding and overtaking violations are one of the most significant driving behavior affecting roadway safety. Speeding related fatalities account for 28.5 percent of total fatalities, of which most of them occur on rural highways. Among the roadway facility types, principal arterial, collector, and local road system account for about 60 percent of speeding related fatalities [2].
• In 2016, drunk driving found to be contributing factors in 28 percent of roadway fatalities in these preventable crashes.
• The level of distraction and duration of distraction also affect the driving performance on roads. Mostly younger drivers are involved in distracted driving due to cell phone or other elector devices.
• In fact, teen driver/younger drivers (below 20 years, mostly male drivers) are very likely to get involved in fatal crashes because of driving inexperience, speeding, DUI, low level restraint usage (seat belt, helmet), and distraction by cell phone usage.
• A history of last 3 to 5 years of crashes, speeding, moving violations, DUI and license suspension status also seem to have some level of correlation to the driving behavior and the risk perception of the drivers involved in severe crashes.

References:
4. Research Objective

This research will develop a methodology to incorporate the aggregate driver characteristics to safety models such as the SPF and SDF, as one or more explanatory variables in the models. The research will also identify the list of driver characteristics/factors which can be aggregated for a given segment, block group, and other spatial units, that can be utilized in safety model prediction. These findings will be incorporated into tools such as the HSM predictive methods.

The following tasks are suggested for performing the research:

Phase I:

- Task 1 – Review of the literature that have evaluated/estimated the impact of driver characteristics on safety to identify the list of driver characteristics variables (or measures) that have been found to contribute to the roadway safety.

- Task 2 – Identify the data needs based on task 1(b). The purpose of this task is to identify the readily available data sources, and outline the data collection and compilation plan. The potential data sources would include but are not limited to Police Citations, FARS and GES, DOT Police crash reports, SHRP 2/NDS, US Census, DMV and so on. The task order team will list the number of states that will be included in the study.

- Task 3 – Select the list of driver behavior variables that can be aggregated over a given spatial unit based on the results of tasks 1 and 2.

- Task 4 - Propose the statistical methodology to conduct the data analysis. The choice of statistical analysis approach depends on the spatial unit selected for developing the crash prediction models. The task order team will propose the methodology for conducting the data analysis for various spatial units (i.e. segment, census block, block group and so on). The panel members will decide upon the final spatial unit and the statistical methodology.

- Task 5 – Prepare a Phase II work plan indicating the data collection plan,
statistical analysis approach for developing the crash models incorporating the driver characteristics, and expected outcome of research into the HSM and other authoritative safety tools.

- Task 6 – Prepare an interim report documenting the literature review, potential data sources, the list of states and proposed work plan

**Phase II:**

- Task 7 – Execute work plan developed in Task 3 and approved by NCHRP panel. Assess the advantages of the developed methodology and compare to existing ones in HSM.
- Task 8 – Prepare final deliverables and guidelines. The task order team will develop final project guidelines report that documents the research and provides the list of driver behavior variables used for developing the crash prediction models. These models would assist highway agencies in estimating the safety impacts of driver characteristics identified in the Project. The ‘draft HSM’ text will also be included in the final report.

5. Implementation Planning

This research will be performed in coordination with the AASHTO Committee on Safety, and the TRB Standing Committee on Highway Safety Performance (ANB25) to complement and improve the knowledge and methods of analysis relating to highway safety management. The findings will be documented in a research report as well as journal papers and presentations at AASHTO and TRB committee meetings. These documents and materials for presentations will also be available to state agencies and the highway safety community in general for training and real world application. In addition, the final report will provide proposed changes for consideration by AASHTO to update the AASHTO Highway Safety Manual.

6. Estimate of Problem Funding and Research Period

   Recommended Funding:  $600,000
   Research Period:  36 months

7. Urgency and Potential Benefits

This research is expected to have a great value for the highway safety researchers and practitioners. There is a strong need to incorporate driver behavior into the crash prediction models. The Highway Safety Manual’s Chapter 2 discusses the role of human factors in highway safety, however more research into behavioral crash causation is needed. Including driver behavior in the HSM will help identify the appropriate strategies and solutions which extend beyond roadway/engineering improvements (education, enforcement, emergency response and evaluation).
This research effort would be beneficial in prioritizing the safety efforts of the state DOTs and the federal agencies. The results of this study can be helpful for outreach programs and initiatives such as American Automobile Association’s Guide to Teen Driver Safety programs.

8. **Person(s) Developing the Problem Statement**
   
   Bahar Dadashova  
   Roadway Safety Program  
   Texas A&M Transportation Institute  
   3135 TAMU  
   College Station, TX 77843-3135  
   b-dadashova@tti.tamu.edu

   Mouyid Islam, Ph.D.  
   Research Faculty  
   Center for Urban Transportation Research  
   University of South Florida  
   4202 E Fowler Ave., CUT100, Tampa, FL 33640  
   mouyid@cutr.usf.edu

   Anusha Musunuru  
   Transportation Analyst  
   Kittelson and Associates, Inc.  
   155 Grand Avenue, Suite 900,  
   Oakland, CA 94612  
   (510) 433-8081  
   amusunuru@kittelson.com

   John Milton  
   Director of Transportation Safety and System Analysis  
   Washington State DOT  
   PO Box 47329  
   310 Maple Park Avenue SW  
   Olympia, WA 98504-7329  
   (360) 704-6363  
   miltonj@wsdot.wa.gov

9. **Nomination for AASHTO Monitor**
   
   John Milton  
   Director of Transportation Safety and Systems Analysis  
   Washington State DOT  
   PO Box 47329  
   310 Maple Park Avenue SW  
   Olympia, WA 98504-7329  
   (360) 704-6363  
   miltonj@wsdot.wa.gov
10. **Potentially Interested AASHTO Councils and/or Committees**
   Committee on Safety

11. **Submitted By**
    Steven A. Buckley, P.E.
    State Highway Safety Engineer
    Bureau of Transportation Safety & Technology
    700 SW Harrison Street, 6th Floor
    Topeka, KS  66603-3745
    785-296-1148

---

**NCHRP Review of C-20**

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The scope of the research is reasonable within the time period and estimated budget with a clear objective to be potentially solvable. The problem statement is of likely interest on a national level as it will aid agencies in implementing and updating future potential editions of the Human Factors Guide for Road Systems, NCHRP Report 600 as well as updated editions of the AASHTO Highway Safety Manual, (HSM). At the time of my review, AASHTO Safety rated the problem statement as their number 2 of their top seven priority submittal problem areas. Would also like to note, there is a current NCHRP research project, 17-80, “Expansion of the Human Factors Guidelines for Road Systems, Second Edition,” currently underway and the potential preliminary results during the course of the research may also contribute to the scope of this research problem statement.

Review Date:
12/10/2018

---

**FHWA Evaluation of C-20**

Philips/HRDS; Anderson/HSA; Rousseau/HSA - There is support for this problem statement and approach. Good proposed research to include driver behavior factors into crash prediction models. Well thought out tasks for completing work.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Comments: Committee on Safety priority #4 of 5

Problem No: 2020-C-21

1. Problem Title
Methods for Short-Term Crash Prediction

2. Background
Current crash prediction methods—such as those in the AASHTO Highway Safety Manual (HSM)—consist of safety performance functions (SPF), crash modification factors (CMF), and severity distribution functions (SDF). These tools use annual average daily traffic (AADT) data along with geometric and operational characteristics to predict annual average crash frequency of roadway sites. While these models have statistical merit, they do not allow users to accurately predict crashes for short-term periods (which are defined as months, weeks, days, hours, or peak periods for this research) and this can be an issue for agencies wanting to assess the impacts of temporary works zones or facility changes. The annual prediction convention also limits the models’ ability to quantify the effects of variables that fluctuate more often than year-to-year, such as operating speeds, operating speed variance, or seasonal fluctuations. The benefit to an agency would be the ability to more accurately assess what seasonal or daily changes could have on crash outcomes. There is a need to explore the development and functional forms of crash prediction methods using finite exposure measures and representing short-term roadway conditions to better account for these variables and understand short-term fluctuations in highway safety performance.

One of the most significant limitations of the HSM—and quantitative safety performance research in general—is the omission of speed-related factors from nearly all aspects of safety predictive methods. Recent research has made little substantive progress in incorporating speed-related factors into crash predictive models. Not only is this seen as a limitation to the analytical aspects of the HSM, it is also one reason why some practitioners have not “bought-in” to using the HSM. Research has shown that a vehicle’s operating speed during crash impact affects injury severity of crash victims (but not prevailing speeds during travel) and that speed differential between drivers affects the potential for and frequency of crashes. However, beyond these general relationships there is minimal consistent, proven evidence for speeds (i.e., posted, average operating, or other) affecting annual crash frequency, although intuitively speed clearly plays a major role in safety data is often grouped in a manner that the underlying impacts of speed are not significant in the estimation. There is an urgent need for research
to explore new data, revised aggregations, and newer statistical methods to better understand how to effectively quantify highway safety on a daily, hourly, or other short-term basis to overcome these limitations of current methods to provide for more useful applications by transportation agencies.

The AASHTO Committee on Safety has identified institutionalization of analytical tools to advance the science of safety as one of its goals in the Committee strategic plan, and this research would help practitioners estimate expected safety performance for a wider range of situations that is currently possible. The Committee has ranked this research problem statement third (of five submitted to NCHRP) for FY 2020.

3. Literature Search Summary

The value of advanced safety predictive methods is well documented in literature, and the analysis approaches are being widely adopted by state and local agencies. Research to date has primarily developed new SPFs, CMFs, and SDFs that predict crashes on an annual scale. As new data become available and these types of models reach the extent of their usefulness, there is a need for additional research to explore the development of more finite, short-term crash prediction models. Several research efforts have begun to explore this area for specific applications\(1,2,3,4\) Some research projects have also considered real-time or simulated crash prediction, which addresses a similar need to this proposed research\(5,6,7\).

Past research projects for the HSM have typically focused on developing crash prediction models for estimating annual crash frequency for only one type of facility. They have included more and more input variables as models and data improve, but generally follow similar modeling procedures and have the same restrictions in application. Essentially all current recommended crash prediction models use AADT as the exposure variable; however, practitioners today have more accurate and real-time exposure data available to them that are not being fully utilized in the context of safety performance estimation. A current USDOT Safety Data Initiative (SDI) project is quantifying the association between crash outcomes and operating speed, volume, and roadway geometrics. However, this project is limited to rural roadway segments and consideration of hourly traffic volume is not listed in the project scope.

At least four national databases can be combined and used to mitigate the current research gap: 1) The National Performance Management Research Data Set (NPMRDS) version 1 and version 2 contain passenger and freight travel time data sets for the National Highway System (NHS) and other roadways; 2) The Highway Safety Information Systems (HSIS), a cooperative endeavor funded by FHWA, is a roadway-based system that provides quality data on a large number of crash, roadway, and traffic variables from a group of selected states (California, Illinois, Maine, Michigan, Minnesota, North Carolina, Washington, Utah, and Ohio); 3) The Highway Performance Monitoring System (HPMS) is a
national level highway information system that includes data on the extent, condition, performance, use and operating characteristics of the nation’s highways; 4) Travel Monitoring Analysis System (TMAS) contains traffic volume data through both temporary traffic counting and continuous traffic counting programs. However, most existing models predict crashes for both travel directions combined, while the proposed research may need to account for crashes in each direction separately to account for different directional traffic flows at various times of day.

References:

4. Research Objective
The purpose of this research is to explore the development of short-term crash prediction models to estimate the safety performance of roads for specific geometric, operational, and exposure characteristics (such as those related to detours, variable speed limits or routes that experience significant changes throughout the year). The research should identify the appropriate measures of exposure, explanatory variables, statistical and machine learning models, model limitations, and other necessary factors to assist researchers in developing models and practitioners in interpreting their results. This research should explicitly explore the use of more precise measures of exposure than AADT and variations in those exposure measures over time to predict crashes.

Beyond the formative research needed to provide recommendations for developing and interpreting the results of short-term crash prediction models, the research should begin to consider the potential for new crash prediction methods to predict the safety effects of basic recurring situations that deviate from average conditions (e.g., day and night, peak periods, signal phasing changes by time of day), when finite safety prediction is needed to compare information
about operations, capacity, and other competing project interests. Short-term methods also have potential applications to short-term traffic control scenarios (e.g., for construction traffic control plans, traffic incident management, or when law enforcement is present) in which roadway conditions and driver behavior stray from normal conditions.

The research should also consider the potential for models to better understand the relationship between operational speed and safety by using random parameter models that allow for distributional fluctuations or time and space. Using current approaches, it is difficult to statistically relate speed—which constantly changes—to annual average estimates of crashes. The NPMRDS is a national database that provides monthly archive of average travel times, reported every 5 minutes when data is available, on the National Highway System. Short-term crash prediction methods may yield more promising results in quantifying the role of speed (using NPMRDS) in safety performance.

Another potential aspect of this research is understanding the safety performance of road networks during special events (e.g., sporting events, holidays, etc.). Often these cases result in extremely high short-term volumes, saturated flows, and changes to normal traffic control patterns. It is unclear how to account for these situations within the context of annual prediction.

Furthermore, it is suggested that this effort be coordinated with NCHRP Projects 17-78, 17-84, 17-85, 17-89, and other ongoing major safety performance research projects, as applicable.

5. Implementation Planning

This research serves as a starting point to better understand how speed and other factors affect safety within time periods shorter than a year. This project has the potential (immediately or over time with further developments) to formulate a better understanding the effects of speeds, time of day, traffic patterns, seasonal difference, work zones, and other recurring and non-recurring short-term fluctuations in roadway characteristics and design.

The research should explore the use of real-time traffic monitoring data (e.g., from intelligent transportation systems (ITS) devices) or simulation to model safety impacts in short periods. This research could help connect ITS and TSMO staff in State DOTs and local agencies with safety engineers to foster effective teams and data sharing agreements.

The results of this research will likely be implemented immediately by safety engineers at States that are already using the HSM or are familiar with advanced safety analysis using safety performance functions. Additionally, the research products will likely be of interest to traffic engineers that are interested in understanding the safety impacts of short-term traffic conditions and traffic control plans.
6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:** $650,000

   **Research Period:** 30 months

7. **Urgency and Potential Benefits**

   This research has the potential to start to account for speed and other real-time operational data, special events, and unique roadway situations that represent safety concerns to DOTs and the public, which are not yet well understood using existing safety prediction methods. The proposed research products would support state DOTs efforts to estimate safety performance and address safety concerns related to shorter term or temporary events, and would help states better meet the needs and expectations of road users.

8. **Person(s) Developing the Problem Statement**

   Tim Harmon  
   Highway Safety Project Manager  
   VHB  
   Venture I, 940 Main Campus Drive, Suite 500  
   Raleigh, NC 27606  
   (919) 741-5542  
   tharmon@vhb.com

   Subasish Das, Ph.D.  
   Associate Transportation Researcher  
   Texas A&M Transportation Institute  
   College Station, TX- 77843  
   (979) 845-9958  
   s-das@tti.tamu.edu

   John Milton, Ph.D., P.E.  
   Director of Transportation Safety and Systems Analysis  
   Washington State DOT  
   PO Box 47329  
   310 Maple Park Avenue SW  
   Olympia, WA 98504-7329  
   (360) 704-6363  
   miltonj@wsdot.wa.gov

9. **Nomination for AASHTO Monitor**

   To be determined.

10. **Potentially Interested AASHTO Councils and/or Committees**
NCHRP Review of C-21

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The scope of the research is reasonable within the time period and estimated budget with a clear objective to be potentially solvable. The problem statement is of likely interest on a national level as it will aid agencies in implementing and updating future potential editions of the AASHTO HSM. At the time of my review, AASHTO Safety rated the problem statement as their number 5 of their top seven priority submittal problem areas. Methods for Short-Term Crash Prediction addresses the two biggest limitations in predicting crashes which are incorporating travel speeds into prediction models, and predicting crashes in short-term operation situations e.g. work zones, using short term traffic counts. I am aware that these limitations were noted at a national peer exchange on Applications in Performance-Based Project Development, which is of high interest to the FHWA Offices of Safety and Operations.

Review Date:
12/10/2018

FHWA Evaluation of C-21

Zineddin/HRDS; Roche/HSA - This is a high priority. Methods for Short-Term Crash Prediction addresses the two biggest limitations in predicting crashes. Incorporating travel speeds into prediction models, and predicting crashes in short-term situations (work zones, using short term traffic counts). These limitations were noted at a national
peer exchange on Applications in Performance-Based Project Development, and are of high interest to the FHWA Offices of Safety and Operations.

AASHTO Committee Evaluation for C-21

Submitted By:
Jameelah Hayes
AASHTO staff
Traffic Engineering

Comments:
The Committee on Traffic Engineering thinks this is an important topic.
Problem No: 2020-C-22

1. Problem Title
The Effect of Vehicle Mix on Crash Frequency and Crash Severity

2. Background
The USDOT Bureau of Transportation Statistics projects that truck travel is expected to increase from 282 million miles per day in 2012 to 488 million miles per day by 2045 (2017). In traffic volume estimates for planning and project development, vehicles are typically classified into two broad categories: 1) passenger vehicles (motorcycles, cars and pickup trucks) and 2) trucks over 10,000 pounds gross vehicle weight. Trucks are often further subclassified, for example as buses, single unit trucks, and combination trucks. A more complete classification system has been established by the Federal Highway Administration (FHWA). The FHWA vehicle classification system separates vehicles into 13 different class groups or categories ranging from motorcycles to multi-trailer trucks with seven or more axles (there are 2 additional groups – group 14 which is not used, and group 15 for unclassified multiple configurations). Data conforming to this classification system has been routinely measured by states across all facility types and reported to the FHWA over a number of years. It well known that vehicle mix is not constant and varies considerably among all facility types. Additionally, vehicle mix is expected to change significantly over time as truck travel continues to increase.

The AASHTO Highway Safety Manual (HSM) has become a key safety management and evaluation toolbox for state and local highway agencies, MPOs, and the safety, design, and operations community. Current HSM tools include predictive methods for a wide variety of highway facility types and site conditions. The current methods account for traffic volumes and other roadway characteristics but not for vehicle mix or distribution of vehicle types.

Recent studies, described below in Section 3, demonstrate the effect of truck traffic on safety performance of roadways, and all the studies indicate that predictive methods for crash frequency and severity would be significantly improved with the inclusion of consideration for vehicle mix. Improved methods will result in better use of the limited funds and resources available for improving the safety of the highway system.
The AASHTO Committee on Safety has identified institutionalization of analytical tools to advance the science of safety as one of its goals in the Committee strategic plan, and this research would help practitioners address a range of safety issues. The Committee has ranked this research problem statement fifth (of five submitted to NCHRP) for FY 2020.

3. Literature Search Summary

The absence of vehicle mix as a factor in HSM methods is contrary to the findings of a number of studies:

- Hauer, et.al. (2004) studied urban four-lane undivided roadways in the state of Washington and found that an increase in the proportion of trucks (up to approximately 10 percent trucks) was associated with a reduction in the number of crashes. Above 10 percent trucks, an increase in percent trucks was associated with an increase in the number of crashes.
- Bonneson and Pratt (2009) observed that the crashes on four-lane rural roads, urban and suburban arterials, and freeways decreased as percent trucks increased. However there was no upward trend above 10 percent trucks. An exception was for rural signalized intersections where crash frequency increased as percent trucks increased.
- Pierce and Park (2014) differentiated between heavy and medium duty trucks when studying crashes on limited access facilities and found differences in contributions of each group to the overall number of crashes. These findings indicate that distinguishing between different types of trucks would be beneficial rather than just incorporating the percentage of trucks.
- Ray and Carrigan (2014) analyzed a national sample of run-off-road crashes and a detailed regional sample and found that heavy vehicles encroach at an average rate of approximately one-third of all vehicles. They also established that crash cost varies with vehicle type. For example, large truck crash costs tend to be 3.52 times greater than typical passenger car costs. Accordingly, vehicle mix adjustment factors for both crash frequency and crash cost are included in the methodology used in the current Roadway Safety Analysis Program (RSAP)
- The recent NHTSA analysis of fatal large truck crashes in 2016 found that trucks are more likely to be involved in fatal multiple-vehicle crashes as opposed to fatal single-vehicle crashes than were passenger vehicles (80 percent of fatal crashes involving large trucks are multiple-vehicle crashes, compared with 61 percent for fatal crashes involving passenger vehicles).

The research cited above along with other recent research conducted related to this topic include:

1. Freight Facts and Figures 2017 - Chapter 3 The Freight Transportation System. USDOT Bureau of Transportation Statistics
4. Research Objective

The objective of this research is to determine the effect of vehicle mix on crash frequency and crash severity for selected facility types using a statistically valid methodology based on and compatible with HSM principles and methods. It is expected the research will result in new safety performance functions and/or vehicle mix adjustment factors that will improve the accuracy and reliability of crash frequency and severity estimates. Given time and cost constraints, it is not practical to address all facility types in this one research project. To take advantage of existing data sets assembled as part of NCHRP Projects 17-45 Enhanced Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges and 17-58 Safety Prediction Models for Six-Lane and One-Way Urban and Suburban Arterials, recommended facility types to be addressed in this project shall include urban and suburban multilane arterial segments, and freeway segments. A third facility type to be addressed is rural multilane arterial signalized intersections. For each of these three facility types, a vehicle mix consisting of a minimum of three basic classes of vehicles is to be investigated: 1) passenger vehicles (includes motorcycles, cars, and pickup trucks), 2) single unit trucks, and 3) combination trucks. Further sub-classification (e.g., motorcycles, cars and pickup trucks) may be provided if determined to be feasible and if the findings of initial phases of work indicate a need to do so.

5. Implementation Planning
This research will be developed in coordination with the AASHTO Committee on Safety and the TRB Standing Committee on Highway Safety Performance (ANB25) to complement and improve the knowledge and methods of analysis relating to highway safety management. The findings will be documented in a research report as well as journal papers and presentations at AASHTO and TRB committee meetings. These documents and materials for presentations will also be available to state agencies and the highway safety community in general for training and real world application. In addition, the final report will provide proposed changes for consideration by AASHTO to update the AASHTO Highway Safety Manual.

6. **Estimate of Problem Funding and Research Period**
   - **Recommended Funding:** $400,000
   - **Research Period:** 30 months

7. **Urgency and Potential Benefits**
   This proposed research will provide a basis for improving predictive methods used to estimate crash frequency and severity. Transportation agencies rely heavily on performance-based practical design to optimize investments in multimodal environments. By incorporating freight and future freight growth along corridors as part of planning, project development, and system management, agencies are better able to incorporate safety performance considerations into decision making and alternatives comparisons.

8. **Person(s) Developing the Problem Statement**
   - **James A. Mills, PE**
     Principal
     Pavement Analytics, LLC
     P. O. Box 670
     Tallahassee, FL 32302
     Phone: 850-322-4661
     E-mail: jmills@pavementanalytics.com
   
   - **Ingrid Potts, PE**
     Transportation Research Center Manager
     MRI Global
     425 Volker Boulevard
     Kansas City, MO 64110-2299
     Phone: 816-360-5284
     E-mail: ipotts@mriglobal.org
Ida van Schalkwyk, Ph.D.
Safety, Policy and Innovations Engineer
Development Division
Washington State Department of Transportation
310 Maple Park Ave, Olympia, WA 98504
PO Box 47387, Olympia, WA 98504-7387
Phone: 360-705-7119 | cell: 360-280-2132 (updated)
E-mail: vanschi@wsdot.wa.gov

9. Nomination for AASHTO Monitor
   To be determined.

10. Potentially Interested AASHTO Councils and/or Committees
    Committee on Safety

11. Submitted By
    Steven A. Buckley, P.E.
    State Highway Safety Engineer
    Bureau of Transportation Safety & Technology
    700 SW Harrison Street, 6th Floor
    Topeka, KS 66603-3745
    785-296-1148

NCHRP Review of C-22

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective to be potentially solvable. The problem statement is of likely interest on a national level as it will aid agencies in implementing and updating future potential editions of the AASHTO Highway Safety Manual, (HSM). This study will also build on existing completed research which is being updated in the new proposed HSM, Second Edition, under NCHRP research project 17-71. At the time of my review, AASHTO Safety rated the problem statement as their number 6 of their top seven priority submittal problem areas.

Review Date:
12/10/2018
FHWA Evaluation of C-22

Scurry/HSA; Amjadi/HRDS; Zineddin/HRDS - This is a high priority. This research would be interesting and provide insights for future safety predictions. This is a needed study considering increasing truck volumes on roads, and effect of truck traffic on safety performance. Worth noting is that an effort is needed to reconcile all these different SPFs/AFs, and re-evaluate the HSM and SPFs overall.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline  

Problem No:  2020-C-23  

1. **Problem Title**  
   “Model Procedures for Post-Event Bridge Damage Assessment and Engineering Evaluation”  

2. **Background**  
   Extreme events, such as fire, flood, earthquake, tornado, and hurricane, can cause widespread bridge damage. After such events, there is a need for the rapid, systematic, inspection of bridges in the affected area to assess damage, evaluate performance, and determine which structures can safely remain open to traffic and which must be closed pending repair. The information generated in these inspections assists emergency managers to coordinate their response, direct repair efforts, and maintain traffic operations in the affected area. Engineering evaluation of structural performance in these events informs updated design codes and standards that can improve performance and reduce impacts to the transportation network from future events. A recent NCHRP synthesis (Topic 46-11) identified common bridge hazards in responding states and the degree to which those states have developed response strategies and inspection processes. Another recent NCHRP project (14-29, resulting in Report 833) presented a framework for deploying personnel, making damage assessments and reporting findings. Many State Departments of Transportation (DOTs) and local agencies have independently developed post-event damage assessment plans but, while there are common elements to these plans, their depth and quality vary widely agency to agency. The goal of this study is the development of model procedures that transportation agencies at all levels of government might reference in the development of their response plans.  

3. **Literature Search Summary**  
   In addition to the previously mentioned NCHRP documents, several state DOTs have developed post-event inspection and damage assessment procedures and guidance.  
   References:  
   
   
4. **Research Objective**

The objective of the research is to develop model procedures that state DOTs can reference in the development of their emergency response plans to ensure that those plans address the need for thorough and effective bridge damage assessment. These procedures would provide a framework for a DOT to:

- Identify potential hazards to the bridge inventory
- Identify key personnel and their roles in the response
- Define response levels
- Define damage assessment stages and associated personnel qualifications, timeframes, and reporting efforts in conducting
  - initial reconnaissance
  - preliminary damage assessment
  - detailed damage assessment
  - engineering evaluation and investigation
- Outline deployment logistics
- Establish communication protocols
- Establish data collection and reporting standards
- Establish decision escalation processes

Specific tasks of the research to accomplish the main objective include:

Task 1: Identify and summarize response procedures already established by state DOTs and other nations. Identify common themes, unique approaches, and best practices.

Task 2: Review current AASHTO guidance regarding emergency response and damage inspection. Identify guidance gaps regarding post-event damage assessment. Identify potential vehicles for publishing the model guidance through AASHTO (guide specification, inclusion in an existing manual or specification, etc.).

Task 3: Prepare an interim research report documenting the results of Tasks 1 and 2. Develop preliminary recommendations for the key aspects of the model procedures.

Task 4: Prepare draft model procedures for post-event bridge damage assessment based on the results of Task 3 and resulting comments from the review panel. Submit the draft procedures to the technical panel for review and comment,
Task 5: Address review comments and publish model procedures and final research report presenting the complete results of the research.

Task 6: Develop draft AASHTO ballot language

The final products of this project will be (a) model procedures for post-event bridge damage assessment and engineering evaluation, (b) a research report with the complete results of the research, and (c) AASHTO ballot-ready manual language for the adoption of the model procedures as AASHTO guidance.

5. Implementation Planning

The model procedures and final report would be immediately available to state DOTs to utilize in response plan development. Inclusion of the model procedures in an AASHTO manual will encourage wider adoption and implementation.

6. Estimate of Problem Funding and Research Period

Recommended Funding: $300,000

Research Period: The project will be completed in thirty-six (36) months.

7. Urgency and Potential Benefits

Every year, events occur with the potential to cause bridge damage impacting local and regional transportation networks. While most states have emergency plans in place to respond to such events, the degree to which those plans address bridge damage varies. NCHRP Synthesis 497 summarized their findings as follows:

Survey responses showed that 86% of states claimed to have an emergency response plan for extreme events. The follow-up interviews however showed that not all of the response plans are tailored for responses to bridge damage.

This research will provide guidance to states working to address bridge damage assessment in their response plans. Without guidance, it will be incumbent on each state DOT to establish assessment procedures, which will lead to redundant efforts that may, in the end, result in inefficient processes.

Developing and disseminating this guidance through the NCHRP process will raise awareness of the need for bridge specific procedures and ensure that the model procedures are relevant to a diverse set of emergencies. National consistency in response procedures will facilitate the sharing of inspection personnel between agencies when the scope of an event exceeds an agency’s capacity to effectively assess damage. Furthermore, effective implementation of bridge damage assessment procedures will improve transportation network resiliency by managing immediate-term disruptions and identifying engineering-based solutions to address vulnerabilities.
8. **Person(s) Developing the Problem Statement**
   Derek Soden, Senior Structural Engineer, FHWA Resource Center, Member AFF50
   Phone: (720) 413-7436   Email: derek.soden@dot.gov
   Elmer Marx, Senior Bridge Design Engineer, Alaska DOT&PF, Chair AFF50
   Phone: (907) 465-6941   Email: elmer.marx@alaska.gov
   Majiid Sarraf, Senior Project Manager, Transtech, Member AFF50
   Phone: (949) 554-5573   Email: msarraf2@yahoo.com

9. **Nomination for AASHTO Monitor**
   Matt Farrar, Idaho Transportation Department
   Tom Ostrom, CALTRANS
   Derek Soden, FHWA
   Dennis Heckman, Missouri DOT
   Richard Pratt, Alaska DOT&PF

10. **Potentially Interested AASHTO Councils and/or Committees**
    AASHTO CBS T-1 Security
    AASHTO CBS T-3 Seismic
    AASHTO CBS T-9 Preservation
    AASHTO CBS T-18 Management, Evaluation and Rehabilitation

11. **Submitted By**
    Richard A. Pratt, PE
    Chief Bridge Engineer / Chair AASHTO CBS T-3 Seismic
    State of Alaska Department of Transportation and Public Facilities
    Juneau, AK 99801
    
    Matt Farrar, PE
    Chief Bridge Engineer / Chair AASHTO CBS T-18 Management, Evaluation and Rehabilitation
    Idaho Transportation Department
    Boise, ID 83707

---

**NCHRP Review of C-23**

Reviewed By:
Waseem Dekelbab
wdekelbab@nas.edu
Comments:

The problem is suitable for funding in the FY 2020 NCHRP. The AASHTO CBS ranked this problem as the 4th in a group of 4 high-priority problems from the problem statements reviewed this year. The objective of this project is consistent with the 2013 CBS Strategic Plan.

Review Date:
12/10/2018

AASHTO Committee Evaluation for C-23

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
This is the #4 priority of the Committee on Bridges & Structures. Report 833 (especially Volume 2) establishes the features of an emergency response plan, such as risk assessment, response levels and assessment stages, and data collection, but it doesn’t show how a DOT might pull all of that information together to establish an effective response process that can be communicated to the public and the individuals responsible for executing the assessments. By developing a set of model procedures that might be considered for inclusion in an AASHTO publication (like, say, the MBE) we would hope to see more consistency in the development of emergency response procedures, while still giving the States room to customize those procedures for their needs. As we stated in the RNS, consistency in the development of response procedures will help immensely in the event that a State requests (or accepts the offer of) assistance from other State or Federal agencies in conducting post-event assessments.
1. **Problem Title**
   Design Options to Reduce Turning Motor Vehicle / Bicycle Conflicts at Intersections

2. **Background**
   Each year, vehicle-bicycle collisions result in hundreds of cyclist deaths and many more non-fatal injuries (the exact numbers are difficult to define due to lack of consistent reporting methods). The most common location for these collisions is at intersections, which inherently have a large number of turning conflicts. For example, over 89% of fatal bicycle crashes reported in New York City during 2005 occurred at or within 25 feet of intersections. As a result, improving bicycle facilities at intersections has become a critical safety topic. Reducing these conflicts is a key objective in improving intersection safety across all modes. Of particular concern for bicyclist safety at intersections are the conflicts between straight-through bicyclists and motor vehicle right-turns and opposing left-turns. Despite the widespread acknowledgement of this problem, transportation engineers and planners still lack definitive guidance on how to safely and effectively design for bicycles at intersections in the United States. Thus, research on effective methods to reduce these conflicts, with accompanying intersection design guidance, is a high priority.

The primary guidance documents for practitioners, including the AASHTO Guide for the Development of Bicycle Facilities and the NACTO Urban Bikeway Design Guide are often based on professional judgment rather than research. Guidance based on research tends to be more general, such as providing countermeasure options, but not specific design guidance (e.g., as in the forthcoming NCHRP 15-63 *Improving Pedestrian and Bicyclist Safety at Intersections* guidance and *BikeSafe*). Current design practices often drop bicycle pavement markings and signs at intersections, providing no positioning guidance for motorists or bicyclists – a practice that has led to confusion in some states as to who has the right-of-way through the intersection. Alternatively, some US jurisdictions’ customary design continues bicycle lane markings all the way through to intersections; in others, the lanes are dashed. Moreover, innovative treatments including bike boxes, use of color, bicycle signals, and separated crossings are being implemented across the country. Some of these have been examined through research studies, and have so far demonstrated promising results, but the results are not conclusive.
There is no comprehensive research to indicate which design provides the most effective approach or the most appropriate situation in which each should be applied. Intersections should be carefully designed to enhance safety, improve operational efficiency, accommodate bicycle travel, minimize conflicts, and reduce the danger that turning cars pose to bicycle through-movements. Research on alternative designs to reduce conflicts at intersections is required to determine best practices to meet these objectives.

3. Literature Search Summary

The following provides an initial list of recent research studies on the design of bicycle facilities that may contain components valuable for this study.

1. AASHTO Highway Safety Manual
2. AASHTO Strategic Highway Safety Plan

4. Research Objective

The proposed research will develop guidelines for intersection design that minimize the risk that motor-vehicle turning movements create for through-
moving bicyclists. To accomplish this, the research should rely on conflict data that can be used to supplement often sparse crash data. The research will:

1) Identify typical and innovative design treatments for bicyclists at signalized intersections.
2) Identify prevalent motor vehicle/bicycle crash types at signalized intersections.
3) Conduct conflict studies at signalized four-way intersection approaches with and without the following design elements:
   - Bike lanes
   - Exclusive turn lanes
   - Marked/dashed bike lane/bike travel path through intersections
   - Colored pavement for bike travel paths through intersections
   - Separate stop bar locations for motor vehicles and bicycles
   - Bike boxes
   - Alternative methods to accommodate bicycle left-turns
   - Bicycle signal-heads with accompanying bicycle specific signal phasing
   - Physical separation of bicycle facilities
   - Other relevant pavement markings, signs, and signal designs.
4) Document safety impacts of various design treatments observed.
5) Summarize research results in a practitioner’s guide for effective accommodation of bicycles at intersections.

A key outcome of this research is the ability to determine those intersection designs that provide the most effective means of improving bicycle safety for specific situations/environments.

5. Implementation Planning

This project will provide value to practitioners and researchers concerned with intersection operations and safety for bicyclists and motorists. The resultant design and operation guidelines could include phased options that would allow for both immediate and longer-term changes for new roadway, reconstruction, and resurfacing projects related to the design of urban intersections. The results of this project could also provide traffic engineers with the evidence they need for implementing newer designs to reduce conflicts and ultimately crashes at intersections, as well as an understanding of how such designs impact operational efficiency. It is expected that the intersection design features studied in this research will be relatively easy and inexpensive to implement in new designs and may have significant safety benefits for bicyclists in particular, but potentially also for other roadway users.

The research results and finding of this project could supplement the information provided in the AASHTO Green Book, the AASHTO Bike Guide, and the 2nd edition of the Highway Safety Manual, by giving more detailed design guidance on intersection strategies aimed specifically at bicyclist-motorist crash types.
The results of this research will be disseminated via a research report and webinars conducted as part of the implementation plan. The research results would be useful to various entities including State DOTs, local governments, traffic engineers, roadway designers, traffic operations and maintenance personnel, pavement markings designers, bicycle facility planners.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:** $600,000

   **Research Period:** 24 months

7. **Urgency and Potential Benefits**

   Improving bicycle facilities at intersections has become a critical safety topic in California. A large percentage of bicyclist-related fatality and injury collisions occur between straight-through bicyclists and right-turning motor vehicles. The California Department of Transportation has taken steps to improve bicyclist safety at and approaching intersections. The Caltrans Highway Design Manual (HDM), Section 403.6 states that “Locations with right-turn-only lanes should provide a minimum 4-foot width for bicycle use between the right-turn and through lane when bikes are permitted, except where posted speed is greater than 40 mph, the minimum width should be 6 feet.” Caltrans implemented this advisory standard which applies even if there is no bike lane (Class II) present. However, this same provision in the CA MUTCD is written in the context of applying only when there is a bike lane (Class II). In 2017, the CA MUTCD was revised to allow as an optional provision, the space for bike use between the right-turn lane and the through lane when no bike lane facility exists. Four foot width continues to be the stated bike use width, except when the posted speed is greater than 40 MPH, the minimum width should be 6 feet. Varying striping is recommended depending on the speed: where the posted speed is greater than 40 miles per hour (mph) and for the case when the speed is less than 40 mph. When the posted speed is greater than 40mph, a buffer may be added to the bicycle lane.

   Even with modifications to the CA MUTCD, so called “right hook” collisions remain a concern. Research is needed to recommend modifications to design and operation of intersections to improve bicyclist safety.

8. **Person(s) Developing the Problem Statement**

   Frank Proulx, PhD
   Researcher
   Toole Design Group
   319 SW Washington Street, Suite 420
9. **Nomination for AASHTO Monitor**
Rachel Carpenter, California DOT
Division of Traffic Operations
1120 N Street, MS-36
Sacramento, CA 95814
916-651-1248
Rachel.Carpenter@dot.ca.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
Active Transportation Council

11. **Submitted By**
Joe Horton, California DOT
DRISI
1727 30th Street, 3rd Floor
Sacramento, CA 95816

On Behalf of:
- ANF20,
- ANB20,
- ANB25
With potential support from:
- AFB10,
  - AHB65.

---

**NCHRP Review of C-24**

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:

This is an important project that will require conflict studies so $600,000 is reasonable, although 30 months are a more realistic time estimate.

Review Date:
11/30/2018

---

**FHWA Evaluation of C-24**

FHWA Intersections Team (HRDS/Wei Zhang, HSA/Jeff Shaw) - The research is needed and speaks to an important safety performance issue that is becoming more acute as more bicycle facilities are built. Research objectives should include signal operations (controller settings, timing, detection, etc.) and the need for strong justification for the representativeness and validity of using conflict data as surrogates to crashes. E. Hilton, HICP-10: The Statement references 'intersections' in general, but the bullets under Section 4, Research Objective, suggest this project would only look at signalized intersections. Another problematic scenario is where the bikeway is on the major roadway and the only traffic control is on the minor approaches. The project seems focused on the design of the intersection, but it should also look at the design of the bikeway. For example, 2-way bike facilities may be more problematic at intersections than 1-way facilities. Gary Jensen/HEPH - There is a lot of research ongoing that examines different elements listed in this proposal, and the researchers would need to avoid potential duplication. The proposal should recognize other ongoing research, including the following at FHWA: Pre-Crash Modification Factors Study for Curb Extensions and Bicycle Specific intersection Markings Left Turn Yield to Bikes Sign Study Evaluation of Crosswalk Patterns for Safety (upcoming) Development of Crash Modification Factors for Different Separated Bike Lane Configurations.
AASHTO Committee Evaluation for C-24

Submitted By:
Kelly Hardy
AASHTO staff
Safety

Comments:
4.5 The objective to "Document safety impacts of various design treatments observed" describes needed research. Will this be done through quantifying the safety impacts using CMFs? Safety is one of many factors for consideration but it should be given the same objective treatment as factors like mobility.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement
Problem No: 2020-C-25

1. Problem Title
Safety Evaluation of On-Street Bikeway Designs

2. Background
Separated bikeways (also known as cycle tracks) are bikeways within or adjacent to the roadway and separated from moving traffic by curbs, parking lanes, striped buffers, or other barriers. They do not include multiuse pathways, which are open to a variety of other non-motorized users and are typically located outside of roadway rights-of-way. On-street bike lanes are located on the roadway and traditionally only separated from traffic by lane markings. Some bike lanes are colored either over their entire length or through conflict areas. While on-street bike lanes have been used in the United States for many years, separated bikeways are becoming increasingly popular throughout the United States, with recently installed facilities in many cities, and numerous other state and local departments of transportation exploring the potential for additional facilities [1].

Many transportation agencies view the separated bikeway facilities as an opportunity to attract higher volumes of cyclists than are attracted to on-street bike lanes. Studies of perceived risk show a preference for separated bikeways among both current and potential cyclists [2,3,4]. While separated bikeways are popular with cyclists, only limited data are available on the safety outcomes of separated bikeways within North America. However, the European experience is that separated bikeways can lead to increased crash rates, especially when crossing side-roads and driveways, with the risk likely related to the amount of traffic crossing the separated bikeways, and the inter-visibility between motor vehicles and bikes on the facility [9]. The risk is even higher with two-way bikeways, with many European cities having removed such facilities. A review of bicycle safety concludes that though the research is sparse and found few studies of intersections [10]. They report that studies suggest that bicycle routes, lanes, and paths increase cyclist safety compared to riding on a road with no bicycle facility or riding on a side path parallel to the road with pedestrians.

With over 600 annual cyclist fatalities in the United States, improving cyclist safety is a critical outcome for bicycle facility design, suggesting the need for objective research on the safety implications of separated bikeways in different situations and of the alternative option of on-street cycle lanes. If European experience shows that there can be safety issues associated with some
separated bikeways, then it is critical that research is undertaken in the United States to understand such matters and to guide the selection of appropriate facilities for each route.

Recent research in Montreal shows that while both separated bikeways and on-street bike lanes seems to be associated with higher total numbers of bicyclist-motorist crashes, they are also associated with lower risk per cyclist [11]. Another Canadian study, using case-crossover design, a method commonly used in the health profession, found that separated bikeways were associated very low risk at non-intersection locations and at intersections the presence of bicycle-specific infrastructure including separated bikeways and on-street bike lanes was not associated with either increases or decreases in cyclist risk [12]. Another study from Montreal found that the risk of injury for riders in cycle tracks was less than those riding in streets [5,9].

As documented by international experience, separated bikeways have the potential to create both safe and comfortable environments that can help transportation agencies meet their goals to provide improved transportation options. However, quantitative research on the safety of separated bikeways within an American context is needed to provide designers with the guidance necessary to ensure that future bicycle facilities are as safe as possible and to determine whether to install such a facility, use on-street cycle lanes or direct cyclists to totally separate cycle paths or bicycle boulevards.

3. Literature Search Summary

Several cities in the United States (e.g. Chicago, Indianapolis, Portland, Washington, D.C.) have recently installed one-way and two-way separated bikeways on roadways with the intent to improve safety. While several of these treatments have been employed and studied in Western European countries and Canada, little research currently exists on the effectiveness of these facilities in the US. Research on the use and effectiveness of these facilities in the US is inconsistent and scattered and should be actively pursued to determine whether and to what extent these treatments benefit bicyclists.


4. **Research Objective**

The proposed research will quantify the safety characteristics of separated bikeways and bike lanes in the US. To accomplish this, the research must:

1. Identify existing separated bikeway and on-street bike lane treatments with various adjoining land-use and side-road and driveway densities on roadways in the US;
2. Review the experience of different types of separated bikeways and on-street bike lanes in North America with respect to crash and injury history;
3. Identify all prevalent crash and conflict types, including motor vehicle/bicycle, bicycle/bicycle, and bicycle/pedestrian, associated with each type of separated bikeways and on-street bike lanes at midblock, driveway, on-street parking, and at controlled and uncontrolled intersection locations;
4. Isolate the physical and human factor causes for the various crash types identified;
5. Identify effective designs to address the operational issues identified;
6. Identify effective designs to address the crash factors identified;
7. Codify designs and guidelines that are useful for designers for a variety of separated bikeway and on-street bike lane types under a range of conditions and roadway types;
8. Determine which, if any, separated bikeway design features offer acceptable levels of safety based on the results of the research;
9. Identify additional research needs.

The investigation should consider a range of separated bikeways and on-street cycle lanes immediately adjacent to roadways, including, but not limited to, one-way and two-way bikeways, bike lanes separated from motor vehicle traffic by different types of barriers or by parking lanes, on-street bike lanes, and paths raised to sidewalk or near sidewalk level. It should consider applications on streets with and without parallel parking, and both signalized and unsignalized intersections. The impact of various design treatments should also be examined to the extent possible, including the impacts of:

- Signal phasing options to separate cyclists and turning motorists; intersection approach treatments;
- Removal of parking to improve sightlines, especially at intersections;
- Access management and driveway frequency;
- Signs and pavement marking at intersections, including colored pavement;
- Advanced stop lines ("bike boxes") to allow bicyclists to queue ahead of motorists at signalized intersections; and
- Alternative methods to accommodate bicycle left-turns

A possible outcome of the research would be information useful for the development of guidance that could be included in, supplement, or update the revised AASHTO Guide for the Development of Bicycle Facilities. One critical issue identified for this guide is the lack of research on various separated bikeway designs in the US. Research results could also be used to update other guidance documents, such as the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide, or influence updates to the Federal Highway Administration’s Manual on Uniform Traffic Control Devices. The research could also be incorporated into the Highway Safety Manual, which is short on risk relationships for bicycle facilities. Other possible outcomes are a greater understanding of the safety, efficiency, connectivity, and maintainability issues associated with some separated bikeway designs, and the identification of additional research needs.

5. **Implementation Planning**
This research will have significant influence on the design of new on-street bikeway designs, by providing clarity about the safety of various bicycle facility designs according to context. The main expected products of the research
include enhanced guidance for the design on-street bicycle facilities and additional information on safety that can be incorporated into the AASHTO Bike Guide and potentially the Highway Safety Manual, to complement ongoing research for NCHRP 17-84. Other resources that would benefit from this more in-depth comparison of bicycle facility safety include countermeasure resources like BikeSafe and the forthcoming NCHRP 15-63 Guidance to Improve Intersection Safety for Pedestrians and Bicyclists.

The results of this research will be disseminated via a research report and webinars conducted as part of the implementation plan.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:** $500,000

   **Research Period:** 24 months

7. **Urgency and Potential Benefits**

   This research has high priority. In addition to providing safety guidance to practitioners on the effectiveness of separated bikeways and on-street cycle lanes, this research would provide additional measures for determining the safety and perceived safety benefits or drawbacks for various treatment types. Jurisdictions throughout the country are searching for quantifiable solutions for bicycle safety issues at intersections and along roadways. This research would be of use to many communities including state departments of transportation, local governments, traffic engineers, roadway designers, traffic operations and maintenance personnel, pavement markings designers, bicycle facility planners.

8. **Person(s) Developing the Problem Statement**

   Krista Nordback, PhD, PE
   Senior Research Associate
   UNC Highway Safety Research Center
   919-962-3493
   nordback@hsrcc.unc.edu
   www.hsrc.unc.edu

   Jamie Parks
   SFMTA Livable Streets Director
   ANF20 Chair
   415.646.2121
   Jamie.Parks@sfmta.com

   Rachel Carpenter, California DOT
   Division of Traffic Operations
   1120 N Street, MS-36
Sacramento, CA 95814  
916-651-1248  
Rachel.Carpenter@dot.ca.gov

9. **Nomination for AASHTO Monitor**  
Rachel Carpenter, California DOT  
Division of Traffic Operations  
1120 N Street, MS-36  
Sacramento, CA 95814  
916-651-1248  
Rachel.Carpenter@dot.ca.gov

10. **Potentially Interested AASHTO Councils and/or Committees**  
Active Transportation Council

11. **Submitted By**  
Joe Horton, California DOT  
DRISI  
1727 30th Street, 3rd Floor  
Sacramento, CA 95816

On Behalf of:  
- ANF20,  
- ANB20,  
- ANB25

With potential support from:  
- AFB10,  
  - AHB65.

---

**NCHRP Review of C-25**

Reviewed By:  
William C. Rogers  
wrogers@nas.edu

Comments:  
This is a worthwhile project. C-29 should be added to it, for a total estimated cost of $600,000.

Review Date:  
12/7/2018
FHWA Evaluation of C-25

E. Hilton, HICP-10: The statement starts off by including bikeways separated by striped buffers in the definition of separated bikeways. Generally these are considered buffered bike lanes and are not considered to be separate. FHWA defines separated bike lanes as having a vertical element to separate the bike lane from motor vehicle lanes. The statement appears to use "on-street cycle lanes" and "on-street bike lanes" interchangeably which adds confusion for the reader. Gary Jensen/HEPH - There appears to be some overlap with an ongoing FHWA research project on Development of Crash Modification Factors for Different Separated Bike Lane Configurations.

AASHTO Committee Evaluation for C-25

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This submission has strong support and is ranked third by Council on Active Transportation Members surveyed. Please consider incorporating G-14 and C-29 into this project.

Submitted By:
Kelly Hardy
AASHTO staff
Safety

Comments:
4.5 Can this include C-29 as one aspect? It will be important to ensure the safety evaluation utilizes the latest methodologies used in safety models to predict crash/risk
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement  
Problem No: 2020-C-26

1. **Problem Title**  
Guidebook for Safe and Effective Application of Bicycle Boulevards

2. **Background**  
Increasing bicycling for transportation has been a policy goal from the federal to the local level for years in the United States (US), yet few cities have managed to achieve significant growth in bicycling mode share, and the national average has increased from just 0.7% to 1.0% since 1994 (1). Research exploring barriers to increased bicycling has examined various factors, including topography, distance, and weather, but one consistent barrier to increasing cycling is the perception that bicycling in mixed traffic is dangerous (2-5). One increasingly popular method to address this barrier is the concept of “bicycle boulevards.” Bicycle boulevards, which may be called other names (e.g., neighborhood greenways, low-volume bikeways), are low-volume, local streets prioritized for bicycle movements, thereby providing cyclists with a viable alternative to cycling on busy roadways. Over the last decade, bicycle boulevards have been developed in many cities throughout the United States, including Berkeley, CA; Portland, OR; Baltimore, MD; Syracuse, NY; St. Paul, MN; and others.

Early evidence about the effectiveness of bicycle boulevards is promising. A study of revealed preference data from Portland, OR found that 10% of riding took place on the bicycle boulevards even though they composed less than 1% of the network (6). In addition, a recent study examining the association between bicycling experience level and preferred bicycle facility type found that bicycle boulevards were one of only three on-road facility types preferred by cyclists of all experience levels (7). The costs of developing bicycle boulevards is also relatively low compared to other facility types such as off-street trails, suggesting that bicycle boulevards may be a cost-effective method of developing a high-quality bicycle network.

Despite the increased use of bicycle boulevards, the concept has not been well-researched. The primary document available to practitioners is a 2009 document published by Alta Planning + Design on Fundamentals of Bicycle Boulevard Planning and Design (8). However, the document is based on cumulative knowledge of practitioners and admits that little research exists regarding the safety, ridership benefits, and appropriate applications of bicycle boulevards. Research on bicycle boulevards is needed to provide practitioners with detailed information on the costs and benefits, appropriate applications, and effective design treatments associated with bicycle boulevards.
3. **Literature Search Summary**

As referenced earlier, Alta Planning + Design and the Initiative for Bicycle & Pedestrian Innovation recently completed the “Fundamentals of Bicycle Boulevard Planning & Design” guidebook. The guidebook included contributors from several metropolitan areas, as well as several transportation engineering and planning firms, suggesting significant interest in the subject. The proposed research will be critical to allow these practitioners to make sound engineering decisions.

4. **Research Objective**

This research will develop comprehensive guidelines supported by research on how to create successful and safe bicycle boulevards. The research will allow practitioners to understand the challenges and benefits of bicycle boulevard implementation and encourage their use in appropriate contexts. This research will satisfy the following key objectives:

- Provide quantitative analysis of safety and ridership impacts of bicycle boulevards
- Survey bicyclists regarding bicycle boulevards and route choice to better understand preferences
- Conduct in-depth case studies of bicycle boulevard experience to determine elements required for successful bicycle boulevards
- Assess cost-effectiveness of bicycle boulevards compared to other types of bicycle facilities with respect to ridership and safety outcomes
- Develop a guidebook synthesizing the research effort and providing practitioners with clear guidance on planning and designing bicycle boulevards.

The final deliverable will summarize lessons learned to develop guidance on appropriate design and location of separated bikeways. The research will result in clear and easy-to-use guidance to promote the development of safe and effective bicycle boulevards across a range of conditions. The primary deliverables will be:

- Planning principles for successfully applying bicycle boulevards;
- Cost information for typical bicycle boulevard elements;
- Summary of the relative safety of bicycle boulevards;
- Matrix of bicycle boulevard characteristics and the appropriate application for a range of conditions and roadway types;
- Recommended set of design treatments for bicycle boulevards; and,
- In-depth case studies highlighting successful example of bicycle boulevard applications.

5. **Implementation Planning**
This research would influence planning and design of bicycle facilities (specifically, bicycle boulevards) and networks on existing roadways, reconstruction projects, and resurfacings related to the design of urban roadways and intersections. City MPOs and local governments need to ensure that the planning investments will yield positive outcomes in the future. The results of this project will inform the city and local planners about the expected impacts of the bicycle boulevards on bicyclist and pedestrian travel demand and ridership rates.

The results of this research will be disseminated via a research report and webinars conducted as part of the implementation plan. Execution and implementation of this research would reduce the safety and effectiveness of bicycle facilities, meeting federal and local goals to increase bicycling and improve bicycle safety. User Community: State departments of transportation (DOTs), local governments, city MPOs, traffic engineers, roadway designers, traffic operations and maintenance personnel, pavement markings designers, bicycle and pedestrian facility planners.

6. **Estimate of Problem Funding and Research Period**

   Recommended Funding: $350,000

   Research Period: 18 months

7. **Urgency and Potential Benefits**

   This research has high priority. With strong federal and state guidance urging increased emphasis on non-motorized transportation, bicycling is an increasingly key component of the transportation system. Moreover, increasing numbers of jurisdictions are choosing to construct bicycle boulevards because they do not require taking space from car lanes or parking, and can therefore often be implemented at a lower cost and without significant community opposition. However, without rigorously tested best practice guidance and a better understanding of the quality of service bicycle boulevards can provide, designs may be less than optimal.

8. **Person(s) Developing the Problem Statement**

   Rebecca L. Sanders PhD
   Research Lead
   TOOLE DESIGN
   503.205.4607 x317
   rsanders@tooledesign.com

   Jamie Parks
   SFMTA Livable Streets Director
   ANF20 Chair
   415.646.2121
9. Nomination for AASHTO Monitor
Rachel Carpenter, California DOT
Division of Traffic Operations
1120 N Street, MS-36
Sacramento, CA 95814
916-651-1248
Rachel.Carpenter@dot.ca.gov

10. Potentially Interested AASHTO Councils and/or Committees
Active Transportation Council

11. Submitted By
Joe Horton, California DOT
DRISI
1727 30th Street, 3rd Floor
Sacramento, CA 95816
On Behalf of ANF20, Bicycle Transportation.

NCHRP Review of C-26

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:
There is a need to develop guidance on bicycle boulevards. The requested funding seems reasonable.

Review Date:
12/7/2018
AASHTO Committee Evaluation for C-26

Submitted By:
Kelly Hardy
AASHTO staff
Safety

Comments:
4 One of the research objectives is to "Provide quantitative analysis of safety and ridership impacts of bicycle boulevards". Will this factor in the comparative safety to removing the bicyclists from the non-bicycle boulevards to notice if there is a safety improvement in the shift to other roadways? If this aspect is included, this will be beneficial research.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Problem No:  2020-C-27

1. Problem Title
Design of geosynthetic MSE walls subjected to vehicle impact on roadside barrier systems placed on top of them.

2. Background
It is estimated that 1 million square meters of MSE retaining wall is constructed annually in the United States alone. Most MSE retaining walls used in highway fill applications are constructed with a roadside barrier system on top of them to redirect an errant vehicle. The system consists of a traffic barrier connected to a below grade moment slab (Fig. 1).

![Fig. 1 – Typical cross section](image)

During the impact, the dynamic load is transferred in part to the MSE wall reinforcement and adds to the static load. National Cooperative Highway Research Program (NCHRP) Report 350 “Recommended Procedures for the Safety Performance Evaluation of Highway Features” and its successor, the AASHTO Manual for Assessing Safety Hardware (MASH-08), define impact performance criteria for roadside barrier systems. These documents define six different test levels of increasing impact severity that incorporate varying impact speeds and vehicle types. These test levels provide a basis for choosing the appropriate roadside barriers.

Guidelines were developed for designing the barrier moment slab and MSE wall reinforcement in the case of steel inclusions to withstand vehicle impact loads.
This was done under NCHRP Project 22-20 “Design of Roadside Barrier Systems Placed on MSE Retaining Walls”. The guidelines were published under the same name as NCHRP Report 663. Since the scope of the latter was limited to passenger vehicle and light truck impacts and did not include consideration of large trucks, NCHRP Project 22-20(02) was launched to develop guidelines for TL-3, TL-4 and TL-5 impact conditions. These studies were, however, restricted to MSE walls with steel inclusions. Using the results of this study on steel inclusions to design MSE wall reinforced with geosynthetics is unwise at best and dangerous at worse. Indeed the difference in behavior between steel inclusions and geosynthetics (stiffness and strength) is significant enough that the dynamic design loads maybe significantly different. Yet geosynthetic MSE walls represent an economic advantage in some cases.

Hence, additional research is needed to enhance our understanding of the behavior of an MSE wall with geosynthetic inclusions and barrier- moment slab system when subjected to impact levels TL-3, TL-4 and TL-5. This project would build upon the work accomplished and the guidelines developed under the projects 22-20 and 22-20(02) and extend it to geosynthetics MSE walls.

3. Literature Search Summary
Over the last few decades, extensive research has been conducted on the design and analysis of mechanically stabilized earth (MSE) retaining walls using geosynthetic inclusions. The result of this work culminated in guidelines for general design and construction procedures for such MSE retaining walls. They are described in the 17th edition of the AASHTO Standard Specifications for Highway Bridges (2002) and the 4th edition of the AASHTO LRFD Bridge Design Specifications (2010). This is also addressed in Federal Highway Administration (FHWA) publications including Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes (2009).

Extensive literature also exists for designing, analyzing, testing, and evaluating bridge rails and other roadside barriers. Until recently, most research on rail impacts has focused on full-scale crash tests. For concrete barriers, the strength analysis is based on the yield line analysis approach; for steel rail barriers, it is based on plastic analysis methods. The recommended design impact forces and design procedures for bridge railings are presented in Section 13 of the AASHTO LRFD Bridge Design Specifications. However, due to the complexity of dynamic vehicle-barrier interaction, evaluation and assessment of rail impact performance continues to be primarily determined through full-scale crash testing (performance based) rather than determined through compliance with a design specification (analysis based).

4. Research Objective
The objective of this research is to develop, in a format suitable for adoption by AASHTO, procedures and guidelines for Geosyntetics reinforced MSE walls subjected to vehicle impact on roadside barriers placed on top of them. The
impacts must include tests levels TL-3, TL-4 and TL-5. The project will consist of engineering analyses, computer modeling, and full-scale testing. The scope of the project would include the following.

**Task-1: Literature review.** This task will consist of collecting existing information worldwide on the design of geosynthetic MSE walls subjected to vehicle impact on roadside barrier systems placed on top of them. Relevant guidelines, crash test data and numerical simulations will be gathered, organized and processed.

**Task-2: Numerical simulations.** This task will consists of simulating the complete impact event in 4 dimensions (x, y, z, t) using an explicit finite element analysis. A series of numerical simulations will be performed in a parametric study. This will help in designing the crash test to be perform in Task 3 and to draft the first set of guidelines for the design of geosynthetic MSE walls subjected to vehicle impact on roadside barrier systems placed on top of them. The numerical simulations will include AASHTO MASH test levels TL-3, TL-4 and TL-5.

**Task 3: Crash tests.** This task will consists of designing, constructing, and performing a crash test. A 3m high 50m long geosynthetic MSE wall will be constructed and instrumented for dynamic measurements. A static test will be conducted after the crash test on an undamaged section of the barrier. The crash test will follow impact conditions of AASHTO MASH test level 4 with a single unit truck. During the impact the load in the geosynthetic reinforcement as well as the deformation of the wall will be collected.

**Task 4: Design guidelines.** This task will consist of finalizing the draft design guidelines developed in task 2 in light of the results of the crash test and static test. The final report will give the details of the work and a suggested set of guidelines in AASHTO LRFD Bridge Specifications format.

5. **Implementation Planning**
   It is envisioned that the implementation of the research results will occur through the adoption and publication in the AASHTO LRFD Bridge Design Specifications to complement the information already available for MSE walls reinforced with steel inclusions.

6. **Estimate of Problem Funding and Research Period**
   **Recommended Funding:** $700,000
   **Research Period:** 36 Months

7. **Urgency and Potential Benefits**
   It is anticipated that the proposed research will produce the following significant results:
In-depth understanding of the deformation, load transfer and failure mode associated with MSE walls reinforced with geosynthetic layers during dynamic barrier impacts.

A set of procedures for the design of geosynthetic MSE walls subjected to vehicle impact on barriers placed on top of them suitable for adoption and publication by AASHTO.

The expected product from this research is a final report that includes the literature review, the numerical simulations, the construction and instrumentation of the geosynthetics MSE wall, the crash test data collected, and the detailed set of procedures for the design of geosynthetic MSE walls subjected to TL-3, TL-4 and TL-5 impacts.

8. **Person(s) Developing the Problem Statement**

Alexander Bardow  
Director of Bridges and Structures  
Massachusetts DOT  
(857) 368-9430  
alexander.bardow@state.ma.us

Tony Allen  
State Geotechnical Engineer  
Washington DOT  
Office: (360) 709-5450  
allent@wsdot.wa.gov

9. **Nomination for AASHTO Monitor**

To be assigned by NCHRP staff.

10. **Potentially Interested AASHTO Councils and/or Committees**

AASHTO Committee on Bridges and Structures would be potentially interested in adopting the results of this research into the AASHTO LRFD Bridge Design Specifications.

11. **Submitted By**

Alexander Bardow  
MassDOT State Bridge Engineer  
Chair, NCHRP Project Panel 22-20 (2)

---

NCHRP Review of C-27
Comments:

· Is the problem potentially solvable through research? If not, why?

The problem is of high priority and can be solved through the proposed research.

· Is it likely of interest to at least 2/3s of the DOTS? If not, why?

Considering the common use of MSE walls across the United States, the research is of likely interest to the majority of the state DOTs.

· Is there a reasonably clear objective? If not, can you suggest a brief improvement?

The stated objective, to develop procedures and guidelines for geosynthetic-reinforced MSE walls subjected to vehicle impact on roadside barriers placed on top of them, is clear and concise.

· Is the scope of the research reasonable? Please recommend changes if needed.

  o Can the research be done in 2-3 years at the most? If not, why?

  o Is the budget adequate? If not, why?

The proposed scope, budget, and schedule are reasonable.

A search of the literature identified one relevant publication:

AASHTO staff
Committee on Bridges & Structures

Comments:
This research possibly has value, but there may be other projects that addressed this topic. If it moves forward, please include a member of T-15 on the panel.

Submitter Response for 2020-C-27

I am in agreement with the comments and offer no responses.

Alexander Bardow
alexander.bardow@state.ma.us
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY 2020 NCHRP Problem Statement Outline

Problem No: 2020-C-28

1. Problem Title
Best Practices for Networking and Historical Data Collection for Traffic Signal Systems

2. Background
Best practices resulting from networking and historical data collection on traffic signal operations are needed. Modern traffic signals are capable of collecting historical data that can be used in maintaining the operation of the systems. In addition, an increasing number of traffic signal systems, including detection and CCTV associated with intersections, are networked. Best practices for using these tools are needed.

Several efforts have been initiated through pooled fund research, including FHWA Every Day Counts initiatives and the National Transportation Operations Coalition “National Traffic Signal Report Card” to improve traffic signal operations. These initiatives have done much to bring about changes in how agencies operate traffic signals. Controllers are now better equipped to store detection data and operation data; i.e., high resolution data, more emphasis on networking signals, and the development of the Utah DOT ATSPM program. With connected vehicle initiatives, traffic signal controllers are capable of transmitting signal phasing and timing information to vehicles.

3. Literature Search Summary
“Performance Measures for Traffic Signal Systems: An Outcome-Oriented Approach” and “Integrating Traffic Signal Performance Measures into Agency Business Processes” developed several performance measures and processes to better operate traffic signals. Now that these new tools have been developed and put in place, best practices for collecting the data, including cloud based solutions, detection configuration using the various detection systems, uses of the data and performance measures, are needed.

4. Research Objective
Provide a best practices document for traffic signal systems, use of networking, central systems, and application of automated traffic signal performance measures.

5. Implementation Planning
Implementation would involve dissemination and implementation of the research products, such as brochures, summaries, presentations, workshops, peer exchanges aimed at specific target audiences, and development of work plans.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**
   Approximate $200,000.00

   **Research Period:**
   2 years

   If the problem statement is selected, this estimate may be adjusted by the project panel.

7. **Urgency and Potential Benefits**

   Traffic signal systems operation can benefit from networking and historical data collection. Bringing forward best practices will facilitate improved operations.

8. **Person(s) Developing the Problem Statement**

   Henry Wickes, P.E.
   Traffic Management Engineering Support Branch Manager
   Traffic Safety Division
   Texas Department of Transportation
   (512) 416-5125
   henry.wickes@txdot.gov

9. **Nomination for AASHTO Monitor**

10. **Potentially Interested AASHTO Councils and/or Committees**

    TRB Standing Committee on Traffic Signal Systems

11. **Submitted By**

    Henry Wickes, P.E.
    Traffic Management Engineering Support Branch Manager
    Traffic Safety Division
    Texas Department of Transportation
    (512) 416-5125
    henry.wickes@txdot.gov

---

**NCHRP Review of C-28**
Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:

The proposed research will be worthwhile and should be coordinated with ongoing data management efforts, like the U.S. DOT's Work Zone Data Exchange (https://www.transportation.gov/av/data). The deliverables should address traditional systems, adaptive signal systems, and systems using automated traffic signal performance measures. The use of private-sector data suppliers should also be explored.

The proposed budget is rather small and I recommend increasing it to $400,000. This would allow other products, such as a data dictionary, to be developed.

Review Date:
11/28/2018

____________________________

FHWA Evaluation of C-28

Eddie Curtis/HOTM - The objective of the problem statement is to provide a best practices document for describing the use of networking, central systems, and application of automated traffic signal performance measures. The EDC4 ATSPM and EDC1 ASCT technology initiatives focused on implementation of technology. This research requested in the problem statement addresses gaps created as an outcome of wide implementation of the technologies and would leverage past investments, providing actionable information to addresses practical issues related to networking, data collection and storage. This is an important project that could help to sustain implementation of these transformative technologies. HRDO - This is a good idea. Data collection is expensive and this could alleviate some of that. However, we don't know why it would take 2 years to finish.

____________________________
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation

FY 2020 NCHRP Problem Statement Outline
Problem No:  2020-C-29

1. Problem Title
   Identify Effects of Flexible Pylon Barriers for Increased Bike Lane Usage

2. Background
   Bike lanes are becoming more common on high speed arterials in cities and suburban areas. These corridors commonly include high ADT values and speed limits up to 50 mph. In many cases, the bike lanes are separated from the vehicular lanes by narrow striped buffer zones. As bike traffic travels in the same direction as vehicular traffic, bicyclists are not able to view stray vehicles intruding into the bike lane areas, often due to distracted driving or driving under the influence. The higher speed limits on these corridors can lead to serious injuries or even fatalities in the case of a rear end crash. This research seeks to identify the effects of installing flexible pylons for bike lanes on curb medians to increase usage of the bike lanes, while also identifying safety benefits of converting striped corridors to corridors with flexible pylons.

3. Literature Search Summary
   Currently, a study is underway, Guidance for Separated/Buffered Bike Lanes with Delineators, managed by the Minnesota Department of Transportation. That study will presumably establish standards for pylon height and design, pylon spacing, curb height, reflectors mounted on the curb with the pylons, treatments for right turning vehicles, treatments for left turning bicycles, and treatments for driveways.

4. Research Objective
   Determine how cities and agencies can utilize flexible pylon systems to increase bike usage, reduce vehicular travel, and improve air quality by converting existing corridors which have bike lanes with striped buffer zones. Researchers would quantify safety benefits by using flexible pylon systems, as well as perceived safety benefits by bicyclists who would use the corridor when pylons are installed.

   This proposed research study would utilize recommended design standards and convert existing corridors that currently include a striped buffer zone to a flexible pylon barrier. Before and after bike traffic would be measured to see how the flexible pylons on mounted curb affects latent demand for bicyclists.

5. Implementation Planning
   The results of this research project would be used by agency planners in deciding whether to convert existing bicycle corridors.
6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**
   
   $200,000

   **Research Period:**
   
   12-18 months

   If the problem statement is selected, this estimate may be adjusted by the project panel.

7. **Urgency and Potential Benefits**

   State DOTs and other agencies will have a set of recommendations and standards for converting existing striped buffer zone bike lanes into pylon separated corridors not only for safety benefits, but for the purpose of encouraging the use of bike lanes.

8. **Person(s) Developing the Problem Statement**

   Mark Johnson
   Transportation Engineer
   Texas Department of Transportation
   (512) 416-3247
   mark.j.johnson@txdot.gov

9. **Nomination for AASHTO Monitor**

10. **Potentially Interested AASHTO Councils and/or Committees**

    AASHTO Pedestrian and Cycles Section of the System Users Group

11. **Submitted By**

    Mark Johnson
    Transportation Engineer
    Texas Department of Transportation
    (512) 416-3247
    mark.j.johnson@txdot.gov

---

**NCHRP Review of C-29**

Reviewed By:
William C. Rogers
wrogers@nas.edu
Comments:

Add to C-25.

Review Date:

12/7/2018

FHWA Evaluation of C-29

Albin/RC-SHD; Arispe/HRDS - NCHRP 22-37 which has just been advertised is looking to develop a safety barrier to separate traffic from pedestrians and bicycles. In this study, part of the background research will include a survey to determine what kind of barrier the states are looking for. Although the study will not determine is flexible pilons will increase usage it would give DOTs another option. Dave Kirchner/HOTO Christoper Douwes/HEPH - The problem statement indicates that they want to study the effects of flex posts mounted on curbs, but in my experience most jurisdictions are installing them on asphalt in marked buffer areas. We think the study should reflect the predominant use; maybe they need to include a more extensive review of existing installations. Are pylon and barrier technologies and practices changing faster than an NCHRP study can move? There may be other technologies that work better.

AASHTO Committee Evaluation for C-29

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This is supported by Council on Active Transportation Members surveyed. Please consider incorporating with C-25

Submitted By:
Kelly Hardy
AASHTO staff
Safety

Comments:
4 Can this be covered in C-25? Since in C-25 it includes, "Determine which, if any, separated bikeway design features offer acceptable levels of safety based on the results of the research". One of the research objectives is "Researchers would quantify
safety benefits by using flexible pylon systems". This should include using advanced safety analytical tools (developing CMFs or CMFS for bike SPF models when available).

Submitted By:
Jameelah Hayes
AASHTO staff
Traffic Engineering

Comments:
The Committee on Traffic Engineering thinks this is a high priority topic.
Research Field D

Materials and Construction
Structural Design Methodology for Cured in Place Pipe (CIPP) Liners in Gravity Stormwater Conveyance Conduits

2. Background
State Transportation Agencies are increasingly using trenchless strategies to rehabilitate and repair aging infrastructure within urbanized areas. Performing pipe repairs to existing systems, as compared to pipe replacement, significantly reduces the construction time and maintenance of traffic operations and roadway reconstruction. This provides increased public safety and cost savings to the states.

One of the most common types of cured in-place pipe liners, felt tube impregnated with resin, does not have sufficient service life and structural capacity material testing. Therefore, it becomes very difficult for DOTs to establish a pipe service life and structural capacity rating after a cured in-place liner is installed.

Cured in-place pipe liners are a trenchless technology that provides a method to structurally rehabilitate concrete and metal gravity stormwater conveyance conduits with minimal impact to the travelling public. The liner consists of a resin-based felt material that is inserted into the host pipe. The felt liner is sealed on one side and either hot water or steam is pumped into the tube to both inflate and cure-in-place the liner against the existing damaged host pipe. The liner will provide the structural load carrying capacity without the requirement to adhere to the host conduit.

This research is intended to benefit all DOTs by creating uniform design standards and material performance measures for this pipe rehabilitation strategy. Currently, there is insufficient information available to ensure the CIPP Liner possesses the properties and durability of the expected life span of this repair strategy; therefore, this research is intended to produce national standards and guidance for use of this pipe liner.

3. Literature Search Summary
A literature search was performed using TRB’s TRID (http://trid.trb.org) portal and 55 records were identified relating to Cured in Place Pipe (CIPP) Liners. Much of the literature available is specific to construction techniques, water quality, and environmental permitting issues. The only relevant works were from 2012 and 1995, respectively: “Liner Testing in Europe – Methods, Standardization, and
Experience,” which addressed materials and strength properties as they relate to European Standards, and “Long-Term Structural Behavior of Pipeline Rehabilitation Systems.” These were the only records that appeared somewhat related to the material durability and structural properties. Overall, there is an absence of literature available that specifically addresses the research identified in this Problem Statement.

4. Research Objective

The objectives of this research would be the following:

1. Research and develop a design methodology for cured in-place pipe (CIPP) liners for structural rehabilitation of gravity stormwater conveyance conduits.
2. Develop a laboratory test method to verify the proposed structural design for conduits that have been rehabilitated using the cured in-place pipe liner technology.
3. Develop an accelerated laboratory methodology to determine liner material durability.
4. Develop laboratory material testing for the felt tube liner and resin.

5. Implementation Planning

The results of this research will result in new guidance for practitioners to better understand the structural properties and design service life for this rehabilitation strategy. This information could be presented in various formats; however, workshops and design handbooks would be the preferred methods to disseminate new design guidance.

6. Estimate of Problem Funding and Research Period

Recommended Funding: Based on similar research projects to evaluate pipe rehabilitation strategies, approximately $400,000 would be expected to cover all research work and the design guidance documentation. Additional funding will be required to support implementation and training, either web-based or in-person. The additional costs for dissemination and implementation is approximately $200,000. Therefore, a total cost of $600,000 is anticipated to produce the research and training to better utilize this pipe rehabilitation strategy.

Research Period: 24 months

7. Urgency and Potential Benefits

Several DOTs have implemented cured in-place pipe liners despite the lack of a national design standard. Other DOTs are waiting for more guidance to be developed prior to implementing this technology. The overall need is to better understand the material properties related to the predicted service life and structural durability. This research will provide designers better awareness of the
anticipated performance properties as they relate to pipe rehabilitation strategies compared to pipe replacement costs. The construction cost savings related to installation, maintenance of traffic delays, and associated infrastructure reconstruction far exceed the pipe lining costs. The continued use of this pipe repair strategy without this research may require designers to limit the life expectancy of this repair without better knowledge of the material properties. However, with this research, better knowledge will be available to designers to make well-informed decisions relating to the design thickness and service life of the rehabilitated pipe system. There are existing testing procedures available for various pipe materials types that can be modified to evaluate this methodology; therefore, the work proposed as part of this proposal, along with the implementation and training, should realistically be achieved within the estimated budget. Likewise, the results of this research will be developed such that the information and guidance can be used by all DOT’s.

8. **Person(s) Developing the Problem Statement**
Carlton D. Spirio, Jr., P.E., Jason Russell
State Drainage Engineer State Construction Environmental Specialist
Florida DOT Florida DOT
(850) 414-4351 (850) 414-4010
*Carlton.spirio@dot.state.fl.us* *Jason.russell@dot.state.fl.us*

9. **Nomination for AASHTO Monitor**
Carlton D. Spirio, Jr., P.E.,
State Drainage Engineer
Florida DOT
(850) 414-4351
*Carlton.spirio@dot.state.fl.us*

10. **Potentially Interested AASHTO Councils and/or Committees**
Technical Committee on Hydrology and Hydraulics

11. **Submitted By**
J. Darryll Dockstader
Research Center Manager
Florida DOT
(850) 414-4617

---

**NCHRP Review of D-01**

Reviewed By:
Amir N. Hanna
ahanna@nas.edu
Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research.

D. Is the scope of the research reasonable?

The scope is not well defined. However, it does not identify the parameters that should be investigated in the research.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 24 months appears inadequate as experimental investigations are likely to be included in the research. A duration of 30 to 36 months seems more appropriate.

F. Is the budget adequate?

The proposed budget of $400,000 appears in adequate as experimental investigations are likely to be included in the research. A budget of $500,000 seems more appropriate.

G. Comments on current or past research on the topic.

The literature review identified several relevant sources. A literature review should be performed as part of the research.

Review Date:
12/7/2018

AASHTO Committee Evaluation for D-01

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
The Committee on Design's Technical Committee on Hydrology & Hydraulics is supportive of this project, and would like a member of TCHH to be included on the panel.
American Association of State Highway and Transportation Officials 
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline
Problem No: 2020-D-02

1. **Problem Title**
   Developing Endurance Characterization Curves for GFRP Reinforcing Bars for Structural Concrete.

2. **Background**

   *AASHTO LRFD Design Guide Specification for GFRP-Reinforced Concrete Bridge Decks and Traffic Railings* (BDGS-1) was recently expanded to include all reinforced concrete members under the 2nd edition – *AASHTO LRFD Bridge Design Guide Specifications for GFRP Reinforced Concrete* (BDGS-2). With this update the endurance limits for cyclic loading were modestly increased to 70% of the *Canadian Highway Bridge Design Code S6-14*. The maximum cyclic load (fatigue threshold) for design was specified as a combination of the Service I dead load components and the Fatigue I live load component (BDGS-2, Section 2.5.4). This project should establish appropriate endurance limits that would be consistent with the *AASHTO LRFD Bridge Design Specifications* reliability index for this limit state. The current *ASTM D7957-17: Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement* does not provide tests methods or acceptance criteria for creep rupture or cyclic loading (fatigue). Standard test methods (*ASTM D3479* for fatigue properties; *ASTM D7337* for creep properties) exist, but there is still need for updated acceptance criteria.

   Fatigue loading due to live load usually is not critical for building design, so there is only tacit support for this type of research expenditure within ACI Committee 440; yet, for reinforced concrete bridge design, the fatigue load limit can often control for continuous spans within the inflexion zone, even for steel reinforcing. Also, the new endurance design limit should be linked to a maximum time for creep rupture based on the number of cycles (e.g., a 125-year service life and 3 million cycles). Current *AASHTO LRFD Bridge Design Specifications* is calibrated for a 75-year service life and a 2-million cycle fatigue threshold. However, GFRP is expected to lengthen and extend the service life, so a 125-year service life and 3 million cycles may be more appropriate for GFRP reinforcing specifications.

   As part of the BDGS-2 specifications, owners must require manufacturers to certify their product meets certain endurance limits, based on testing. However, it is impractical to require each manufacturer to develop their own endurance curves. Therefore, new industrywide endurance limit characterization curves would allow manufacturers to assure that a product meets the established endurance limits through simple short duration verification testing.

   This research project meets the AASHTO CBS Strategic Plan objectives:
1. Extend Bridge Service Life
3. Maintain and Enhance the AASHTO Specifications
6. Optimize Structural Systems

3. **Literature Search Summary**

The literature search did not provide sufficient information to indicate definite endurance limits for GFRP bars. Existing research points toward fatigue and creep rupture information specific to materials and environmental conditions and largely related to aerospace and marine applications. Some limited studies are under way at Owens Corning Science & Technology with preliminary proprietary data shown below in Figure 1 (contact Dave Hartman for more information dave.hartman@owenscorning.com).

![Figure 1: Calculated Million Hour Creep Rupture Strength to ACI 440.3R B.8 in [brackets] with Glass/Resin Type and Rebar Tensile Elastic Modulus trend in (parenthesis).](image)

4. **Research Objective**

The objective of this research is to develop endurance limits that would meet the AASHTO LRFD Bridge Design Specifications reliability requirements. This work should include developing the applicable resistance factors based on guaranteed
ultimate strength of the reinforcing bar. This work would involve the following tasks:

1. Literature search of test methods and accelerated testing
2. Develop testing procedures for fatigue rupture
3. Develop testing program to produce the endurance characterization curves
4. Perform the testing
5. Review and analyze test results
6. Recommend endurance limits
7. Develop rapid surrogate test method for Quality Assurance (optional task depending on budget)

The testing and recommended results should cover products from multiple bar sizes and manufacturers (three minimum manufacturers and bar sizes).

5. Implementation Planning
The Research results will be implemented in the AASHTO LRFD Bridge Design Guide Specifications for GFRP Reinforced Concrete (BDGS-2), and the Surrogate Quality Assurance test will be implemented as ASTM/AASHTO material testing specifications. The development of the endurance limits will set the reliability and safety of the GFRP reinforced structures and components facilitating wider implementation and acceptance. This is also expected to improve economy and efficiency.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $400,000
Research Period: 36 months

7. Urgency and Potential Benefits
New endurance limits characterization curves based on the properties of the currently used materials would allow bridge designers to design structures and components for uniform reliability and safety. At the same time, this would allow manufacturers to assure that a product meets the established endurance limits and owners to verify it through simple short duration quality assurance testing. While new endurance limits will improve safety, reliability, and economy, standardization of materials testing/acceptance standards will improve the approval process for owners.

GFRP reinforced concrete structures are corrosion free and have the potential to reduce/eliminate corrosion, the leading cause of bridge deterioration. This project will move the GFRP reinforced concrete from specialty to mainstream.

8. Person(s) Developing the Problem Statement
Sam Fallaha, P. E.  Ahmad Abu-Hawash, P. E.
9. **Nomination for AASHTO Monitor**

Sam Fallaha, P. E.
Assistant State Structures Design Engineer
Florida Department of Transportation
850-414-4296
sam.fallaha@dot.state.fl.us

10. **Potentially Interested AASHTO Councils and/or Committees**

- AASHTO Committee on Bridges and Structures/T-6 Fiber Reinforced Polymer Composites.
- AASHTO Committee on Materials and Pavements.

11. **Submitted By**

J. Darryll Dockstader
Research Center Manager
Florida Department of Transportation
850-414-4617
darryll.dockstader@dot.state.fl.us

---

**NCHRP Review of D-02**

**Reviewed By:**
Amir N. Hanna
ahanna@nas.edu

**Comments:**

A. Is the problem potentially solvable through research? If not, why?
The problem is likely to be solvable through research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research as to update the endurance limits. However, it is suggested the objective be stated as modifying AASHTO LRFD Bridge Design requirements.

D. Is the scope of the research reasonable?

The scope is well described but provides no information on the parameters that should be evaluated in the experimental investigations.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 36 months appears adequate.

F. Is the budget adequate?

The proposed budget of $400,000 appears inadequate. Because of the research is expected to include experimental investigations, a larger budget of about $500,000 seems more appropriate.

G. Comments on current or past research on the topic.

The problem statements notes that no relevant research existed. However, a more rigorous literature review should be performed as part of this research.

Review Date:
12/7/2018

AASHTO Committee Evaluation for D-02

Submitted By:
Pattricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
Needed to advance use of FRP
Submitter Response for 2020-D-02

From: [email: darryll.dockstader@dot.state.fl.us]

Comments:

D. Is the scope of the research reasonable?

The scope is well described but provides no information on the parameters that should be evaluated in the experimental investigations.

Response: The experimental investigation should include testing for creep and fatigue of GFRP bars in air and in concrete.

1. Fatigue: Compression -Tension, Tension-Tension cycling in concrete and in air.
2. Creep: Tension in concrete and in air
3. Creep: Compression in concrete & Fatigue Compression-Compression (columns)

G. Comments on current or past research on the topic.

The problem statement notes that no relevant research existed. However, a more rigorous literature review should be performed as part of this research.

Response: Creep and fatigue testing data after the reformulation of GFRP resins in the early 2000 is limited.

1. No synthesis of current research, and very limited fatigue data on rebars.
3. E-CR glass, vinyl-esters and epoxies, did not become popular until mid-2000 after the durability improvements were recognized.
AASHTO STANDING COMMITTEE ON RESEARCH (SCOR)
NCHRP Problem Statement Outline

Problem No: 2020-D-03

1. Problem Title
Protocols for the Continuous Pavement Deflection Measuring Devices: Calibration and Structural Assessment

2. Background
State, Federal, and in some cases local agencies have recognized the value and need of better cost effective treatments on their perspective roadways. Having a robust structural condition assessment method other than from visual distress surveys is certainly a significant step in that direction. There is now a wealth of published literature on the ability and feasibility of utilizing Continuous Pavement Deflection Measuring Devices (CPDD). Some agencies have gone as far as establishing structural correlations between CPDD’s and the Falling Weight Deflectometer (FWD); several have gone as far as developing indices that can be incorporated into the decision matrices of their Pavement Management System (PMS).

Though there is a plethora of published literature as previously mentioned on the utilization of CPDDs, no agency has gone as far as establishing standard practices or calibrations methods for CPDD. For example, there are ASTM standards for the FWD (ASTM D4694) and nationally recognized calibration centers as well. The same is true for other pavement assessment devices such as locked wheel friction testers (ASTM E274) and roadway surface profilers (ASTM E950). Ultimately, to ensure the accuracy of CPDDs, standards by some national organization or agency, whether it be ASTM, AASHTO, NCHRP or FHWA, need to be developed and implemented to ensure that CPDDs are properly calibrated and designed so that accurate readings are being taken. Furthermore, competition has a tendency to drive down assessment costs as well as allow different companies to manufacture CPDDs that are able to provide comparable results between devices. Having a nationally recognized organization produce such standards ensures that.

3. Literature Search Summary
The Strategic Highway Research Program 2 (SHRP 2) published a report (S2-R06F-RW-1) entitled, “Assessment of Continuous Pavement Deflection Measuring Technologies.” The objectives of the study were to assess the potentials of continuous deflection devices as a tool to contribute to pavement management rehabilitation and treatment selection as well as the ability to identify structurally deficient sections at the network level. There conclusions were that CPDDs can provide adequate repeatability for network level collections, can produce deflection measurements that are broadly comparable to the FWD, and can provide measurements that support critical network-level applications.
The above referenced SHRP 2 report also highlighted the need for further work in two major areas: CPDD correlative exhibition (hereafter referred to as exhibition) and tools for PMS. The exhibition would entail selecting roadways with varying typical sections and varying surface conditions in different regions of the USA. The CPDDs and the FWD would assess the roadways in the exhibition at similar times (e.g. within 24 hrs.) with multiple passes at different speeds.

Tools for PMS would also be a deliverable. The exhibition would provide procedures to obtain engineering parameters that could be used to determine rehabilitation and pavement preservation treatments. In conjunction with the exhibition and tool development for PMS, there is a need to establish standard practices and/or calibrations methods for CPDDs.

4. Research Objective
The objectives of this research are twofold (calibration and structural assessment), each with subcategories. Calibration procedures for CPDDs is the first. In the calibration portion, procedures will be established to calibrate the CPDDs to a reference such as the FWD. Standard deviations and bias for the deflections or deflection basin will be established. The second objective is to establish structural assessment guidelines for parameters obtained from CPDDs. These parameters include in-place structural number, layer moduli, base curvature index, surface curvature index, and structural health index.

Phase 1:

1. Conduct a literature review on the utilization of CPDDs.
2. Conduct surveys of US and State DOTs to assess the state of the practice for CPDDs, which include calibration and verification procedures.
3. Develop an experimental plan for assessing the accuracy of CPDDs, validating robust structural parameters based on CPDD measurements, and for developing a standard calibration procedure for CPDD devices.
4. Prepare an Interim report to present Phase 1 findings and clearly delineate the plan of work for Phase 2 of the project.

Time frame: 8 months (2 months should be allowed for NCHRP review of the Interim report)

Phase 2

1. Conduct the experimental plan approved in Phase 1.
2. Develop calibration procedures for CPDDs with the Falling weight deflectometer as the reference device.
3. Provide structural assessment guidelines for CPDDs. This would include field testing procedures and equations for the calculation of in-place structural number, pavement layer moduli, base curvature index, surface curvature index, and structural health index.
4. Deliver a Manual of Practice on the calibration and structural assessment using CPDDs.
5. Prepare a final report documenting all aspects of
research. Time Frame: 18 months

5. Implementation Planning

State DOTs could make use of the research results in several ways. Hosting workshops in each State would be beneficial. This would allow the appropriate State representatives such as Pavement Management Engineers, Design Engineers, Maintenance Engineers and Upper DOT management the opportunity to learn about the benefits of utilizing these devices as well as teach them to utilize it in the arenas of Pavement Management, Preservation, and design. Webinars and circulars would be beneficial as well.

6. Estimate of Problem Funding and Research Period

The estimated funding for this project is $450,000 and the time required to complete all three phases is 24 months.

7. Urgency and Potential benefits

Due to the associated cost and slow test process, the use of structural capacity indicators in pavement management activities has been limited. The use of CPDDs, which measure deflections at highway speeds, offers the potential to characterize the structural capacity of the road network without major delays and in a cost-effective way. This will allow identifying structural deficient pavements and will ensure that cost-effective rehabilitation and maintenance treatments are selected. Therefore, the proper choice of maintenance and rehabilitation treatments based on CPDDs measurements may save significant amount of financial resources for the DOTs.

8. Person(s) Developing the Problem Statement

1. Kevin Gaspard, P.E., Louisiana Transportation Research Center, 4101 Gourrier Ave., Baton Rouge, LA. 70808, Tel. 225-767-9104, Fax. 225-767-9108, email kevin.gaspard@la.gov

2. Zhongjie Zhang, PH.D, P.E., Louisiana Transportation Research Center, 4101 Gourrier Ave., Baton Rouge, LA. 70808, Tel. 225-767-9162, Fax. 225-767-9108, email: zhongjie.zhang@la.gov

9. Nomination for AASHTO Monitor

   Tyson Rupnow, Ph.D., P.E.,
   Associate Director of Research,
   Louisiana Transportation
   Research Center 4101
   Gourrier Ave.
   Baton Rouge, LA 70808.
   Tyson.Rupnow@la.gov
   1-225-767-9124

10. Potentially Interested AASHTO Councils and/or Committees

AASHTO Committee on Materials and Pavements –
NCHRP Review of D-03

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

· Is the problem potentially solvable through research? If not, why?

The problem is of high priority and can be solved through the proposed research.

· Is it likely of interest to at least 2/3s of the DOTS? If not, why?

All states conduct pavement deflection testing to assess pavements for rehabilitation and as part of their asset management procedures. Using CPDDs for these purposes should reduce costs and increase the safety of these operations.

· Is there a reasonably clear objective? If not, can you suggest a brief improvement?

The stated objectives, to develop to calibrate CPDDs to a reference such as the FWD and establish structural assessment guidelines for parameters obtained from CPDDs, are clear and concise.

· Is the scope of the research reasonable? Please recommend changes if needed.
  o Can the research be done in 2-3 years at the most? If not, why?
  o Is the budget adequate? If not, why?

The proposed scope and schedule are reasonable. An increase in the budget to $600,000 is recommended.
FHWA Evaluation of D-03

Sivaneswaran/ HRDI-20 - A recently completed FHWA study (www.fhwa.dot.gov/publications/research/infrastructure/pavements/15074/) and the scope of a new VA DOT led Transportation Pooled Fund study - TPF-5(385) "Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)" (https://www.pooledfund.org/Details/Study/637) includes a number of the items in this Problem Statement (PS). If this PS is selected, the objective should be changed to the development of standard procedure for quality assurance and quality control of TSDD data for highway agencies so as not to reinvent or duplicate other national efforts! Suggest use of Traffic Speed Deflection Devices (TSDD) instead of CPPD to be consistent with previous efforts. Earlier efforts refers to it as TSDD and keeping the same would help from a communication standpoint. Also, the key benefit of these devices is that they are traffic speed that avoids the need for traffic control. Except RDD, the devices are not continuous though close to it. Another acronym is not in the best interest of advancing this technology. Mensching/ HRDI-10 - A reference "such as the FWD" is mentioned in the research objectives. Is it worthwhile to include other devices in addition to FWD (like GPR)? Do you expect much to be found with respect to state-of-practice with CPDDs that was not documented in the SHRP2 report? Phase I time period seems tight. Implementation planning section needs more thought - it is not clear who is offering or developing these workshops for example. T. Van/ T. Yu, HIF - Idea has merit but may be premature. Specifically, the scope of this problem statement is too broad, especially for the estimated time and budget. There are only two commercially available devices in US at present and costs to use them is very high. A more realistic scope for this work (for the budget, time, and feasibility) may include a review of the state-of-the technology/state-of-the-practice, feasibility assessment (of the use of CPDD for structural assessment) and demonstration of the proposed methodology for structural evaluation using CPDD.

Submitter Response for 2020-D-03

From: [email: Tyson.Rupnow@la.gov]

Comments:
Sir we have reviewed the comments on the problem statement referenced above and offer the following response.
1. We concur with changing the CPPD title to TSDD throughout the document.
2. Adding the GPR as part of the collection process would be beneficial.
3. If the committee feels that more time is needed for Phase 1 we would agree with whatever time extension the committee decides.
4. Regarding who would teach the workshops for implementation, we assume that this would be either FHWA or its selected consultant.

5. We feel that reducing the scope to only a review of state of the practice, feasibility assessment, and demonstration of the proposed method would limit the benefit for State DOTs. There have been several thousand miles of collected data in the USA with TSDD's already plus much more mileage is being collected currently in a TSDD pool fund study of which Louisiana is part of. There has also been much mileage collected with TSDD's in Europe and Australia. What is currently needed are standards, guidelines, calibrations methods, etc... for TSDD's. At the moment, State DOTs have to rely totally on the TSDD contractors to inform them what is needed as well as assure them that the measurements are accurate. We understand the reviewer's concerns and they have merit. However, something that is implementable is imperative at this time. If more time and/or funds are needed to accomplish this, then we suggest that the committee make the appropriate adjustments of time and funding to the problem statement.

We appreciate the opportunity to offer these comments.

Contact Info:
Louisiana Transportation Research Center
Kevin Gaspard, P.E.
Pavement Research Manager
4101 Gourrier Ave
Baton Rouge, LA 70808
225-767-9104
Kevin.gaspard@la.gov
Comments: This Problem Statement was developed by the AASHTO TSP2 Emulsion Task Force and is considered a pressing need for practitioners of Pavement Preservation

I. PROBLEM NUMBER

2020-D-04

II. PROBLEM TITLE

The Efficacy of Emulsion-based Rejuvenating Seals

III. RESEARCH PROBLEM STATEMENT

Pavement preservation is an important tool DOTs use to maintain and enhance the conditions of their highways. Pavement preservation treatments do not improve the structural capacity of a pavement; rather they delay pavement deterioration by sealing cracks, preventing pavement oxidation, and, in the case of surface seals, rejuvenating the exiting pavement surface layers.

Preservation treatments utilizing asphalt emulsions as the binder have generally been considered secondary to hot mix asphalt (HMA) technologies. As such, these treatments have not been upgraded or researched to the same extent as HMA technologies. Over the last 5 years, however, the AASHTO TSP2 Emulsion Task Force (ETF) has made a concerted effort to improve the state of the science in emulsion technology and to create consistent, performance-based standards (specifications, test methods, design practices, etc.) that are sponsored by AASHTO and are not vendor specific. To date, twelve standards have been approved.

The ETF is comprised of members from DOTs, FHWA, academia, and representatives of the Asphalt Emulsion Manufacturer’s Association (AEMA), International Slurry Surfacing Association (ISSA), and Asphalt Reclaiming and Recycling Association (ARRA). The ETF has focused on creating and delivering materials standards to the AASHTO Subcommittee on Materials.

Rejuvenating seals are believed to have the ability to modify the surface binder of aged, cracked pavement surfaces. If they can rejuvenate the surface, they may be able to restore functionality to old pavements and allow them to function for longer without total reconstruction.
This is an area that has not received adequate investigation. There are new materials on the market that warrant a review those materials and the efficacy of rejuvenating seals.

IV. LITERATURE SEARCH SUMMARY

Glover, Charles J. and Freeman, Thomas J.; Guidelines on the Use of Fog Seals and Rejuvenator Seals; Texas A&M University. Texas Transportation Institute (TTI); TxDOT Research Project 0-5091; 2007

Estakhri, Cindy K. and Agarwal, Harish; Effectiveness of Fog Seals and Rejuvenators for Bituminous Pavement Surfaces; TxDOT Research Project 0-1156; Texas A&M University. Texas Transportation Institute (TTI); 1991

There is little research performed recently in the area of emulsion-based rejuvenating seals.

V. RESEARCH OBJECTIVE

The objective of this project is to study emulsion-based rejuvenating seals to determine the extent that they penetrate and rejuvenate asphalt the pavement. If these materials can penetrate and rejuvenate, what specification should be used for the materials (materials specification), how does one design a project to use them (design guide) and how does a DOT construct a project (construction specification)?

The research will include:
- a review of previous work in the area (both national and international), and
- conduct materials research to determine the efficacy of rejuvenating additives in the emulsion-based rejuvenating seals

If there are materials that penetrate and rejuvenate sufficiently, researchers should develop:
- a materials specification,
- design guidelines, and
- construction guide specifications for their use.

The Materials Specification will address rejuvenating emulsion materials and should contain an indicator of rejuvenating potential. The Design Guide will include the benefits of the treatments and what distresses can be addressed as well as the suggested application rates of materials needed. The Construction Guide Specification will address the construction operations required, including
Quality Assurance practices, with possible adjustments for local materials and experience.

Deliverable documents will be in conformance with AASHTO format.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$450,000

**Research Period:**

24 months

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

The creation of AASHTO Material Specifications, Design Guidelines and Construction Guide Specification will make it easier for DOTs to implement rejuvenating seal treatments for pavement preservation.

VIII. PERSON(S) DEVELOPING THE PROBLEM

Colin A Franco, RIDOT Associate Chief Engineer (Materials and Quality Assurance); Co-Chair – AASHTO TSP2 Emulsion Task Force; Member – AASHTO Committee on Pavements and Materials

Chris Lubbers, Kraton Performance Polymers, Inc., Technical Sales and Marketing Development Manager – Emulsions; Co-Chair – AASHTO TSP2 Emulsion Task Force

Darren Hazlett, Research Fellow, University of Texas – Center for Transportation Research; Member – AASHTO TSP2 Emulsion Task Force

IX. PROBLEM MONITOR

TBD

X. DATE AND SUBMITTED BY

Colin Franco
RIDOT
and
Darren Hazlett
University of Texas
NCHRP Review of D-04

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

· Is the problem potentially solvable through research? If not, why?

Yes, the problem is solvable through research.

· Is it likely of interest to at least 2/3s of the DOTS? If not, why?

A presentation by RejuvTec, Inc. at the 2017 Purdue Road School indicated that this technology was then used by more than 30 state DOTs.

· Is there a reasonably clear objective? If not, can you suggest a brief improvement?

The objective statement is clear and concise.

· Is the scope of the research reasonable? Please recommend changes if needed.

The scope, to develop a material and construction specifications for the use of emulsion rejuvenating seals for pavement preservation, is reasonable.

· Can the research be done in 2-3 years at the most? If not, why?
· Is the budget adequate? If not, why?

Both the recommended budget and period of performance are reasonable.

A search of the literature since 2014 identified the following relevant publications:


Review Date:
12/3/2018
I. PROBLEM NUMBER

2020-D-05

II. PROBLEM TITLE

Construction Specifications for Pavement Treatments – Slurry Seals and Tack Coats

III. RESEARCH PROBLEM STATEMENT

Pavement preservation is an important tool DOTs use to maintain and enhance the conditions of their highways. Pavement preservation treatments do not improve the structural capacity of a pavement; rather they delay pavement deterioration by sealing cracks, preventing pavement oxidation, and, in the case of surface seals, rejuvenating the exiting pavement surface layers.

Preservation treatments utilizing asphalt emulsions as the binder have generally been considered secondary to hot mix asphalt (HMA) technologies. As such, these treatments have not been upgraded or researched to the same extent as HMA technologies. Over the last few years, however, the AASHTO Transportation System Preservation Technical Services Program (TSP-2) Emulsion Task Force (ETF) has made a concerted effort to improve the state of the science in emulsion technology and to create consistent, performance-based standards (specifications, test methods, design practices, etc.) that are sponsored by FHWA and/or AASHTO and are not vendor specific.

The ETF is comprised of members from DOTs, FHWA, academia, and representatives of the Asphalt Emulsion Manufacturer’s Association (AEMA), International Slurry Surfacing Association (ISSA), and Asphalt Reclaiming and Recycling Association (ARRA). The ETF has focused on creating and delivering materials standards to the AASHTO Subcommittee on Materials.

A slurry seal is a homogenous mixture of emulsified asphalt, water, well-graded fine aggregate and mineral filler that is used to fill existing pavement surface defects as either a preparatory treatment for other maintenance treatments or as a wearing course.
A tack coat is the application of an emulsified asphalt or performance-graded (PG) asphalt binder, followed by any applied surface layer. The tack coat is used to ensure a good bond between the existing asphalt or concrete pavement and an overlay, between the multiple lifts of a new structural pavement and at any vertical surfaces that the new layer will be placed adjacent to, such as curbs, gutters, utilities, and construction joints. Tack coats can be used in pavement maintenance activities or in new construction.

Materials specifications and design guides exist for slurry seals and tack coats (AASHTO MP 32-17 Materials for Slurry Seal, AASHTO PP 87-17 Slurry Seal Design, AASHTO MP 36-18 Materials for Asphalt Tack Coat, AASHTO PP 93-18 Asphalt Tack Coat Design) but construction guidelines are less developed. Some agencies have developed construction specifications for local jurisdictions, but standardized nation-wide construction guide specifications do not exist.

The creation of construction standards is now necessary in order to implement these treatments. This research seeks to develop construction guidelines for slurry seals and tack coats.

IV. LITERATURE SEARCH SUMMARY

Braun Intertec Corporation; Alternatives to Seal Coats; Minnesota Department of Transportation (Mn/DOT); TRS 1602; February 2016"

International Slurry Surfacing Association; Recommended Performance Guideline for Emulsified Asphalt Slurry Seal; Annapolis, Maryland; February 2010


Wilson, Bryan, Seo, Ah Young, and Sakhaeifar, Maryam; Performance Evaluation, Specifications, and Implementation of Non-Tracking Tack Coat Performance; Report Number FHWA/TX-16/0-6814-1; September 2016

Eedula, Srinivasa R. and Tandon, Vivek; Tack Coat Field Acceptance Criterion; University of Texas at El Paso. Center for Transportation Infrastructure Systems; PSR 0-5216-S; 2006

Tashman, Laith, Nam, Kitae, and Papagiannakis, Tom; Evaluation of the Influence of Tack Coat Construction Factors on the Bond Strength Between Pavement Layers; Report Number WA-RD 645.1; Washington State Department of Transportation (WSDOT)
V. RESEARCH OBJECTIVE

The object of this project is to produce AASHTO Construction Guide Specifications for the application of Slurry Seals and Tack Coats. This will assist highway agencies in tailoring their own specifications to the local conditions and environments and will aid DOTs in implementing these treatments in their pavement Transportation Asset Management Program (TAMP).

The Construction Guide Specification will address the construction operations required, with possible adjustments for local materials and experience.

The research will include a review of previous work in the area, including construction standards, construction specifications, and construction practices both national and internationally.

Deliverable documents will be in conformance with AASHTO format.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $125,000

**Research Period:** 12 months

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

The creation of AASHTO Construction Guide Specifications together with existing Design Guidelines and Materials Specifications will make it easier for DOTs to implement Slurry Seals and Tack Coats for pavements.

VIII. PERSON(S) DEVELOPING THE PROBLEM

Colin A Franco, RIDOT Associate Chief Engineer (Materials and Quality Assurance); Co-Chair – AASHTO TSP2 Emulsion Task Force; Member – AASHTO Committee on Pavements and Materials
Chris Lubbers, Kraton Performance Polymers, Inc., Technical Sales and Marketing Development Manager – Emulsions; Co-Chair – AASHTO TSP2 Emulsion Task Force

Darren Hazlett, Research Fellow, University of Texas – Center for Transportation Research; Member – AASHTO TSP2 Emulsion Task Force;

IX. PROBLEM MONITOR

TBD

X. DATE AND SUBMITTED BY

Colin Franco
RIDOT
September 21, 2018

NCHRP Review of D-05

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

· Is the problem potentially solvable through research? If not, why?

There are numerous DOT and industry specifications or guidelines, as well as ASTM D3910, available for slurry seal and tack coat construction that can provide a sound basis for solving this problem.

· Is it likely of interest to at least 2/3s of the DOTS? If not, why?

All asphalt pavement construction and rehabilitation require tack coats as a prerequisite for satisfactory performance. A June 2018 Nevada DOT report showed that more than 30 DOTs make extensive use of slurry seals in their programs.

· Is there a reasonably clear objective? If not, can you suggest a brief improvement?

The objective is clear and concise.

· Is the scope of the research reasonable? Please recommend changes if needed.
  o Can the research be done in 2-3 years at the most? If not, why?
  o Is the budget adequate? If not, why?
The research scope and the proposed period of performance are reasonable. However, the budget should be increased to $250,000 to provide adequate work hours to accomplish the objective.

Review Date:
12/3/2018

FHWA Evaluation of D-05

Morgan Kessler, HRDI - This is needed research, and would be complementary to a number of completed NCHRP projects, and AASHTO adoption of chip seal/slurry seal design specifications. These include NCHRP 14-37 and 14-38. A. Nieves /HIF - Slurry Seal and Tack Coat specifications are completed by the ETF. Another project waiting for completion deals with chip seal and micro surfacing for construction specifications is due soon and will shed some light into the construction specification area. We should wait for conclusion of NCHRP-14-37 (just published http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP14-37_FR.pdf)
2020-D-06

American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Comments: This problem was initiated by the Bridge Technical Working Group of the AASHTO Committee on Maintenance and was endorsed by the committee members at the annual meeting in July 2018

Problem No: 2020-D-06

1. Problem Title

2. Background
   Nondestructive testing and evaluation (NDT/E) and structural health monitoring (SHM) are proven methodologies and associated technologies for the inspection and evaluation of civil infrastructure, particularly for the highway industry. Recently, as part of MAP-21 and FAST-ACT legislation, requirements for bridge owners to develop data driven asset management programs have been introduced. In an effort to develop these types of programs, many stakeholders have turned to NDT/E and SHM as a means of acquiring data that will allow them to be informed with regards to the performance of their assets. However, because NDT/E and SHM represents a relatively new set of technologies in the civil infrastructure industry, a set of guidelines for State and Local Transportation Agencies to procure these services do not exist.

   Because the stakeholder requirements vary, there exists the vulnerability that practitioners meeting the bare minimum experience level could be operating in one state when their credentials would not be acceptable in others. This variability in consistency between states, introduced by varying solicitation requirements, only increases the gap between condition rating reporting between states, when the true intent of repeatable testing is do the opposite. There exists a need to develop a guideline for civil infrastructure that will include best practices, quality standards, and solicitation guidelines for stakeholders to follow to ensure consistency when procuring NDT/E and SHM services for data driven asset management. The AASHTO Committee on Maintenance (MaC) Bridge Technical Working Group (BTWG) as well as the TSP National Bridge Preservation Partnerships have identified consistency in data collection and reporting as paramount needs for the future preservation and maintenance of the nation’s bridges, and thus, procuring these services consistently throughout the US is vital.

3. Literature Search Summary
The American Society of Nondestructive Testing (ASNT) provides certification levels for steel testing, however, professional certifications for testing and monitoring other structural materials and systems, such as concrete or timber bridges, have not been thoroughly developed. The Federal Highway Administration’s (FHWA) Long Term Infrastructure Performance Program (LTIP), formerly known as the Long Term Bridge Performance Program (LTBP), has released a set of data collection protocols for testing in service bridges with the goal of ensuring consistent data collection and reporting. Additionally, the American Concrete Institute (ACI), American Society of Civil Engineers (ASCE), and the Federal Institute for Materials Research and Testing in Germany (BAM) have all developed similar protocols. However, there does not exist a single set of guidelines to follow that identify the best practices for field data collection, analysis, and reporting with regards to NDT/E and SHM. Additionally, and subsequently, there is not a single set of guidelines to identify vendor qualification criteria when procuring these services. Finally, procurement guidelines on how to solicit and procure services for best practices including vendor qualification criteria for State Departments of Transportation NDT/E and SHM have not been identified or developed.

For this reason, it is difficult for State and Local Transportation Agencies to easily solicit NDT/E and SHM without developing a specific quality requirement for each individual solicitation. Additionally, because there has been little collaboration between states, the quality requirements between these solicitations varies from state to state.

While multiple institutions (ASNT, FHWA, ACI, ASCE, and BAM, as mentioned above) are developing what could be considered portions of this guideline, these efforts primarily focus on guidelines or best practices for implementing or performing testing, monitoring, installation, analysis, etc. and there is no single effort to develop this particular document for use in assisting State and Local Transportation Agencies to develop improved procurement guidelines for NDT/E and SHM.

A literature search was performed at both TRID (http://trid.trb.org) and http://rip.trb.org/ for the terms “guidelines,” “nondestructive,” “structural,” “monitoring,” and “procurement.” No existing and/or previous research was identified that matches the scope and/or deliverables of this project.

4. Research Objective

The objective of this research will be to develop a guideline for procurement of NDT/E and SHM services for the civil infrastructure industry with a focus on highway infrastructure based on quality of service and best practices for consistent, quality driven, data collection, analysis, and reporting.

5. Implementation Planning

The results of this study will be a document available to all state DOTs and other civil infrastructure stakeholders for use in soliciting and procuring NDT/E and SHM services. Presentations at AASHTO Bridge and Maintenance Committees are recommended along with webinars for state DOTs.
6. **Estimate of Problem Funding and Research Period**

**Recommended Funding:**

The proposed funding for this project is as follows:

1. Project Management and Coordination - $15k
2. Kickoff Meeting and Final Presentation (assuming travel to Washington, DC for PI and Co-PI) - $15k
3. Task 1 (below) - $25k
4. Task 2 (below) - $20k
5. Task 3 (below) - $30k
6. Task 4 (below) and reporting - $20k
7. Peer Review - $12.5k
8. Webinar and other implementation activities - $12.5k
9. **Total** - $150k

**Research Period:**

The research period is estimated to be 16 months including three months for review and revision of a draft final report, and one month for review and revision of each interim report. This research includes the following specific task-based activities:

1. Perform of a study of the existing documents in circulation that identify best practices, guidelines, protocols, etc. on applications and data collection and analysis related to NDT/E and SHM for highway infrastructure;
2. Survey of existing stakeholders for identification of existing:
   a. Methodologies and practices currently used for NDT/E and SHM in each of their areas,
   b. Capabilities for NDT/E and SHM and what services they would need to procure,
   c. Methodologies, procedures, or guidelines currently used to procure NDT/E and SHM.
3. Development of guidelines for procurement based on best practices identified in (1) and needs identified in (2);
4. Production of a final document identifying best practices and guidelines for procurement of NDT/E and SHM for civil infrastructure with a focus on highway infrastructure.

7. **Urgency and Potential Benefits**

This guideline will increase the ease of which stakeholders can procure and implement NDT/E and SHM type service contracts by ensuring that the same quality standards are in place across the United States while simultaneously ensuring that these stakeholders receive data of a high enough quality that can be used to confidently manage their assets.

The value of the research is that the services utilized to collect data through technical methodologies will be procured in a consistent manner...
throughout the United States. This will allow for improved asset management locally and nationally. Additionally, as parts of this work have been accomplished through previous research and/or council work at ASNT, ACI, ASCE, and FHWA, developing the necessary contract language and best practices will be possible within the constraints of the proposed schedule and budget. With procurement guidelines as the final deliverable, the product of the research will be immediately ready for implementation by states interested in procuring NDT/E and SHM services. Finally, as legislation and improved data collection and analysis technologies continue to push for improved, quantitative bridge inspection techniques, state DOTs will be encouraged to utilize the products of this research.

8. **Person(s) Developing the Problem Statement**
   1. Shane D. Boone, Ph.D., VP-NDE, BDI, (919) 907-8887, shaneb@bditest.com
   2. John S. Popovics, Ph.D., P.E., Professor, University of Illinois at Urbana-Champaign, (217) 244-0843, johnpop@illinois.edu
   3. ASNT Infrastructure Committee

9. **Nomination for AASHTO Monitor**
   Jeff Milton, Bridge Preservation Specialist, Virginia Department of Transportation, 4219 Campbell Ave, Lynchburg, VA 24501, (434) 856-8278 (office), (434) 841-1463 (mobile), Jeffrey.Milton@VDOT.Virginia.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
    AASHTO Committee on Maintenance Bridge Technical Working Group

11. **Submitted By**
    AASHTO Committee on Maintenance Bridge Technical Working Group
    Jeff Milton, Bridge Preservation Specialist, Virginia Department of Transportation, 4219 Campbell Ave, Lynchburg, VA 24501, (434) 856-8278 (office), (434) 841-1463 (mobile), Jeffrey.Milton@VDOT.Virginia.gov

---

**NCHRP Review of D-06**

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:
A. Is the problem potentially solvable through research?  If not, why?

The problem is likely to be solvable through research.

B. Is it likely of interest to at least 2/3s of the DOTS?  If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research and suggests emphasis on highway infrastructure. However, the information provided in the problem statement appears to pertain primarily to bridges. It is suggested the a well defined scope that limits the research to bridges (possibly concrete bridges) be proposed.

D. Is the scope of the research reasonable?

The scope is not well described. It is suggested that the scope be limited highway bridges (possibly concrete bridges).

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 16 months appears inadequate; a longer duration of 24 to 30 months appears more appropriate.

F. Is the budget adequate?

The proposed budget of $150,000 appears inadequate; a larger budget of about $400,000 seems more appropriate.

G. Comments on current or past research on the topic.

The problem statements notes that no relevant research existed. Efforts by FHWA under the auspices of the Long-Term Infrastructure Program (LTIP) in procuring such equipment are relevant to the proposed research and should be considered. Also, a more rigorous literature review (and possibly a survey of state DOTs) should be performed as part of this research.

Review Date:
12/7/2018
Azari/ HRDI-20 - By reading the title, this is very important topic and States always ask for such documents to assist them with procuring NDE services. However, by reading the tasks, I believe there is too much included in this proposed study and $150k is definitely not sufficient. It includes both NDE and SHM and there are many tasks besides "procurement" tasks. FHWA's NDE Program is planning to start a new study in FY19 to document current practice in States, identify deployment-ready technologies and quantify Return on Investment. I suggest to narrow down the scope of this proposed study to focus on procurement guidelines for NDE technologies.

---

AASHTO Committee Evaluation for D-06

Submitted By:
Patricia Bush
AASHTO staff
Committee on Bridges & Structures

Comments:
There is a definite need for this. Please include a member of the Committee on Bridges & Structures on the panel.

---

Submitter Response for 2020-D-06

From: [email: jon.wilcoxson@ky.gov]

Comments:
In response to comments provided, the Maintenance Committee proposes the following modifications to the problem statement:


Research Objective Revision: The objective of this research will be to develop a guideline for procurement of NDT/E services for concrete components of highway bridges, based on quality of service and best practices for consistent, quality driven, data collection, analysis, and reporting.

Research Duration Revision: 30 months.

Budget Revision: $400,000.

Also, we agree that the LTIP efforts are relevant and will be considered along with a more rigorous literature review and possibly a survey of state DOTs.
Contact Info:
Jon Wilcoxson, PE
Assistant State Highway Engineer
Kentucky Transportation Cabinet
200 Mero St
Frankfort KY 40622
502-782-5615

Review Date:
1-18-2019
Comments: This problem statement was initiated by the Emulsion Task Force and vetted by the Pavement Technical Working Group of the AASHTO Committee on Maintenance. It was endorsed by the committee members at the annual meeting in July 2018 and was the third-highest NCHRP research priority of the committee.

Problem No: 2020-D-07

1. Problem Title
Guide Construction Specifications for Cold In-place Recycling (CIR) and Cold Central Plant Recycling (CCPR)

2. Background
Pavement preservation is becoming an important activity for DOTs in maintaining and enhancing the condition of their highways. With the enactment of MAP 21 wherein the DOTs have to show improved performance in the conditions of their highways, the use of pavement preservation treatments will be crucial to meet the performance goals. Pavement preservation treatments are treatments that do not improve the structural capacity of a pavement, but do delay pavement deterioration. In the case of CIR and CCPR, they are considered a minor rehabilitation pavement preservation treatment when topped with a thin overlay. They treat cracks of a higher severity than what other preservation techniques can treat, and the recycled layer is topped with a thin overlay to modify the pavement structure to produce a more long-lasting system. CIR and CCPR treatments are part of a sustainable strategy for reducing the need for new aggregate and new asphalt while using lower energy and creating fewer emissions.

Preservation treatments using asphalt emulsion as the binder have almost always been considered secondary to hot mix asphalt technologies and are therefore not as well understood. These technologies have not been upgraded or researched as much as HMA. However, over the last five years the FHWA PPETG (Pavement Preservation Expert Task Group) and ETF (Emulsion Task Force) have made a concerted effort to 1) improve the state of the science in emulsion technology, and 2) create consistent performance-based standards (specifications, test methods, design practices, etc.) that are sponsored by FHWA and/or AASHTO and are not vendor specific.

The rationale for creating AASHTO standards for pavement preservation treatments was to provide credence, and more importantly, buy-in from the DOTs. In order to implement any of these treatments into construction projects, material AND construction standards have to be created first, and in the case of CIR and CCPR, a mix design practice and material specifications have been created and submitted to the AASHTO Subcommittee on Materials (SOM). However, as noted
in NCHRP Synthesis 421, one of the barriers to greater use of these treatments is lack of specifications. Development of guide construction specifications accounting for the best practices by agencies and contractors will greatly assist in increased use of these treatments, especially by agencies with little past practice with in-place recycling.

3. Literature Search Summary
Literature that should be considered include the Asphalt Recycling and Reclaiming Association’s (ARRA) Basic Asphalt Recycling Manual (BARM); NCHRP Synthesis 421, Recycling and Reclamation of Asphalt Pavements Using In-Place Methods.

4. Research Objective
The objective of this project is to produce an AASHTO Construction Guide Specification for the application of cold in-place recycling and cold central plant recycling. This will assist highway agencies to tailor their own specifications to the local conditions and environments. This will go a long way in getting DOTs to implement this treatment for their pavement preservation programs. The research to produce the construction guide standards should include a review of previous work in this area. This should include a review of construction specifications and practices that are in use in several state DOTs already performing this work.

5. Implementation Planning
It is anticipated that the research will result in publication of AASHTO standards on CIR and CCPR construction specifications. These standards will be presented in webinars and presentations to the appropriate AASHTO committees.

6. Estimate of Problem Funding and Research Period
**Recommended Funding:**
$175,000

**Research Period:**
12 months

7. Urgency and Potential Benefits
The creation of this construction guide specification, together with the already drafted design practice and materials specifications, should make it easier for DOTs to implement this treatment. MAP 21 and the required performance enhancements of the aging highway system makes it imperative that this effective treatment is used on a more regular basis.

8. Person(s) Developing the Problem Statement
The problem statement was developed with the support of the Emulsion Task Force (ETF). The ETF is made up of members from DOTs, FHWA, academia,
and representatives of AEMA (Asphalt Emulsion Manufacturers Association), ARRA (Asphalt Recycling and Reclaiming Association), and ISSA (International Slurry Surfacing Association). The ETF has been working on creating standards for AASHTO and has delivered several materials standards related to pavement preservation.

Persons within the ETF who worked on the development of this statement are:

Recycling Emulsions Subcommittee members of the ETF
Todd Thomas, Colas Solutions and chair of the Recycling Emulsions Subcommittee of the ETF
Steve Cross, Oklahoma State University and Technical Director of ARRA
Colin Franco, Rhode Island DOT
Anita Bush, Nevada DOT
Darren Hazlett, Texas DOT
Mike Voth, FHWA-CFLHD
Chris Lubbers, Kraton

9. Nomination for AASHTO Monitor
   TBD

10. Potentially Interested AASHTO Councils and/or Committees
    AASHTO Committee on Maintenance, AASHTO Committee on Materials and Pavements, AASHTO Committee on Construction

11. Submitted By
    Jon Wilcoxson
    Research Coordinator – AASHTO Committee on Maintenance
    200 Mero St
    Frankfort KY, 40622
    502-782-5615
    jon.wilcoxson@ky.gov

NCHRP Review of D-07

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?
The problem appears to be solvable through research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research. Although not stated, the research appears to be limited to the recycling of asphalt pavements.

D. Is the scope of the research reasonable?

The scope is not described but is expected to deal with the recycling of asphalt pavements and follow a systematic approach (review of literature and practices, identification of relevant items, drafting sections and chapters, etc.) to develop the anticipated guide specifications.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 12 months appears adequate.

F. Is the budget adequate?

The proposed budget of $175,000 appears adequate.

G. Comments on current or past research on the topic.

No earlier studies or existing guide specification have been cited. Recognizing that relevant studies have been performed and some state DOTs have guidelines and specification relevant to the subject, a literature review and possibly a survey of state DOTs should be performed as part of the research.

Review Date:
12/7/2018

FHWA Evaluation of D-07

Kessler/ HRDI-20 - Advances have been recently with other methods and materials associated with pavement preservation, and the proposed project would similar in approach to these, but specific to CIR and CCPR. Like the other preservation techniques, CIR and CCPR needs reliable and widely vetted guide specifications such
that the practitioner is less reliant on contractor sales, and has a good set of specification to put in their contracts. HICP-40 - This project will help the continued implementation of in-place recyling by creating a national standard.

Submitter Response for 2020-D-07

From: [email: jon.wilcoxson@ky.gov]

Comments:
Propose revising the title and objective to clarify that the objective is focused on asphalt pavements.

Revised Title:
Guide Construction Specifications for Cold In-place Recycling (CIR) and Cold Central Plant Recycling (CCPR) for Asphalt Pavements

Revised Objective:
The objective of this project is to produce an AASHTO Construction Guide Specification for the application of cold in-place recycling and cold central plant recycling. This will assist highway agencies to tailor their own specifications to the local conditions and environments and aid DOTs unfamiliar with CIR to implement this treatment for their pavement preservation programs.
It is anticipated that the research effort to meet this objective would encompass the following tasks:
1. Survey and review of construction specifications and practices that are in use in several state DOTs already performing this work.
2. Survey/ interview state materials and construction engineers.
3. State DOT Survey/ Interview and Specifications Review Results
A survey of state DOTs CIR specifications will be included in this study. Research below will be relevant to this effort.
Recommended Construction Guidelines For Cold In-place Recycling (CIR) Using Bituminous Recycling Agents CR101, Asphalt Recycling and Reclaiming Association’s (ARRA), Revised 4/7/2016
Jinhai Yan ; Fujian Ni, Ph.D., P.E. ; Zhuohui Tao ; and Jonathan Jia, Development of Asphalt Emulsion Cold In-Place Recycling Specifications, GeoHunan International Conference 2009

Contact Info:
Jon Wilcoxson
Assistant State Highway Engineer
Kentucky Transportation Cabinet
200 Mero St, Frankfort KY 40065
502-782-5615

Review Date:
1/20/2019
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline
Problem No: 2020-D-08

1. Problem Title
   Improvement of Certification Method of Inertial Profiling Systems for Network Data Collection

2. Background
   As one of the national performance metrics, International Roughness Index (IRI) is required to be collected and submitted annually to Federal Highway Administration (FHWA), per 23 CFR 490.309. IRI, along with other performance metrics, is also employed to determine performance measures, based upon which the 4-year performance targets are established. In order to collect reliable pavement data, state transportation agencies are required to develop Data Quality Management Programs (DQMPs).

   One of the critical elements of DQMP is the certification of data collection equipment. Most states certify their inertial profiling system, which is used to collect IRI, in accordance with AASHTO R56 “Standard Practice for Certification of Inertial Profiling Systems”. However, the repeatability and accuracy requirements in R56 are only employed for test sections less than 150 in./mi.. As stated in R56, “a lower agreement score may be accepted for the medium rough section that has an IRI greater than 150 in./mi.” Given that the threshold of poor section in terms of IRI is 170 in./mi., there is a gap of repeatability and accuracy requirements in R56 for network IRI collection. Additionally, the agreement scores in R 56 are employed for construction quality control and acceptance at project-level. It is arguable that whether it is necessary to employ the same repeatability and accuracy requirements for network data collection, where the purpose of data collection is quite different from that of construction QC/QA testing.

   The purpose of this research is to fill the gap in AASHTO R56, which is under TS-5a of AASHTO Committee on Materials and Pavements, so that state transportation agencies and stakeholders will be able to utilize R 56 to certify inertial profiling systems for network IRI collection. This project will involve researching and documenting nationwide practices of certifying inertial profiling systems for network data collection; investigating the measurement variability of IRI for different types of test section; evaluating the influence of measurement variability on the performance measure related to pavement IRI. The final delivery of this research project will be able to assist transportation agencies to select requirements for equipment repeatability and accuracy based on their needs for network data collection. The outcome of this research will make recommendations for revision of AASHTO R 56.
3. Literature Search Summary

Literature search was conducted on trid.trb.org. The searching keywords are inertial profiling system; profiler; IRI; IRI certification.

International Roughness Index, which is a standard method to characterize pavement smoothness, is the most common used indicator to evaluate pavement condition (1). It is widely employed for pavement construction acceptance and network-level pavement evaluation. Well-certified data equipment is indispensable for collecting reliable pavement data. There are many factors influencing the process of equipment certification, including laser sensors, surface types and texture, season, test speed, types of devices, etc (2-10). A recent published NCHRP synthesis focused on the state-of-the-practice of certifying inertial profilers for construction acceptance and network-level data collection (11). This study documented the state of practice on profiler certification from state DOTs by conducting questionnaire. The results revealed that of all the 44 responded state DOTs, 30 states didn’t certify profilers for network IRI collection. In order to collect reliable network data, states performed time-historical comparison and/or parallel tests between vendors’ and state DOT-owned profilers. For those states conducting profiler certification for network-level data collection, most of them developed their own certification program. The test sections and methods used for certify profilers for network-level data collection are the same as those used for construction acceptance. The findings from the survey indicated that there is no nationwide consistence among state DOTs in certifying profilers for network-level IRI collection.

The purpose of IRI collection for construction acceptance and network-level pavement evaluation is different from each other. For construction acceptance, tests are performed on a newly constructed surface with relative low IRI value, and test results are generally used for construction payment, whereas for network-level data collection, a wide range of IRI will be covered, and test results are used for overall rating. Therefore, the preciseness and accuracy requirements for the two scenarios could be different. Based on the investigation of LTPP data, it was found that the variability of network-level IRI could significantly affect the results of pavement performance measures (12).

By extensive literature review, there is a lack of studies that focused on the how to certify test equipment for network pavement IRI collection. No more technical details on how states certify their test equipment for network data collection was found in Literature (11). Literature (12) investigated the influence of variability of IRI measurement on network-level performance measures based on the LTPP database with limited types of test equipment. A nationwide research is needed to address these issues and improve the current procedure of certifying test equipment for network-level pavement IRI collection.

4. Research Objective
The objectives of this research are to
1) Investigation into the influence of IRI variability on national performance measure at network-level data collection.
2) Identify the range of roughness for test sections and the associated repeatability and accuracy requirements for certify inertial profiling systems for network data collection.
3) Develop and document recommendations for AASHTO Standard Practice that could be used by state transportation agencies to certify inertial profiling systems for network data collection.

5. Implementation Planning
In order to make the final outcome of this research more practical to state DOTs, data analyses on a wide range of certification test results are needed. State DOTs and stakeholders are encouraged to participate in the survey and providing research team with results of certification.

6. Estimate of Problem Funding and Research Period
Recommended Funding:
The recommended funding for the intended project is $125,000.

Research Period:
It is estimated that this research will take **14 months** to complete. The research period will include
- 6 months of collection of results of equipment certification practices;
- 4 months of data analysis and processing;
- 2 months of reviewing and revising interim reports (2 interim reports will be expected).
- 2 months of reviewing and revising draft final report;

7. Urgency and Potential Benefits
In response to performance measures reporting and performance target setting, per MAP-21 requirement, it is urgent that state transportation agencies utilize reliable methods to certifying inertial profiling systems for network IRI collection and understand how the certification requirements may influence the performance measures. The outcome of this research will fill the gap in AASHTO R 56 which can be used by state transportation agencies for conducting equipment certification for obtaining more reliable network-level pavement IRI data. Based on the literature search, the current studies have provided a solid foundation of the intended research, based on which the goal of this research will be successfully achieved within the period and expense specified in this problem statement.
8. **Person(s) Developing the Problem Statement**
Mark Woods, State pavement engineer, Tennessee Department of Transportation, 615-532-3622, Mark.Woods@tn.gov
Andy Mergenmeier, Senior Pavement and Materials Engineer, Federal Highway Administration, 667-239-0879, Andy.Mergenmeier@dot.gov
Xiaoyang Jia, Pavement management Specialist, Tennessee Department of Transportation, 615-253-5464, Xiaoyang.Jia@tn.gov
Ulises Martinez, Transportation Project Specialist, Sr., Tennessee Department of Transportation, 615-350-4155, Ulises.Martinez@tn.gov
Bayan Faraj, Graduate Transportation Associate, Tennessee Department of Transportation, 615-253-5464, Bayan.Faraj@tn.gov

9. **Nomination for AASHTO Monitor**
Mark Woods, State pavement engineer, Tennessee Department of Transportation, 505 Deaderick Street, James K Polk Building, Suite 400, 615-532-3622, Mark.Woods@tn.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
AASHTO Committee on Materials and Pavements
Other ??

11. **Submitted By**
AASHTO Committee on Materials and Pavements

**Appendix**

**Reference**

(2) Gagarin, N, Mekemson, J and Orthmeyer, R, Accuracy Limitation of road profiler based on a single-axis accelerometer, Symposium on pavement surface characteristics, 6th, Portoroz, Slovenia, 2008.
(3) Emmanuel G Fernando and Gerry Harrison, Construction of New Profiler Certification Tracks, FHWA/TX-13/5-9047-01-1, Texas A&M Transportation Institute, 2014.
(4) Darel Mesher, Chris Coram, Wei He, Chuck McMillan, Seasonal variation and repeatability in high speed IRI surveys on Alberta Provincial Highways, Seventh International Conference on Managing Pavement Assets, Calgary Alberta, Canada, 2008.
(7) Rohan W Perera, Starr D Kohn, and Larry J Wiser, “Factors contributing to difference between profiler and the International Roughness Index”, Transportation


(10) Mekemson, JR. and Gagarin, N., Performance of inertial profilers subjected to certification procedure, Symposium on Pavement surface characteristics of Road and Airport, 5th, 2004, Toronto, Ontario, Canada.


---

NCHRP Review of D-08

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem is solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

Because state DOTs are required to collect IRI measurements annually (and report them to the FHWA), it is expected that all DOTs would be interested in this topic.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, is clear as to improve the certification practice for inertial profiling systems described in AASHTO R56, Standard Practice for Certification of Inertial Profiling Systems. The research will develop recommended modifications to improve this standard practice.
D. Is the scope of the research reasonable?

The scope is reasonable.

E. Can the research be done in 2-3 years at the most?

The proposed duration of 14 months may not be adequate; an increase to 18 months is suggested.

F. Is the budget adequate?

The proposed budget of $125,000 may not be adequate to address all factors involved in the certification process; an increase to $200,000 is suggested.

G. Comments on current or past research on the topic.

Although several research sources are cited, a literature review should be conducted as part of the project to identify and consider relevant research.

Review Date:
12/7/2018

---

FHWA Evaluation of D-08

Wiser/HRDI-30 - The Problem Statement is consistent with discussions held September 21, 2018, by the multi-state steering committee for TPF-5(354) "Improving the Quality of Profile Measurements" with South Dakota as the lead agency. One difference is that the discussion at the pooled fund study included operator certification, which should be included in this Problem Statement. One thing that the members of the pooled fund study would not advocate based on current knowledge is lowering the cross-correlation requirements for accuracy and repeatability. That doesn't mean that the question shouldn't be investigated, but all study to date points to maintaining the current requirements. The "Critical Profiler Accuracy Requirements" report (https://deepblue.lib.umich.edu/handle/2027.42/13900) which was a product of the TPF 5(063) "Improving the Quality of Pavement Profiler Measurement" pooled fund study needs to be referenced. This report provides a great background on what is of importance when collecting data for a pavement profile. Based on recent research studies conducted by FHWA including the "2015 Evaluation of High-Speed Inertial Profilers", awaiting publication, the inertial profiler industry has developed high speed devices that a very capable of collecting the wavelengths of importance on all pavement surface types if the height sensors can meet the AASHTO M 328 resolution requirements, use line laser technology, and are mounted close to the surface. It is encouraged to expand the portfolio of potential reference devices beyond the list of
walking pavement profilers. The recommended funding is not sufficient to fund this work. T. Van/HIF - Concur that this project is urgently needed. However, the estimated cost is too low to accomplish objectives.

---

**AASHTO Committee Evaluation for D-08**

Submitted By:  
Casey Soneira  
AASHTO Liaison  
Committee on Materials and Pavements (COMP)

Comments:  
The current AASHTO R-56, "Standard Practice for Certification of Inertial Profiling Systems" was develop before the current FHWA requirements (MAP-21) for collecting and submitting International Roughness Index Data. AASHTO R-56 does not fully correspond with these newer data requirements. This relatively low cost and short duration project will provide the means for every State to institute an improved profiler certification process that will fully comply with the needs stated in current Federal law. Many state expressed interest in being involved with this project and the following states have expressed interest in being on the panel for this project: FL, AL, GA, TN, WY, MO, MD.

---

**Submitter Response for 2020-D-08**

From: [email: csoneira@aashto.org]

Comments from Mr. Donahue: I've incorporated all NCHRP and FHWA comments to the degree possible in the attached doc, with changes highlighted

Contact Info: John Donahue john.donahue@modot.mo.gov

Review Date: 1/9/19
I. PROBLEM NUMBER
   2020–D-09

II. PROBLEM TITLE
   Performance Specifications Implementation Guide

III. RESEARCH PROBLEM STATEMENT

   Many public transportation agencies are in the process of implementing some type of performance specifications for asphalt mix and concrete. Reasons for doing so include a desire to improve long-term durability, encourage contractor innovation, better align design requirements with construction, and to have rational pay adjustments tied to predicted project life.

   Ongoing initiatives such as Balanced Mix Designs for asphalt mixes and Performance Engineered Concrete Mixes lend themselves to a performance specification approach by introducing higher level test methods that are intended to be more directly related to material performance than current methods. Introduction of these test methods and mix design criteria will have a major impact on existing quality assurance programs. Agencies will need to make informed decisions regarding applicability of new tests to process control, quality control, and/or acceptance. Lot and subplot sizes may need to be adjusted to account for test time and complexity. Quantity of material obtained for testing may need to be increased. Technician training and certification programs will need to be addressed, as will laboratory qualification/accreditation programs. Independent Assurance procedures will need to be developed, and the impact on dispute resolution programs must be assessed. Precision and bias of the newer test methods will need to be determined, along with appropriate specification limits for various quality characteristics. New approaches to pay adjustments will need to be developed.

   Agencies will benefit from a performance specification implementation guide for asphalt and concrete. The transition from current QA practices which often rely on properties such as aggregate gradation or mixture volumetrics to performance-related criteria will be challenging, and will introduce new risks for DOTs and contractors. Understanding the impact on performance-related
testing on the core elements of quality assurance will help this transition to occur in a controlled fashion, and could help minimize risk to both parties during the implementation process.

IV. LITERATURE SEARCH SUMMARY

There have been several recent studies related to this subject. NCHRP Synthesis “Performance Specifications for Asphalt Mixtures” documents the current state of practice with regards to performance tests used in conjunction with volumetric properties for asphalt mixtures. One of the suggestions for future research identified by the authors is “Guidance to agencies and contractors on how to successfully implement the use of [Performance-Based Specifications] for asphalt mixtures.” This proposed research would help achieve this goal.

The SHRP2 report “Strategies for Implementing Performance Specifications: Guide for Executives and Project Managers” provides excellent guidance on high-level implementation strategies considering organizational, cultural, legal, and project delivery considerations. It identifies areas for agencies to consider regarding sampling, testing, and acceptance/payment, but does not drill down to provide guidance on these issues.


Scott III, Sidney; Konrath, Linda; Ferragut, Ted; Anderson, Stuart; Damnjanovic, Ivan; Huber, Gerald; Katsafansa, Jim; McGhee, Kevin; Sprinkel, Michael; Ozyildirim, Celik; Diefenderfer, Brian; Merritt, David; Dawood, Dan; Molenaar, Keith; Loulakis, Michael C; White, David; Schaeffer, Vernon R.: “Performance Specifications for Rapid Highway Renewal” - Transportation Research Board, SHRP2 Report S2-R07-RR-1, 2014.

Each of the studies referenced below provide information regarding test methods, quality control and acceptance procedures, and recommended specifications, but none of them provide guidance on implementing performance specifications while considering all the core elements of a quality assurance program.

RESEARCH OBJECTIVE

Develop a guide to assist public transportation agencies with implementation of performance specifications for asphalt and concrete materials.

Possible tasks include:

Task 1 – Literature review.

Task 2 - Provide clear, consistent definition of terms related to performance specifications.

Task 3 - Identify existing test methods and mix design procedures that are likely to be included in performance specifications for asphalt and concrete. Include those tests and procedures from SHRP2 R07 “Guide Performance Specifications.”

Task 4 - Determine the impact of implementing these tests and procedures on DOT QA programs, including: technician training and certification; laboratory accreditation; Lot and sublot sizes; material sample sizes; turnaround time for test results; cost of testing; applicability of various tests for design approval, process control, quality control, acceptance; IA procedures; dispute resolution process.

Task 5 - Develop guidance for agencies to use during implementation of performance specifications. Include guidance on setting up pilot projects/shadow specifications, setting appropriate control and specification limits, and suggest ways to gain buy-in from agency and industry personnel.

Task 6 - Publish the final guide as a draft AASHTO recommended practice.

ESTIMATE OF PROBLEM FUNDING AND RESEARCH

Recommended Funding:

$400,000.00

Research Period:

24 months
VII. URGENCY AND POTENTIAL BENEFITS

Performance specifications have the potential to dramatically improve the long-term durability of pavements and structures. Even a small increase in project life would result in millions of dollars in annual savings for state DOTs. Guidance on proper implementation of performance specifications could help avoid early failures which could slow or prevent implementation, and could help minimize risk to DOTs and contractors.

VIII. IMPLEMENTATION PLANNING

Implementation of the guide will be accomplished through presentations at the AASHTO Committee on Materials and Pavements, adoption as an AASHTO recommended practice, and through presentation at various regional and national meetings and conferences, including the TRB annual meeting. Challenges will include aversion to the real or perceived risks by both agencies and contractors, lack of trained personnel, and cost of associated equipment, training and specification development. Inconsistent terminology related to QA and performance specifications will present challenges by inhibiting effective communication at the national level.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Rick Bradbury, Director of Materials Testing and Exploration, Maine Department of Transportation
Tel: (207) 624-3482
Richard.bradbury@maine.gov
Dr. Dimitrios Goulias
Associate Professor
Director of Undergraduate Studies
Civil & Environmental Engineering
Department University of Maryland
0147 G.L. Martin Hall, College Park,
MD 20742 Tel (301)405-2624, Fax (301) 405-2585

X. AASHTO MONITOR

XI. SUBMITTED BY

Rick Bradbury, Director of Materials Testing and Exploration, Maine Department of Transportation
Tel: (207) 624-3482
Richard.bradbury@maine.gov
NCHRP Review of D-09

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research. Although not stated, the research appears to be limited to highway pavements.

D. Is the scope of the research reasonable?

The scope is not well defined but is expected to cover only highway pavements (both asphalt and concrete).

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 24 months appears adequate.

F. Is the budget adequate?

The proposed budget of $400,000 appears adequate.

G. Comments on current or past research on the topic.

Several studies have been cited. However, the research could benefit from ongoing research sponsored by the FHWA and the asphalt industry; coordination with these activities would be helpful.

Review Date:
12/7/2018
FHWA Evaluation of D-09

Corrigan/ HRDI-20 - High priority item for agencies. Performance specifications have the potential to dramatically improve the long-term durability of pavements and structures. Even a small increase in project life would result in millions of dollars in annual savings for State DOTs. Agencies will benefit from a performance specification implementation guide. May need to limit the scope to more fundamental tests which can more adequately ascertain performance and are sensitive to materials and pavement mixture properties. Is this project correctly categorized under F - Maintenance? Or should it more correctly be placed under D? Materials and Construction? Due to the emphasis on pavement performance testing and impacts on QA activities, it would appear to be a Materials and Construction item. HICP-40/ HICP-50 (J. Withee) - This project was widely supported by the AASHTO COMP and TRB Committtee AFH20. This problem statement is an important next step in the ongoing implementation of performance specifications that will assist states with a walkthrough of the practical considerations of this approach. Care should be taken that Task 3 on test methods does not get too far down in the technical details as there is significant research already on the testing options. Task 4 on impacts to quality assurance programs is much needed as there has been limited research in this area to date.

AASHTO Committee Evaluation for D-09

Submitted By:
Casey Soneira
AASHTO Liaison
Committee on Materials and Pavements (COMP)

Comments:
This work will further the widespread and high priority work in asphalt (Balanced Mix Design) and concrete (Performance Engineered Mixtures) materials performance testing and previous SHRP2 "Guide Performance Specifications" This proposal is extremely timely and needed by States to provide a way forward to implement these important testing and specification developments. Implementation is the key, this work will answer how. The following states have expressed interest in participating in this research: WI, CA, CO, AL, ME, VT, NE, KS, NY, PA, MN

Submitter Response for 2020-D-09

From: [email: csoneira@aashto.org]
Comments: FHWA comments: The submitter appreciates the positive feedback from the FHWA reviewers. Regarding Mr. Corrigan's comment about limiting to more fundamental tests, I don't disagree, but this would likely be driven by the technical panel and research team, based on their knowledge of which tests are being implemented by agencies. I agree with Mr. Withee's comment regarding suggested Task 3. The objective is to look at the various types of performance tests being proposed strictly from the point of view of determining the impact on QC and Acceptance testing related to relative test complexity, duration, specimen size, etc. Agree very much with the comment regarding Task 4.

NCHRP comments: The submitter appreciates the positive comments. I agree very much with the comment regarding coordination with ongoing FHWA and industry efforts.

Contact Info: Rick Bradbury: Richard.bradbury@maine.gov

Review Date: 1/4/2019
To date state highway agencies (SHAs) routinely accept highway materials based on quality assurance (QA) procedures. These QA procedures are based on certifications and material requirements, a variety of material specifications (method, end-result and performance requirements) and acceptance plans, which are part of a QA program. These quality assurance requirements consider in most cases the federal regulations for construction QA procedures 23 CFR, Part 637B, the Federal Highway Administration (FHWA) recommendations on developing QA programs, and AASHTO recommendations for QA.

Several studies have identified the potential advantages of incorporating nondestructive testing (NDT) into the QA process for highway materials. Use of NDT methods provide “added value” in the QA process since they allow for: quickly assessing product uniformity in real-time as construction progresses; identification of potential defects during construction allowing for quick corrective actions; inspection/testing at higher frequency and replication without destructive or damaging effects related to coring and other destructive testing; and thus, can lower testing and inspection cost while improving construction quality and available data for SHAs to use in the acceptance process. In regards to concrete, NDT methods are able to evaluate concrete properties and uniformity, honeycombing and segregation, cover depth, and detect reinforcement location and characteristics. Similarly, in asphalt mixtures NDT methods can identify thermal uniformity, density and stiffness. While several NDT test methods have been explored for several years, the transition from research and forensic investigations to QA has been somewhat limited because of either the complexity of such methods or lack of required training by QC technicians and agency inspectors.


V. RESEARCH OBJECTIVE

Develop a manual to assist state highway agencies with the development and implementation of Quality Assurance Plans incorporating Non Destructive Testing.

Possible tasks include:

1) Literature review. This should include: i) an overview of existing Quality Assurance procedures in place for concrete and asphalt materials for highway applications; ii) review the current practice in NDT methods applicable to asphalt and concrete materials for highway applications.

2) Identify NDT methods that are likely to be included in quality control (QC) and acceptance testing for asphalt and concrete. Objective of this review does not include any NDT experimental testing but rather to
review the knowledge and results with NDT methods available in practice.

3) Recommend QA program(s) incorporating NDT for asphalt and concrete materials in function of the specific highway applications. NDT methods could be considered for adoption into a QA process during: quality control testing by the contractor; and, inspection, verification and acceptance testing by SHA inspectors. Determine the impact of implementing these NDT tests and procedures on SHA QA programs, including: technician training and certification; laboratory accreditation; Lot and subplot sizes; material sample sizes; turnaround time for test results; cost of testing; applicability of various tests for process control, quality control, acceptance; IA procedures; dispute resolution process; and cost/benefits analysis assessment.

4) Develop a guidance manual that provides an overview of the current practice of NDT methods applicable to concrete and asphalt mixtures along with a brief description of the principles of operation, detection capabilities, potential benefits, and, associated limitations and drawbacks. Objective of such manual is not to recommend to SHAs any specific NDT method but rather to illustrate the features of different methods and how they are applicable to QA. Include guidance for agencies on the: development and implementation of NDT based QA procedures; on setting up pilot QA procedures before full scale implementation; assessing appropriate control and specification limits, and suggest ways to gain buy-in from agency and construction personnel.

5) Develop an implementation plan, publish the final guide as an AASHTO recommended practice and provide workshops and webinars to SHAs and FHWA personnel.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH

Period Recommended Funding: $250,000.00

Research Period: 24 months

VII. URGENCY AND POTENTIAL BENEFITS

NDT based QA plans have the potential to dramatically improve the quality of accepted highway materials and reduce SHA buyer risk since they allow for: quickly assessing product uniformity in real-time; identification of potential defects during construction allowing for quick corrective actions; inspection/testing at higher frequency and replication without destructive or damaging effects; and thus, can lower testing and inspection cost while
improving construction quality and reducing SHA buyer risk and potential for contract litigation. The long-term effects of higher quality construction will be improved durability and performance of highway structures, which would result in millions of dollars in savings for state highway agencies.

VIII. IMPLEMENTATION PLANNING

Implementation of the guide will be accomplished through presentations at the AASHTO committees pertinent to materials, pavements and bridges, adoption as an AASHTO recommended practice, workshops and webinars to SHAs and FHWA personnel, and through presentation at various regional and national meetings and conferences, including the TRB annual meeting.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Dr. Dimitrios Goulias
Associate Professor
Director of Undergraduate Studies
Civil & Environmental Engineering
Department University of Maryland
O147 G.L. Martin Hall, College Park,
MD 20742 Tel (301)405-2624, Fax (301) 405-2585

X. AASHTO MONITOR

XI. SUBMITTED BY

Katherine Holtz
CDA Program Director-Strategic Projects
Division Texas Department of Transportation Katherine.Holtz@txdot.gov

Rick Bradbury
Director of Materials Testing & Exploration Maine Department of Transportation Richard.bradbury@maine.gov

NCHRP Review of D-10
Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research.

D. Is the scope of the research reasonable?

The scope is not well defined. As written it appears to include all highway assets (pavements, bridges, culverts, etc.). However, different NDT approaches are required for the different types of assets (e.g., NDT approaches that are suited for asphalt pavements may not be appropriate for concrete pavements or steel structures). It is suggested that the scope be limited to specific applications (e.g., pavements or bridges).

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 24 months appears adequate if the scope is limited to certain assets.

F. Is the budget adequate?

The proposed budget of $250,000 appears adequate if the scope is limited to certain assets.

G. Comments on current or past research on the topic.

Several studies have been cited but further literature review should be performed as part of the research.

Review Date:
12/7/2018
FHWA Evaluation of D-10

Azari/ HRDI-20 - The document resulting from this study would be very useful and would be the first step toward developing guidelines and manuals for different applications of NDE technologies. The asking budget is also reasonable. HICP-40/ HICP-50 (J. Withee) - This project was supported by TRB committee AFH20 and is supported by AASHTO COMP. Questions are being raised by States as to how to incorporate NDT into the QA program and this project would help. Task 2 on identification of NDT methods should include information on accuracy, reproducibility, and complexity of data interpretation for each test method. These factors will be very important for States in making a determination on which methods might best enhance their quality assurance programs.

AASHTO Committee Evaluation for D-10

Submitted By:
Casey Soneira
AASHTO Liaison
Committee on Materials and Pavements (COMP)

Comments:
The current Code of Federal Regulations is written to correspond to historical destructive methods of sampling and testing that allow for larger/multiple/split samples to be acquired randomly and tested at a later date by various entities. Relatively new AASHTO Non Destructive Test (NDT) Methods such as PP-80 "Paver Mounted Thermal Profiling", PP-81 "Intelligent Compaction" and PP-98 "Asphalt Surface Dielectric Profiling System using Ground Penetrating Radar" generate data in real time that is only available during construction operations. These methods collect data faster and on a widespread manner that instantly provides the means to consider the quality of the work and make improvements. Incorporating these systems into the acceptance decision will improve the final product and reduce inspection costs. This work will provide the means to validate these new test methods and incorporate them into specifications. The following states have expressed interest in participating and supporting this research: AL, NE, CT, AK, CO, MO, MN
I. PROBLEM NUMBER
2020-D-11

II. PROBLEM TITLE
Developing test method and specification limits to evaluate trackless tack and tack coats for different paving applications

III. RESEARCH PROBLEM STATEMENT
Bonding of different layers within a pavement structure is critical to ensure its durability. The quality of this interfacial bond is dictated by the quality and durability of the tack coat used during pavement construction, maintenance or rehabilitation. Over the last few years, there have been several developments (some that are proprietary) in terms of the equipment to apply the tack coat as well as in terms of the tack coat material itself. Specifically, over the last few years the use of trackless tack has gained a lot of attention in the pavement industry. One of the main advantages of trackless tack is that it allows for the tack coat to remain in place on the surface even with construction traffic until the mix is placed on it. The ability to retain the desired amount of tack on the pavement surface is strongly tied to the overall durability of the bond and the pavement surface.

Several producers have developed some variation of a trackless tack coat and have approached different roadway agencies for product approval. Agencies and in some cases producers of these products have developed several different laboratory tests to evaluate the trackless character of the emulsion and its bond strength to qualify the use of this material. There is a need to revisit these methods that have been developed, particularly over the last decade, and develop a standard test method(s), relevant parameters that are indicative of the trackless character and bond strength derived from these method(s), and tentative specification limits based on field performance and/or criteria.

IV. LITERATURE SEARCH SUMMARY

Most of the research relevant to this topic can be classified into three categories.

The first broad category is related to the development of a mixture-on-mixture specimen test for use in the laboratory or field to evaluate the efficiency of a tack coat (1-6). For example, such tests involve the use of a composite lab or field specimen that is subjected to a direct shear, torsion, pull off or other mode of loading to induce either adhesive failure in the tack coat that binds the two specimens or cohesive failure in the specimen itself when the tack coat is exceptionally strong. This category also includes studies that have used the aforementioned test method to evaluate the optimal application rate of tack coat for different tack coat types and mixture types (e.g. optimal tack coat rate for fine vs coarse mixes). Note that these studies have focused on the use of tack coats in general and are not specific to trackless tack. The most recent large scale study on this topic is
documented in NCHRP Report 712. In the context of this problem statement, it is important to review studies in this category for potential use as a validation tool in addition to field validation.

The second category of tests focuses on the evaluation of the tack coat material itself without using the tack coat material between two mixture specimens. This is important from a standardization and purchase specification point of view because there is no standard asphalt mixture specimen that can be used to evaluate the bonding characteristics of a tack coat. For example, in one study the mixture-on-mixture testing format was used to evaluate the tack coat but using a polymer specimen instead of a mixture specimen to standardize the substrate type (8). Other studies have measured rheological properties of the tack coat (e.g. using a Dynamic Shear Rheometer or a pull-off tester) and attempted to correlate these to the performance of the tack coat in laboratory or field (9-10). Again, these studies are not necessarily focused on trackless tack but are related to tack coats in general. Based on a preliminary review of the literature, there appears to be a need to identify such tests that can be used to screen and specify the tack coat.

The third category of tests is specific to trackless tack and relates to the ability of the trackless tack coat to retain its trackless characteristic under different conditions. A few different tests have emerged in this category. For example, the ASTM D711 test with rubber gaskets and a heavy roller intended for paints has been adapted by Virginia to evaluate the trackless tacking characteristic (7). Another study reports the development and use of a DSR as a pull-off device to evaluate the trackless characteristic of the tack coat (11). This study also reports that this method was originally developed by some of the trackless tack producers to evaluate the efficacy of their products. This category is also one of main focus areas of the proposed study.

V. RESEARCH OBJECTIVE

The research study is intended to develop standard test method(s), parameters and tentative specification limits to evaluate the durability of tack coats and also the trackless characteristics of trackless tacks. These tests are intended to evaluate the tack coat material itself and supplement testing with mixture specimens as developed in previous studies.

Specifically, this study must consider, but not be limited to, the following aspects:

1. Review existing literature for (i) available methods from NCHRP Project 09-40 and other studies to evaluate the quality of tack coats in the field and laboratory, and identify specific methods (field and/or lab) that can be used as the basis to validate the findings from this study, (ii) methods to evaluate the quality of the tack coats as a material including trackless tack using devices such as the DSR or pull-off tester, and (iii) methods to evaluate the trackless quality of a trackless tack.

2. Develop and/or modify test method(s) to evaluate the performance related characteristics (e.g. bond strength, ductility while taking into account factors such
as temperature sensitivity and aging) of tack coats including trackless tacks, and trackless characteristics of a trackless tack. Identify and validate parameter(s) from such test(s) using performance of the tack coat in laboratory and/or field conditions.

3. Analyze performance requirements for different pavement structure configurations (e.g. tack coat shear strength or bonding requirements will be different when used with an ultrathin overlay), and propose specification limits for the tack coat properties measured above for different pavement configurations.

4. Provide draft AASHTO specifications related to the methods developed above.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
The recommended funding is $500,000 for a duration of two years.

VII. URGENCY, PAYOFF POTENTIAL AND IMPLEMENTATION
Tack coats dictate the efficiency of any pavement structure to function as an integral unit and perform for its intended design life. Over the past few years there has been increase in the use of preservation technologies such as thin and ultrathin overlays that induce very high stresses on the tack coat. In addition there has been an increase in the use of trackless tack to facilitate the construction of pavements and a number of producers have emerged with competing technologies. These emerging products and changes in construction can benefit the industry but there is also an urgent need to ensure that these technologies deliver what is promised. The findings from this study will help bring together and perhaps improve on the several disparate studies that are already being conducted by different states to address this issue.

VIII. PERSON(S) DEVELOPING THE PROBLEM
Dr. Amit Bhasin
Director, Center for Transportation Research
a-bhasin@mail.utexas.edu

Lyndi D. Blackburn, P.E.
Alabama DOT
Asst. State Materials & Tests Engineer
(334) 206-2203
blackburnl@dot.state.al.us

IX. PROBLEM MONITOR
Lyndi D. Blackburn, P.E.
Alabama DOT
Asst. State Materials & Tests Engineer
(334) 206-2203
blackburnl@dot.state.al.us

X. DATE AND SUBMITTED BY
REFERENCES


8. Aliasghar Dormohammadi, Cheng Zhu and Vivek Tandon, Laboratory Evaluation of Tack Coat Quality, Poster Session PP2, 4th Conference of Transportation Research Group of India (CTRG), December 2017, Mumbai, India


NCHRP Review of D-11

Reviewed By:
Amir N. Hanna
ahanna@nas.edu
Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research.

D. Is the scope of the research reasonable?

The scope is reasonable but needs more clarity and specifics. It is suggested that the scope identifies the specific applications for which the recommended test method will be developed. Also, proposing specification limits should not be part of the research. However, the research should propose an approach that can be used to select appropriate limits for specific applications.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 24 months appears adequate.

F. Is the budget adequate?

The proposed budget of $500,000 appears adequate.

G. Comments on current or past research on the topic.

Several studies have been cited but further literature review should be performed as part of the research. the research should build on the work performed in NCHRP Project 09-40.

Review Date:
12/7/2018

Submitter Response for 2020-D-11

From: a-bhasin@mail.utexas.edu
Comments:

Based on the feedback from NCHRP we would like to add some clarification to the Scope of Work. The edited version is below.

SCOPE OF WORK:
Specifically, this study must consider, but not be limited to, the following aspects:

1. Review existing literature for (i) construction and engineering properties of tack coats that are relevant for different paving applications (e.g. properties that are significant for thin and ultra-thin overlays may be different from properties significant for tack coats several inches below the final pavement surface), (ii) available methods from NCHRP Project 09-40 and other studies to evaluate the quality of tack coats in the field and laboratory, and identify specific methods (field and/or lab) that can be used as the basis to validate the findings from this study, (iii) methods to evaluate the quality of the tack coats as a material including trackless tack using devices such as the DSR or pull-off tester, and (iv) methods to evaluate the trackless quality of a trackless tack.

2. Develop and/or modify test method(s) to evaluate the performance related characteristics (e.g. bond strength, ductility while taking into account factors such as but not limited to (i) temperature sensitivity and aging) of tack coats including trackless tacks, (ii) trackless characteristics of a trackless tack, and (iii) type of paving application where the tack coat is intended for being used. Identify and validate parameter(s) from such test(s) using performance of the tack coat in laboratory and/or field conditions.

3. Analyze performance requirements for different pavement structure configurations (e.g. tack coat shear strength or bonding requirements will be different when used with an ultrathin overlay), and propose a methodology to obtain specification limits for the tack coat properties measured above for different pavement applications.

4. Provide draft AASHTO specifications related to the methods developed above.

Contact Info:
Lyndi Blackburn; blackburnl@dot.state.al.us
Amit Bhasin; a-bhasin@mail.utexas.edu
Darren Hazlett; Darren.Hazlett@austin.utexas.edu

Review Date:
15 January 2019
Research Field E

SOILS AND GEOLOGY
NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2020-E-01

II. PROBLEM TITLE

Guidance on the Selection and Use of Flow Resistance Values in Two-Dimensional (2D) Hydraulic Models

III. RESEARCH PROBLEM STATEMENT

Numerical hydraulic modeling involving fluid flow requires information on the interaction between the fluid domain and its boundaries. Free-surface flow in open channels such as rivers, irrigation canals, roadside drainage ditches, streets/gutters, etc., is analyzed by assigning Manning’s n values to the land features comprising the flow boundaries. For relatively straight, prismatic channels, the Manning’s n value can be related to other measures of roughness such as the Chezy coefficient C and the Darcy friction factor f . However, for natural channels, the Manning’s n value is widely recognized as a lumped parameter that includes the effects of a variety of factors such as (Chow, 1959):

- Boundary roughness,
- Degree of channel irregularity,
- Variations in channel cross section,
- Relative effect of obstructions,
- Vegetation, and
- Degree of meandering.

Manning’s n values for channels and floodplains are typically estimated from standard tables that have been developed from well-documented studies (e.g. Chow, 1959; Barnes, 1967; Arcement and Schneider, 1989; Brunner, 2016). Where field data are available, Manning’s n values can be determined as part of a calibration effort. Manning’s n values can be estimated for various land use types based on field reconnaissance, aerial imagery, site photos, or proposed project plans. In 1D models such as HEC-RAS, a composite n value is typically calculated for horizontally varying n values within the main channel (Chow, 1959,
equation 6-17). Roughness related to bedforms in alluvial channels is described in Hydraulic Engineering Circular No. 20, “Stream Stability at Highway Structures,” (HEC-20) (Lagasse et al., 2012).

The transportation hydraulics community of practitioners recognizes that flow resistance values (or “roughness” values) along with channel and floodplain geometry are the two most important factors in estimating discharge capacity and water surface elevations (Zevenbergen et al., 2012). Where possible, calibration to actual flood events with known discharges and high-water marks is strongly encouraged, along with sensitivity analysis and testing. The Manning’s n value impacts bridge scour predictions, floodplain management, and hydraulic sizing of bridges and culverts. Projects involving pavement overlays, roadway widening, realignment, and/or bridge or culvert replacement are very common examples.

Historically, 1D models (e.g. HEC-RAS, Brunner, 2016) have been used to assess hydraulic conditions and water surface elevations for transportation projects using existing Manning’s n value charts from the previous studies. However, practitioners in the transportation hydraulics community are transitioning to 2D hydraulic modeling (e.g. SRH-2D, Lai 2008) to yield more accurate results and are discovering that the existing Manning’s n values do not reliably yield reasonable results when used with 2D models. Manning’s n values provided in current guidelines were developed in the context of using simplified equations and 1D models (e.g., Barnes 1967). However, a 1D hydraulic model is dependent on cross section placement and spacing assumptions and does not consider lateral movement of the flow (Zevenbergen et al., 2012).

Efforts led by FHWA through the Every Day Counts (EDC) program were initiated in EDC-4 (2017-2018) under the “Collaborative Hydraulics: Advancing to the next Generation of Engineering (CHANGE) innovation to increase the use of 2D hydraulic modeling in State DOTs. The success of the program and participation (44 states are participating) have carried the CHANGE innovation to the next EDC-5 (2019-2020).

The 2D hydraulic modeling computational tools and graphical user interfaces such as SMS (Aquaveo, 2018) have become more versatile, powerful, and user-friendly along with accessible computing technology and hardware. The same factors that affect the reliability of the bridge scour equations, including uncertainty in the estimation of Manning’s n values, affect water surface elevations, inundation levels, and flow velocity, all of which are important to transportation hydraulic modeling.

In a 2D model, some of the components commonly lumped into 1D flow resistance values are accounted for directly in the constitutive equations for shallow water flow. Because of this, it is reasonable to conclude that the roughness values used for 2D models should be lower than those used in 1D models. At present, there have not been adequate studies published on this
topic to make definitive conclusions regarding adjustments appropriate for 2D models. Anecdotal information suggests that a significant variation from current roughness selection guidance may be warranted.

At present, the FHWA recommends using unadjusted Manning’s n values from resources such as those cited above for estimating roughness values for use in 2D models (Zevenbergen et al., 2012). However, as stated in Vennard and Street (1975), “There is no substitute for experience and judgment in the interpretation and selection of values for n,” and in current practice, this selection is done by the hydraulic modeler.

If there is a systematic bias between the roughness values needed to calibrate 2D models versus well-posed 1D models using the same underlying data set, then it is important to recognize and quantify that difference. When sufficient calibration data are available, reasonable adjustments to estimated roughness values will likely be justified for 2D modeling applications. The focus is to increase the reliability and decrease the subjectivity in modeling efforts by promoting sound engineering practice via the development of guidance on appropriate selection of Manning’s n values for 2D modeling applications.

As is the case with 1D models, most 2D models allow for the variation of Manning’s n values with flow depth. Most land use types can result in a variation of roughness values depending on flow depth. Chow presented results from various studies that show how the Manning’s n value decreases with an increase in depth and discharge (Chow 1959, pp 104-106). However, there is only limited guidance presented by Chow for the numerical values of n related to different depths. During laboratory experiments, the relative roughness of willows standing and laying down during different discharges was documented during laboratory experiments conducted under NCHRP Project 24-39 (Lagasse et al. 2016, pp 70-72), but the range of flow depths and willow configurations were limited.

References Cited:


IV. RESEARCH SCOPE

The scope of this research project is briefly summarized as follows:

1. Perform a literature review to identify and document domestic and international protocols, guidance documents, reference manuals, and recommended practices for selecting resistance values for 2D hydraulic modeling at highway crossings and in transportation corridors.

2. Conduct a survey of practitioners to define the current state of practice in selecting roughness values for 2D hydraulic modeling and identify potential data
resources. Agencies involved in river and floodplain management will be surveyed.

3. Identify model databases from well-documented field and laboratory studies that can be used to calibrate, verify, and identify roughness values appropriate for 2D hydraulic models.

4. From the data sets identified in Task 3, develop illustrative examples as “how-to” guidance for building 2D hydraulic models with emphasis on selection of roughness values for a variety of situations commonly encountered in transportation engineering practice. Situations to be illustrated by way of example using 2D models will include:

- Flow in main channel and overbank areas
- Flow in main channel and overbanks, including a bridge and approach roadway embankments
- Flow in main channel and overbanks, including a submerged bridge deck (i.e., pressure flow), and overtopping of one or both approach roadway embankments
- Split flow and return
- High gradient stream in narrow canyon with roadway and bridge

Each of the above scenarios will be modeled using both 1D and 2D hydraulic models in order to compare and contrast the selection of appropriate Manning’s n values. Sensitivity of the models to Manning’s n selection will be fully explored and documented and detailed guidance on the selection of roughness values will be developed.

The emphasis of this task will be on steady flow models, but if well-documented unsteady flow data sets are available, they will be considered as well.

5. Produce a final research report documenting the results of the research effort.

6. Produce an implementation handbook as a guidance document for practitioners.

V. RESEARCH OBJECTIVES

The objectives of this research effort are to:

a. Assess and document the state of the practice with respect to the selection of Manning’s n values for 2D hydraulic modeling applications compared to traditional 1D approaches commonly used by State DOTs in transportation-related settings.
b. Develop guidelines for selecting roughness values for 2D modeling that can be implemented by FHWA, the DOTs, and other transportation hydraulics practitioners as this state of the practice evolves.

To achieve these objectives, at a minimum the following tasks are to be performed:

**Phase I tasks:**

1. **Review of existing knowledge:** Research needs to be done to summarize the existing body of knowledge and the research needed to fill the gaps that are reflected by the current state of practice (see Sections III and IV above).

2. **Formulate a work plan and survey State DOTs and other agencies:** This task will include a survey of State DOTs (and other agencies as identified in Section IV above) to determine commonly used 2D hydraulic models in transportation-related settings. Consultation with FHWA Resource Center personnel is highly encouraged during this task. The work plan will identify the hydraulic modeling approaches to be evaluated and will provide a plan for identifying potential field sites and laboratory studies that could yield data sets for model calibration and verification, with emphasis on the selection of roughness values.

3. **Identify field and laboratory data sets to be used in the assessment of 2D models:** This task will include compiling data from previous studies where reliable and well-documented methods have been employed to model low flows and flood flows in transportation-related riverine settings. This includes various methods for establishing materials (roughness) characteristics from field studies, aerial imaging, and topographic and hydrographic survey data, including lidar data collection and processing. Data sets to be employed in modeling various hydraulic scenarios will be presented and discussed (see Section IV above). The scope of this task does not include coastal or tidally-influenced applications.

4. **Submit an Interim Report with recommendations for Phase II of the research project:** The Interim Report will present the findings and recommendations from Tasks 1-3 above and will include a plan for Phase II of the research. The Phase II work plan must be approved by the NCHRP Research Panel prior to commencing Phase II tasks, described below.

**Phase II tasks:**

5. **Develop and calibrate 2D hydraulic models identified in Phase 1:** This task will consist of developing, interpreting, and documenting the 2D modeling for the scenarios described in Section IV above. The discussion should emphasize the proper selection and implementation of Manning’s n values, with particular
attention given to the recommended methods that are used in 1D versus 2D models. The pros and cons of spatial refinement in the models and sensitivity to spatial variability in Manning's n should also be discussed.

6. Produce illustrative examples of common riverine model applications: This task will focus on providing detailed and definitive guidance to the transportation hydraulic modeling community by way of illustrative examples. The common hydraulic scenarios described in Section IV above will be modeled using both 1D and 2D models, with ample discussion supplemented by photos, figures, graphs and model output tables. Detailed guidance on selecting roughness values for the various scenarios will be provided and will highlight the differences in Manning’s n roughness values appropriate for 1D versus 2D applications.

7. Final Deliverables: The final deliverables will consist of two documents. The first document will present the research performed and will include a detailed literature review, the results of the Survey of Practitioners, the identification and documentation of field and laboratory data sets, and the 1D versus 2D illustrative examples.

The second document will be an abbreviated guidance manual which will emphasize the appropriate selection of Manning’s n values for use in 2D hydraulic models, and will be geared to the needs of the hydraulic modeling community of practitioners using a “how-to” approach. Specific guidance will be given to discussing and comparing/contrasting the results of the 1D versus 2D modeled scenarios described in Section IV as related to their sensitivity to the roughness values selected. This guidance manual will also provide an annotated list of references to facilitate access to additional information relevant to 2D hydraulic modelers.

It is anticipated that the data sets for all hydraulic model scenarios will be made available as web-only documents to be made available by accessing the TRB web site.

VI. ESTIMATE OF RESEARCH FUNDING AND RESEARCH PERIOD

Recommended Funding:

$500,000

Research Period:

30 months

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION
Measures to improve the accuracy, reliability, and consistency in selecting roughness values for the application of 1D and 2D hydraulic models at highway crossings and in transportation corridors will represent a major step forward in the evolving state of practice. Some state DOTs have readily embraced the application of 2D models for transportation facility planning, analysis, and design; other states have held back and taken a more “wait and see” approach as the tools and techniques have continued to advance.

At present, whether a 1D or a 2D modeling approach is taken, there currently exist many inconsistencies from state to state, and even within states at the various district levels, on how to develop hydraulic models that are accurate and reliable. Fundamental to this issue is the selection and assignment of Manning’s $n$ resistance values for a variety of channel types and land uses in the overbank floodplain areas. Manning’s $n$ values along with channel and floodplain geometry (i.e., topographic and hydrographic surface data) are recognized to be the two most important components for developing and calibrating hydraulic models. Definitive and detailed design guidelines are lacking on proven methods to improve the state of practice, on a national level, in the rapidly-advancing field of 2D hydraulic modeling.

Hydraulic modeling by its nature involves a compromise between the need to establish detailed data inputs to increase accuracy and reliability of the modeled scenario, and the cost to acquire such data given the objectives of the particular project or issue being examined. For example, hydraulic modeling to determine the suitability of different project alternatives for aquatic organism passage may require much more refined and data-intensive inputs compared to a model that is created for broader floodway/floodplain management decisions.

Identifying feasible, cost effective, and consistent guidance and methods to improve the state of the practice in selecting roughness values for hydraulic modeling is highly desirable. The payoff potential to owners of transportation facilities, in particular roadways, bridges and culverts, is significant if the accuracy and reliability of hydraulic models can be improved. It is always the case that project costs increase in proportion to the degree of uncertainty in the analytical method being used.

Implementation of new guidance would be oriented toward revisions of FHWA Hydraulic Design Series (HDS) manuals on 1D and 2D hydraulic modeling approaches and recommendations, the AASHTO drainage manual, and the FHWA’s Every Day Counts (EDC) 2D Hydraulic Modeling Reference Manual (currently in preparation).

VIII. PERSON(S) DEVELOPING THE PROBLEM STATEMENT
IX. PROBLEM MONITOR

To be assigned by NCHRP staff.

X. POTENTIALLY INTERESTED AASHTO COUNCILS AND/OR COMMITTEES

AASHTO Technical Committee on Hydrology and Hydraulics (TCHH)
TRB AFB60, Standing Committee on Hydrology and Hydraulics

XI. DATE AND SUBMITTED BY

October 31, 2018

Jeffrey E. Syar, P.E.
Administrator
ODOT Office of Hydraulic Engineering
1980 West Broad Street, Columbus, Ohio 43223 USA
Jeffrey.Syar@dot.ohio.gov

NCHRP Review of E-01
Comments:

- Is the problem potentially solvable through research? If not, why?

The problem is of high priority and is potentially solvable through the proposed research.

- Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The impact of flooding on transportation infrastructure is an issue of national interest and scope. This research, if successful, will aid in better design of infrastructure to withstand flood events through the transition from 1D to 2D hydraulic modeling.

- Is there a reasonably clear objective? If not, can you suggest a brief improvement?

The key objective, to develop guidelines for selecting roughness values for 2D hydraulic modeling, is clearly stated.

- Is the scope of the research reasonable? Please recommend changes if needed.
  - Can the research be done in 2-3 years at the most? If not, why?
  - Is the budget adequate? If not, why?

The proposed scope and schedule are reasonable. An increase in the budget to $600,000 is recommended.

Review Date:
12/3/2018

______________________________

AASHTO Committee Evaluation for E-01

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
The Committee on Design's Technical Committee on Hydrology & Hydraulics strongly supports this research project. The proposed research timely given that there is a 2D modelling initiative in FHWA's Every Day Counts program. Please include a TCHH member on the panel.
Research Field F

MAINTENANCE
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation
NCHRP Problem Statement

Comments: This problem statement was initiated by the Equipment Technical Working Group of the AASHTO Committee on Maintenance and was endorsed by the committee members at the annual meeting in July 2018.

Problem No: 2020-F-01

1. Problem Title
Strategies to Maximize Vehicle and Equipment Resale Values to Optimize Fleet Total Cost of Ownership

2. Background
Every State DOT Organization has surplus, obsolete or end-of-life equipment. State DOT’s also strive towards a common goal: to realize the highest possible recovery for its assets. Maximizing asset recovery to enhance sales value potential and increase sales proceeds is an important component of an overall strategy for managing fleet total cost of ownership.

Fleet management organizations need to determine:
- How much labor and/or cost to put into an item to prepare it for sale;
- Available methods of marketing their assets (e.g., via local or regional public auctions, sealed bids, private-party transactions, on-line auctions, buy-back, trade-in sales, salvage/scrap, etc.); and
- Effective timing and quantity of sales.
- Opportunities for improving operations

Currently DOTs do not have a guide to make the best decision to market their used equipment, nor do they have a means to determine the advantages and disadvantages of the options available. This results in lost money due to ineffective and inefficient marketing, poor timing of sales, or the wrong mix and quantity of items offered for sale. DOTs market their equipment on an on-going basis. It is crucial to have a robust guide to ensure the best marketing decisions can be made to leverage the highest return.

The results of this research would help:
- DOT fleet managers prepare and schedule equipment for marketing and determine the level of repair (if any) prior to sale,
- Fleet financial officers estimate the capital recovery, and
- Target the most appropriate bidders and marketing method timing.

3. Literature Search Summary
The literature search identified several articles on this topic. Listed publications did not address the holistic approach to marketing surplus DOT fleet items. Operational
impacts such as timing, reconditioning, marketing, etc. need to be included. The proposed research will address these shortcomings in the existing body of knowledge.


The page above links to an article that discusses the survey results by NAFA. Color graphs are provided for quick overview of survey results.


https://www.automotive-fleet.com/156928/iaras-centralized-vehicle-data-repository-arrives

The page above links to an article that discusses the potential benefits of the Centralized Vehicle Data Repository offers. This new centralized data repository allows a single place for marketers to access build data, MSRP, recall, and warranty information at the VIN level – potentially see better pricing as a result.


https://www.automotive-fleet.com/156643/flds-strategy-to-optimize-fleet-marketing-services

The page above links to an article that outlines FLD’s short-term focus on new technologies; its new-term focus on cloud-based inventory management; and a long-term goal of international expansion, particularly in South America.


The above article that discusses the buyers’ perspectives changing, sellers adapting in quest to solidify value of alternative fueled vehicles.


https://www.automotive-fleet.com/148365/marketing-comes-of-age-online
The page above links to an article that discusses the evolution of online auctioning.


https://www.automotive-fleet.com/156928/iaras-centralized-vehicle-data-repository-arrives

The page above links to an article that discusses the marketing considerations begin before purchasing a vehicle and continue through its operational life. Fleet managers should always keep an eye to the future when managing fleet assets.


https://www.automotive-fleet.com/147813/key-milestones-in-fleet-marketing

The page above links to an article presents a timeline of fleet marketing industry.


https://www.government-fleet.com/145344/alternative-marketing-channels-for-government-fleets

The page above links to an article that discusses the traditional marketing channels as well as alternative marketing channels.


https://www.donlen.com/fleet-marketing-best-practices/

The page above links to a white paper that list out the four key area fleet manager should focus to maximize the resell value of their vehicles.


https://www.researchgate.net/publication/46102921_Used_Car_Marketing

The page above links to a study that investigates the used car business, particularly in the United States, Europe and Turkey. The purpose of the study is to uncover the main drivers of the used vehicle business and applicable competition means for OEMs and dealers.


The page above links to an article that discusses the public fleets teaming up on vehicle marketing, whether with another public agency or private auctioneer, talk about how they do it and what they’ve learned.


https://www.government-fleet.com/156061/marketing-green-vehicles

The page above links to an article that discuss while some type of “green” vehicle have been around for a while, new technologies on vehicles make resale value difficult to estimate.


https://www.worktruckonline.com/157048/how-to-maximize-truck-resale-values

The page above links to an article that discusses how a truck is spec has a direct bearing of its future resale value.


The above article that discusses to get the most profit for these assets requires careful planning long before the truck goes up for sale. For some fleets, a truck’s value does not come up until it’s for marketing.


file:///M:/Project/Lifecycle/Thesis_1321005_KULUMBEG_Alexander.pdf

The page above links to a paper that investigates how Mercedes-Benz Slovakia uses Facebook’s marketing functions. It uses mean comparison tests to analyze metrics extracted from the fan page of Mercedes-Benz Slovakia.
The articles, reports and survey listed above cover a broad array of topics related to marketing but they lack the coherent and holistic perspective approach. Moreover, they do not explore in detail alternative options that would avoid marketing all together, such as buyback program, trade-ins, etc. which may possibly simplify fleet management.

4. Research Objective

The primary objective would be to develop guidelines for state DOT fleet management organizations to use when disposing and marketing surplus used fleet assets. The end-product would promote increased sales values to reduce fleet total cost of ownership and will be specific enough to address:

- Disposal methods by vehicle and equipment types,
- Disposing of vehicles and equipment that are in various conditions,
- Disposal methods (auction, buy-back, trade-ins, salvage, etc.),
- Time or day of week/year and quantity of items offered,
- Frequency, location, and bundling of items, and
- Amount of reconditioning/clean-up/repair to perform (if any).

Expected tasks would include:
1. Perform a survey of fleet organizations, including state DOTs, other large public-sector organizations, appropriate private companies, and national equipment marketing companies. This survey will catalog and develop information on the relative cost effectiveness of the specific equipment decommissioning and disposal methods they employ.
1. Assess and evaluate results of the survey to identify relevant factors that would increase sales values.
2. Develop and recommend a decision tree that includes guiding principles to accomplish the project objectives.

5. Implementation Planning

The target audience for this research would be state DOT fleet managers, maintenance engineers, fleet financial officers, auctioneers, and possibly even design engineers whom may alter the design of the equipment to increase its resale value. The guideline would be championed by AASHTO Maintenance Committee with the Equipment Technical Working Group (TWG) taking the lead role for dissemination and training. Details on the use of the guide and tool would be provided through webinars and through presentations at the annual AASHTO Maintenance Committee and the Equipment Management Technical Service Program (EMTSP) meetings.

Metrics that could be used to determine the effectiveness of the recommended research include the following:
- The number of state DOTs that have used the guidelines to develop and implement new marketing programs.
• The number of equipment managers who have found these guidelines to be useful.
• Reductions in used equipment marketing costs
• Increases in used equipment residual values (while controlling for the effects of inflation and changes in equipment specifications).

6. Estimate of Problem Funding and Research Period
   **Recommended Funding:** $300,000
   **Research Period:** 18 months

7. Urgency and Potential Benefits
Implementing best practices for surplus assets, could substantially increase proceeds thus lowering overall cost of the fleet operations. This additional revenue may provide the necessary funding to allow fleet managers to replace additional assets in a quest to meet their goals for replacing all equipment assets beyond their optimal replacement criteria. To do so will have an overall effect of reducing repair expenses and enhancing current replacement budgets.

For fleets that are funded through a charge back system from their operation’s budget, the additional revenue would be reflected in lower charge back rates potentially resulting in additional highway maintenance being accomplished for the same amount of dollars spent.

8. Person(s) Developing the Problem Statement
   John F. White, P.E.
   Director of Supply and Equipment
   Supply and Equipment Office
   South Carolina Department of Transportation
   (803) 737-6675
   whitejf@scdot.org

   Lisa Kunzman,
   Supervising Equipment Engineer
   California Department of Transportation
   Division of Equipment
   (916) 227-9705
   lisa.kunzman@dot.ca.gov

9. Nomination for AASHTO Monitor
   Tim Cunningham, P.E.
   Chair, AASHTO Maintenance Committee, Equipment TWG
   Chair, AASHTO EMTSP Oversight Panel
   Equipment Engineer
   Kansas Department of Transportation
11. Submitted By
   Jon Wilcoxson, P.E.
   Director of Maintenance
   Kentucky Transportation Cabinet
   200 Mero St
   Frankfort, KY 40622
   502-782-5615
   jon.wilcoxson@ky.gov

NCHRP Review of F-01

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research?  If not, why?

The problem appears to be solvable through research. However, recognizing that several related research project were recently completed (Project 13-04) and others are still in progress or planned (e.g., Projects 13-05, 13-06, 13-07, and 13-08), it is suggested that this research be postponed by a year or two to allow consideration of the findings of these project in the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS?  If not, why?

The topic of research should be on interest to the majority, if not all, state DOT fleet managers.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research, and elaborates on the expected uses of the research product.

D. Is the scope of the research reasonable?
The stated scope appears specific and should yield the expected product.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 18 months appears inadequate; 24 months appears more appropriate to allow time for validation of project recommendations.

F. Is the budget adequate?

The proposed budget of $300,000 appears sufficient.

G. Comments on current or past research on the topic.

Several studies have been cited, but further literature review should be performed as part of the research. The research could also benefit from the findings of several ongoing and planned NCHRP projects if the research is postponed by a year or two.

Review Date:
12/6/2018

FHWA Evaluation of F-01

Kessler/ HRDI-20 - In full disclosure, I am a member of AHD60, and the problem statement originators are on this committee as well. I support this work, as it is needed from an asset management perspective, and it would be complementary to several other NCHRP fleet asset projects that are ongoing and recently completed. This project would do useful, proactical research into a topic that has historically received little formalized study, yet its subject matter is very relevant and impactful to DOTs.

Submitter Response for 2020-F-01

From: [email: jon.wilcoxon@ky.gov]

Comments:

Granted there are several equipment management research projects recently completed or underway, but this research project is specific to the area of fleet management related to optimizing the financial return when disposing of equipment. It is not expected that it would be significantly impacted by the results of the research for utilization management (13-05), formulating long range equipment replacement needs (13-06), calculating ownership and operating costs (13-07), or deciding repair verses replacement of equipment (13-08).
This research should help develop guidelines for maximizing the return for the disposal of equipment while minimizing the effort and cost to dispose of that equipment. Results from the above projects may impact when an asset is ready for surplus or how certain cost elements are calculated, but the guidelines developed in this project should not be impacted by those results. Additional literature review as a part of the research could be useful but I am not aware of a compelling reason to delay the project waiting for results of research that will not significantly impact this research.

I agree that the proposed timeframe of 18 months would have been aggressive and that 24 months is a more reasonable timeframe.

**Contact Info:**
Jon Wilcoxson, PE
Assistant State Highway Engineer
Kentucky Transportation Cabinet
200 Mero St
Frankfort KY 40622
502-782-5615

Review Date:
1/18/2019
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Comments: The problem statement is supported by the Pavement Technical Working Group of the AASHTO Committee on Maintenance and was endorsed by the committee members at the annual meeting in July 2018

Problem No: 2020-F-02

1. Problem Title
   Benefit-Cost Analysis of Chip Seal Binder Alternatives

2. Background
   Chip Seals, Seal Coats, and Surface Treatments, names that many times are used interchangeably, are road maintenance treatments that involve application of one or more layers of a single layer of binder covered with a single layer of aggregate. The binder can be an emulsified binder or hot applied binder. Some state DOTs use strictly emulsified binders. Others use strictly hot applied binders. Others use a mixture of emulsion and hot applied binders. There are cost differences, storage differences, long-term storage differences, safety differences, environmental, and traffic control differences between using hot applied versus emulsified binders for chip seals. Are there short-term and long-term performance differences in using these two types of binders? We need a cost benefit analysis of using asphalt emulsion versus hot applied binders to study the possible differences listed above and any others identified. Identify the differences and between emulsion and hot applied binders and the impacts of this material choice. Conduct a cost-benefit analysis of long-term performance.

3. Literature Search Summary
   There has been research on chip seals regarding when to open emulsion chip seals to traffic, comparing polymer modified emulsion and non-polymer modified emulsion, the bond development between emulsion and chip seal aggregate, and other chip seal or emulsion factors. However, very little has been done to directly study performance of hot applied chip seals and emulsified binder chip seals. Research that was reviewed is summarized below:

   **Performance-Based Analysis of Polymer-Modified Emulsions in Asphalt Surface Treatments**
   Richard Kim and Jaejun Lee
   Study of Chip Seals with modified and un-modified emulsions. Modified emulsions performed better initially, long-term and in LCCA.

   **Surface Performance Grading System to Grade Chip Seal Emulsion Residues**
   Denise Hoyt, Amy Epps Martin, and Scott Shuler
Describes development of SPG and several research projects (NCHRP 14-17, TxDOT) and details recovery methods and evaluation of test sections.

**Correlating Rheological and Bond Properties of Emulsions to Aggregate Retention of Chip Seals**
Timothy D. Miller, Zelalem A. Arega, and Hussain U. Bahia

Development of the Bitumen Bond Strength (BBS) and correlations to DSR, Strain Sweep, and sweep test.

**Field Validation of Performance-Based Polymer-Modified Emulsion Residue Tests--The FLH Study**
Gayle King, Helen King, Larry Galehouse, Michael Voth, Laurand Lewandowski, Chris Lubbers, and Paul Morris

Describes residue recovery and testing of emulsions used in the Federal Lands study.

**Determining Time to Uncontrolled Trafficking After Chip Seal Construction**
Scott Shuler and Anthony Lord

Moisture loss is directly related to strength gain using a modified sweep test. One could monitor moisture loss to determine when to open the chip seal to traffic.

**When to Broom or Remove Traffic Control Safely on Fresh Emulsified Asphalt Chip Seals**
Scott Shuler

Field tests of measuring moisture loss as an indicator of strength gain in chip seals. Three full-scale test projects were evaluated.

**Correlation of Moisture Loss and Strength Gain in Chip Seals**
Isaac L. Howard, Scott Shuler, Walter S. Jordan III, James M. Hemsley, Jr., and Kevin McGlumphy

Correlation of moisture loss and strength gain in chip seals using a modified sweep test to measure strength gain.

**Sensitivity of ASTM D7000 Sweep Test to Emulsion Application Rate and Aggregate Gradation**
Petrina Tutumina Johannes, Enad Mahmoud, and Hussain Bahia

Effects of emulsion application rates and aggregate gradation on sweep test performance. The sweep test was not found to be a good design tool.

**Chip Seal with Lightweight Aggregates for Low-Volume Roads**
Md Shahidul Islam and Mustaque Hossain

Evaluated various aspects of light weight chip seal aggregates in Kansas. Indicated that aggregate-emulsion compatibility is a significant factor. Hardness of aggregate determined rutting susceptibility.

**Aggregate Retention in Chip Seals**
Farhana Rahman, M. Shahidul Islam, Haritha Musty, and Mustaque Hossain

Studied aggregate types and impact on retention. Light aggregates performed best. Precoating did not make a significant difference.

**Development of Emulsion Residue Testing Framework for Improved Chip Seal Performance**
Andrew J. Hanz, Petrina Johannes, and Hussain U. Bahia

Used DSR and BBS to evaluate emulsion residues. These worked well at high and intermediate temperatures.
Surface Treatment Binder Construction Toolkit  
Ambarish Banerjee, Andre Smit, Amit Bhasin, Jorge Prozzi, Sanjaya Senadheera, Andrew Tubb, Lei Niu  
Field test methods for residue percent, viscosity, and construction timing spreadsheet with field conditions.  
Scott Shuler, Anthony Ford, Amy Epps-Martin  
Describes chip seals, performance factors, design and construction, materials selection, quality control, and performance for a complete manual on chip sealing.

4. Research Objective  
Conduct a Cost-Benefit analysis comparing chip seals constructed with hot applied binder versus emulsified binder. Including a comparison of initial material cost, short and long term storage considerations, safety concerns, environmental differences (carbon footprint, sustainability), and most importantly short term and long term chip seal performance.

Performance includes the ability to seal the surface and provide a skid resistant surface in both the short term (few months after construction) and long term (years after construction). Additionally, what are the lifetimes seen in the field. Cost-Benefit should include life cycle cost determinations.

5. Implementation Planning  
Research findings will be presented to interested AASHTO Committees and partners. Potential venues for presentations include annual meetings of the Committee on Maintenance, Committee on Materials and Pavements, and the TSP2 regional partnerships. Webinars will also be conducted to provide opportunities for more widespread distribution.

6. Estimate of Problem Funding and Research Period  
**Recommended Funding:**  
Estimated at $600,000  
Research Period:  
36 months

7. Urgency and Potential Benefits  
SHAs need to know if there are any long term performance differences between using hot applied and emulsified ship seal binders. There are also additional considerations of sustainability, safety, etc. that could influence material selection.
For many SHAs, chip seals represent the most used and most effective maintenance activity for preserving roadways and maintaining a high level of service expected by the public.

The Texas Department of Transportation for instance spends approximately $300,000,000 per year on seal coats. For Texas alone, any change which increases life of a seal coat by one year for only 20% of chip seals can save $9,000,000 per year.

8. Person(s) Developing the Problem Statement
Darren G. Hazlett, P.E.
Texas Department of Transportation
Construction Division
125 E. 11th Street
Austin, Texas 78701
darren.hazlett@txdot.gov
512-416-2456

9. Nomination for AASHTO Monitor
Darren G. Hazlett, P.E.
Texas Department of Transportation
Construction Division
125 E. 11th Street
Austin, Texas 78701
darren.hazlett@txdot.gov
512-416-2456

10. Potentially Interested AASHTO Councils and/or Committees
AASHTO Committee on Maintenance, AASHTO Committee on Materials and Pavements

11. Submitted By
Jon Wilcoxson
Research Coordinator – AASHTO Committee on Maintenance
200 Mero St
Frankfort KY, 40622
502-782-5615
jon.wilcoxson@ky.gov

NCHRP Review of F-02
Comments:

A. Is the problem potentially solvable through research? If not, why?

As written, the problem is not well defined but if improved (as noted below) it would be solvable through research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

At least 2/3 of the DOTs should be interested in this topic if scope is revised.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement seems to suggest a research effort to conduct benefit-cost analysis of chip seals produced with different binders, and focuses on skid resistance. Recognizing that the binder is only one component of the chip seal cost, skid resistance is one of several purposes of chip seal application, and that material and construction prices depend on many factors such as location, size of project, and chip seal design, the research should focus on developing a methodology for evaluating the benefit-cost chip seal alternatives. In this manner, the methodology would be applicable to all chip seal purposes and performance parameters (e.g., roughness, cracking, and rutting), all chip seal types and materials, and all project-specific conditions.

D. Is the scope of the research reasonable?

Not as defined. As noted above the research should consider all chip seals types and materials, all performance parameters, and site and project factors affecting costs and benefits. In addition the scope should be limited to developing a methodology for conducting cost-benefit analysis; performing the analysis for example situations for illustration. In this manner, the research will produce a proposed methodology for evaluation the cost-benefits of chip seal alternatives that can be used for a the situation on hand.

E. Can the research be done in 2-3 years at the most?

The proposed duration of 36 months seems excessive; a duration of 18 to 24 months appears adequate.

F. Is the budget adequate?
The proposed budget of $600,000 seems excessive; a budget of 250,000 to 300,000 seems adequate.

G. Comments on current or past research on the topic.

Several source are cited but a literature review should be conducted as part of the project to identify and consider relevant research.

Review Date:
12/6/2018

__________________________________________

FHWA Evaluation of F-02

Kessler/ HRDI-20 - I think there is good information to be gained by doing this research, however it may be more useful if it consideres not only cost-benefit, but sustainability analysis as well. Perhaps an LCA approach may be good. We support the overall goal of this proposal.

__________________________________________
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Comments: This problem statement was initiated by the Pavement Technical Working Group of the AASHTO Committee on Maintenance and was endorsed by the committee members at the annual meeting in July 2018. This was the highest priority NCHRP problem statement ranked by the committee members.

Problem No: 2020-F-03

1. Problem Title
   Guidelines for Incorporating Maintenance Costs into a Transportation Asset Management Plan

2. Background
   MAP-21 established a performance-based Federal-Aid Highway Program that includes a requirement for state transportation agencies to develop and update a risk-based Transportation Asset Management Plan (TAMP) that identifies investment and management strategies to improve or preserve asset conditions and the performance of the National Highway System (NHS). Although only pavements and bridges on the NHS are required to be included in the TAMP, states are encouraged to include all roadway assets within the right-of-way. At a minimum, the TAMP should include the following information:

   • A summary of NHS pavement and bridge assets, including a description of conditions.
   • Asset management objectives and measures.
   • The identification of any performance gap.
   • A lifecycle cost and risk management analysis.
   • A 10-year financial plan and corresponding investment strategies.

   While most states are able to capture past and planned expenditures on capital projects, states are finding it challenging to incorporate maintenance costs into their TAMP. This situation is influenced by a number of factors, including those listed below:

   • Maintenance data is not easily linked to pavement and bridge management systems so it is not easy to track maintenance applied to specific pavement sections or bridges.
   • Maintenance plans have short-term horizons. Longer-term planning documents, such as the Statewide Transportation Improvement Program (STIP), include only capital investments.
• Maintenance funds are not committed to a single asset type. For instance, agencies generally do not establish a budget specifically for guardrails or culverts.

The absence of maintenance cost data in a TAMP must be addressed to fully capture the investments being made by states in the transportation system. This is especially important as state transportation agencies shift their focus from system expansion to system preservation, which places more of an emphasis on preventive maintenance activities. There are at least three parts of the TAMP where maintenance costs should be included:

• The analysis of life cycle cost strategies to demonstrate the cost-effectiveness of preservation programs and the increase in maintenance costs associated with deferred capital improvements.
• The development of the financial plan, showing anticipated revenue for the next 10 years and planned investments in transportation assets. The financial plan should address all investments in the highway system, including both capital and maintenance investments.
• The development of investment strategies, which identify how funds will be invested in the over the next 10 years. These strategies should reflect the results of the life cycle analysis, which typically stresses investments in both capital and maintenance activities.

The guidance developed under this research will provide the information needed by practitioners to use available pavement and bridge maintenance data to address each of these elements of a TAMP. In addition, the guidance will address the use of available information to incorporate other roadside assets (such as guardrails and culverts) into a TAMP.

This problem was identified at the 2015 meeting of the AASHTO Highway Subcommittee on Maintenance (SCOM) as a high priority to be addressed. The research will support the SCOM mission to provide technical and policy guidance to the member states and addresses the Committee’s goal to promote accountability and transparency through performance management.

3. Literature Search Summary

There is no information currently available specifically focused on how maintenance costs should be incorporated into a TAMP. Instead, the focus has been at a higher level, addressing the general content of a TAMP and its development within an organization.

Development of an Implementation Manual for Geotechnical Asset Management for Transportation Agencies, Mark Vessely

The primary objectives of this research were to define what geotechnical assets are; identify performance expectations, targets, and means of measurement; identify how to incorporate risk analysis principles and processes into asset
management for geotechnical assets; and develop a manual for creating and implementing geotechnical asset management plans.

2014 Transportation Asset Management Peer Exchange – Preparing for MAP-21 Implementation Hyun-A Park, William Robert, Katherine Lawrence

The purpose of this peer exchange was to provide DOTs an opportunity to share information on best practices in transportation asset management and implementing a TAMP. The peer exchange was organized around three primary themes: developing a MAP-21-compliant TAMP; performance measures; and risk assessment.

New Hampshire DOT Transportation Asset Management Implementation Plan

This plan involved a self-assessment; in-depth face-to-face interviews with internal stakeholders; an asset management workshop with Major Staff and Executive Staff; and development of a draft implementation plan which was reviewed and presented to Executive Staff. Input received was incorporated into the final TAM Implementation Plan.

Vermont Agency of Transportation TAM Implementation Plan

This document introduces the topic of TAM, summarizes practice at VTrans; establishes a goals for integrating TAM in the Agency business model; and recommends an asset management work plan with practical implementation steps that support the vision and goals.

Minnesota DOT Work Plan for Developing a Transportation Asset Management Plan

This document outlines a plan for conducting the work required to develop the Department’s first formal TAMP. It is based on input from MnDOT’s Asset Management Steering Committee and Project Management Team (PMT), which include members from a broad cross-section of the Department and the FHWA.


The objective of this research project was to develop an online resource with guidance on preparing a transportation asset management plan (TAMP), integrated with electronic templates for use by state highway agencies to assist them with meeting federal requirements for TAMP development.

4. Research Objective

The research objective is to develop guidance that can be used by state transportation agencies to better incorporate maintenance costs into life cycle cost analysis, financial plans, and investment strategies included in a TAMP. The research objective will include the following activities:
• Review existing TAMPs and summarize the extent to which maintenance costs are incorporated into the life cycle cost analysis, financial plan, and investment strategies. Use this review to identify key gaps in how maintenance costs are considered in a TAMP.
• Identify content areas where maintenance costs could be better incorporated into a TAMP.
• Determine adequacy of available maintenance data to support the needs in each TAMP content area.
• Develop guidance to better account for past and planned maintenance costs as states develop their TAMP. Consider agencies at various levels of maturity in terms of their maintenance management practices in the guidance and address special requirements that must be addressed to incorporate assets other than pavements and bridges in the TAMP.
• Prepare a final report that includes the findings, provides guidance for state transportation agencies, and identifies further research needs in this area.

5. Implementation Planning

Research findings will be presented to AASHTO Committees and partners. Potential venues include meetings of the Committee on Maintenance, Subcommittee on Asset Management, and the Standing Committee on Performance Management. Webinars will also be conducted to provide opportunities for more widespread distribution.

6. Estimate of Problem Funding and Research Period

Recommended Funding:
$200,000

Research Period:
15 months

7. Urgency and Potential Benefits

All states will have been required to submit initial Transportation Asset Management Plans by June of 2019. However, the incorporation of maintenance costs will be an important component for states to include as they update their TAMPs to account for changing conditions, goals, and financial plans.

8. Person(s) Developing the Problem Statement

AASHTO Committee on Maintenance, Pavement Technical Working Group

9. Nomination for AASHTO Monitor

Scott Capps
Road Maintenance Operations Engineer
North Carolina Department of Transportation
4809 Beryl Road
10. Potentially Interested AASHTO Councils and/or Committees
AASHTO Committee on Maintenance, AASHTO Subcommittee on Asset Management

11. Submitted By
Jon Wilcoxson
Research Coordinator – AASHTO Committee on Maintenance
200 Mero St
Frankfort KY, 40622
502-782-5615
jon.wilcoxson@ky.gov

NCHRP Review of F-03

Reviewed By:
Lawrence D. Goldstein
lgoldstein@nas.edu

Comments:
This study should be delayed until the recently-initiated NCHRP 02-26 is completed: Implementation of Programmatic Life Cycle Cost Analysis in a Transportation Asset Management Framework.

Review Date:
12/4/2018

FHWA Evaluation of F-03

Kessler/HRDI-20 - It seems this effort may dovetail with a recently-delivered HRDI project titled "Priortizing Assets for Inclusion in TAMPs". As States figure out their TAMP approach, many have found capturing maintenance costs elusive. This project would likely provide good guidance on this topic. S. Gaj/HISM - This research is needed and will support practitioners as they consider all types of activities that impact highway infrastructure conditions. Good topic, important to address these issues of maintenance costs and how to include address for life cycle planning analysis in an Asset Management Plan. Recommend that as part of this study there is an emphasis on life
cycle planning and financial information needed and how this can be captured. Metrics to consider include funding, mile od treatment, square foot of bridge deck or other.

AASHTO Committee Evaluation for F-03

Submitted By: Matthew Hardy
AASHTO staff
Performance-Based Management

Comments:
1. The Subcommittee on Asset Management supports this research problem statement as it does read like it will fill a gap in how maintenance costs should be addressed in TAMPs. If it is selected by the Research and Advisory Committee for funding, we would suggest the funding be made available to NCHRP 08-109, Updating the AASHTO TAM Guide, rather than a new project. We believe the timing could be advantageous and allow for a more in-depth discussion of maintenance costs and issues as it pertains to TAMPs.
2. If selected please include representation from the CPBM Subcommittee on Asset Management on the project panel.

Submitted By: Kelly Hardy
AASHTO staff
Safety

Comments:
A critical aspect of performance that relates to safety

Submitter Response for 2020-F-03

From: jon.wilcoxson@ky.gov

Comments:
The objective of NCHRP 02-26 research project is to develop guidance and one or more example tools to demonstrate quantitative asset-level, project-level, and network-level models for predicting the life cycle costs associated with preservation, replacement, and risk mitigation activities on the full range of highway assets. These costs may include agency, user, and non-user stakeholder costs. They may be associated with condition, risk, mobility, safety, or any other quantifiable aspect of transportation system performance.
This proposed research (F-03) is a needed element and it would complement the result of NCHRP 02-26. It is anticipated that NCHRP 02-26 will state that maintenance costs (preventive, routine and reactive) need to be included, but won't outline the framework on the procedure.

Contact Info:
Jon Wilcoxson
Assistant State Highway Engineer
Kentucky Transportation Cabinet
200 Mero St, Frankfort KY 40065
502-782-5615

Review Date:
11/20/2019
Research Field G

Traffic
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION
AMERICAN ASSOCIATION OF STATE HIGHWAY AND
TRANSPORTATION OFFICIALS

NCHRP Research Problem Statement
Submitted October 12, 2018

I. PROBLEM NUMBER
2020-G-01

II. PROBLEM TITLE
Traffic Signal Change and Clearance Intervals for Left-Turn Phases

III. RESEARCH PROBLEM STATEMENT
Change (yellow) and clearance (all-red) intervals are two critical safety parameters for signalized intersections. Extensive research has been completed and the Institute of Transportation Engineers is attempting to formalize “recommended guidelines” based on that research. However, there are two areas related to left-turn signal phases where little research has been conducted. These areas include:

- **Perception / Reaction Time for left-turning traffic.** There is research on perception / reaction times; however, most of the studies have been conducted in the context of drivers in through lanes. It is observed, but not conclusively documented, that drivers entering a left turn lane with a protected left turn phase have a greater expectation of having to stop, as contrasted with drivers in through lanes, and thus use a shorter perception/reaction time. Therefore perception /reaction times may be significantly different for left-turning traffic compared to through traffic.

- **Entry delay for left-turning traffic.** The value of the all-red clearance interval can be adjusted to account for the delay of drivers and pedestrians entering the intersection on the next signal phase. Research has documented the delay of drivers and pedestrians entering the intersection on the next signal phase. However, most of the studies have been conducted in the context of vehicles clearing in through lanes. Therefore the entry delay time may be significantly different for left-turning traffic compared to through traffic.

IV. LITERATURE SEARCH SUMMARY
- An ITE Recommended Practice: Guidelines for Determining Traffic Signal Change and Clearance Intervals, Institute of Transportation Engineers, October 2018. (As of this submission, the publication has not yet been formally adopted by the ITE Board of Directors)
V. RESEARCH OBJECTIVES
Using field data from a variety of geographic areas, settings (urban vs. rural), and geometric configurations (signal lane, dual lane), develop ranges and recommended values for left-turn phases for use in traffic signal change and clearance interval calculations for perception / reaction time and entry delay.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
It is estimated that this research can be completed over a 12-month period, at a cost of about $200,000.

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION
Once completed, the values could be adopted by agencies operating traffic signals. The use of research-based values will result in traffic signal operations that are safer and more efficient. Modified national guidelines could later be adopted by the Institute of Transportation Engineers or other organizations.

VIII. PERSONS DEVELOPING THE PROBLEM
Mark Luszcz (Mark.Luszcz@state.de.us) and John Fisher (johnfisherpe@gmail.com)

IX. PROBLEM MONITOR
TBD

X. DATE AND SUBMITTED BY
October 12, 2018
AASHTO Committee on Traffic Engineering
Mark Luszcz, P.E., PTOE
Chief Traffic Engineer
Delaware Department of Transportation
169 Brick Store Landing Road
Smyrna, DE 19977
John Fisher
City of Culver City, CA
431 Grand Avenue
South Pasadena, CA 91030

NCHRP Review of G-01
Reviewed By:
Camille Crichton-Sumners
crichton-sumners@nas.edu

Comments:
The research need is to develop ranges and recommended values for left-turn phases for use in traffic signal change and clearance interval calculations for (perceived) reaction time and entry delay. Provided this is not covered in the body of knowledge, this will be helpful for traffic engineers to better understand how motorists behavior impact left-turn signal timing. If simulation is used, the budget should be increased to 350 and 24 months would be more realistic.

Review Date:
12/10/2018

__________________________________________________

FHWA Evaluation of G-01

Eddie Curtis/HOTM: This is an area of traffic signal timing where research is necessary to validate the range of agency practices that are currently used to develop change and clearance intervals for LT vehicles. The objective and approach provided in the problem statement should be augmented to include behavioral studies to supplement the proposed field data collection. A field study alone is unlikely to provide the full range of dimensions that will be operative to providing meaningful guidance in this area. HRDO - Good idea. Could address a large source of intersection crashes. Schedule and budget seem appropriate.

__________________________________________________

AASHTO Committee Evaluation for G-01

Submitted By:
Jameelah Hayes
AASHTO staff
Traffic Engineering

Comments:
The Committee on Traffic Engineering thinks this is an important topic.
Research Problem Statement

Submitted October 12, 2018

I. PROBLEM NUMBER
2020-G-02

II. PROBLEM TITLE
Temporary Traffic Control at Driveways within a One-Lane, Two-Way Section

III. RESEARCH PROBLEM STATEMENT
When a lane is closed on a two-lane, two-way road provisions must be made to alternate one-way movement of the two original travel lanes through the work area using methods such as flagger control, a pilot car, or portable traffic signals. However, these methods are not always feasible for controlling access points, such as residential and business driveways, based on conditions (e.g., work duration, traffic volume at access point, time of day, and cost of the method). Thus, these locations are typically self-regulating. Unfortunately, this creates the potential for drivers entering the roadway from these access points to misunderstand the direction of traffic, enter the roadway going in the wrong direction, and collide with another vehicle travelling through the work zone. Driveway assistance devices (DADs) were developed to help motorists better understand how to safely enter the one-lane, two-way operation and proceed in the proper direction of travel. Currently, DADs work in synchronization with portable traffic signals placed at each end of the lane closure on the main road. Therefore, DADs also reduce the wait times for vehicles at driveways. Several states have requested and received permission from the Federal Highway Administration (FHWA) to experiment with DADs on active construction projects. However, a lack of consistent design and application, as well as varying measures of effectiveness, across implementation sites has limited the ability to adequately assess the effectiveness of these devices.

IV. LITERATURE SEARCH SUMMARY
Research in 2013 by the Texas A&M Transportation Institute (TTI) resulted in the development of two prototype DAD designs (i.e., blank-out sign and modified hybrid) that could be used to control traffic entering from low-volume access points. Laboratory and field studies in Texas found that the blank-out sign design was better understood than the modified hybrid design. However, the blank-out sign design was somewhat more costly and not as readily available as the modified hybrid design. Furthermore, since 2014 several variations of the modified hybrid design have been implemented at work zones in 19 states. However, many questions remain as to the appropriate design of the DADs and their effectiveness. Is the modified hybrid design the best design to inform
motorists how to safely enter the one-lane, two-way operation? If so, what are
the proper type, size, color, and arrangement of the indications? Are regulatory
signs needed to adequately convey the proper action to motorists? If so, what is
the appropriate sign legend? Consequently, there is a significant need for
cohesive research effort to determine the proper design and effectiveness of
DADs.

V. RESEARCH OBJECTIVES
The objectives of this research are to:
• Determine the design of DADs that best directs motorists to safely enter the one-
  lane, two-way operation and proceed in the proper direction of travel.
• Evaluate the effectiveness of DADs for controlling traffic entering a one-lane, two-
  way section of roadway from driveways and low-volume side streets.
• Develop guidelines regarding the use of DADs.
• Develop proposed language for incorporating DADs into the Manual on Uniform
  Traffic Control Devices (MUTCD).

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
It is estimated that this research can be completed over a 12-month period, at a
cost of about $200,000.

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION
Currently, there is not a cost-effective means of controlling low-volume access points in
alternating one-lane operations. The lack of positive control puts the contractor and
highway agency at a substantial liability risk to a wrong-way crash within the one-lane
section. Vendors can offer possible solutions, but without national research to determine
the appropriate design and operating criteria for these solutions, agencies and
contractors will not know whether the solutions themselves pose a risk due to confusion
and improper response by drivers to the devices. In addition, some states are using
DADs without a request to experiment from the FHWA. A lack of consistent design,
application, and formal evaluations across the implementation sites is hindering the
adoption of DADs into the MUTCD and the number of manufacturers in the marketplace.
The DAD designs developed to date are non-proprietary devices. Conducting national
research in the public domain will help preclude an entity from developing a proprietary
DAD device.

VIII. IMPLEMENTATION PLANNING
The target audience for the research findings will be state agencies. Early adopters that
are currently evaluating or interested in using DADs include, but are not limited to, Texas
DOT, Michigan DOT, North Carolina DOT, Massachusetts DOT, Mississippi DOT, and
Nebraska DOT. Currently, the use of DADs requires a request to experiment from the
FHWA. One of the primary objectives of the research is to identify the most appropriate
design of DADs and then develop proposed language for incorporating DADs into the
MUTCD.
Implementation tasks include a review of all previous experimental applications of the DAD and documenting the visual cues that were used to convey to the motorists the intent of the device and recognition of the proper direction of travel.

IX. PERSONS DEVELOPING THE PROBLEM
Melisa D. Finley, P.E., Research Engineer, Texas A&M Transportation Institute, 979-845-7596, m-finley@tti.tamu.edu

X. AASHTO MONITOR
TBD

XI. DATE AND SUBMITTED BY
October 12, 2018
AASHTO Committee on Traffic Engineering
Neil E. Boudreau, State Traffic Engineer
MassDOT Highway Division
10 Park Plaza, Boston, MA 02116
Phone: (857) 368-9655
Email: neil.boudreau@state.ma.us

XII. REFERENCES

NCHRP Review of G-02

Reviewed By:
Camille Crichton-Sumners
crichton-sumners@nas.edu

Comments:
The research objectives include: (1) design driveway assistance devices (DADs) that best directs motorists to safely enter the one-lane, two-way operation and proceed in the proper direction of travel, (2) evaluate the effectiveness of DADs, (3) develop guidelines, and (4) develop proposed language for incorporating DADs into the Manual on Uniform Traffic Control Devices (MUTCD). It is likely to require simulation to help evaluate effectiveness and field testing prior to making recommendations for that would
be incorporated into MUTCD. The budget and time both need to be increased to 500K and 36 months, respectively.

Review Date:
12/10/2018

AASHTO Committee Evaluation for G-02

Submitted By:
Jameelah Hayes
AASHTO staff
Traffic Engineering

Comments:
The Committee on Traffic Engineering thinks this a high priority topic. It is #3 in their proposal rankings.
1. **Problem Title**
Crash Modification Factors for Intelligent Transportation Systems (ITS) Applications

2. **Background**

   It is generally understood that Intelligent Transportation Systems (ITS) applications, such as variable/dynamic/changeable message signs, CCTVs, traffic monitoring stations, ramp meters, and RWIS, help manage traffic and improve incident response, thus enhancing safety on our roadways. However, actual data, specifically crash reduction data resulting from ITS applications, is very limited. It is therefore proposed that a research project be executed that develops Crash Modification Factors (CMFs) for the various ITS applications typically deployed.

   This research would inform engineers, transportation agencies, and the public of the safety benefits of ITS applications by quantifying the reduction in crash frequency and/or severity resulting from ITS applications. It would help justify and obtain safety-related funding for ITS applications, as well as provide quantifiable information to message the need for ITS applications to transportation project delivery teams, planning organizations, and the public.

   This research topic is supported by the AASHTO Special Committee on Research and Innovation, and is specifically relevant to the AASHTO Committee on Transportation System Operations (CTSO), Subcommittee on Technology, Working Group on Intelligent Transportation Systems.

3. **Literature Search Summary**

   UDOT’s Research Department did a literature search on the topic of crash modification factors for ITS. Some exist for certain traffic signal applications and variable speed limit applications, but several resources confirmed the lack of CMF’s for ITS, as indicated by the following:

   - FHWA Summary Report: Crash Modification Factors Needs Assessment Workshop, March 2015: “CMFs are needed for ITS/technology strategies, including speed cameras by area type (e.g., schools versus other urban, suburban, freeways, arterials), red-light cameras, road weather information/management systems, and dynamic message signs.”
4. Research Objective
Desired outcome of this research includes the development of Crash Modification Factors (CMFs) for commonly deployed ITS applications:
- Variable/Dynamic/Changeable Message Signs
- CCTVs
- Traffic Monitoring Stations
- Ramp Meters
- Road Weather Information Systems (RWIS)

Coupled with the CMFs could be additional information on and calculation procedures for safety benefit/cost ratios for each ITS application.

5. Implementation Planning
It is anticipated that these research results will be intuitive in application and require minimal effort to disseminate and implement. However, the results of this research should be communicated at relevant workshops and/or annual meetings on a national level, such as those administered by AASHTO or FHWA, and that involve multiple state DOTs. The research results should also be made available on applicable websites, such as cmfcleaninghouse.org, which is funded by FHWA, and is a searchable website dedicated to providing crash modification factor information for various countermeasures.

6. Estimate of Problem Funding and Research Period
Recommended Funding:
It is recommended that $250,000 be budgeted for this research project as indicated below:
- 9 total months of work performed by professional employees: $150,000
- 18 total months of work performed by supporting staff: $75,000
- $25,000 contingency

Research Period:
It is estimated that this research would require 18 months of total time, including 12 months to research, collect data, and study impacts of the various ITS elements on crash rates, 3 months for interim reviews, and 3 months for draft final report review.

7. Urgency and Potential Benefits
ITS is now a mainstay in DOT programs, projects, and strategies, yet is lacking sufficient research and data on actual safety and other benefits. As building and expanding roadways becomes increasingly costly and otherwise prohibitive, understanding how ITS can benefit existing and future transportation systems is imperative. Safety is the number one goal of most, if not all, DOTs in the country, and understanding how ITS fits into accomplishing this goal from a crash reduction standpoint will help DOTs nationwide to secure funding and support for ITS solutions. This will lead to improving our transportation system at a much lower cost than traditional building and expansion of the system.

8. **Person(s) Developing the Problem Statement**  
Tyler Laing  
ITS Program Manager  
Utah Department of Transportation  
801-910-2491  
tlaing@utah.gov

9. **Nomination for AASHTO Monitor**  
Tyler Laing  
ITS Program Manager  
Utah Department of Transportation  
801-910-2491  
tlaing@utah.gov

10. **Potentially Interested AASHTO Councils and/or Committees**  
This problem statement is submitted by an AASHTO council and/or committee.

11. **Submitted By**  
AASHTO Committee on Transportation System Operations (CTSO)

---

**NCHRP Review of G-03**

**Reviewed By:**  
Mark S. Bush  
mbush@nas.edu

**Comments:**

The scope of the research is reasonable with a relatively clear objective to be potentially solvable for the development of associated CMFs; however, I am concerned for the extent of the scope that the estimated budget and time period is extremely low and should be reconsidered unless the scope be very narrowed down. The problem statement is very timely due to the ubiquitous nature of ITS and its applications as well as the ever expanding advancements in connected and autonomous vehicle
technologies. In the engineering safety community it is of interest on a national level as it will aid agencies in implementing and updating future potential editions of the AASHTO Highway Safety Manual, (HSM). This study will also build on existing completed or on-going research which is being updated in the new proposed HSM, Second Edition, under NCHRP research project 17-71.

Review Date:
12/10/2018

FHWA Evaluation of G-03

John Corbin/HOTM - Will be desirable to distinguish between devices such as DMS, location-specific systems such as Red Light Running Photo-enforcement, and network systems such as RWIS. Perhaps should be more focussed by a global scan and synthesis to more completely frame issues and a prospective approach. Proposal could be refined in consultation with AASHTO safety committees and Committee on Transportation System Operations, as well as FHWA Offices of Safety (HSA) as well as Safety & Operations Research (HRDSO). Scurry/HSA - Overall this is a great research proposal that addresses a document need. The subject matter is also very timely. However, I think they have underestimated both the budget ($250K) and schedule (18 months) to develop what appears to be CMFs for 5 strategies.

AASHTO Committee Evaluation for G-03

Submitted By:
Venkat Nallamothu
AASHTO Staff
CTSO

Comments:
CTSO agrees with comments from FHWA and NCHRP that funding could be increased. We will ask SCOR to re-examine the funding if this is selected.

Submitter Response for 2020-G-03

From: [email: pzelinski@aashto.org]

Comments: CTSO concurs with the comments from FHWA and NCHRP that funding should be increased. We will ask SCOR to reexamine the funding for this project if it is selected.

Contact Info: Pat Zelinski, pzelinski@aashto.org, 202-624-7830
Review Date: December 27, 2018
I. PROBLEM NUMBER

2020-G-04

II. PROBLEM TITLE

Determining the Readiness and Effectiveness of Freeway-Based Corridor V2X Applications for Improving Congestion and Safety

III. RESEARCH PROBLEM STATEMENT

Infrastructure owners and operators (IOOs) are struggling to determine which V2X applications to prepare for based on promises to improve congestion and safety on freeway corridors. V2X refers to the ability of vehicles to communicate to the traffic system around them, whether its other vehicles or the infrastructure, to facilitate the movement of people and goods while improving safety. To date, many V2X applications have not been developed and tested beyond a proof-of-concept stage, while other applications have been or will be piloted in the near future, such as part of the three U.S. Department of Transportation (DOT) Connected Vehicle (CV) Pilots in New York City, Tampa, and Wyoming. As a result, there are significant gaps in knowing the “readiness” for larger scale deployments. IOOs also want to know how much improvement in congestion and safety will occur if investment is made in or to support V2X applications and what is the return on their investment (user delay, environmental, property damage, loss of life, etc.). The realized improvement could vary depending on the percentage of connected and/or automated vehicles that make up the overall vehicle fleet as well.

Many of the freeway-based CV applications that have been conceptualized or developed to-date have not been advanced beyond the proof-of-concept stage and most have not been deployed in a real-world or pilot scenario. For example, applications listed at the CV Resource Implementation Architecture site (https://local.iteris.com/cvria/) all have systems architecture developed, but many of the applications require a significant amount of systems engineering and software development to make the applications deployable. IOOs need to have a better understanding of the time and investment that is required to make these applications ready for real-world usage.
There are no standard methodologies to evaluate the improvements in congestion and safety for freeway-based V2X applications. Past efforts have focused on the cost of CV infrastructure, such as the AASHTO Connected Vehicle Field Infrastructure Footprint Analysis, but little on the benefits. Having a method to evaluate the real-world benefits, in terms of congestion and safety improvements, of CV infrastructure would allow IOOs to better understand how to make investments.

IV. LITERATURE SEARCH SUMMARY

Limited studies of the readiness of applications or the evaluation of benefit-cost has been conducted due to the small number of real-world deployments for many of the freeway-based V2X applications. The following list are potential sources of review:


Talas, Mohamad; Bradley, Margaret; Rausch, Robert; Benevelli, David; Sim, Samuel. Connected Vehicle Pilot Deployment Program Phase 1: Deployment Readiness Summary: New York City: Final Report, Report No. FHWA-JPO-16-310. September 2016. ITS-Joint Program Office.


Wright, James; Garrett, Kyle; Hill, Christopher; Kreuger, Gregory; Evans, Julie; Andrews, Scott; Wilson, Christopher; Rajbjanandi, Rajat; Burkhard, Brian. National Connected Vehicle Field Infrastructure Footprint Analysis Final Report, Report No. FHWA-JPO-14-125, June 2014. ITS-Joint Program Office.

V. RESEARCH OBJECTIVE

This research focuses on freeway-based V2X applications that are currently at various levels of concept development, proof-of-concept, or pilot stages and are expected to
provide meaningful safety and/or congestion benefits. The development of these applications is changing and evolving at a rapid pace. Various applications will be researched and will be selected at the outset of the research based on current advancements and research gaps at that time.

This research will focus on four main objectives: (1) Develop criteria and methodology for determining the readiness of current and future applications, (2), Quantify the safety and/or congestion performance benefits of each application, (3) Develop a methodology to determine a return on investment, in Dollars, for agencies to help determine the benefit of investment into connected vehicle infrastructure, and (4) Evaluate the benefit-cost ratio of application deployment for various connected and automated vehicle penetration rates.

VI. Research Proposed
Potential Tasks:

**Literature review:** Conduct a comprehensive literature review on the readiness of freeway based V2X applications and the estimation or evaluation of benefits of V2X deployments.

**Applications to be Researched:** From the V2X applications currently listed on the Connected Vehicle Resource Implementation Architecture site (https://local.iteris.com/cvria/), develop a list of freeway-based applications to be included in the research. Selection criteria for applications should consider the number of pilots underway or planned to be underway during the research timeframe.

**Draft “Readiness” Criteria:** Develop draft criteria for determining “readiness” of freeway-based V2X applications. Criteria for “readiness” should consider national work done beyond initial architecture or concept of operations, complexity of systems engineering, availability of “off-the-shelf” applications, ability to use proven and available infrastructure technology, the need for communication to other backend systems, the need for non-edge algorithms or other backend processing, compatibility with obtainable Basic Safety Message information, compatibility with standard on-board unit (OBU) equipment, and the timeline to implement.

**Data Assessment:** Obtain and review sample results from ongoing demonstration projects and field tests and assess their suitability for estimating improvements and benefits in congestion and/or safety.

**Microsimulation Evaluation:** Using microsimulation, evaluate the benefit of each selected V2X application in improving congestion and safety on freeways.

- Determine the most appropriate measure of effectiveness component of the simulation for each application. Cross reference with FHWA’s Surrogate Safety Assessment Model (SSAM) where appropriate using vehicle trajectory information from the microsimulation. If available, utilize crash modification factors for connected vehicles from the national Crash Modification Factor Clearinghouse.
b. Develop a post-processing methodology to capture the improvement in congestion and safety. Prepare a test case using findings from ongoing and completed demonstration projects.

c. Select a freeway testbed already coded and calibrated in a microsimulation tool.

d. Conduct scenarios for each V2X application, determining improvement benefits at various penetration rates of connected vehicles (CVs) and automated vehicles (AVs).

**Benefit-Cost Analysis:** Summarize benefit results of each V2X application and develop cost assessment for each deployment. Calculate a return on investment, in Dollars, for each application in terms of congestion and safety benefit.

**Assessment Tool:** Develop an assessment tool that predicts the "readiness" of various V2X applications and determines the benefit-cost of those applications.

a. From the draft “readiness” criteria, develop an assessment module that determines the “readiness” of applications based on predetermined criteria.

b. Develop a methodology/tool to calculation return on investment for each application in terms of congestion and safety benefit.

c. Provide a scalable output based on deployment size and CV and AV penetration rates.

**VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD**

**Recommended Funding:**

$500,000

**Sponsors:**

AHB20 – Freeway Operations Committee. Chair: Beverly Kuhn, 979.862.3558, b-kuhn@tamu.edu.

**Research Period:**

30 months

**VII. URGENCY AND POTENTIAL BENEFITS**

As a result of this research, it will help agencies better determine how to invest money into connected vehicle technology along freeway corridors. This research will produce new analytical methodologies and tools to assess the benefit of connected vehicle applications. The proposed research addresses several gaps in understanding the benefits of various freeway-based applications, how connected and automated vehicle penetration rates impact the benefits and the benefit-cost of the applications.

**VIII. IMPLEMENTATION PLANNING**

The outcome of this research will help agencies plan and better determine how to invest money into connected vehicle technology along freeway corridors. Agencies will be able to
have an understanding of the benefit-cost of deployments of connected vehicle technology and can use the results to help with short and long range planning.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Jim Katsafanas, P.E., PTOE, Michael Baker International, jkatsafanas@mbakerintl.com
James Colyar, P.E., Federal Highway Administration, James.Colyar@dot.gov
Chris Poe, P.E., Texas Transportation Institute, C-Poe@tti.tamu.edu
Kevin Miller, P.E., Kapsch TrafficCom North America, kevin.miller@kapsch.net

X. AASHTO MONITOR

Galen McGill, Oregon DOT, galen.e.mcgill@odot.state.or.us; and Scott Marler, Iowa DOT, scott.marler@iowadot.us

XI. SUBMITTED BY

AASHTO Committee on Transportation System Operations

________________________________________

NCHRP Review of G-04

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:

The FHWA review indicates that there are several ongoing efforts that impact the proposed research, in particular the Volpe effort. I think this project could produce useful results and there will be an ongoing need to evaluate applications as the technologies are deployed and evolve. It may be best left in the FHWA's hands though to make coordination easier.

Review Date:
12/10/2018

________________________________________

FHWA Evaluation of G-04
John Corbin/HOTM - The proposal appropriately acknowledges USDOT's Analysis, Modeling, and Simulation (AMS) Program, but overlooks more recent related initiatives in cooperative automated transportation. G-04 does not adequately consider the integration of connected and automated technologies and their incremental incorporation into the vehicle fleet and associated traffic operations. While the implicit project scope is detailed and well-structured, the dated CV Program context (including reference to CVRIA) begs comprehensive updating. G-04 and G-23 should be combined. A prospectively integrated single problem statement should address the potential coordination with USDOT's Cooperative Automated Research Mobility Applications (CARMA) as well as the USDOT-funded CAMP LLC initiative to evolve a Cooperative Automated Driving System (CADS) research roadmap. Vadakpat, Govindarajan/HRDO - There is a lot of similarity between the proposed project and a current project underway being performed by Volpe that is looking to develop a framework for V2I benefits estimation tool to be used by IOOs. It is not clear what specific applications this project is targeting. It would be helpful to lay out the specific applications this project would target to determine the benefit/cost. The proposal refers to using data that doesn't exist (crash modification factor for connected vehicles). There seems to be some inconsistency in the terminology. Is the intent to model Automated vehicles in the simulation model? Are these autonomous vehicles? Overall the proposal lacks a coherent approach. There are clear signs that this may turn out to be just another simulation exercise with data that may (or not) be available for calibrating the simulation models. It would have helped immensely if the proposers clearly identified the corridor(s) they that have targeted for this exercise.

AASHTO Committee Evaluation for G-04

Submitted By:  
Venkat Nallamothu  
AASHTO Staff  
CTSO

Comments:  
The authors were not aware of the most recent FHWA and Volpe Center research efforts in this field, so thank you for pointing these out and we would welcome the opportunity to better coordinate with FHWA to define a problem statement that does not directly overlap, but instead collaborates and compliments, ongoing efforts such as CARMA, CADS research roadmap, and Volpe V2I benefits estimation tool. That being said, we still see a need for a readiness assessment tool to be developed that assists agencies in determining how best to invest resources into connected vehicle applications and associated roadway and digital infrastructure systems.

Submitter Response for 2020-G-04

From: [email: vnallamothu@aashto.org]
Comments: The authors were not aware of the most recent FHWA and Volpe Center research efforts in this field, so thank you for pointing these out and we would welcome the opportunity to better coordinate with FHWA to define a problem statement that does not directly overlap, but instead collaborates and compliments, ongoing efforts such as CARMA, CADS research roadmap, and Volpe V2I benefits estimation tool. That being said, we still see a need for a readiness assessment tool to be developed that assists agencies in determining how best to invest resources into connected vehicle applications and associated roadway and digital infrastructure systems.

Contact Info: Venkat Nallamothu, vnallamothu@aashto.org, 202-624-5497

Review Date: January 8, 2019
AASHTO STANDING COMMITTEE ON RESEARCH
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

NCHRP Problem Statement

I. PROBLEM NUMBER

2020-G-05

II. PROBLEM TITLE

Utilizing Connected & Automated Vehicle (CAVs) Data to Enhance and Optimize Freeway Operations Strategies, Algorithms and Performance Measures

III. RESEARCH PROBLEM STATEMENT

The application of new technologies in traffic operations and management began more than fifty years ago, with the introduction of digital computers. Continuous developments in computer technology, real-time data sources, and communications have created new opportunities for developing and evaluating new strategies to improve mobility and safety in freeway networks. Several active traffic and demand management (ATDM) systems have been implemented based on real-time information from fixed data sources (e.g., loop detectors, radars, cameras), as well as mobile sources (probes, smart phones).

The use of Connected & Automated Vehicles (CAVs) will provide public agencies with the opportunity to transform mobility and safety of highway facilities. The data generated and shared between CAVs and transmitted to other vehicles (V2V) and the infrastructure (V2I) in real time will provide the opportunity for agencies to improve how they actively manage traffic and travel. Furthermore, the ability for agencies to collect this information will potentially minimize the need for fixed sensors that are costly to acquire, install and maintain.

The active management and operation of freeways can be enhanced with the use of CAVs data could include, but is not limited to, variable speed limits, speed harmonization and warnings, part-time shoulder use, queue warning, wrong-way detection, platooning, ramp metering, incident detection, congestion-based tolling, and provision of route guidance based on a vehicles destination. Also, cooperative merging and lane changing will improve freeway operations especially in merging and weaving areas. Furthermore, multilevel strategies for local (bottleneck throughput) and global (network travel time) can be implemented in the network.
CAVs also bring several challenges in data acquisition, management, analytics and utilization. Existing Transportation Management Systems and Centers (TMCs) are not equipped to handle the data streams that will be generated from CAVs both in terms of the amount and type of data. The data generated from CAVs depend on the number and type of vehicles in operation (sharing information to full automation). Also, there will be variations in data availability in parts of the network and at different times. Furthermore, the ability of systems to collect, compile, and send CAV data in real-time to the TMC or a central location could be very cost prohibitive or require information to be synthesized before sending.

Guidance is needed on how the CAVs data will be utilized alone and in combination with other existing sources of data systems already use to provide reliable estimates of performance measures. Agencies will also be challenged with collecting, compiling, using, and for storing different types of data.

IV. LITERATURE SEARCH SUMMARY

The following list are potential sources of review:


V. RESEARCH OBJECTIVE

The main objective of this research is to develop and demonstrate a framework for how to utilize the information from CAVs to enhance and optimize freeway operations strategies, algorithms and performance measures.

This research will focus on how CAV data can be used to augment how existing operational strategies are used and performance analyzed. The research will provide examples of how an operational strategy (e.g., ramp metering) could change with the use of only CAV data or the fusion of CAV data with existing sources of data typically being used by a traffic management system. This research will also cover how CAV data can be effectively utilized alone and in combination with other existing sources of data to provide reliable estimates of performance measures.

VI. Research Proposed

Potential Tasks:
Literature review: Conduct a thorough literature review on the type and characteristics of CAVs derived data and their use in freeway performance measures and ATDM strategies.

Draft framework development: Develop a framework for CAV data utilization for freeway monitoring and strategy development and operations. Define data requirements. Develop methods for estimating performance measures from CAV data.
- Investigate what portions of the “standard” Basic Safety Message would correlate to the needs to support freeway operations enhancement strategies, e.g. global positioning, speed, vehicle size).
- Develop procedures for data storage, processing of CAV data. Investigate a) how data CAV data are aggregated (e.g., by time stamp, GPS location), b) investigate if the degree of data processing can be completed at the roadside to reduce the amount of data transmitted to the TMC, c) how the data will be fused with existing data sources.
- Investigate how certain freeway management existing algorithms (e.g., ramp metering) may be modified to incorporate CAV data.

Data assessment: Obtain and review sample data from ongoing demonstration projects and field tests and assess their suitability.

Test plan development: Develop a test plan to assess the use of CAV data in development and operation of freeway control strategies through simulation.
- Select a freeway testbed already coded and calibrated in a microsimulation tool1.
- Select the freeway control strategy to be tested using both conventional data (i.e., loop detectors) and CAV data.
- Modify the strategy as appropriate for use with CAV data
- Develop scenarios regarding the penetration rate of CAVs, connectivity technology.

Execute the Test Plan: Execute the test plan and document the benefits of using CAV data for the selected strategy.

Analysis of the results: The research will investigate how the CAV data will be fused with the data from conventional sources to determine the state of the system, and the required CAVs penetration rate for ATDM strategies. The research will also investigate the best location for data processing to occur, whether it can occur at the roadside or needs to be transmitted back to the traffic management center. Finally, this research will address how agencies can manage and mitigate the challenges with collecting, compiling, using, and storing different types of data.

Framework development: Based on the simulation results revise the draft framework as appropriate.

---

1 FHWA sponsored ATMS testbeds can be used in this task.
VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**
$500,000

**Sponsors:**
AHB20 – Freeway Operations Committee. Chair: Beverly Kuhn, 979.862.3558, b-kuhn@tamu.edu.

**Research Period:**
24 months

VII. URGENCY AND POTENTIAL BENEFITS

The findings from this research will help agencies determine how to better use new data sources from CAVs to better operate freeways and to help develop operational strategies for freeway corridors. This research will demonstrate how CAV data can be used and leveraged to improve traffic management systems.

VIII. IMPLEMENTATION PLANNING

The outcome of this research will help agencies plan for future enhancements to traffic management and operational strategies for congested freeway corridors. Agencies will be able to have an understanding of the benefits of additional data sources available from automated and connected vehicle technology and can use the benefits to help with short and long-range planning.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Alex Skabardonis, University of California, Berkeley, skabardonis@ce.berkeley.edu
Jon Obenberger, P.E., Federal Highway Administration, jon.obenberger@dot.gov
James Colyar, P.E, Federal Highway Administration, James.Colyar@dot.gov
Jim Katsafanas, P.E, PTOE, Michael Baker International, jkatsafanas@mbakerintl.com

X. AASHTO MONITOR

Galen McGill, Oregon DOT, galen.e.mcgill@odot.state.or.us; and Scott Marler, Iowa DOT, scott.marler@iowadot.us

XI. SUBMITTED BY

AASHTO Committee on Transportation System Operations
NCHRP Review of G-05

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:
The FHWA review identifies related ongoing effort. In addition, NCHRP 08-119, Developing Data Standards and Guidance for Transportation Planning and Traffic Operations, will be starting soon and is expected to address some of the data management issues. Data will be an ongoing issue as these technologies are deployed and evolve but it is not clear how the proposed project fits with these other efforts.

Review Date:
12/10/2018

FHWA Evaluation of G-05

John Corbin/HOTM - There is a need for the project advanced by this proposal, subject to coordination with problem statements G-04 and G-23. Vadakpat, Govindarajan/HRDO - The proposal states "Develop a framework for CAV data utilization for freeway monitoring and strategy development and operations. Define data requirements. Develop methods for estimating performance measures from CAV" Is the intent to develop this framework for all ATDM strategies identified earlier in the introductory section? It seems that the crux of this work is to use CAV data as one additional data source to improve existing operational strategies. A much more interesting research will be to study what additional operational strategies are possible with CAV data. The intent of test plan is not clear. What is the connectivity technology referred to in sub-task d under test plan development? I don't believe the proposal deals with the immediate agency needs as it relates to CAVs.

AASHTO Committee Evaluation for G-05

Submitted By:
Venkat Nallamothu
AASHTO Staff
CTSO

Comments:
Thank you for the suggestion to coordinate this effort with G-04 and G-23. The proposal suggests a general framework that covers how CAV data can be used to enhance existing freeway operations strategies and performance measures generally, and then
moves on to investigate and develop enhanced strategies and algorithms for a smaller subset of specific freeway operations strategies (e.g., ramp metering was suggested in the statement). By focusing on how to enhance existing freeway operations strategies and algorithms that agencies already implement and use today, we believe this proposal does deal with immediate agency needs and how agencies can begin integrating CAV data into existing systems. The idea to also research what additional operational strategies (beyond existing ones) are possible with CAV data is a good suggestion, although additional funds and time may be needed for this. While there is complimentary work underway (e.g., Volpe V2I benefits estimation tool) what has been proposed is still needed. This is especially true for proposal G-05.

Submitter Response for 2020-G-05

From: [email: vnallamothu@aashto.org]

Comments: Thank you for the suggestion to coordinate this effort with G-04 and G-23. The proposal suggests a general framework that covers how CAV data can be used to enhance existing freeway operations strategies and performance measures generally, and then moves on to investigate and develop enhanced strategies and algorithms for a smaller subset of specific freeway operations strategies (e.g., ramp metering was suggested in the statement). By focusing on how to enhance existing freeway operations strategies and algorithms that agencies already implement and use today, we believe this proposal does deal with immediate agency needs and how agencies can begin integrating CAV data into existing systems. The idea to also research what additional operational strategies (beyond existing ones) are possible with CAV data is a good suggestion, although additional funds and time may be needed for this. While there is complimentary work underway (e.g., Volpe V2I benefits estimation tool) what has been proposed is still needed. This is especially true for proposal G-05.

Contact Info: Venkat Nallamothu, vnallamothu@aashto.org, 202-624-5497

Review Date: January 8, 2019
2020-G-06

AASHTO STANDING COMMITTEE ON RESEARCH
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

FY2020 NCHRP Problem Statement Proposal
1. PROBLEM NO: 2020-G-06

2. PROBLEM TITLE
Experimental Implementation of Big Data Analytics for Traffic Incident Management

3. BACKGROUND
There is much talk about Big Data these days within the field of transportation; however, many groups and organizations do not fully understand or appreciate the scale of the data, the concepts, and the paradigm shift that is necessary to move from traditional data collection, storage, and analytics to the implementation of Big Data. This shift is not simply a linear one; rather, it requires completely new approaches to data collection, storage and management, and procurement of IT services, as well as skill sets that most agencies do not have and which are difficult to acquire. Furthermore, there are few ready to use Big Data data sets that can be used to demonstrate the benefits of this approach, particularly for Traffic Incident Management.

The recently completed project NCHRP 17-75, Leveraging Big Data to Improve Traffic Incident Management (TIM), was developed to begin to address these issues. Products from this project include a list of Big Data Opportunities, Big Data guidelines for transportation agencies and TIM programs, and Outreach Materials. One of the most significant findings of NCHRP 17-75 is that in order to gain the most benefits from Big Data approaches and analytics, a large-scale, multi-state implementation is essential. In addition, three barriers to implementation were identified: organizational culture, organizational capabilities, and access to large amounts of varied data. These significant technical and non-technical barriers would be difficult for any agency to overcome and should be addressed through continued national-level research into implementation.

This proposed project is a critical next step to document issues and demonstrate the feasibility and value of the Big Data approach; NCHRP is the ideal multi-state environment for this work. Products from this project will be used by state DOTs to enhance their TIM programs specifically and to enhance general operations/TSMO programs. The NCHRP 17-75 panel originally submitted this as a project for NCHRP implementation funds. NCHRP 20-44 panel endorsed this proposed project but stated it should be solicited as a continuation project rather than an implementation project.

4. LITERATURE SEARCH SUMMARY
When NCHRP 17-75 Leveraging Big Data to Improve Traffic Incident Management was selected, there were no existing projects addressing that topic. A search on October 5, 2018, of TRID and RIP for “traffic incident management big data” and “operations
“incident big data” does not return directly applicable projects except for NCHRP 17-75. While there are research projects related to “operations big data” in both research databases, the field of TIM has specific research and operations needs, as shown in NCHRP 17-75, so the most effective and useful research into how to use big data to improve TIM is to conduct the proposed project starting with the results from NCHRP 17-75.

5. OBJECTIVE
The objective of this project is to demonstrate the feasibility and practical value of the Big Data approach to improve TIM. The project will demonstrate the scale and variety of the data needed, the data sources that can be leveraged, the Big Data concepts (e.g., cloud data storage, open data, data management), and the Big Data analytics techniques through real-world data, examples, and case studies. Proposed tasks include:

1. Establish a data environment in which data can be stored and analyzed:
   a. Integrate multiple, diverse datasets into a data analytics environment.
   b. Document openness of data, as well as challenges with gaining access to the data.
   c. Provide a description of the data environment.
   d. Establish the costs of the data environment.
   e. Describe the data management (storage, data structure, accessibility, security, etc.).
2. Develop use cases for improving TIM – based on the data collected, explore the data and identify possible analyses that would help to improve TIM.
3. Apply Big Data analytics techniques to produce real-world examples.
5. Develop lessons learned and case studies – document lessons learned throughout the process and develop case studies to enhance (i.e., give a practical basis for) the NCHRP 17-75 guidelines to further support and improve adoption and implementation. The case studies will look at using local, regional, state, and national data sets to develop the proof of concept. In addition, the case studies will aim to show how the use of the Big Data approach can support tracking national TIM performance measures: roadway clearance time, incident clearance time, and number of secondary crashes, as well as other measures. Through more detailed information about the TIM timeline, agencies should be able to better pinpoint causes of delay during response.

6. IMPLEMENTATION PLANNING
The project will involve the documentation of lessons learned and use cases, as noted in task 5 above. Implementation support could include peer exchanges, workshops, and presentations to support state DOT implementation.

7. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding: This effort will be labor intensive as it will be the first effort to leverage big data on such as large scale. As such, it is estimated that the project will
need the equivalent of two researchers for two years. In addition, the project cost includes $100,000 for implementation. **COST: $500,000**

**Research Period:** Researchers will work with multiple state DOTs and other data sources, so the research period will need to take into account the time needed to work with various entities and to conduct implementation activities. **PROJECT DURATION:** 30 months

8. **URGENCY AND POTENTIAL BENEFITS**

With the completion of NCHRP 17-75, now is the time to conduct this proposed project, when the research is relevant and up to date.

(a) **Value:** The product will be valuable to DOTs; the findings of NCHRP 17-75 showed that due to the paradigm shift needed for data sources, storage, and use, a large-scale pilot is needed to facilitate this shift. DOTs and other response agencies will benefit from detailed guidance and use cases on how to leverage these new data sources to realize the benefits, and show practical value and return on investment

(b) **Successful achievement:** Building on 17-75, proposed project is likely to be successful

(c) **Likelihood of implementation-ready products:** Proposed project is a pilot implementation with supporting documents so likelihood is high

(d) **Likelihood of implementation by state DOTs:** State DOTs will be significant participants in the pilot so likelihood high; project will seek to include variety of cases (i.e., urban/rural, freeway/arterial)

9. **PERSON(S) DEVELOPING THE PROBLEM STATEMENT**

- **Eileen Singleton**  
  Principal Transportation Engineer  
  Baltimore Metropolitan Council  
  esingleton@baltometro.org  
  410-732-0500 x 1033

- **Melissa Clark**  
  Transportation Engineer (Electrical)  
  Division of Research, Innovation and System Information  
  Melissa.clark@dot.ca.gov  
  916-227-4172

10. **NOMINATION FOR AASHTO MONITOR**

- **Galen McGill**  
  System Operations & ITS Manager  
  Oregon DOT  
  Galen.E.MCGILL@odot.state.or.us  
  503-986-4486

11. **POTENTIALLY INTERESTED AASHTO COUNCILS AND/OR COMMITTEES**

Not applicable

12. **SUBMITTED BY**

The following committees support this proposal:

- AASHTO Committee on Transportation Systems Operations (CTSO)
- TRB Regional Transportation Systems Management & Operations Committee (TSMO)
### Name

<table>
<thead>
<tr>
<th>Name</th>
<th>Contact Information</th>
<th>Committee / Project Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scott Marler</td>
<td>Iowa DOT <a href="mailto:scott.marler@iowadot.us">scott.marler@iowadot.us</a> 515-239-1040</td>
<td>a a</td>
</tr>
<tr>
<td>Galen McGill</td>
<td>Oregon DOT <a href="mailto:Galen.E.MCGILL@odot.state.or.us">Galen.E.MCGILL@odot.state.or.us</a> 503-986-4486</td>
<td>a</td>
</tr>
<tr>
<td>Thomas Jacobs</td>
<td>University of MD, College Park <a href="mailto:tjacobs@umd.edu">tjacobs@umd.edu</a> 301-405-7328</td>
<td>a</td>
</tr>
<tr>
<td>Eileen Singleton</td>
<td>Baltimore Metropolitan Council <a href="mailto:esingleton@baltometro.org">esingleton@baltometro.org</a> 410-732-0500 x 1033</td>
<td>a a</td>
</tr>
<tr>
<td>Melissa Clark</td>
<td>Caltrans <a href="mailto:Melissa.clark@dot.ca.gov">Melissa.clark@dot.ca.gov</a> 916-227-4172</td>
<td>a</td>
</tr>
</tbody>
</table>

---

**NCHRP Review of G-06**

**Reviewed By:**
Lawrence D. Goldstein
lgoldstein@nas.edu

**Comments:**

This research addresses an emerging problem and opportunity for incorporating new data resources into traffic management requirements. One other study recently concluded that should also be considered in terms of background is NCHRP Report 868: Cell Phone Location Data for Travel Behavior Analysis.

**Review Date:**
12/4/2018

---

**FHWA Evaluation of G-06**
Peter Huang/HRDO, Jodoin and Austrich/HOP - The problem statement is well written. It stated several key problems such as institutional issues (organization culture and capability) and technical issues (data resource and accessibility). It listed 5 major tasks and used traffic incident management (TIM) as a main example to showcase the usefulness of the Big Data method. I think that the proposed cost and the duration are reasonable, and the expected benefits is reachable. Anna Eigen, HRDS - I see great merit in this topic as it will take advantage of emerging data science techniques. It also draws from needs found in several States and their data. It will also be sensitive to diverse data sharing issue, inherent in video footage. This could be a future cost-saving approach and should dovetail or be the next generation of tools produced with Exploratory Advanced Research support.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Comments: This problem statement was developed by the TRB Joint Subcommittee on Rural Road Safety Policy, Programming and Implementation. It was included in the NCHRP 20-122 Rural Transportation Issues: Research Roadmap project interim report and presented by the research team to R&I per panel direction. It is being submitted by the AASHTO Special Committee on Research and Innovation per action taken at their meeting on October 29-30, 2018.

Problem No: 2020-G-07

1. Problem Title
MIRE Data Requirements Supporting Safety Improvements on Unpaved Roads

2. Background
   Newer federal regulations (beginning with The Moving Ahead for Progress in the 21st Century (MAP-21) and continuing with the Fixing America’s Surface Transportation (FAST) Act) strongly supported the view that quality data for all public roads provides the foundation for making important decisions regarding the design, operation, and safety of roadways. The federal regulations required that states must have safety data (e.g., roadway, traffic, and crash) systems with the ability to perform safety problem identification and countermeasure analysis. The Model Inventory of Roadway Elements (MIRE) establishes a basic data set that can be used in GIS-based analysis of roadway characteristics and safety. Roadway and Safety data consistent with MIRE recommendations is critical for agencies of all sizes. These consistent data sets are needed to aid agencies in developing safety performance measures and making sound safety investments to reduce fatal and injury crashes.

   Subsequent regulations required states to adopt and use a subset of the MIRE data (known as Fundamental Data Elements or FDE) in the safety data systems. As there are 37 FDE and collecting all of this information for every roadway would be a challenge for states, a tiered system was created. Therefore, 37 FDE are required for non-local paved roads, 9 FDE are required for paved local roads, and 5 FDE are required for unpaved roads.

   The 5 FDE that are required only describe the ownership, functional class, beginning, and end points of the unpaved roadway. While the requirements were put in place intentionally to not overburden states and due to the local agency barriers for data collection, they do not provide enough data to perform safety problem identification and countermeasure analysis, to showcase the safety difference between paved and unpaved roads, nor to identify national trends.

   Safety data analysis is needed as unpaved roadways account for almost 35% of the 4 million miles of roadways in the U.S. and this number may be increasing, as the technique of converting paved roads to unpaved is increasing for roadways with low volumes. A large portion of the unpaved roadways in the U.S. are the responsibility of local and rural road owners, with many owned and maintained by multiple agencies.
(including local, Tribal, and Federal Lands). Unpaved roads accounted for 546 fatal crashes in 2016 with 93% of these fatal crashes being single-vehicle crashes (Anderson, Skorseth et al. 2017). Safety concerns with unpaved roads include, but are not limited to: no shoulders, narrow lanes, sharp curves, limited sight distance, roadside obstacles, minimal signing and delineation. At times, safety or safety issues on unpaved roads are caused by things that are not common on paved roads, such as road surface condition and road dust.

Therefore, research is needed to identify additional FDE (i.e., traffic, geometric and crash data) that are appropriate, achievable, and implementation-ready for unpaved roads and allow for safety studies to be conducted. The minimum recommendations should be enough to conduct a low data safety assessment such as iRAP or usRAP. These FDE could be provided as suggested additional data collection elements to local agencies.

3. Literature Search Summary

Although unpaved roads make up a large percentage of US roadways, they have not been the focus of many research projects; however, those that have been conducted focus on the safety on unpaved roads and the needs for consistent data. The research includes:

- **Operational Safety of Gravel Roads in Rural and Tribal Communities: Vulnerability to Structural Failures and Geo-hazards** - Center for Safety Equity in Transportation, 2017, Active  
- **NCHRP Synthesis 48-09 Report Integration of Roadway Safety Data from State and Local Sources** – In review by TRB awaiting publishing 2018  
- **Safety Performance Functions for Rural Two-Lane County Road Segments** - Transportation Research Board 97th Annual Meeting, 2018  
- **Safety for Low Volume Unpaved Roads – A New Way for Safer Roads** - International Road Federation – 1997  

4. Research Objective

The objectives of this research are to:

1. Identify the necessary FDE for analyzing safety data on unpaved roads;  
2. Explore and document the barriers for local, Tribal and Federal Lands agencies for collecting, maintaining, and sharing this data with state DOTs;  
3. Conduct a pilot data collection; and  
4. Create guidance and training for local, Tribal, and Federal lands for collecting the unpaved road data.
The need for unpaved road safety research can further be seen in the fact that the Federal Highway Administration has proposed an Unpaved Road Safety Pooled Fund (https://www.pooledfund.org/Details/Solicitation/1419). If chosen, this NCHRP research project would further assist that pooled fund in their objectives and that pooled fund would provide a forum for the training to be conducted and to identify a pilot location. The research team will need to work closely with the pooled fund (if implemented).

5. Implementation Planning

The end product of this research will be a list of FDE for unpaved roads, a technical report addressing the barriers for and training for unpaved road data collection, and the results of the pilot data collection. It will also include a plan for future incorporations into MIRE and potential additional research that can be conducted on unpaved roads.

The research findings should be targeted to a variety of agencies including state DOTs who are responsible for reporting MIRE data and local and rural road owners responsible for the maintenance and data collection on unpaved roads. Key decision makers and early adopters are anticipated to be from the Forest Service and Tribal Lands with a large number of unpaved roads, as well as, the states that have joined the Unpaved Roads Pooled Fund Study including Alaska Department of Transportation and Public Facilities, Iowa Department of Transportation, Kansas Department of Transportation, Minnesota Department of Transportation, and North Dakota Department of Transportation.

6. Estimate of Problem Funding and Research Period

Recommended Funding: $300,000  Recommended Research Period: 12-18 months

- Phase I: Address objectives 1 and 2 (MIRE FDE for unpaved roads and barriers to implementing)
- Phase II: Address objectives 3 and 4 (pilot and create guidance/training)

7. Urgency and Potential Benefits

The anticipated product for this research is appropriate, achievable, implementation-ready, MIRE Fundamental Data Elements used for unpaved roads. These suggested additional FDE can be included in the next version of MIRE or as a supplement to the current MIRE version 2.0.

MIRE recommendations are critical to agencies of all sizes, but this research project would most benefit local and Tribal transportation agencies, and Federal Lands agencies by providing them with a guide for consistent data sets to help develop safety performance measures and prioritize safety investments to reduce fatal and injury crashes.

Negative impacts if not funded include continued lack of a consistent data set for unpaved roads, the inability to properly conduct systemic safety analysis for unpaved roadways, and not accounting for the safety difference in unpaved versus paved roadways.
8. **Person(s) Developing the Problem Statement**

   Anthony R. Giancola, P. E., Transportation and Local Government Consultant, 202 297 0751, tonygiancola@rcn.com

   Jaime Sullivan, P.E., Research Engineer, Western Transportation Institute at Montana State University, 774-571-3503, Jaime.sullivan2@montana.edu

   John Shaw, P.E., Researches, Institute of Transportation at Iowa State University, 515-294-4366, jwshaw@iastate.edu

   On behalf of TRB Joint Subcommittee on Rural Road Safety Policy, Programming and Implementation

9. **Nomination for AASHTO Monitor**

   TBD

10. **Potentially Interested AASHTO Councils and/or Committees**

   Data Management and Analytics
   Safety
   Materials and Pavements
   Maintenance
   Planning
   Traffic Engineering
   Transportation Systems Operations

11. **Submitted By**

    AASHTO Special Committee on Research and Innovation

---

**NCHRP Review of G-07**

Reviewed By:
Camille Crichton-Sumners
crichton-sumners@nas.edu

Comments:

There is a need for unpaved road safety research. Expanding the use of Model Inventory of Roadway Elements (MIRE) basic data set for unpaved roads will be difficult due to the heterogeneity of agency practices, but a valuable exercise. States tribal and local transportation roadway owner/operators will have varied levels of maturity, so recommendations must be scalable. Coordination and data acquisition for locals, tribal governments and some states will be difficult. Additional time and resources are suggested. 30 months with 400K budget.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

(This Problem Statement was a top-ranked problem statement by the AASHTO Technical Committee on Geometric Design. It was also the #1 Ranked Research Problem Statement by the AASHTO Technical Committee on Research members)

FY2020 NCHRP Problem Statement Outline

Problem No: 2020-G-08

1. Problem Title
   Acceleration and Deceleration Rates used in Roadway Design Criteria

2. Background
   The values we are currently using for our design criteria may be outdated. As a result we may be designing roads that are not as efficient as they could be and more expensive to construct. In the current design criteria, a deceleration rate value of 11.2 ft/s$^2$ is used. This value may need to be updated and increased due to the current vehicle fleet’s capabilities and changes in road wearing surfaces. Consideration of the appropriate deceleration and acceleration rates for driver comfort should also be considered with the vehicle fleet’s capabilities. Vehicles are now able to stop more quickly, because more have anti-lock brakes, better tires, and better overall technology. A 95th percentile value of 2.5 seconds for perception/reaction time (PRT) is also commonly used. In combination with the 11.2ft/s$^2$ deceleration rate, this may be overly conservative. Similarly, vehicles are also able to accelerate more quickly due to engine improvements and other vehicle improvements. Changes in acceleration and deceleration rates will have a great impact on the design criteria used for designing roads. Locations most likely to be affected include interchanges and intersections. For example, entrance ramps could have a shorter required acceleration length and exit ramps could have a shorter required deceleration length. This would not only lead to a decrease in construction cost, but may also decrease construction time, since less would need to be built. Also, if the deceleration rate is increased, the braking distance and, as a result, the stopping sight distance would decrease. The profession should also consider if the object height should be modified from 2 feet and if 3.5 feet is still an accurate height for the driver’s eye. Our research will look at these values used in the design criteria and bring them up to date, in order to ensure we are constructing roads as efficiently as possible. Findings that recommend revisions to the acceleration and/or deceleration rates would then be considered for adoption in the AASHTO Green Book and then subsequently used in design by roadway engineers.
3. **Literature Search Summary**

- Yang, Guangchuan; Wang, Zhongren; Xu, Hao; Tian, Zong. “Feasibility of Using a Constant Acceleration Rate for Freeway Entrance Ramp Acceleration Lane Length Design” *Journal of Transportation Engineering, Part A: Systems* Volume: 144 Issue Number: 3 Publisher: American Society of Civil Engineers ISSN: 2473-2907

Based on NCHRP 400, “Determination of Stopping Sight Distances”:
- Most modern countries use a perception reaction time of 2 seconds instead of 2.5 seconds. This is closer to the 85th percentile of drivers than the 95th percentile used in the AASHTO policies.
- The deceleration rate of 11.2 ft/s² is very conservative, and does not represent an emergency stop.
- The object height of 2 ft is very conservative given the current fleet of vehicles with high mounted center taillights and the driver's inability to recognize the need to stop for a 2' high object at great distances.
- The 85th percentile driver’s eye height is higher as crossover, trucks, and SUVs
represent a larger segment of the vehicle fleet and safety standards have resulted in much taller vehicles.

4. Research Objective
This research will determine appropriate acceleration and deceleration rates to be used in design. PRT, eye height and object heights will be evaluated and appropriate design values determined. The results are expected to be incorporated into the AASHTO Green Book. The values included in the Green Book should be based on current vehicle fleet operating abilities. The values in the current edition of the Green Book are based on a prior vehicle fleet.

Some of the tasks that could be completed in this project include:

- Completion of a comprehensive literature review. This review should include research on vehicle fleet composition, performance of the vehicle, advanced technologies and their presence in the vehicle, percentage of vehicles with the advanced technologies (i.e., anti-lock brakes and other performance/safety innovations related to braking and accelerating), tire / pavement friction based on current tires in production and typical pavement surface parameters.
- Evaluate the current research and identify which components need additional research. This could include:
  - Tire performance / friction factors.
  - Vehicle fleet.
    - Eye height and Object height (tail light height).
    - Which vehicles to use in design (is it still heavy vehicles/trucks and everything else)?
    - Acceleration and deceleration capabilities.
  - Vehicle operator.
    - Acceptable acceleration rate, deceleration rate, and PRT.
    - Should the design parameters be modified if we have a high presence of “older” drivers? What would quantify “high presence”? What if the vehicle does not have a human operator? Should this be considered and will alternative design parameters result from this (autonomous vehicles with reduced perception reaction times).
    - Should different acceleration/deceleration rates be used in different road locations (e.g., interchange ramps, intersections, and other locations)?
- Perform the research based on needs identified above and make recommendations.
- Propose new text based on the results of the research project for the next edition of the AASHTO Green Book.

5. Implementation Planning
All engineers and agencies involved in the design of roads will benefit from this research.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $500,000

Research Period: 18 Months

7. **Urgency and Potential Benefits**
   This research is important, because as our vehicular technology advances, so must our design criteria. We should use design criteria that is applicable to our current vehicle fleet. Designing to a prior vehicle fleet (and driver) can cause over design (additional costs) or under design (potential safety impacts). The benefits of updating the design criteria could be substantial. We would like to have the results of this research before the next edition of the *Green Book* is published.

8. **Person(s) Developing the Problem Statement**
   - Richard D. Wilder, PE, Director, Design Services Bureau. New York State Department of Transportation. (518) 457-5922 Rick.Wilder@dot.ny.gov
   - David McDonald, PE, Chief Roadway Engineer, Hanson Professional Services Inc. 630-990-3800 dmcdonald@hanson-inc.com

9. **Nomination for AASHTO Monitor**
   For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by NCHRP staff, but if you wish to nominate yourself or someone for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

10. **Potentially Interested AASHTO Councils and/or Committees**
    AASHTO Council on Highways and Streets

11. **Submitted By**
    AASHTO Technical Committee on Geometric Design, supported by the TRB Committee on Geometric Design and the TRB Committee on Operational Effects of Geometrics.

    Contact:  Jeff Jones, Chair, AASHTO Technical Committee on Geometric Design Assistant Chief Engineer of Design, Tennessee Department of Transportation Suite 700, James K. Polk Bldg. Nashville, Tennessee 37243-0349 e-mail: Jeff.C.Jones@tn.gov

---

**NCHRP Review of G-08**
Comments:

The proposed research is appropriate for the NCHRP and the research results could be incorporated into the 8th edition of the Green Book. Much of the work would be based upon driver/passenger comfort rather than physics and this data will be difficult to collect and analyze. Collaborating with automated vehicle developers would be beneficial since they are also interested in comfortable ranges of acceleration and deceleration rates. This effort could use the SHRP2 naturalistic driving data.

A related issue that arose during discussions on the 7th edition of the Green Book was the proportion of deceleration that takes place before drivers enter a turn bay. This affects the bay length calculation and no good source of information was found in the relevant NCHRP research.

Eye height information should be fairly easy to obtain but determining what to do with the distribution of heights will require a risk analysis (as will the distributions of object heights and perception-reaction times).

Review Date:
11/28/2018

FHWA Evaluation of G-08

FHWA Intersections Team (HRDS/Wei Zhang, HSA/Jeff Shaw) - We concur with AASHTO that this is a high priority topic, and suggest the problem title be tweaked to "Roadway and Intersection" to be certain that the project addresses key differences in PRT and Accel/Decel for expected vs. unexpected scenarios, intersection vs. segment, emergency vs. non-emergency, etc. Also, it may be helpful to frame this as exploring a performance-based approach that is suitable for both new construction as well as evaluation of existing facilities. Finally, the project budget may need to be higher in order to have sufficient resources for new research (both test track and field) using current fleet vehicles/technology.

AASHTO Committee Evaluation for G-08

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is the #1 priority of the Committee on Design.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

(This Problem Statement was a top-ranked problem statement by the AASHTO Technical Committee on Geometric Design. It was also the #2 Ranked Research Problem Statement by the AASHTO Technical Committee on Research members)

FY2020 NCHRP Problem Statement Outline
Problem No: 2020-G-09

1. Problem Title
Designing for Target Speed

2. Background
The current state of practice for designing roadways within the United States is to choose a “design speed” for a roadway and use that speed as an input to determine other roadway factors. AASHTO defines design speed as follows:

*Design speed is a selected speed used to determine the various geometric features of the roadway. The assumed design speed should be a logical one with respect to the topography, anticipated operating speed, the adjacent land use, and the functional classification of the highway.*

The definition for “target speed” is the speed that you intend for drivers to go, rather than “design speed”. For example, a straight roadway with 12-foot travel lanes and no curbs in an urban setting may technically have a “design speed” of 45 mph due to its design characteristics, but the desired “target speed” for that roadway may be 25 mph.

The topic of “design speed” versus “target speed” typically centers on roadways with speed limits between 25 mph and 45 mph especially where the 85th percentile speed is higher than the posted speed limit. Agencies are often asked the question “What can be done to reduce the speeds to obtain a desired target speed?” and that question is often difficult to answer due to the nature of design with speed being an input instead of an output along with knowing what roadway and non-roadway elements actually influence a driver’s speed choice.

The purpose of this research is to investigate the question of what roadway / non-roadway elements influence operating speed. This research would focus on roadways with a posted speed limit between 30 and 40 mph, typically collectors and arterials within an urban/suburban context. The research would review various elements of roadways where the 85th percentile speed is at or near the posted speed (within 5 mph) and those roadways where the 85th percentile speed is over the posted speed limit by 10 mph or more. These elements could include roadway width, shoulder width, presence of curbs, driveway...
density, tree density and size, presence of on-street parking, presence of on-street bicycle facilities, presence of transit stops, roadway curvature (both horizontal and vertical), signal density, presence of sidewalks, sidewalk width and setback, building setback, land use, pedestrian and bicyclist activity, as well as others. The result of the research should provide the profession with better knowledge of what elements may affect speed and how to incorporate those elements into better design.

3. Literature Search Summary

- Stamatiadis, Nikiforos, Analysis of Inconsistencies Related to Design Speed, Operating Speed and Speed Limits, Kentucky Transportation Center Research Report, 2004, 64p.
- Recent and in-process research, including:
4. **Research Objective**

The objectives of this research are as follows:

- Summarize the research conducted in this area, including identifying how those findings should be considered when collecting data in Phase II of the project.
- Identify elements that influence speed, including roadway and non-roadway features. Examples of roadway features include lane width, shoulder width, etc. Examples of non-roadway features include the presence of trees, building setback, land use, etc.
- Identify and evaluate two different sets of roadways with posted speeds between 30 and 40 mph that have:
  - 85th Percentile Speed that is within 5 mph of Posted Speed.
  - 85th Percentile Speed that is over 10 mph of Posted Speed.
- Determine how the identified roadway and non-roadway elements influence operating speed and/or influence the speed difference between the 85th percentile speed and the posted speed limit.
• Recommend best practice for which roadway and non-roadway elements should be considered when an agency selects a target speed. Develop recommendations on how the findings can be incorporated into the design process

5. Implementation Planning
State DOTs would use this information to determine which roadway/non-roadway elements could be modified in order to reduce speeding. This could involve providing information to local/county roadway agencies, conducting a pilot test on their own roadway, or provide assistance (financial or non-financial) to local/county roadway agencies for a pilot project to evaluate recommendations in the report.

6. Estimate of Problem Funding and Research Period
Recommended Funding:
$750,000

Research Period:
36 months

The duration is based on spending approximately the first 6 months conducting a literature search and summary of previous research, as well as the determination of roadway and non-roadway elements to include in the research. The next 6 months would identify roadways to evaluate, which would involve working with state DOTs and local jurisdictions to determine availability of data. The next twelve months would involve collecting and evaluating the speed and roadway / non-roadway data. Finally, the remaining time would involve evaluating the findings and developing recommendations and documentation.

7. Urgency and Potential Benefits
Given the recent push by local/county jurisdictions to identify characteristics to reduce speeds and implement the use of “target speed” instead of “design speed”, the urgency is between one to three years. The potential values to state DOTs is to address the gap that exists on how various roadway and non-roadway elements influence speed and incorporate that knowledge into the design process. The likelihood that this research can be achieved within the given timeframe is high, given state/local participation in the research. The likelihood that this research would be used by state DOTs is high, as well as local/county agencies. This research topic was listed as a high priority by the AASHTO Technical Committee on Geometric Design during their June 2018 joint meeting with the TRB Committee on Geometric Design and the TRB Committee on Operational Effects of Geometrics.
8. **Person(s) Developing the Problem Statement**
Sarah Binkowski, Transportation Engineer, Southeast Michigan Council of Governments, (313) 204-8200, binkowski@semcoq.org

Jim Rosenow, Office of Project Management & Technical Support, Minnesota Department of Transportation, (651) 366-4673, james.rosenow@state.mn.us

Hermanus Steyn, Senior Principal Engineer, Kittelson & Associates, Inc., (503) 535-7455, hsteyn@kittelson.com

Kay Fitzpatrick, Senior Research Engineer, Texas A&M Transportation Institute, (979) 845-7321, k-fitzpatrick@tamu.edu

9. **Nomination for AASHTO Monitor**
For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by NCHRP staff, but if you wish to nominate yourself or someone for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

10. **Potentially Interested AASHTO Councils and/or Committees**
If this problem statement is not submitted by an AASHTO council and/or committee, suggest the council(s) and/or committee(s) that might be interested in the research results and that could support implementation.

11. **Submitted By**
AASHTO Technical Committee on Geometric Design, supported by the TRB Committee on Geometric Design and the TRB Committee on Operational Effects of Geometrics.

Contact: Jeff Jones, Chair, AASHTO Technical Committee on Geometric Design Assistant Chief Engineer of Design, Tennessee Department of Transportation Suite 700, James K. Polk Bldg. Nashville, Tennessee 37243-0349
e-mail: Jeff.C.Jones@tn.gov

---

**NCHRP Review of G-09**

Reviewed By:
B. Ray Derr
rderr@nas.edu
Comments:

The proposed research is appropriate for NCHRP and of critical interest to many transportation agencies. Of particular concern is how to reduce vehicular speeds to improve the safety of pedestrians and bicyclists. Determining how to influence speed is a difficult topic but one that is worth pursuing. It will also be an important effort to advance performance-based design.

Review Date:
11/28/2018

FHWA Evaluation of G-09

E. Hilton, HICP-10 - High priority project and high importance to HIF and to our role managing the geometric design program. Zineddin/HRDS; Xu/HSA - High Priority: It is an important issue that needs to be address. But it appears that it's uncertain how the relationship between speed and various design factors could be defined/established based on available research/studies. It is also vital to review SHRP2 related work in this area.

AASHTO Committee Evaluation for G-09

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is the #2 priority of the Committee on Design.

Submitted By:
Elizabeth Robbins
Chair
Planning

Comments:
COP's #5 priority: Mesh this problem statement with work underway with the Institute of Traffic Engineers (ITE) to raise the profile of speed as a factor in crash severity and "moving the needle" on Target-Zero-type objectives for many state DOTs.
Submitted By:
Jameelah Hayes
AASHTO staff
Traffic Engineering

Comments:
The Committee on Traffic Engineering thinks this a very high priority topic. It is #1 in their proposal rankings.
FY2020 NCHRP Problem Statement Outline
Problem No:  2020-G-10

1. Problem Title
Advanced Modeling of Driver Performance on Horizontal Curves

2. Background
The side friction factors may need to be adjusted due to multiple factors. Both tires and road wearing surfaces have changed, which affect the friction between them. Since NCHRP Report 439 (Superelevation Distribution Methods and Transition Design) was published, there have been findings that superelevation following the NCHRP 439 transitions may cause greater side forces than expected. More sophisticated vehicle dynamics simulation models are also now available that provide advantages over using the point-mass model for design, such as accounting for grade, deceleration/acceleration, and analysis of the dynamics of individual axles.

We also need to consider changing the design superelevation from increments of two tenths, which may be too precise. What precision can contractors actually construct? Many believe this is not practical to contractors. Considering performance-based design principles, are there acceptable differences in superelevation from the current design superelevation rate that would be acceptable? Could the design speeds for the various design superelevation rates be modified? The side friction factor also represents the lateral acceleration, so the way we model lateral acceleration in horizontal curve design may need to be changed. Since the previous research was completed, there are different vehicle types in the vehicle fleet and a departure from the point-mass model. Are there better models we should use that work better with the current fleet of vehicles? If there are better models, which should we use and how does that change the equations we use for design?

The AASHTO Highway Safety Manual, the collective experiences of state transportation departments, and TRB Special Report 214 have shown that the minimum radii in AASHTO’s Green Book are not threshold values that correlate to safety or operational problems. Based on NCHRP Report 774 (Superelevation Criteria for Sharp Horizontal Curves) and NCHRP Report 439:

- The current approach for selecting the maximum side friction factors for design is based upon research from the 1930s and 1940s.
- Wet-tire side friction values are much higher than the AASHTO side friction factors used in design.
• The margin of safety for rollovers is variable since the current side friction factors used in design are more conservative at high speeds.

3. Literature Search Summary

4. Research Objective
This research will update appropriate values for use in horizontal curve design. Multiple advancements have affected previous data and models that have been used to establish horizontal curve design guidance. Side friction factors were established in the 1930s and 1940s, and then they were reviewed in 2000 under NCHRP Report 439 and found the values to be generally consistent with the prior values. With advancements in tire design and manufacturing and pavement wearing surfaces and mixes continuing to develop, a reexamination of appropriate side friction factors for use in design need to be examined. More sophisticated vehicle dynamics simulation models have also been developed to model the behavior of vehicles in curves. Current Green Book horizontal curve design is based on the point-mass model. As the vehicle fleet has advanced, the newer vehicle models may also be able to refine acceptable driver comfort as it relates to horizontal curvature within superelevation transition areas and when the curve is fully superelevated.
Some of the tasks that could be completed in this project include:

- **Completion of a comprehensive literature review.**
  - Identify research on vehicle fleet composition, performance of the vehicle, advanced technologies and their presence in the vehicle, percentage of vehicles with the advanced technologies (i.e., stability mechanics and other performance/safety innovations), tire / pavement friction based on current tires in production and typical pavement surface parameters. (Note this effort overlaps with another research needs statement – to evaluate potential revisions to acceleration and deceleration lengths.)
  - Identify available vehicle models and which may be candidates to replace the point-mass model.

- **Evaluate the current research and identify which components need additional research.** This could include:
  - Tire performance / friction factors (Wet & Dry)
  - Pavement wearing surface (Types & Friction in combination with tire performance)
  - Vehicle fleet
    - Which vehicles to use in design (i.e., keep two primary categories of heavy vehicles/trucks and everything else, or some other classification)
    - Stability capabilities
  - Cross-slope constructability (Is 0.2 the appropriate interval for design superelevation? NYSDOT has adopted 0.5 increments.)
  - Vehicle operator (Should the design parameters be modified if we have a high presence of “older” drivers? What would quantify “high presence”?)

- **Perform the research based on needs identified above and make recommendations.**
  - Revised side friction factors for use in design.
  - Revised design superelevation rates.
  - Superelevation transitions.
  - Appropriate vehicle model

- **Propose new text based on the results of the research project for the next edition of the AASHTO Green Book.** Revisions would be expected in what is currently Chapter 3 “Elements of Design”.

5. **Implementation Planning**
   All engineers and agencies involved in the design of roads will be impacted by this research.

6. **Estimate of Problem Funding and Research Period**
   **Recommended Funding:**
$1,000,000

Research Period:
18 Months

7. **Urgency and Potential Benefits**
This research is important, because as our vehicular technology advances, so must our design criteria. We should use design criteria that is applicable to our current vehicle fleet. Designing to a prior vehicle fleet and old vehicular models may cause over design (additional costs) or under design (potential safety impacts). The benefits of updating the design criteria could be substantial. We would like to have the results of this research before the next edition of the “Green Book” is published.

8. **Person(s) Developing the Problem Statement**
AASHTO Subcommittee on Design, TRB Geometric Design Committee, and TRB Operational Effects of Geometrics Committees. Primary authors as follows:
- David McDonald, Chief Roadway Engineer, Hanson Professional Services Inc. (630) 990-3800 dmcdonald@hanson-inc.com.
- Daren Torbic, Principal Traffic Engineer, MRIGlobal. (814) 237-8831 dtorbic@mriglobal.org
- Richard D. Wilder, PE, Director, Design Services Bureau. New York State Department of Transportation. (518) 457-5922 Rick.Wilder@dot.ny.gov

9. **Nomination for AASHTO Monitor**
For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by NCHRP staff, but if you wish to nominate yourself or someone for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

10. **Potentially Interested AASHTO Councils and/or Committees**
AASHTO Council on Highways and Streets

11. **Submitted By**
AASHTO Technical Committee on Geometric Design, supported by the TRB Committee on Geometric Design and the TRB Committee on Operational Effects of Geometrics.

Contact: Jeff Jones, Chair, AASHTO Technical Committee on Geometric Design Assistant Chief Engineer of Design, Tennessee Department of Transportation Suite 700, James K. Polk Bldg. Nashville, Tennessee 37243-0349 e-mail: Jeff.C.Jones@tn.gov
NCHRP Review of G-10

Reviewed By:  
B. Ray Derr  
rderr@nas.edu

Comments:

The proposed research is appropriate for the NCHRP and the results would be widely used by designers.

My understanding is that the side friction factors generally reflect driver comfort rather than loss of control (plus a safety factor). I have seen presentations from HERE Technologies showing full trajectories of real vehicles navigating curves and this source of data should be explored. The SHRP2 Naturalistic Driving data may also be useful.

Construction tolerances for superelevation is a separate, but related, issue and could be approached through a survey of practitioners. It may also be useful to consider how the super changes as the pavement is maintained.

Review Date:  
12/7/2018

FHWA Evaluation of G-10

Philips/HRDS; Anderson/HSA; Rousseau/HSA - We are unable to support this project. Unclear from this problem statement/research proposal how driver performance is going to be modeled. This is all about tire friction and vehicle performance on curves. Very little about human/vehicle/roadway interaction. Where is the linkage to safety, crashes, and driver performance?

AASHTO Committee Evaluation for G-10

Submitted By:  
Patricia Bush  
AASHTO staff  
Committee on Design

Comments:
This is endorsed by the Committee on Design.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  
FY2020 NCHRP Proposed Problem Statement

Problem Number: 2020-G-11

1. Problem Title  
Aligning Geometric Design Controls, Criteria and Elements with Roadway Context, Modal Priority and Functional Classification

2. Background

Since 1984, the AASHTO “Green Book” (A Policy on the Geometric Design of Highways and Streets) and other roadway design criteria have been primarily based on a functional classification system of a hierarchical network composed of arterials, collector, and local roads. This classification is further assigned by an urban or rural designation. This system is described in detail in Highway Functional Classification Concepts, Criteria, and Procedures (FHWA-PL-13-026).

This traditional system of highway and street classification has been under increasing scrutiny and discussion because of its inability to reflect emerging design issues such as context-sensitive design, livable communities, practical design, and other innovative approaches. The following are some key concerns with the existing system:

- Designation as simply urban or rural land use context is insufficient to adequately account for the full range of contexts that can exist along a highway or street.
- Classification leads to recommended or limited design choices that may not be optimal for the particular facility and its adjacent land use contexts. These restrictions promote “designing to standards” rather than use of engineering judgment in carefully considering the safety, operational, and other impacts of design decisions on all travel modes using facility.
- The public often questions the use of these classifications as the basis for design decisions.
- The current system is focused on the needs of vehicle drivers and does not fully or effectively address the needs of other types of user modes (e.g., pedestrians, bicyclists, transit riders, freight vehicles). In particular, it does not help with design decisions that must balance benefits for one mode against disbenefits for another.

Project 15-52, Developing a Context-Sensitive Functional Classification System for More Flexibility in Geometric Design, was completed in 2018. NCHRP Research Report 855, An Expanded Functional Classification System for Highways and Streets, was published later in 2018 and the final product of this research. This report presents an expanded functional classification system for highways and streets that builds upon the current system to provide a better basis for the preliminary engineering of a design project, including developing the purpose and need. In particular, it provides additional contexts beyond urban
and rural, facilitates accommodation of modes other than personal vehicles, and adds overlays for transit and freight.

The purpose of this proposed research is to further implement the work of NCHRP 15-52/Report 855 by developing recommended geometric design controls, criteria, and elements ranges and applications that are considered appropriate to the expanded context and modal functional classification matrix. This research will build on and advance previous and current geometric design research efforts for applying the design flexibility that currently exists in the Green Book to address the full range of system, context, and modal aspects of street and highway design in order to create a modal balance to achieve successful outcomes. These considerations will allow the planner/designer to identify potential areas of concern and determine the tradeoffs required to best accommodate all users and achieve the end operating conditions that are desired. Alternative designs should be developed and evaluated in order to deliver a design that is contextually appropriate and best achieves the balance of service, safety, convenience, and accessibility to all modes present or planned.

3. Literature Search Summary

A literature search found extensive research products and guidance on planning for all travel modes along roadways, especially on an area-wide basis, but very little specific research and guidance on comprehensive, context-sensitive multimodal geometric design guidance for facilities or intersections. Limited geometric design research and guidance is available in this subject area. Several studies have been conducted that dealt with the safety of the various non-vehicle roadway users, but little has been done to correlate balance of design elements to optimize the relative safety risks and operational levels of service between various motorized and non-motorized roadway users across a range of contexts and functional classifications.

There are many documents that should be considered as part of this research. Some of the more relevant documents include:

- Transportation Research Board. 2016. NCHRP Report 15-52: *Developing a Context-Sensitive Functional Classification System for More Flexibility in Geometric Design*
4. **Research Objective**

The objectives of the research are to identify appropriate applications and ranges of design controls, criteria, and elements across a range of functional classifications, contexts, and modal priorities consistent with the recommendations of Research Report 855. This work will identify the geometric design parameters for the types and designs of facilities needed to serve the travel demands of all current and planned user modes across a range of contexts within each functional classification. The results will be presented in the form of design guidelines supporting each of the cells of the table in
The research should include a literature review of previous research and current practice, development of a work plan to achieve the research objectives, collection of applicable best practices and supporting information, assessment of the safety and operational effects of various combinations of design controls, criteria, and elements, and preparation of a final report. The final report should include proposed changes to AASHTO documents, if the results support such changes.

5. Implementation Planning
The results of this research could be directly incorporated into standard references, including the AASHTO Green Book (for geometric configurations) and the MUTCD (unique signing, pavement markings, and signalization needs) as related to the geometric design elements. In addition, the information could be used to update guidebooks such as AASHTO Pedestrian and Bicycle Accommodation guides.

The findings of this project will be directly applicable to the planning, design and operation of roadways and intersections. Designers will have more comprehensive design guidance for these types of roadway facilities and the mobility and safety of all roadway users will be improved through better designs and integration of modes. The findings will be of interest to a number of TRB committees, AASHTO, State DOTs and other roadway design agencies. They will also have the potential to provide new material for such authoritative documents as the HCM and various state standards and guidelines.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $350,000
Research Period: 18 months

7. Urgency and Potential Benefits
In 2016 AASHTO approved a committee restructuring plan that addressed a number of elements including the need for the organization to provide more multimodal and context-focused guidance to the transportation profession along with guidance on use of flexibility in the design process.

Urgency:
This research topic was identified as a high priority by the AASHTO Technical Committee on Geometric Design, the TRB Committee on Geometric Design, and the TRB Committee on Operational Effects of Geometrics at their combined meeting in June 2018 from among a broad set of problems considered.

The research is critically needed to fill gaps in current roadway design guidance to address and serve the needs of all roadway facility users being served in the roadway
right-of-way. The research results should be presented in a standalone document that can be used to supplement existing design policies and guidelines.

8. Person(s) Developing the Problem Statement
R. Marshall Elizer, Jr., P.E., PTOE, Assistant Secretary, Washington State DOT, 310 Maple Park Ave. SE, PO Box 47395, Olympia WA 98504, Phone: (360) 705-7309, E-mail: elizerm@wsdot.wa.gov

Douglas W. Harwood, Transportation Research Center Manager, MRI Global, 425 Volker Boulevard, Kansas City, MO 64110, Phone: (816) 753-7600, Ext 1571, Fax: (816) 561-6557 E-mail: dhanwood@mriresearch.org

9. Nomination for AASHTO Monitor
Proposed AASHTO Monitor: R. Marshall Elizer, Jr., P.E., PTOE, Assistant Secretary, Washington State DOT, 310 Maple Park Ave. SE, PO Box 47395, Olympia WA 98504, Phone: (360) 705-7309, E-mail: elizerm@wsdot.wa.gov

10. Potentially Interested AASHTO Councils and/or Committees
Councils: Highways and Streets, Public Transportation, Active Transportation Committees: Design, Traffic Engineering, Safety

11. Submitted By
AASHTO Technical Committee on Geometric Design, supported by the TRB Committee on Geometric Design and the TRB Committee on Operational Effects of Geometrics.

Contact: Jeff Jones, Chair, AASHTO Technical Committee on Geometric Design Assistant Chief Engineer of Design, Tennessee Department of Transportation Suite 700, James K. Polk Bldg. Nashville, Tennessee 37243-0349 e-mail: Jeff.C.Jones@tn.gov

NCHRP Review of G-11

Reviewed By: B. Ray Derr rderr@nas.edu

Comments:
The proposed research would build upon the work document in NCHRP Report 855 that has been incorporated into the 7th edition of the Green Book by providing more explicit design guidance for the various classifications. Some of the work would be suitable for the 8th edition but there will likely be more material than could be incorporated into it.
That material could be incorporated into agency design manuals based upon their assessments of its utility.

The proposed work complements that of Problem Statement C-12 which provides planners guidance on selecting the most appropriate context class.

Review Date:
11/28/2018

FHWA Evaluation of G-11

E. Hilton, HICP-10 - High priority project and high importance to FHWA and to our role managing the geometric design program.

AASHTO Committee Evaluation for G-11

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This is supported by Council on Active Transportation Members surveyed.

Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is endorsed by the Committee on Design.

Submitted By:
Kelly Hardy
AASHTO staff
Safety

Comments:
Works for safety, traffic and design
Submitted By:
Jameelah Hayes
AASHTO staff
Traffic Engineering

Comments:
The Committee on Traffic Engineering thinks this is an important topic.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation
FY2020 NCHRP Problem Statement Outline

Problem No: 2020-G-12

I. Problem Title

Trade-offs for Cross-sectional Reallocation on Urban and Suburban Roads

II. Background

Transportation professionals strive to provide safe and reliable service for automobiles, freight, pedestrians, bicyclists, and transit in balance with the desire to enhance communities and minimize impacts to the environment. Designs for urban and suburban streets must effectively serve all transportation modes and provide an appropriate operational and safety balance among those modes.

The allocation of space within the travelled way (i.e. the road’s cross-section) provides the elements that allow for the movement of vehicles, transit, bicycles and freight. Roadway design guidance exists for the individual elements of the traveled way, such as lane width, bicycle lanes, on-street parking, medians, midblock crossings and pedestrian refuge islands, and transit stops. However, current design guidance may not reflect the complex trade-offs transportation professionals must consider for roadways in varying contexts. Also, in constrained locations certain combinations of minimal widths for adjacent elements may have undesired consequences. For example, combining minimum width travel lanes adjacent to minimum width bicycle lanes and parking.

Many transportation agencies have reallocated existing cross-sectional pavement space through resurfacing projects as an effective and low-cost strategy to improve safety and develop multi-modal corridors. There are many options for reconfiguring a roadway to add bicycle lanes, sidewalks, on-street parking or transit stop pull-outs. Oftentimes these types of projects are referred to as “Road Diets”. There are many potential benefits to reallocating the use of pavement space. Providing for a two-way left turn lane (TWLTL) can greatly reduce the risk of rear-end and angle collisions for mid-block left-turning motorists. Decreasing the number of road lanes reduces pedestrian and bicycle exposure to traffic when crossing the street and the extra space can be used to add pedestrian refuge islands, widen sidewalks, and enhance local businesses along the corridor by providing outside areas for showcasing merchandise or providing seating for restaurant diners. Cross-sectional reallocations can also provide opportunities to add bicycle lanes to the street or for installing bus pullouts so transit users can enjoy safer stops that do not hinder the flow of traffic. Cross-sectional reallocations can be relatively inexpensive to implement, especially when done through a resurfacing project.

Although cross-sectional reallocations can offer significant multi-modal benefits, they may not be feasible or appropriate in all locations. Transportation agencies must consider numerous factors in terms of feasibility and the overall objectives of the corridor for
balancing service among modes. Since there are likely to be positive and negative effects associated with road configuration choices, it is critical to consider the potential outcomes for all users and assess both the beneficial and detrimental outcomes in relation to overall goals and objectives of the project. However, there is limited guidance available to transportation professionals on the key considerations and how to evaluate trade-offs when screening and evaluating cross-sectional reallocations on projects.

III. Literature Search Summary

Ongoing – NCHRP 03-112: Operational and Safety Considerations in Making Lane Width Decisions on Urban and Suburban Arterials

Safety and Operational Analysis of 4-Lane to 3-Lane Conversions (Road Diets) in Michigan, Lyles, Richard W., M. Abrar Siddiqui, William C. Taylor, Bilal Z. Malik, Gregory Siviy, and Tyler Haan, Lansing, Michigan: Department of Civil and Environmental Engineering, Michigan State University (2012)


Road Diet Informational Guide, FHWA (2014)

IV. Research Objective

The objective of this research is to develop enhanced guidance on the key considerations when evaluating and designing cross-sectional allocations on urban and suburban streets. This guidance should be based on a combination of contextual considerations and quantitative operational and safety-performance information and should examine potential mitigation strategies to minimize negative effects. The enhanced guidance should consider the volume of traffic individually within each mode for the combination of modes being considered in both the before and after conditions. An evaluation framework, including appropriate performance measures is desired.

The research should examine the safety and operational aspects of a sampling of representative cross-sectional reallocations over a range of design parameters (i.e. lane widths, speeds, and varying cross-sectional elements, and various volume combinations for the modes being considered). The guidance should also consider driver expectations and behaviors over a range of traffic conditions. Development of this guidance will require the examination of field data and site observations supplemented with safety modeling considerations and traffic operational simulations.
The research should examine both performance and feasibility aspects related to cross-sectional reallocation. The issues associated with evaluating these proposals are complex and need research to offer modern perspectives and insights on safety performance and economic trade-offs associated with such roadway changes. The final report should include enhanced guidance targeted to design practitioners.

V. Implementation Planning
Support for transportation agencies to implement the research results could be in the form of webinars and materials for an instructor led-training course. Other activities to help facilitate dissemination and implementation of the guidance would include presentations at national conferences and practitioner peer exchanges aimed at specific target audiences.

VI. Estimate of Problem Funding and Research Period

**Recommended Funding:** $400,000

**Research Period:** 24 months

VII. Urgency and Potential Benefits

This research need has been identified as a high priority by the AASHTO Technical Committee on Geometric Design, the TRB Committee on Geometric Design, and the TRB Committee on Operational Effects of Geometrics at their June 2018 combined meeting. The research is needed to provide enhanced guidance that will directly affect future design practices for use nationally.

VIII. Persons Developing the Problem

Jeremy Fletcher (Florida DOT)  Larry Sutherland (WSP)
jeremy.fletcher@dot.state.fl.us  Larry.Sutherland@wsp.com

Susan Keen (Virginia DOT)  Mark Doctor (FHWA)
susan.keen@vdot.virginia.gov  mark.doctor@dot.gov

Pete Jenior (Kittelson & Assoc)
pjenior@kittelson.com

IX. Nomination for AASHTO Monitor

Antonette Clark (Caltrans)
antonette.clark@dot.ca.gov

X. Potentially Interested AASHTO Councils and/or Committees
AASHTO Committee on Design
AASHTO Technical Subcommittee on Geometric Design

XI. Submitted By
AASHTO Technical Committee on Geometric Design, supported by the TRB Committee on Geometric Design and the TRB Committee on Operational Effects of Geometrics.

Contact: Jeff Jones, Chair, AASHTO Technical Committee on Geometric Design
Assistant Chief Engineer of Design, Tennessee Department of Transportation
Suite 700, James K. Polk Bldg. Nashville, Tennessee 37243-0349
e-mail: Jeff.C.Jones@tn.gov

NCHRP Review of G-12

Reviewed By:
B. Ray Derr
derr@nas.edu

Comments:
The proposed research is appropriate for the NCHRP and likely to be widely used. Many agencies have implemented road diet and other types of projects that reallocate the cross-section and the guidance will be able to draw upon these experiences. These types of projects can improve the level of service for non-passenger-vehicle modes with relatively minor impacts on the passenger vehicles. They are inexpensive projects that can substantially advance community goals.

Review Date:
11/28/2018

FHWA Evaluation of G-12

E. Hilton, HICP-10 - It's unclear what this work would add to, for example, the guidance provided in the Road Diet Informational Guide (FHWA, 2014). Christopher Douwes/HEPH - G-12 and G-14 are similar and could possibly be combined.

AASHTO Committee Evaluation for G-12
Submitted By:
Patricia Bush
AASHTO staff
Committee on Design

Comments:
This is endorsed by the Committee on Design.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement
Problem No: 2020-G-13

1. Problem Title
Impact of Traffic Speed on Perceived and Actual Risk of Bicycling

2. Background
Encouraging bicycle transportation has been a policy objective in the United States for nearly two decades. All levels of government agencies have identified increased bicycling as a way to increase physical activity, reduce carbon emissions and greenhouse gases, increase mobility and social equity, and promote lively places. Between 1994 and 2010, the proportion of utilitarian bicycle trips (i.e., not recreational) in the United States grew by 43% (from 0.70% to 1.00%), and bicycle commute trips by 22% (from 0.40% to 0.49%) (Flusche, 2010), but the overall percentage of bicycle trips remains low.

Research investigating barriers to bicycling suggests that perceived traffic risk is a consistent deterrent (Dill & Voros, 2007; Sener, et al, 2009; Winters, Davidson, et al., 2010). However, it is unclear how various aspects of perceived risk affect current and potential bicyclists. Little is known about how traffic speeds affect cyclists' perceptions of safety and comfort—particularly when sharing the road with motor vehicles.

Similarly, the profession lacks understanding of the relative risk of cyclists sharing the road with drivers in various circumstances and design speeds. The effect of traffic speeds (and motor vehicle impact speeds) on the severity of pedestrian crashes has been well-studied (Rosén et al., 2011), finding strong correlation between increasing motor vehicle speeds and increasing crash severity. These effects have generally been assumed to apply to bicycle crashes, although little research has examined bicycle-specific effects of traffic speed. A small study in New Zealand found that the effects of traffic speed on fatality rates may differ between pedestrians and cyclists, but more research is necessary to understand how risk may differ at various speeds (Koorey, 2011).

It is also well-established that people—particularly less-experienced cyclists—generally prefer to be separated from vehicular traffic when bicycling (Winters, et al, 2010; Winters, et al., 2011; Landis, et al., 1997; Tilahun et al., 2007), but little research has studied how these preferences change under various speed conditions.

3. Literature Search Summary
Findings from this research would complement research done for NCHRP 15-42: *Recommended Bicycle Lane Widths for Various Roadway Characteristics* and NCHRP 07-17: *Pedestrian and Bicycle Transportation Along Existing Roads*.


4. **Research Objective**

The proposed research will investigate the effects of different traffic speed environments on the perceived and actual safety of bicyclists and develop research-based guidance for safe accommodation of bicyclists under various speed conditions. The majority of the effort will be directed at gathering field-based observational data.
The research will consist of the following tasks:

1. **Literature review and synthesis of current practice** - A comprehensive review of research related to bicycle safety and traffic speeds will be conducted. The review will cover material published in academic journals and other sources. Building on information found in the published literature, the research will synthesize current knowledge about: 1) the bio-mechanics of actual vehicle impact speeds/angles and their likely effect on bicyclist injuries; 2) the effect that different speed environments (based on observed speeds or posted speed limits) have on the likelihood and severity of bicycle injuries; and, 3) people’s perceptions of traffic risk while bicycling in various speed environments.

2. **Identify and prioritize critical issues for further investigation** - Based on the results of the literature review and synthesis of knowledge, the research will identify and prioritize the most critical research issues for which guidance is needed. The prioritization of critical issues should incorporate outreach to transportation agencies (e.g., focus groups, surveys, stakeholder interviews) to understand critical knowledge gaps and issues. The prioritized critical issues will form the basis of subsequent research tasks.

3. **Design a multi-pronged, field-based data collection experiment** - Working from the list of prioritized issues, a field-based observational experiment will be designed. The experiment design will address as many critical issues as feasible. As noted above, this work could include bio-mechanical studies of traffic speed impact on bicyclists, if deemed practical and necessary from the literature. It will also likely include both 1) collection of traffic and crash data to determine the effect that different speed environments have on the likelihood and severity of bicycle injuries; and 2) perception studies of people regarding bicycling in different speed environments.

4. **Collect and analyze data** - Implement the data collection program and analyze the results to draw cross-cutting lessons on the effects of different traffic speed environments on the perceived and actual safety of bicyclists.

5. **Develop a research report and guidelines** - The final product of the research will be a user-friendly report summarizing the findings of the studies. The guidelines will be research-based, practical, and applicable to practitioners operating in a wide range of contexts.

5. **Implementation Planning**

The research will be valuable for safety and traffic operations researchers and practitioners. The results from this project could provide traffic engineers
concerned with safety, design, and operation with guidelines to improve new and existing roadways and more safely accommodate bicycles. The resulting guidance could also be used to inform “complete streets” guidelines and road safety policy and promotion material regarding traffic speeds and bicycle safety, by providing a deeper understanding of the range of facility types safe for bicyclists on roadways signed at various speeds. While the forthcoming AASHTO Bicycle Guide is anticipated to provide some guidance in this area, a deeper understanding of bicyclists perceived and actual safety per traffic speed scenario would complement the Bike Guide and provide helpful nuance for practitioners.

The forthcoming 2nd edition of the Highway Safety Manual is considering adding a new chapter that will include the bicycle and pedestrian safety performance functions currently being developed in the NCHRP 17-84. NCHRP 17-84 does not account for the safety impacts of various speed environments on the bicycling risk. The results of this project could potentially be added to the HSM’s new chapter to provide an-depth insights to the expected impact of posted speed limits on bicycling risk.

The results of this research will be disseminated via a research report and webinars conducted as part of the implementation plan.

6. **Estimate of Problem Funding and Research Period**
   
   **Recommended Funding:** $500,000

   **Research Period:** 24 months

7. **Urgency and Potential Benefits**
   
   This research is a priority as indicated by the large number of transportation agencies with “complete streets” policies and safety initiatives targeted at speed management including the Caltrans Pedestrian and Bicycle Safety Branch.

8. **Person(s) Developing the Problem Statement**
   
   Rebecca L. Sanders PhD
   
   Research Lead
   
   TOOLE DESIGN
   
   503.205.4607 x317
   
   rsanders@tooledesign.com

   Jamie Parks
   
   SFMTA Livable Streets Director
   
   ANF20 Chair
   
   415.646.2121
   
   Jamie.Parks@sfmta.com

   Rachel Carpenter, California DOT
   
   Division of Traffic Operations
9. **Nomination for AASHTO Monitor**
Rachel Carpenter, California DOT
Division of Traffic Operations
1120 N Street, MS-36
Sacramento, CA 95814
916-651-1248
Rachel.Carpenter@dot.ca.gov

10. **Potentially Interested AASHTO Councils and/or Committees**
Active Transportation Council

11. **Submitted By**
Joe Horton, California DOT
DRISI
1727 30th Street, 3rd Floor
Sacramento, CA 95816

On Behalf of ANF20, Bicycle Transportation.

---

**NCHRP Review of G-13**

**Reviewed By:**
William C. Rogers
wrogers@nas.edu

**Comments:**

This proposal has merit as the relationship between speed and bicycle crashes could use additional research. The research should coordinate with NCHRP 17-92, Developing Safety Performance Functions for Rural Two-Lane Highways that Incorporate Speed Measures,

**Review Date:**
11/30/2018
FHWA Evaluation of G-13

Zineddin/HRDS; Xu/HSA; Redmon/HSA; Do/HRDS - This is a low priority. Many factors impact bicyclists perceptions of risk - roadway conditions (surface and geometric), traffic conditions (volume, density, component, and speed), etc. These factors are correlated and impact each other in terms of their impacts on bicyclists' perceptions. So the scope of the proposed study is kind of too narrow and would impact the results and usefulness of the study. It is also unclear how the study will research bicyclists' perceived risk. The lit review did not include older research on the Bicycle Compatibility Index or the Bicycle Level of Service which looked at how bicyclists felt (comfort level) on different roadways. In terms of the crash data, it seems like hospital data would need to be analyzed somewhat, but that information is notoriously hard to get. How would that be handled? How could this study info eventually be incorporated into AASHTO Bike Guide and other documents?

AASHTO Committee Evaluation for G-13

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This submission is supported by Council on Active Transportation Members surveyed.
1. Problem Title: Safety Benefits of Lane Reduction on Major Urban and Suburban Streets

2. Background
This study would create urgently-needed knowledge on the magnitude and type of severe injury and fatality (KSI) reduction to be expected from reducing the number of mixed-traffic through lanes on multilane streets. While the safety and operational benefits of 4-to-3 road-diet conversions are well-documented, the specific safety benefits of lane reduction or reassignment is not as widely understood. The redesign of major multilane streets has potential to dramatically reduce traffic fatalities, and these streets have a major need for improved pedestrian, transit, and bike facilities. The vast majority of the recent increase in pedestrian deaths occurred on urban arterials; arterial streets showed a 67% increase in pedestrian fatalities from 2009 to 2016, while local and collector-street rates increased by only 9%. [Hu & Cicchino, 2018]

This project will identify the injury, severe injury, and fatality reduction to be expected when reducing the number of through traffic lanes per direction on an existing multilane urban or suburban street. This will include the specific benefits of reducing lane number from 2 to 1 or from 3 to 2, independent of the provision of left turns. Consolidating directional though traffic into one lane from two, or into two lanes from three, has several direct operational benefits that may result in KSI reduction. These include reduction in top-end speeding, simplification of and shortening of midblock pedestrian and bike crossings, simplification of intersection crossing, and potentially a reduction in the speed of vehicles turning into the redesigned street, and reduction of the number of lanes of oncoming traffic crossed by left turning vehicles.

The other attributes of road diets and other street redesigns have documented and potential safety and operational (all-modes comfort and person-throughput) benefits of their own. The provision of dedicated bicycling facilities instead of mixed-traffic bicycling; reduction in crossing distance; provision of pedestrian refuges; and removal of left turns and/or parking maneuvers from through motor vehicle. Few studies have attempted to isolate these potential sources of crash reduction.

3. Literature Search Summary
A literature search was conducted using TRID, RIP, and various online databases, and through outreach to the National Association of City Transportation Officials. Significant documentation is available on the safety benefits of 4-to-3 lane conversions, including
through the Pedestrian & Bicycle Information Center’s CMF clearinghouse, but these sources do not isolate a CMF for through-lane reduction specifically. Several sources have begun to document 5-to-3 and larger projects, but few have attempted to isolate the sources of crash reduction: reduction in lane number; provisions of dedicated bicycling facilities instead of mixed-traffic bicycling; reduction in crossing distance; provision of pedestrian refuges; removal of left turns and/or parking maneuvers from through motor vehicle lanes.

- Bike Portland, *SE Multnomah Street Pilot Project (Timeline)*:  https://bikeportland.org/tag/ne-multnomah-st-project

4. **Research Objective**: To a) create a CMF for projects that reduce the total number of mixed-traffic through lanes on multilane downtown, urban, and suburban streets, ideally generating a CMF relevant for KSI for each mode, b) to document reductions to be expected in the high end of motor vehicle speeds, and c) to document the conditions and design decisions associated with the most successful serious-injury-reducing projects.

Potential project stages are as follows:

- **Initial findings**: Technical memo on initial findings from available data sources and literature review. Data provided in spreadsheet or database format. (This material will include most of the non-CMF findings.)
- **Interim report**: before-after descriptive statistics on existing projects
- **Meeting**: major involved jurisdictional representatives/project designers or managers.
- **Final Report**: Above plus: CMFs based on projects completed during the course of research.
**Evaluation of Existing Guidance & Policy:** Based on findings, this project should evaluate and provide critical examinations of existing nationally-relevant guidance and policy, in particular the AASHTO Green Book (7th Edition), NACTO Urban Street Design Guide, and potentially city and state design guides or policies.

**Likely Areas of Research:**
The study will compare before and after results for major street redesigns, focusing on KSI outcomes (people killed or severely/seriously injured), correlated or proxy factors, and other potentially relevant outcomes. Correlates with KSI may include high-end spot speeds, average spot speeds, and conflict counts. Other elements that may help agencies use of the findings would include quantification of the experience of stress/comfort for active/vulnerable road users; an understanding of travel time reliability outcomes for transit vehicles, and throughput or other performance outcomes for general traffic.

**Street Redesign Categories:** While every roadway redesign is different, major categories can be developed. Four are proposed here, but these can be expanded in the course of research:

- 5-lane to 3-lane conversions, encompassing streets in which the ‘before’ condition was primarily two mixed-traffic lanes each way with either left turn pockets and a flush or built median, or a two-way left turn lane. The after condition is typically one motor vehicle lane each way, with a buffered, separated, or parking-protected bike lane. In some cases, the repurposed lanes are bus lanes; in others, they are center-running BRT or LRT rights of way, or expanded sidewalks.

- 7-lane to 5-lane conversions, similar to the above but with three lanes each way in the ‘before’ condition.

- Any other lane repurposing on 5-lane-or-larger two-way streets (such as removing one mixed-traffic lane in one direction, or removing lanes on streets in starting configurations other than 5 or 7 lanes).

- Reduction in the number of through motor vehicle lanes on a one-way street with at least three marked lanes in the ‘before’ condition.

**Varieties of Lane Repurposing & Reduction:** Removed lanes can be reassigned to a variety of uses, which may have distinct safety or operational benefits: conversion of one or more lanes to bicycle infrastructure such as separated, parking-protected or buffered bike lanes, conversion to sidewalk or public space, conversion to transit lanes, conversion to parking or loading uses, or conversion to a mix of turn lanes and above-mentioned uses. While it is unlikely that enough before-after examples will be found to statistically distinguish the effects of one or another ‘after’ use, inclusion of several varieties of after conditions will provide value to practitioners considering whether a safety benefit may apply to a rail or bus project in particular.

**Curbside/Streetside context:** The introduction of curbside parking, loading and public space such as parklets is documented to reduce speeds and reduce some crash types. [Dumbaugh] Since some lane reductions involve the addition of parking, or the
conversion of full-time to part-time parking, these contexts should be documented, and if possible their interaction with lane reduction should be analyzed.

Uncontrolled left turn and pedestrian crossing locations: Since two sources of potential risk on a multilane street are the need to cross multiple lanes at an uncontrolled pedestrian crossing, or to cross multiple lanes while making a left turn, the study should seek to identify whether the outcomes of lane repurposing vary in relation to these factors. This could be tested by the uncontrolled by the distance between signal/beacon-controlled intersections, the number of uncontrolled pedestrian network demand points (i.e. midblock crossing demand points, such as T-intersections.). This factor be especially important in relation to pedestrian crash outcomes.

Street network. Connected grid networks are demonstrated to have lower crash rates than low-connectivity trunk-and-branch networks; this is often reflected in urban vs. suburban context. If possible, this project should note how network context may affects crash reduction . [Ewing & Dumbaugh].

Motor vehicle volume and speed: speed management is a key element of large-street crash reductions in the reviewed case studies. Since motor vehicle volume and pedestrian and bike volume and built urban context influences vehicle speed – especially speeds at off-peak times, associated with higher crash risk tends– the study should include analysis of the relationship between peak and off-peak volumes, vehicle speed, and the injury-reduction results of lane reduction treatments. Speed-KSI correlations may help evaluate future projects even before KSI outcomes are known.

5. Implementation Planning
The research products should be designed to be as usable as possible to practitioners in agencies. Data and knowledge collected should be easily disseminated in common spreadsheet or website formats.

6. Estimate of Problem Funding and Research Period
Recommended Funding: The requested budget for this project is $500,000, with at least $150,000 being set aside for data collection or purchase of large-sample-size data or reusable data/video collection equipment, and at least $50,000 being set aside for travel and event expenses. $5

Research Period: 12-24 Months. Proposed Timeline:
2 months: detailed needs identification and outline, outreach to experienced jurisdictions/project designers, data collection/acquisition plan.
4 months: Convening of major involved jurisdictions/project designers to identify needs, annotated outline, international literature search/review, and presentation of existing data (i.e. synthesis of existing material.)
6 months: before data collection (for unbuilt project sites), after data collection/acquisition and QA/QC if needed for already-built project sites), analysis of already-built sites. Interim report for already-built sites.
Final 12 months: after data collection/acquisition and QA/QC if needed for newly-built project sites, analysis of the foregoing, draft final report, phone/web convening with involved jurisdictions, final report.

7. **Urgency and Potential Benefits**

The safety problems facing large streets often interjurisdictional in nature, with states owning a large portion of the arterial street network even in major cities. In many cases, states own and construct these streets, while cities operate signals and maintain the streets. In small cities and suburban towns, it is common for states to own a main commercial street or significant parts of downtown. These streets are a small but difficult-to-manage portion of State DOT networks that account for a far outsize share of risk.

8. **Person(s) Developing the Problem Statement**

Matthew Roe, National Association of City Transportation Officials.
(646) 324-8352. Matthew@nacto.org

Stephanie Dock, District Department of Transportation
202.671.1371. stephanie.dock@dc.gov

9. **Nomination for AASHTO Monitor**

Zu-xuan Deng, District Department of Transportation, zu-xuan.deng@dc.gov

10. **Potentially Interested AASHTO Councils and/or Committees**

Committee on Design
Committee on Safety
Council on Active Transportation

11. **Submitted By**

Stephanie Dock, District Department of Transportation
202.671.1371. stephanie.dock@dc.gov

---

**NCHRP Review of G-14**

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:
The scope of the research is reasonable with a relatively clear objective; however, I am concerned for the extent of the scope the limitations on site availability and sample size to allow the research project to potentially conclude with a scientifically and statistically reliable outcome. Since a breakdown of the budget was presented, some items such as purchasing data equipment and travel are very questionable items. On a positive note, the problem statement is relevant to the engineering safety community and the potential results will aid agencies in implementing and updating future potential editions of the AASHTO Highway Safety Manual, (HSM). This study may also build on existing completed or on-going research which is being updated in the new proposed HSM, Second Edition, under NCHRP research project 17-71.

Review Date:
12/10/2018

---

FHWA Evaluation of G-14

Amjadi/HRDS; Scurry/HSA; Shaw/HSA - We are concerned, mainly, for site availability and sample size limitations to yield a scientific outcome for this study for the suggested types of road categories. We are not sure how many 5-to-3 or 7-to-5 projects would potentially be available to make this possible. For the proposed fund requirement, why would $150K be needed to purchase data collection equipment, and what the $50K for travel would be used for. Christopher Douwes/HEPH - G-12 and G-14 are similar and could possibly be combined.

---

AASHTO Committee Evaluation for G-14

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This submission is supported by members in Council on Active Transportation based on survey results. Please consider incorporating with C-25

---

Submitter Response for 2020-G-14

From: Jeremy Fletcher, Florida DOT; Matthew Roe, NACTO
If these are being combined, I would encourage the title to be re-termed “Safety (and Operational!) Impacts of Allocation of Cross Section Width on Urban and Suburban Arterials”. While there are benefits to lane reduction, there could be negative impacts to
parallel streets (and other modes) within the corridor that should be considered in the analysis.

In many cases, when doing road diets on high-volume streets to accomplish a context design (which may be warranted), traffic volumes are pushed to adjacent streets and those increases in volume (AADT) will statistically result in crash (and pedestrian conflict) increases to those streets. This should be part of any benefit cost analysis for lane reductions. To assume that vehicles will disappear is not realistic. There should also be a discussion in the report on Public Awareness to ensure that this is something the community wants. We sometimes take road diets to public meetings and they get a resounding “no” from the local residents.

I understood that of G-12 was more focused on resurfacing projects and the best ways to allocate existing widths based on modal balance or expected use/volume. Not so much as a focus on lane reduction by itself. It may be that in an emerging transit or high truck corridor that lane widths need to be increased.

Jeremy W. Fletcher, P.E., P.S.M.
Florida Department of Transportation
Roadway QA Administrator
605 Suwannee Street - MS 32
Tallahassee, Florida 32399-0450
Ph: (850) 414-4320, Fax: (850) 414-5261
http://www.fdot.gov/roadway/QA/QA.shtm

Thanks to the reviewers' helpful comments on the "Safety Benefits of Lane Reduction on Major Urban and Suburban Streets" Research Needs Statement, we have made minor modifications, reflected in the attached, and the potential for merging this statement with RNS G-12. I am in touch with the writers of that RNS, copied here. I'd be happy to talk further at the committees' convenience, as we all feel that a merger is worth exploring.

In the meantime, a revised statement is attached. Both FHWA and NCHRP reviewers identified two issues, both now addressed: limitations on sample size, and provision of budget for data collection.

In consolation with researchers with experience in similar forms of analysis, it was decided that regression models should be buildable that can isolate the effects of left turn lane provision and bike lane or parking-lane provision from lane number reduction, the core statistical question of this research. Thus, potentially hundreds of additional sites, including some known four-lane-to-two-lane conversions without left turn lanes, can be added to the analysis.

The research budget has been modified to an undifferentiated $400,000. Ideally, some portion of the budget, such as $100,000, would be dedicated to data needs. Several researchers consulted prior to the original proposal indicated that gaps in data, especially operational data such as radar/spot speed or even traffic volume, and in many cases multimodal volume, was not available from existing datasets. Since cross-section allocation decisions are often made based on these attributes, it is important to have such data and, if possible, identify CMFs for multiple categories of street differentiated by these attributes. For example, if lane reduction is more beneficial with
the highest volume streets, or the lowest volume streets, or if it is largely associated
with changes in spot speed rather than volume, jurisdictions will want to know.
Finally, we are in contact with the authors of 2020-G-12 on "Trade-offs for Cross-
sectional Reallocation on Urban and Suburban Roads" to determine if there are ways to
combine these potential projects.
This would likely require that G-12 expand its scope to specifically include crash injury
reduction benefits, as well as include streets larger than four lanes; the current G-12
scope does not specify these interests. However, it may be quite beneficial to combine
these studies.
Since that study is examining traffic effects, the inclusion of analysis of network-wide
effects of lane conversion projects on transit and private vehicle travel time and
reliability may be a useful part of its scope. Network effect on travel time is a major
question consistently received by jurisdictions implementing these projects that cannot
usually be answered through simple before-after data collection, and may call for big-
data approaches. As with speed, some US cities have access to such data at a large
scale already, and some do not.
NACTO is aware of a number of large-data sources that could be brought to bear on
this important set of research questions that many practitioners and roadway owners
consider critical to resolving the ongoing, serious, widespread safety challenges of
urban and suburban arterial streets.

Matthew J. Roe
National Association of City Transportation Officials (NACTO)
Direct: 646.324.8352 | Mobile: 646.628.3337
matthew@nacto.org | http://nacto.org | @nacto
Problem No: 2020-G-15

1. **Problem Title**
   Next Generation of the USLIMITS2 Speed Limit Setting Expert System

2. **Background**
   NCHRP 3-67 Expert System for Recommending Speed Limits in Speed Zones was completed in 2006, resulting in the deployment of the USLIMITS2 Speed Limit Setting Expert System. The system was developed based on results from previous research, responses from practitioners to hypothetical case studies as part of two web-based surveys, input from experts from three panel meetings, and lessons learned from an earlier version of the USLIMITS program developed by the Australian Road Research Board for FHWA. The system and documents related to decision rules can be found at [https://safety.fhwa.dot.gov/uslimits/](https://safety.fhwa.dot.gov/uslimits/).

   Based on input from the user, USLIMITS2 employs a decision algorithm to advise the user of the speed limit for the specific road section of interest. The algorithm focuses primarily on operating speeds, 85th percentile speed, and 50th percentile speed to determine the recommended speed limit based on other variables inputted by the user. While minor updates were made to USLIMITS2 in early 2018 to improve usability, the decision algorithm has not been updated since 2006. However, the NCHRP 3-67 final report concluded that, “Given that the expert system is now and will continue to be a web-based product, it will be important for credibility reasons to keep it up to date. It is important that the results of new research are used to improve the knowledge base and refine the decision rules of the algorithm. A comprehensive review of the literature at least every 3 years is recommended followed by appropriate updates in the algorithm as necessary.”

3. **Literature Search Summary**
   The decision rules used in USLIMITS2 were developed based on information from research and practices. While much research exists on speed limit setting, there has been no research done to date on the updates needed to the USLIMITS2 decision algorithm since it was first developed and implemented. This project is aimed to incorporate the existing speed limit research and state-of-practices including several NCHRP projects to develop the needed updates to USLIMITS2 to ensure that the system is consistent with current speed setting practices and recommendations.

4. **Research Objective**
The objective of this research is to (1) use current literature, interviews with State and local agencies, discussions with experts, and feedback on the current USLIMITS2 system to determine what updates are needed for the USLIMITS2 decision algorithm and (2) to implement the findings by updating the algorithm, conducting user testing of the revised system, and deploying the updates. The research will make use of the findings from other NCHRP projects such as 17-76 -- Guidance for the Setting of Speed Limits, 17-79 Safety Effects of Raising Speed Limits to 75 mph and Higher, and 20-05; Topic 49-08 Pedestrian Safety Relative to Traffic Speed Management to ensure that USLIMITS2 is consistent with recommendations from other NCHRP projects.

The updates to USLIMITS2 decision algorithm may include but not be limited to how to better incorporate the proximity to pedestrian and bicyclist facilities, school zones, and work zones; the prevalence of sidewalks in the area; rural roads that have higher speed limits than what is currently considered acceptable in USLIMITS2; urban areas that have significant future development planned; areas that are a mix of commercial and residential development, agencies that do not use 85th or 50th percentile data; and agencies that do not use crash rates but instead use critical rates or other relevant data.

**Phase 1 – Conduct Research on Current Speed Setting Procedures**

Task 1: Review current literature and practices on guidelines, criteria, and procedures used for setting speed limits in speed zones in the United States.

Task 2: Review the status of the Australian X-Limits system, on which USLIMITS2 was based, to determine if any of the updates to the Australian system would also be applicable to the US system.

Task 3: Establish a panel with subject-matter experts on setting and enforcing speed limits.

Task 4: conduct workshops/webinars/surveys to identify user needs for decision algorithm updates.

Task 5: conduct experts panel workshops/webinars to gather inputs and develop critical decision rules and logic flow for the updated algorithm, including how missing data will be handled.

Task 6: Submit an interim report documenting Tasks 1 through 5. The report will include an updated, detailed work plan with milestones for Phase 2.

**Phase 2 – Develop and Implement Updates to USLIMITS2**

Task 7: Develop the updated algorithm and implement it within the system, making other necessary updates to the interface to include adding new input fields and updating existing input fields.
Task 8: Conduct beta testing of the updated system with both the subject matter experts and an independent, representative sample of users.

Task 9: Update the system as necessary based on beta testing findings and complete final testing to ensure the system works as it is intended.

Task 10: Prepare the updated files and work with FHWA to implement the files in the existing system.

Task 11: Prepare a maintenance guide for the web site administrator, documenting the changes made to the algorithm and any necessary information to use for future maintenance of the system.

Task 12: Submit a final report documenting the entire research effort, including updated flow charts illustrating the new decision algorithm.

5. Implementation Planning
FHWA currently provides a help email, help@uslimits.org, for user questions and makes training available to agencies who request it. FHWA will also provide webinars, case studies, and best practices through its ongoing USLIMITS2 support contract. Marketing of the updated USLIMITS2 will be important to ensuring the tool becomes commonplace in State DOTs and local agencies to assist in validating speed limits. During the research, it will be helpful to ask users what other type of assistance they may need to convince management to include the use of USLIMITS2 in State speed setting guidance and manuals, as well as how the tool may be marketed more broadly.

6. Estimate of Problem Funding and Research Period
Recommended Funding: $350,000 ($200,000 for Phase 1 and $150,000 for Phase 2)

Research Period: 30 months

7. Urgency and Potential Benefits
Per NHTSA, in 2016, 18% of drivers involved in fatal crashes were speeding at the time of the crash and 27% of those killed were in a crash involving at least one speeding driver. Setting safe speed limits is one strategy and foundation of speed management to reduce speeding related crashes and fatalities. USLIMITS2 is the only tool available for setting appropriate speed limits with the consideration of all prevalent factors impacting speed limits setting.

In July 2017 the NTSB Safety Study NTSB/SS-17/01 PB2017-102341, Reducing Speeding Related Crashes Involving Passenger Vehicles, included the recommendation, “Revise Section 2B.13 of the Manual on Uniform Traffic Control Devices so that the factors currently listed as optional for all engineering studies are required, require that an expert system such as USLIMITS2 be used as a validation tool, and remove the guidance that speed limits in speed zones should
be within 5 mph of the 85th percentile speed.” The study stated that “USLIMITS2 can be used as a complementary tool to validate the results of engineering studies…” and, “The NTSB concludes that expert systems such as USLIMITS2 can improve the setting of speed limits by allowing traffic engineers to systematically incorporate crash statistics and other factors in addition to the 85th percentile speed, and to validate their engineering studies.”

In addition, USLIMITS2 has been widely promoted by FHWA as one of Proven Safety Countermeasures initiative (PSCi) program.

Furthermore, the AASHTO Committee on Safety strategic plan includes strategies related to using data driven analytical tools to reach the goal of zero road deaths by 2050. Likewise, the publication Toward Zero Deaths: A National Strategy on Highway Safety also recommends the implementation of analysis tools that support data-driven decision making.

NCHRP 3-67 recommended a comprehensive review of the literature be conducted at least every 3 years followed by appropriate updates in the algorithm as necessary. It has now been 12 years since USLIMITS2 was deployed, with no updates to the algorithm in that timeframe. Given the emphasis placed on the use of data driven analytical tools to reduce roadway fatalities, and the NTSB recommendation to include USLIMITS2 in the MUTCD, it is important that the USLIMITS2 decision algorithm is updated so that it is based on current research and data that is commonly used by State and local agencies to determine safe speed limits. The results of the research will ensure that USLIMITS2 continues to be a useful tool to State and local agencies as they work toward reducing highway fatalities and injuries of all road users. By not conducting this research there is the risk that the tool will become obsolete and the effort that was put into developing it will have been wasted.

8. **Person(s) Developing the Problem Statement**
   Guan Xu, P.E.
   Highway Engineer
   Federal Highway Administration
   (202) 366-5892
   Guan.xu@dot.gov

9. **Nomination for AASHTO Monitor**
   TBD

10. **Potentially Interested AASHTO Councils and/or Committees**
    AASHTO Committee on Safety

11. **Submitted By**
    Guan Xu, P.E.
    Highway Engineer
NCHRP Review of G-15

Reviewed By:
Camille Crichton-Sumners
ccrichton-sumners@nas.edu

Comments:

The research seeks to build upon NCHRP Project 3-67 "Expert System for Recommending Speed Limits in Speed Zones" was completed in 2006, resulting in the deployment of the USLIMITS2 Speed Limit Setting Expert System. The research need statement (submitted by FHWA) includes evaluating and making updates as needed to the USLIMITS2 decision algorithm. The scope—which include 12 tasks—will likely require additional resources, so the budget should be increased to 450K and the timeframe, 36 months.

Review Date:
12/10/2018
1. **Problem Title**
   Improving Traffic Incident Management in an Automated Vehicle Environment

2. **Background**
   Automated vehicles are rapidly becoming a common fixture in the driving environment. The pace at which innovation is being developed and the rapid adoption of technology indicates that automated vehicles will grow very rapidly. It is estimated that there may be 10 million automated vehicles on the road by 2020 and as many as 1 in 4 vehicles by 2030.\(^1\) Many questions exist concerning the integration of automated vehicles into our current and future roadway networks.

   While the technology holds great promise, particularly for improved safety, how automated vehicles react when approaching traffic incidents is not well understood among incident responders. Where the designed environment might accommodate technology, introducing an unplanned event like a traffic incident creates variability that complicates operations and safety.

   Incident responders are uniquely vulnerable road users when operating at roadway incidents. Per national statistics, an average of 13 law enforcement officers, 3 firefighters, and 38 tow truck operators are struck and killed while working at roadside each year. In addition, at least 19 safety service patrol operators have been killed since inception of those programs.\(^2\) These responders need to have a basic understanding of how automated vehicles function to ensure that on-scene activities like vehicle positioning, emergency lighting use, and temporary traffic control device placement are compatible with vehicle systems that detect the presence of an incident.

   There is a need to increase understanding among incident responders and tailor responder training and procedures to complement emerging automated vehicle technologies.

3. **Literature Search Summary**
   While there have been numerous research projects on the topic of connected and automated vehicles, the body of research on the topic of traffic incident

---

\(^1\) Garret, Oliver. 10 Million Self-Driving Cars will Hit the Road by 202 – Here’s How to Profit. Forbes. March 3, 2017. https://www.forbes.com/sites/oliviergarret/2017/03/03/10-million-self-driving-cars-will-hit-the-road-by-2020-heres-how-to-profit/#39b6266f7e50

management as it relates to automated vehicle technology is practically untouched.

If research on operations is scant, how automated vehicles operate when approaching unplanned events like roadway incidents is even more of an enigma for incident responders. The current state of the practice for responder training is the National TIM Responder Training Program which has no information on the topic. The absence of past research and responder procedures on the topic underscores the need for foundational research on the topic.

4. Research Objective

Understanding how automated vehicles behave when approaching a traffic incident can improve safety among incident responders. If incident responders perform actions that make them more visible to approaching automated vehicles, those vehicles can potentially engage systems to avoid conflicts sooner. Unfortunately, the breadth of understanding automated vehicle capabilities approaching responders/incidents is minimal. Creating a compendium of information on the topic is an essential first step in the objective to improving incident response in an autonomous vehicle environment.

To document how automated vehicles behave when approaching incidents, existing industry literature, safety research, government regulation, and anecdotal crash experience can create an inventory of conditions and operating parameters where automated vehicles experience roadway incidents. Meetings with industry professionals and relevant organizations can supplement knowledge and understanding of the topic sufficiently for relating to traffic incident response.

To understand responder actions, the national state of the practice for traffic incident management is evidenced in the National Traffic Incident Management (TIM) Responder Training Program. Responder vehicle positioning, emergency vehicle lighting, high visibility safety apparel, and temporary traffic control devices are some of the actions that responders undertake in incident response.

When understanding responder actions and typical automated vehicle actions are considered together, there is an opportunity to create training for incident responders that can ensure they manage traffic incidents in a way that provide maximum warning for approaching traffic, including automated vehicles.

5. Implementation Planning

The findings of this research are readily distributed through the National TIM Responder Training Program, state DOTs, professional organizations repressing responder disciplines, and national webinar.

Integrating the findings of this research into existing responder training programs can be accomplished through the National TIM Responder training program.
which is delivered as a train-the-trainer, classroom, e-learning, and virtual product. Administered by the FHWA, the National TIM Responder Training Program can be updated relatively easily by the agency.

State Departments of Transportation engage in TIM activities through TIM teams, coalitions, councils, and other collegial groups. Many states have an employee that is dedicated to the topic of TIM who facilitates TIM meetings, contact lists, training, and information sharing.

National professional organizations representing police, fire, EMS, transportation, and towing organizations support the National TIM Responder Training Program and broader TIM objectives. These organizations provide an excellent opportunity to distribute research findings through trade publications and magazines, presentations at conferences, and web site content.

Finally, a national webinar on the topic is an excellent way to share research findings.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**

   It is estimated that this research will require approximately 250,000 to execute this project including research, panel review, reports, and technology transfer.

   **Research Period:**

   It is estimated that this research will require 18 months.

7. **Urgency and Potential Benefits**

   NCHRP 20-24(98) stabled a Connected/Automated Vehicle Research Roadmap for AASHTO. The Roadmap project established infrastructure operations as an important part of research on the topic. There is significant activity in the connected/automated vehicle space, however none that affects the safety of incident responders.

   There is a very high demand for information on this topic among more than 1 million traffic incident responders including police, fire, EMS, towing, and transportation professionals. Current training systems do not include information about connected or automated vehicles, leaving a gap that may impact safety, secondary crashes, and quick clearance strategies.

   This project will fill a gap in CAV research and should produce a tangible and product that will be eagerly consumed by practitioners who are charged with responding to roadway incidents.
8. **Person Developing the Problem Statement**
   Paul Jodoin
   Traffic Incident Management Program Manager
   Federal Highway Administration
   1200 New Jersey Avenue SE
   Washington, DC 20590
   202-366-5465
   paul.jodoin@dot.gov

9. **Nomination for AASHTO Monitor**
   TBD

10. **Potentially Interested AASHTO Councils and/or Committees**
    TBD

11. **Submitted By**
    Paul Jodoin
    Traffic Incident Management Program Manager
    Federal Highway Administration
    1200 New Jersey Avenue SE
    Washington, DC 20590
    202-366-5465
    paul.jodoin@dot.gov

---

**NCHRP Review of G-16**

**Reviewed By:**
B. Ray Derr
rderr@nas.edu

**Comments:**

There is substantial overlap with NCHRP Project 20-102(16), Preparing Traffic Incident Management (TIM) Responders for CVs and AVs, that will be getting started soon. The problem statement will be provided to the panel and I expect they will incorporate many of its elements. I recommend waiting to see how that project meets the submitter's needs.

**Review Date:**
12/10/2018
1. **Evolving TMC Operation to Emulate a Video Game Environment**

2. **Background**

   Transportation Systems Management and Operations (TSM&O), as implemented through Traffic Management Centers (TMC), is critical to national mobility, the economy, the environment, and social well-being. TMC operations shall become increasingly complex and performance-outcome based, and require increasingly sophisticated and automated protocols, and new approaches to visualization of transportation systems. The TSM&O industry needs to expand its appeal as a career field to attract the next generation of potential employees.

   Exploring how TMCs function at the operator’s level with the objective of creating a video-game-like environment could significantly improve TMC operations and make this occupation more attractive to new generations of workforce. One approach is to match the interests, cognitive tendencies, and learning styles of the emerging workforce to a video-game-like environment, where functions such as incident management could be considered a game with a set of rules (protocols), using a playing surface (video wall), and in competition with (virtual) others, to achieve certain performance outcomes (e.g. incident clearance time target). This approach to TMC operations could have several important and beneficial outcomes:

   - Increase the attractiveness of the TSM&O/TMC career.
   - Transitionally integrate the video-game-like environment into TMC operations: a video-game-like platform could initially function as a training platform that is fully integrated into TMC operations (to replace or supplement certain TMC functions) after a period of refinement through training applications.
   - Advance the state of TMC operations practice and TSM&O strategies/tactics through insights gleaned from the TMC with a video-game-like platform.

3. **Literature Search Summary**

   Few studies have been done on topics overlapping traffic management and operations and video games (see ref.). Both disciplines have been quite enhanced over the last few decades, but little has been done to apply video gaming technology to traffic management. Probably the most applicable work is Gridlock Buster, a video game developed by the University of Minnesota (Leau et al., 2010), in which players choose preferred levels of traffic demand, traveling speed, and network size to control traffic through traffic signals. However, it was only applied in a learning environment for high-school students; more advanced use (viz. in TMCs)
does not seem to be documented in the literature. Other studies, e.g. Filipowicz et al. (2017) and Young et al. (1997), investigate simplistic scenarios of driver perception or belong to a different area of transportation (e.g. air traffic ops). In yet others, simulation-based training is used in for air traffic control, using actual event data as a potential model for TMC simulation-based training in a video game environment (Jurcic et al., 2016; ATC YouTube video, 2018). Yen (2016) discusses how gamification can make transportation systems in general better, concluding that the question is not whether gamification works, “but where it may be useful and how to design a successful intervention.” In other industries, gamification is known to increase efficiency of certain workspace environments. For example, Seixas et al. (2016) have shown benefits of gamification in the engagement of students in the elementary schools. Hofacker et al. (2016) have shown that gamification positively impacts mobile marketing strategies.

4. Research Objective

The research will investigate ways to integrate video-game-like platforms and applications with functions of TMCs and develop relevant guidance, addressing potential barriers and benefits of integration. The research should study how other industries and fields of transportation (e.g. aviation) have used video-gaming. The researcher/s should meet with video game developers to brainstorm video game design elements and how TMC tasks could be transformed into strategic tasks a player would perform to win the game: i.e. how to make TMC tasks fun, interesting, and challenging but serious enough to resolve traffic issues. The researchers should look innovatively at existing procedures and toolboxes used at TMCs when discussing elements for potential video games. For example, the TSM&O Toolbox could be considered a bag of powers to be used in a video game where a player must know/decide which to use in any scenario to win. This interactive approach to decision making could be used to select strategies in complex decision-support systems like the one with Integrated Corridor Management. Emphasis should be given to video-gaming benefits – from those impacting efficiency of traffic stream to those affecting safety.

Tasks anticipated in this project include the following:

- Review literature to identify current practices of using, or considering, video-gaming platforms and applications in TMC (and traffic in general) applications
- Organize multiple stakeholder (DOTs, industry, academia, etc.) meetings, forums, and surveys to get feedback about potential roles and barriers when trying to integrate video-gaming platforms and applications in TMC operations
- Propose, develop, test, and analyze video-gaming applications in several TMCs
- Describe success of the tests from the previous task and develop recommendations for future research and implementation
5. **Implementation Planning**
Research outcomes could present significant motivation for state DOTs to implement this research and consider video-game-like applications in their TMCs. It is envisioned that this research would be introductory step towards such implementation, which would motivate private sector, academia, and government agencies to further improve potential video gaming applications for TMCs and work on their field implementation. The findings from the research, along with a potential a TMC-based video game prototype, could be showcased in a number of workshops and meetings.

6. **Estimate of Problem Funding and Research Period**
**Recommended Funding:** $600K or more.
**Research Period:** 24 months

7. **Urgency and Potential Benefits**
The goal is to help the TMC community understand which aspects of TMC operations could be enhanced with video-game-like applications to improve the safety and efficiency of monitored traffic operations. Desired outcomes include improved workforce recruiting and innovative strategies and tactics for traffic monitoring and incident clearing now unavailable in TMCs.

8. **Person(s) Developing the Problem Statement**
Mark Plass, Traffic Operations Engineer  
Aleksander Stevanovic, Ph.D., P.E.  
District Four Assoc. Prof. of Civil, Environ. & Geom.  
Florida Department of Transportation Florida Atlantic University  
Mark.Plass@dot.state.fl.us  
(954) 777-4399

9. **Nomination for AASHTO Monitor**
Mark Plass

10. **Potentially Interested AASHTO Councils and/or Committees**
AASHTO Committee on Traffic Engineering

11. **Submitted By**
J. Darryll Dockstader, Research Center Manager  
Florida Department of Transportation  
Darryll.Dockstader@dot.state.fl.us  
(850) 414-4617

**References**


Young, W C; Broach, D; Farmer, W L. THE EFFECTS OF VIDEO GAME EXPERIENCE ON COMPUTER-BASED AIR TRAFFIC CONTROLLER SPECIALIST, AIR TRAFFIC SCENARIO TEST SCORES. Federal Aviation Administration, 1997, 13 p; https://trid.trb.org/view/724563.


---

NCHRP Review of G-17

G-17/4
Comments:

The research seeks to determine how other industries and fields of transportation (e.g. aviation) have used video-gaming and see how it could potentially increase appeal of a TSMO/TMC career, use the videogame platform as a training platform and advance the state of TMC practice. It is an interesting concept and worth exploring, although, individuals with no interest in videogames may be disinterested. The budget is high but is reasonable since simulation would be used. Allotted time should be increased to 30 months.

Review Date:

12/10/2018

FHWA Evaluation of G-17

Jimmy Chu/HOTM - Agree that video game concept is a way to engage operators and motivate them to stay actively involved. However, gamification has already been tested or applied successfully in the transportation industry as listed in the references. The end results of this project is to develop recommendations for future research and the implementation of the gaming concept would be five to six years away. Also, the proposal does not consider the Artificial Intelligence (AI) technologies and potential areas of AI applications in Transportation Management Center (TMC) operations. AI could potentially be trained to solve traffic control problems and has the ability to copy human actions. In the near future, most of the TMCs will rely heavily on AI such as machine learning and decision support system to manage the operations, then the AI will make the gaming concept obsolete. Therefore, we do not see any gains to conduct this kind of research. HRDO - Well written proposal, but low priority. Existing capability does not exist beyond the resources identified in the problem statement developed by the U of Minnesota. Applicability to existing practitioners appears very limited, as the training they could perform using information associated with their agencies existing system would be more realistic. Many undergraduate and graduate programs include transportation planning or traffic engineering where similar learning outcomes are addressed. Due to the unknown demand, what would be the base product for the software and its ability to be used (e.g., open source, free) on different types of devices, and cost to develop and put into operation (e.g., user feedback) the cost could exceed what is estimated and use may be limited.
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline

Problem No: 2020-G-18

1. Problem Title
   Impacts of Color, Intensity, and Duration of Emergency Traffic Patrol Lights on
   Human Perception

2. Background

   Human eyes have different perception-reaction times (PRT) to different colors of lights,
   intensity and their durations. Little research has been conducted so far on the impacts of
   different colors and durations of lights mounted on the Emergency Traffic Patrol (ETP)
   vehicles. Due to the human “cone of vision,” some colors of lights are perceived as being
   farther away than they actually are, and other color lights the opposite. The PRT may also
   depend on other factors such as the position of lights, blinking vs. static, and glare. There
   is a need to better understand the impacts of different colors, intensity and durations of
   lights on ETP vehicles.

   Another aspect of human response to emergency response vehicle lights
   (including police vehicle lights) is the problem of scene safety for emergency responders.
   According to the National Law Enforcement Officers Memorial Fund, 564 officers died
   due to vehicle crashes from 2005 to 2016, which consists of 31% of all line-of-duty
   deaths. An ideal warning light system should not only be easily detected and recognized
   in a variety of complex environments but also avoid interferences to human eyes caused
   by bright light.

3. Literature Search Summary

   It is now understood that human eyes perceive dim and bright light using different
   photoreceptors, namely rod and cone photoreceptors. The visual system, from retina to
   visual cortex, is configured into day or night mode for processing visual information in
   response to different light intensity. These neural mechanisms in visual system are
   biologically optimized for sensing light in natural condition rather than the aberrant light
   patterns used by the warning light.

   Over the past decade, some studies have been done on the effectiveness of ETP
   lights regarding color, intensity and flash patterns (1, 2). In addition, human behavior
   studies have revealed that response time and depth perception are significantly altered by
   light color and intensity (3, 4). Furthermore, bright warning light systems used at night
   significantly impair the vision of oncoming drivers and other personnel on the scene (5).

   Although there are a variety of light colors designated for ETP vehicles, most
   emergency vehicles use one or combinations of five colors, namely, red, blue, amber,
   white and green. Red lights are commonly used on police, fire, and EMS vehicles; blue
   lights are used as a contrasting color to red and/or other colors; amber lights are usually
used on construction vehicles; white is typically used as a contrasting color to other colors of lights used on an emergency vehicle; green lights are most commonly used to signal the position of an Incident Command Post (ICP) (6). Previous studies have found that reaction time (RT) to red stimuli is shorter than green and blue light (3). An empirical study on motorists’ reaction time has found that white light was perceived at the greatest distance followed by amber, red and blue (7). However, the effects of light color in complex traffic environment have not been systematically studied.

The lights and light bars on ETP vehicles are required to be strong enough to be seen from any direction within 500 feet of the vehicle, however, beyond the limit, the current ETP light intensity varies largely. Although high light intensity increases the visibility, it also causes blinding effects, photophobia, and light-induced anxiety (2, 8, 9). In addition, the flash rates of emergency light also vary in a wide range, and excessive flash rate may cause distraction, night blindness, and even acute diseases, such as seizure and anxiety attack.

Understanding how the visual features (e.g. color, intensity, and flash rates) affect human perception is essential for designing a more effective and safer ETP warning light system. Human vision uses four types of photoreceptors – rod, blue cone, green cone, and red cone (Figure 1). Recently, a fifth type of photoreceptors has been discovered in the retina. It is known to be responsible for detecting the overall light intensity of the external world, and plays essential roles in switch visual system between day-mode and night-mode; it also plays important roles in light-induced anxiety and photophobia (see Ref. 8 for review). The human visual system has different configurations that optimize its function in dim or bright condition. One of the major problems of the high-intensity warning light system is that the warning light could fool the visual system and switch it to day-mode at night, which could largely compromise the visual functions of motorists and increase the risk of accidents.

Human retina acquires information pixel-by-pixel at the photoreceptor layer, then neural circuitry further processes the information to extract the essential visual features. Figure 2 shows the anatomy of human eye with a schematic enlarged retina (10). A recent study has discovered that an expanding image on retina triggers an urgent-alarm signal in the neural system (11). The urgent-alarm system is particularly used for detecting approaching objects, such as predators and other potential threats. We propose to take

**Figure 1. Normalized absorbance spectra of the four class of photoreceptors.**

**Figure 2. A drawing of section through the human eye with a schematic enlargement of the retina (10).**
advantage of this biological feature to optimize the warning light system (See Research Approach and Anticipated Results).

Both the central and peripheral regions of human visual field are important for responding to an emergency. The human retinal central region, also called fovea, is enriched in cone photoreceptors that is responsible for the high-resolution image-forming vision; while retinal peripheral region has much less cone photoreceptors, as a result, the peripheral region presents significantly reduced visual accuracy. Furthermore, the visual information acquired in these two regions is also processed differently in the downstream neuronal circuitry in brain(10).

REFERENCES
4. **Research Objective**

The overall goal of the project is to understand how color, intensity and other features of ETP lights affect human visual perception, and design optimized light patterns to promote effective signals with minimal visual interferences. The study has the following three key objectives:

- Characterize the relationships between color, intensity and flash pattern of warning light and human perception response time under a variety of roadway lighting environments.
- Identify a color/intensity/flash pattern that minimizes the visual interferences.
- Evaluate a prototype of a light warning system and develop an implementation guideline.

To study the perception reaction time in response to various visual stimuli, a virtual reality simulation system would be needed to screen a large variety of visual stimuli. The results will then need to be validated in field tests. Maryland Department of Transportation is currently sponsoring a research project on this topic based on Maryland’s roadway conditions and driving population. It is expected that this NCHRP project will have a national perspective, study a more diverse group of human subjects, and have a stronger statistical support for an ideal design.

5. **Implementation Planning**

The research should produce recommendations on changes in the current designs or practices to help motorists better identify emergency response vehicles at a traffic incident. Please consider all elements of emergency lighting such as brightness, duration, color, pattern, installation location, and others. Some of these elements may vary in effectiveness due to roadway configuration and weather conditions. Public education recommendations to get the motorists to understand their role in saving lives as they come upon an incident are also welcomed.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**
   $500,000

   **Research Period:**
   24 months

7. **Urgency and Potential Benefits**

The traditional use of EPT lights has persisted based upon the dogma and inertia of past practice, rather than objective evidence for effectiveness or better outcomes. A better design of the warning light system will enable the critical roles of traffic incident management, reduce secondary incidents, and protect emergency responders.
8. **Person(s) Developing the Problem Statement**

Hua Xiang  
Research Programs Manager  
Maryland Department of Transportation  
State Highway Administration

9. **Nomination for AASHTO Monitor**

10. **Potentially Interested AASHTO Councils and/or Committees**

11. **Submitted By**

Hua Xiang  
Research Programs Manager  
Maryland Department of Transportation  
State Highway Administration

---

**NCHRP Review of G-18**

Reviewed By:  
Mark S. Bush  
mbush@nas.edu

Comments:

The scope of the research is reasonable within the time period and estimated budget with a relatively clear objective to be potentially solvable or provide beneficial results. The problem statement is of likely interest on a national level as it will also potentially aid transportation departments of implementing the Human Factors Guide for Road Systems NCHRP Report 600 (HFG) as well as for future potential updates or enhancements to proposed future editions. The research also has relevance to the AASHTO Highway Safety Manual, (HSM). Would also like to note, there is a current NCHRP research project, 17-80, “Expansion of the Human Factors Guidelines for Road Systems, (HFG), Second Edition,” currently underway but not scheduled for completion until the end of 2019 or potentially early 2020 and the potential preliminary results during the course of the research may also contribute to the scope of this research problem statement.

However though, full implementation of the problem statement research project’s results on emergency traffic patrol lights are outside the jurisdictions of DOTs as this involves a plethora of other emergency vehicles such as police, fire, ambulance, towing,
etc. Although relevant to NCHRP, this study should also be considered for partial or full funding from other resources or agencies such as NHTSA, or other.

Review Date:
12/6/2018

FHWA Evaluation of G-18

Philips/HRDS; Anderson/HSA; Rousseau/HSA - We support this project. Good problem statement/research proposal to understand impacts of colors and visual characteristics of lights of Emergency Traffic Patrol (ETP) vehicles. Approach seems sound, but could also consider how these things affect people as they age.

Submitter Response for 2020-G-18

From: [email: hxiang@sha.state.md.us]

Comments:
Regarding the NCHRP comment about shared funding due to the inclusion of other emergency vehicles other than DOTs in this research, I would note that DOT ETP vehicles are positioned upstream at an incident scene and are the initial vehicle viewed by oncoming motorists. The effective lighting of these vehicles is most critical to the safety of the scene, especially while travel lanes are blocked. The results of this study may bleed over and benefit others, such as law enforcement while on a traffic stop, but the primary goal is to ensure lighting is most effective for DOTs while assisting disabled vehicles on the shoulder and while protecting incident scenes.

Contact Info:
Scott Yinger
Deputy Director, Operations
Maryland Department of Transportation
State Highway Administration
Office of CHART & ITS Development
410-582-5618
syinger@mdot.state.md.us

Review Date: 12/20/2018
Problem Number: 2020-G-19

Problem Title:
Challenges, Gaps, and Solutions in the Deployment of Advanced Traffic Control (ATC) Systems

Research Problem Statement:
Traffic signal control is one of the most important components in an efficiently operated roadway network. Effective traffic signal operations also require of operators an integrated body of knowledge including traffic engineering, electrical engineering and communications. Standards and technologies for traffic signal systems evolve slowly over time. Major changes in traffic signal technology has not been observed in the last twenty years. While this phenomenon may be rooted in concerns of investment protection, system technology lifespan and continuity, as well as necessary staff training within public agencies, the limitations of existing traffic signal systems are surfacing today. As examples: the maximum number of I/O channels at a Caltrans/NEMA traffic signal cabinet is 16 and it is becoming insufficient at intersections, especially after the flash yellow arrow (FYA) indication is widely adopted; some early models of traffic controllers in the field lack necessary network modules to become an integral part of advanced traffic management systems (ATMS); and many existing traffic controllers do not have sufficient computing power for emerging applications such as connected vehicles.

The next generation of traffic signal systems in the U.S., known as Advanced Traffic Control (ATC) systems, has been driven by industry and overseen by three national associations: AASHTO, ITE and NEMA. After over ten years of discussions and developments, manufacturers began roughly two years ago to produce and promote this next generation of traffic signal systems. At this time, several states and/or municipalities have decided to or are considering an upgrade to their current traffic signal systems with the latest ATC systems.

The new ATC standards released for traffic signal controllers heavily reference the NEMA TS2 standard in an effort to minimize the migrating efforts for public agencies and also address a few long-standing issues with the older systems. In the meantime, the new ATC traffic signal systems offer many new features and reserve sufficient computing resources for future applications. For instance, the new standard specifically call for a minimum computing power and RAM memory for ATC-compliant controllers which far exceed the needs for the practice today. For the cabinets, the ATC cabinet is completely modularized and the physical wiring is minimized and the ATC cabinet can greatly expand the capability to integrate various detectors and I/O channels. Most ATC cabinets in the market today support 32 output I/O channels to traffic lights by default and can be easily expanded. ATC cabinets can also support many detector channels by expanding the input I/O channels.
Despite the above promising features of ATC traffic control systems and cabinets many concerns are held among the state DOTs. While the advantages of the ATC system over the legacy systems seem obvious there is currently not enough research and first hand examples available for the state DOTs to better see and understand the potential benefits. Although the ATC standards have been published and are readily accessible they are admittedly difficult to grasp by those not experienced in this field. Uncertainty of necessary training is another area of concern. To address these issues and facilitate the deployment of ATC traffic control systems it would be beneficial to conduct research on ATC traffic signal control systems to help the state DOTs better understand this new system. Specifically, the following deliverables are proposed:

1. Descriptions and explanations of the ATC traffic control system components in a way that could be easily understood by traffic engineers and technicians in state DOTs
2. A survey of ATC traffic signal control system deployments from all over the U.S.
3. An estimation of required training efforts for DOT staff with the assistance of volunteering state DOT(s).

Submitted by Mississippi (Updated version)

NCHRP Review of G-19

Reviewed By:
Camille Crichton-Sumners
ccrichton-sumners@nas.edu

Comments:

The research need seeks to develop descriptions and explanations of the Advanced Traffic Control (ATC) Systems components in a way that could be easily understood by traffic engineers and technicians in state DOTs. If not a duplication of other research efforts, this will be helpful to traffic engineers in state transportation agencies and others. Literature review and surveying the states to capture the current state of practice should require 300K and 24 months.

Review Date:
12/10/2018

FHWA Evaluation of G-19

Eddie Curtis/HOTM - The ATC Standard was reviewed to validate? the "research problem" describe in the problem statement. The Standard is informative to a qualified reader. It is not likely that research is the need, but rather training, technical assistance
and peer support. A number of States have expressed similar concerns and an effort is currently underway to organize a peer group to address the immediate needs of the practice. Mississippi DOT will be included in this effort. HRDO - Providing agencies with more documentation of what, why, and how to deploy and maintain new ATC technology could be very valuable in their decision making process. Might want to add to it how ATCs can support the accommodation of automated and connected autonomous vehicles as well.

Submitter Response for 2020-G-19

Traffic signal control is one of the most important components in an efficiently operated roadway network. Effective traffic signal operations also require of operators an integrated body of knowledge including traffic engineering, electrical engineering and communications. Standards and technologies for traffic signal systems evolve slowly over time. Major changes in traffic signal technology has not been observed in the last twenty years. While this phenomenon may be rooted in concerns of investment protection, system technology lifespan and continuity, as well as necessary staff training within public agencies, the limitations of existing traffic signal systems are surfacing today. As examples: the maximum number of I/O channels at a Caltrans/NEMA traffic signal cabinet is 16 and it is becoming insufficient at intersections, especially after the flash yellow arrow (FYA) indication is widely adopted; some early models of traffic controllers in the field lack necessary network modules to become an integral part of advanced traffic management systems (ATMS); and many existing traffic controllers do not have sufficient computing power for emerging applications such as connected vehicles.

The next generation of traffic signal systems in the U.S., known as Advanced Traffic Control (ATC) systems, has been driven by industry and overseen by three national associations: AASHTO, ITE and NEMA. After over ten years of discussions and developments, manufacturers began roughly two years ago to produce and promote this next generation of traffic signal systems. At this time, several states and/or municipalities have decided to or are considering an upgrade to their current traffic signal systems with the latest ATC systems.

The new ATC standards released for traffic signal controllers heavily reference the NEMA TS2 standard in an effort to minimize the migrating efforts for public agencies and also address a few long-standing issues with the older systems. In the meantime, the new ATC traffic signal systems offer many new features and reserve sufficient computing resources for future applications. For instance, the new standard specifically call for a minimum computing power and RAM memory for ATC-compliant controllers which far exceed the needs for the practice today. For the cabinets, the ATC cabinet is completely modularized and the physical wiring is minimized and the ATC cabinet can greatly expand the capability to integrate various detectors and I/O channels. Most ATC cabinets in the market today support 32 output I/O channels to traffic lights by default and can be easily expanded. ATC cabinets can also support many detector channels by expanding the input I/O channels.
Despite the above promising features of ATC traffic control systems and cabinets many concerns are held among the state DOTs. While the advantages of the ATC system over the legacy systems seem obvious there is currently not enough research and first hand examples available for the state DOTs to better see and understand the potential benefits. Although the ATC standards have been published and are readily accessible they are admittedly difficult to grasp by those not experienced in this field, they are primarily prepared for signal manufactures to build ATC-compliant systems instead of a guide book for state DOT users (traffic engineers, managers and technicians) to reference in their daily operations. In the meantime, since some ATC systems have been deployed and it would be beneficial to conduct a survey to understand the needed training efforts of migrating to the new ATC systems. To address these issues and facilitate the deployment of ATC traffic control systems it would be beneficial to conduct research on ATC traffic signal control systems to help the state DOTs better understand this new system. Specifically, the following deliverables are proposed:

1. Descriptions and explanations of the ATC traffic control system components in a way that could be easily understood by traffic engineers and technicians in state DOTs
2. A survey of ATC traffic signal control system deployments from all over the U.S.
3. An estimation of required training efforts for DOT staff with the assistance of volunteering state DOT(s).
4. How the ATC traffic signal control system could benefit the imminent age of connected vehicle and automated vehicles?

Response to the comment:
Eddie Curtis/HOTM - The ATC Standard was reviewed to validate? The "research problem" describe in the problem statement. The Standard is informative to a qualified reader. It is not likely that research is the need, but rather training, technical assistance and peer support.
[Response]: Thanks for the comments. The ATC standards we referred to include three documents:

1. Advanced Transportation Controller Cabinet User commend draft (circulated date August 14, 2017)
2. Advanced Transportation Controller (ATC) Standard (v5.2b) (released date: Sep-25,2006)
3. Model 2070 Controller Standard (ATC 5202 v03.04) (Released Date: Dec-28, 2012)

After briefly read these documents to better understand the ATC system, we conclude they are intended for manufacturers of traffic signal systems to build ATC-compliant systems instead of a handbook for traffic operations. The focuses, terminologies and requirements for electrical knowledge in the above documents are beyond typical experienced traffic engineers, traffic managers and technicians. We state DOTs are reluctant to accept this new standard due to various concerns. As such we do think a research should be conducted to develop a comprehensive and more straightforward
document for the traffic engineers, manager and technicians to quickly understand this new standard. Similar success has been witnessed by the FHWA-sponsored “Traffic Signal Manual” project in which the signal control concepts are illustrated in a very straightforward manner even though all those concepts are originally defined in NEMA-TS/Caltrans standards.

In the meantime, it would be beneficial if this research include case studies and surveys for the existing deployments. Such information will provide insights for the state DOTs to make decisions.

A number of States have expressed similar concerns and an effort is currently underway to organize a peer group to address the immediate needs of the practice. Mississippi DOT will be included in this effort.

[Response]: Thanks. We would like to get involved.

HRDO - Providing agencies with more documentation of what, why, and how to deploy and maintain new ATC technology could be very valuable in their decision making process. Might want to add to it how ATCs can support the accommodation of automated and connected autonomous vehicles as well.

[Response]: This is what we wish to see. Components of connected and automated vehicles have been added into the updated write-up.

The research need seeks to develop descriptions and explanations of the Advanced Traffic Control (ATC) Systems components in a way that could be easily understood by traffic engineers and technicians in state DOTs. If not a duplication of other research efforts, this will be helpful to traffic engineers in state transportation agencies and others. Literature review and surveying the states to capture the current state of practice should require 300K and 24 months.

[Response]: We haven’t heard or seen similar research on this topic since the wide deployment of ATC systems has just started. It could need more funds and time if the scope of work is expanded.
NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2020-G-20

II. PROBLEM TITLE

Predicting Urban Street Speed and its Relationship to Reliability and Level of Service

III. RESEARCH PROBLEM STATEMENT

The prediction of free-flow and travel speeds consists in a key element for analyzing the efficiency of an Urban Arterials. It relates to running time between intersections, a crucial component to coordination and overall travel time calculation, defining the quality of operations of arterials and entire systems. The Highway Capacity Manual (HCM) has historically provided a reliable methodology to estimate urban street speeds, which has been improving throughout its editions and has shown to be consistent with other alternative tools (1).

During the development of the 6th edition of the HCM (2), clarifications on the existing models by Bonneson, Pratt and Vandehey (3), regarding the estimation of the free-flow speed from field data and the use of the methodology were made, as well as considerations regarding the relationship between posted speeds, travel and free flow speeds, especially in CBD areas, and the effect of on-street parking (4). As a result, an updated set of equations was presented, following the format. In the HCM 6th edition, the estimation of speed is performed in three main steps: (a) Base-Free-Flow Speed; (b) Free-Flow Speed, (c) and Travel Speed.

Base Free Flow Speed $S_{f_0}$ and free flow speed $S_f$ are calculated sequentially, as a function of a base calibration factor $s_{calib}$ and a speed constant $s_0$, that is dependent on the posted speed. Adjustment factors are applied to account for the road cross section, the access point density, on-street parking and signal spacing.

However, some studies have showed low values for the coefficient of determination for HCM methodologies when comparing estimates to real data
This was especially true when posted speed limit was 35 mph or higher. These results not only suggest that further research on this subject might be needed, but that nonlinearities and interactions regarding different speed limit policies should be investigated.

Some of the main gaps in the HCM methodology and aspects that need to be addressed are:

- Further investigation of the aspects that were introduced in the HCM 6th edition model;
- In depth research of the relationship between posted speed and free-flow speed and its interaction with other model variables.
- It is desirable to keep the model as simple and straightforward as possible to the final user.

In the absence of a reliable estimation model or one that may be easily implemented, some agencies have developed their own methodologies and it is not uncommon for agencies to assume free-flow speeds being either equal or close to the posted speeds, perhaps due to the complexity and data requirements of the HCM model. The establishment of a straightforward HCM methodology to estimate speed is expected to assist agencies and practitioners that could benefit from the large effort and data background that were involved in the development of the manual, especially those who do not have a consolidated body of knowledge on Urban Streets Segment analysis.

IV. LITERATURE SEARCH SUMMARY

Studies for the estimation of average speeds can be divided in two main branches, depending on the analysis level. While some studies used the operations level of analysis, others focused on providing planners with simple models to predict speed on urban arterials, usually by adapting existing HCM equations (6) or by calibrating, evaluating and making recommendations on existing models that are implemented in commercial software (7).

On the operations level, since the year of release of the HCM 2010, some research has been conducted worldwide to develop, calibrate and validate speed prediction models for urban streets, being the most relevant studies discussed in this section. Those studies contribute to the discussion regarding the aspects that should be taken into consideration to design such models, so that a desirable balance between ease-of-use and accuracy can be attained.

Bassani and Sacchi (8) and Eluru et al. (9) used different statistical and econometric models to correlate roadway design and geometric features to operating speed in the Italian and Canadian local and arterial roads. The results
highlight the role of various street characteristics including number of lanes, presence of parking, presence of sidewalks, vertical grade, and bicycle route on vehicle speed proportions.

Dhamaniya and Chandra (10) added complexity to their model by extending the basic concept of the linear speed-density relation to mixed traffic condition, and developed speed prediction equations for five different categories of vehicles generally found on an urban arterial. The effect on average speed caused by each vehicle type is also explained.

Bonneson, Pratt and Vandehey contributed to the current HCM model by including empirical relationships between free flow speed and posted speed (3), resulting in a policy sensitive model. Also, the effect of on-street parking was studied (4).

The recent work from Thiessen, El-Basyouny and Gargoum (11) proposed the creation of three models: one that combined arterial and collector locations, one for arterials only, and one for collector roads only. The results revealed that roads with sidewalks that were farther away from the road and with low object density or tree density were all associated with higher operating speeds. Locations with monolithic walks on both sides of the road had lower operating speeds. Furthermore, operating speeds decreased as access increased, while longer roads had higher operating speeds. Other variables that were found to be influential were medians and bus stops.

The specific impact of midblock pedestrian activity was also found to be relevant, as shown by a study released in 2018 (12) As little guidance is given by the HCM on capturing the interactions between pedestrians and automobiles at unsignalized midblock pedestrian crosswalks on urban street segments, the results of this study showed that the traffic volume and the pedestrian volume are the most significant models.

V. RESEARCH OBJECTIVE

The objective of this research project is to develop an enhanced method to predict speed and its relationship to reliability and level of service that can be implemented in the Highway Capacity Manual methodology for signalized intersections and urban arterials.

The following tasks are proposed in order to achieve this goal:

Task 1. General Work Plan. The objective of this task is to develop a general work plan that target the objectives of the study and validate the project objectives, desired deliverables and project schedule.
Task 2. Literature Review and Current Practice. The objective of this task is to review relevant literature on speed prediction models for urban arterial and current practice adopted by agencies throughout the country.

Task 3. Draft Methodologies. The objective of this task is to develop draft methodologies on proposed prediction models, describing the expected inputs, outputs, strengths and limitations. The impact of non-motorized modes on automobile speed must be included.

Task 4. Data Collection Plan. This task aims to develop plans to guide the collection of data. The research agency is expected to develop a comprehensive list of study locations in a manner that the data reflects different traffic scenarios throughout the country, as well as the key parameters to be collected and which approaches or sources will be adopted to collect data.

Task 6. Data Collection and Preliminary Results. The objective of this task is to implement the approved data collection plan developed in Task 4. The task also includes the preliminary analysis of the data against the proposed draft methodology from Task 3, indicating needs for method review, additional validation, and others.

Task 7. Validation and Methodology Refinement. The objective of this task is to comprehensively analyze and validate the data collected in Task 6, and perform any methodology refinement needs previously identified.

Task 8. Report. The Report shall summarize the work performed on the previous tasks, along with significant conclusions and recommendations for implementation. It must include but not be limited to:

- Methods for free flow speed prediction;
- Methods for the estimation of the effect of traffic, environmental and geometry characteristics on the base prediction model;
- Recommendations on the adaption of the method to account for the effect of the non-motorized traffic activity;
- Analysis of the tradeoff between accuracy and simplicity, as a function of the number of steps to be undertaken by the analyst to use the procedure and the number of input parameters to be incorporated to the final mode.
- Recommendations on default values for the model parameters;
- Guidance for implementation on the Highway Capacity Manual;
- Discussion on the relationship between speed and level of service on urban arterials;
- A user-friendly guide that will assist traffic signal engineers in state and local agencies and practitioners to implement the proposed practices;

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding:

$300,000

Research Period:

24 months

VII. URGENCY, POTENTIAL BENEFITS AND IMPLEMENTATION

The Highway Capacity Manual (HCM) has been providing a reliable methodology to estimate urban street speeds, which has been improving throughout its editions and is used as a reference by planner, agencies and software developers. However, because of the increasingly complexity of the models and often inconclusive relationships with policy-sensitive variables, many agencies and other users have adopted alternative tools or other guidelines, that not always lead to results that are backed by field data and might diverge from solutions used by third parties.

The development of a straightforward method to predict speeds on urban arterials and its relationship to reliability and level of service can benefit researchers and practitioners, by providing an analytical method that will serve as a resource for operations and safety studies, policy-making, as well as by supporting software development. Ultimately, the better understanding of speeds on urban streets and its consideration on existing methodology may contribute for more efficient methodology to address capacity assessment on arterials and transportation systems. Also, the development is of great value for agencies and municipalities, especially those without any guidelines on the subject.

It is envisioned that this research will lead to the incorporation of the produced methodologies into a future version of the HCM. Any changes or updates to the HCM will need to be formally adopted by the TRB Highway Capacity and Quality of Service (HCQS) Committee (AHB40). Based on the updated HCM methodology and recommendations from the research team, guidelines for enhancement of the current methodology will be established.

IX. REFERENCES


X. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

- Gustavo R de Andrade, PhD Research Assistant, University of Florida Transportation Institute, 512 Weil Hall, Gainesville, FL 32611-6580, guriente@ufl.edu
- Marcus Januario, Ph.D., Senior Traffic Engineer – Bolton & Menk, Inc., 855 Wright Brothers Blvd SW, Suite 2A, Cedar Rapids, IA, 52404, marcusja@bolton-menk.com

XI. AASHTO MONITOR
The objective is to develop an enhanced method to predict speed and its relationship to reliability and LOS that can be implemented in the Highway Capacity Manual methodology for signalized intersections and urban arterials. The budget should be 400K and 30 months in order to accomplish the suggested tasks which include method validation.

Review Date:
12/10/2018

FHWA Evaluation of G-20

John Halkias/HOTM - We're giving this a low score. The research problem statement states that the HCM provides a reliable methodology to estimate urban street speeds and has been improving throughout it numerous editions. On the one hand, it states that some agencies have developed their own methodologies due to the complexity and data requirements of the HCM model. It also states that some studies have shown low values for the coefficient of determination of the HCM methodologies and further suggests that further research might be needed and that nonlinearities and interactions should be investigated making the model even more complex. On the other hand, the problem statement states that it is desirable to keep the model as simple and
staraightforward as possible and the establishment of a straightforward HCM methodology is expected to assist agencies and practitioners that could benefit from the large effort and data background that were involved in the development of the manual. I don't see how developing an enhanced method would simplify the model and make it straightforward. If anything, it would make it more complex especially if nonlinearities and interactions are taken into consideration.

AASHTO Committee Evaluation for G-20

Submitted By:
Anna Bosin
AASHTO Staff
Active Transportation

Comments:
This submission is supported by Council on Active Transportation Members surveyed.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement Outline  
Problem No: 2020-G-21

1. **Problem Title**  
Applications of RFID and Wireless Technologies for Highway Construction

2. **Background**  
Transportation is one of the largest and the most critical sectors in the US. It must continuously meet traveling demands by adding new as well as maintaining and operating existing infrastructure. All these are investment intensive requirements and managing them appropriately typically requires significant amount of funds. While efforts are made to manage highway construction project efficiently, emerging and innovative technologies that can help are currently not utilized to their fullest capacity. Consequently, material management, labor management, quality management, operations, safety, and maintenance have seen limited improvements from the use of innovative technologies, making it a need that the research community investigates ways to embrace the latest technologies available for state departments of transportation (DOTs) to use for highway construction.

The success of transportation construction projects largely depends on resource management, safety, and meeting quality expectations. Resources requiring diligent management are material, labor, space (the project site), equipment, finances, and time. These resources are required at the right time, at the right place and in right quantities. While these resources are in use, safety must be ensured. Once used, the utilized resource must achieve the expected quality outcomes. Sub-optimally managed resources, having unsafe conditions and inefficient quality management, could significantly influence project performance. Therefore, the use of technologies such as radio-frequency identification (RFID), barcodes, e-ticketing, global positioning systems, and other associated wireless technologies have the ability to track and document material and resource movements as well as construction progress in a more efficient manner.

This research directly aligns with Application of Emerging Technologies (AFH 30) that calls for automating construction, which will enable performing work with fewer labor and enable the industry to be more reliable, efficient and cost effective.

3. **Literature Search Summary**  
Literature review shows that RFIDs and other related wireless techniques have been successfully used in highway construction industry, but in a limited capacity. For example, e-ticketing is used by Iowa DOTs to track loads of asphalt materials for paving work. The method uses GPS tracking, geo-zoning and time
stamping location of trucks to ensure proper asphalt tracking, safety, and quality compliance. Wireless systems consisting of RFID tags combined with GPS locators are also available (Valarmathy et al, 2013) and these can be deployed to assist project participants to exercise enhanced control on material management. On the other hand, RFID tagged personal protection equipment (PPE) have been deployed to track labor movement, determine their efficiency, and ensure their safety (Kelm et al 2013). In terms of quality management, DOTs have used commercially available advanced RFID tags for sensing and transmitting real-time information about moisture (Yang, 2014), concrete deterioration (Kang and Gandhi, 2010), temperature (Murthy, 2015), and crack detection (Shiraiwa and Enoki, 2011). Lastly, the Internet of Things (IoT) increasingly is a part of our daily lives, as sensing technologies become commonplace. Smart City initiatives will heavily rely on wireless sensors, such as RFIDs. On the same lines, researchers have shown that RFIDs can be used to navigate autonomous cars safely within specific lanes (Prinsloo and Malekian 2016). Similarly, speed monitoring, smart parking, and collision aversion are a few things that have been successfully proven to be implemented using wireless technologies, thus bringing them within the reach of DOTs for implementation.

Findings of NCHRP 372 and other literature review indicates that RFIDs combined with other sensing methods can be used for various highway construction and operational activities. These include, but are not limited to, material management, quality control, structural health monitoring, small tool management, pavement response to loads, in-situ concrete moisture monitoring, construction fleet management, and operations and maintenance.

4. **Research Objective**

Advancement in sensing and transmitting technologies has significantly improved wireless transmission. Projects where such devices were used reported beneficial outcomes through improved resource and quality management. But, due to some reasons, the beneficial outcomes could not attract the highway construction industry to adopt it to its fullest potential and as a result there exists a lag in terms of reaping the benefits of technological advancements. The wireless transmission technology enables sensing, counting, measuring, documenting, identifying, locating, tracking, and transmitting information in real time. These features can help project managers to manage time, money, quality, and safety of any project effectively. However, a significant difference exists between wireless technologies’ acceptance versus the expected acceptance and efficient use. Research is needed to bridge the gap between the existing technology buy-in, efficient use of technologies, and the beneficial applications of advanced wireless technologies to the highway construction industry.

5. **Implementation Planning**

This research will enable bridging the gap between the existing technologies and their application to the construction industry. Establishment of construction industry standards and identification of best practices will be one of the major
outcomes of this research. Availability of industry standards will enable a seamless adoption of these techniques throughout the supply chain. Other outcomes include achieving awareness within construction industry, identifying (or developing) analytical and optimization tools and reducing the potential risks. However, achieving these outcomes will need an industry wide adoption, which will be based on economic feasibility, adequate protection against data theft, system integration and high reliability. Further dissemination of this research should be made to DOTs as well as the private parties that work with DOTs on highway construction projects.

6. **Estimate of Problem Funding and Research Period**

   **Recommended Funding:**
   - Recommended funding for this project is $400,000 to $500,000

   **Research Period:**
   - It is estimated that 30 to 36 months will be required to perform the research.

7. **Urgency and Potential Benefits**

   Some of the benefits realized while using these techniques are:
   1. Reduced time for locating and tracking materials/pieces.
   2. Hassle free documentation of operations, maintenance, repair history and warranty claims.
   3. Availability of onsite operational support through availability of personnel data, timekeeping, fleet management and progress status.
   4. Instant and easy data availability to decision makers and administrative staff.
   5. Reduced paper work and related hassles.
   6. Convenient digital data storage, analysis and transfer.

8. **Person(s) Developing the Problem Statement**

   Deepak Sharma
   California State University – Fullerton
   Assistant Professor
   657-278-3450
   dsharma@fullerton.edu

   Katherine Holtz
   Texas Department of Transportation
   Strategic Contract Management Director
   512-201-3612
   Katherine.Holtz@txdot.gov

9. **Nomination for AASHTO Monitor**
This problem statement is sponsored and submitted by the AASHTO Committee on Construction and the Michigan Department of Transportation. The TRB Standing Committee on Construction Management (AFH10) provided development of the problem statement and supports this submission.

10. Potentially Interested AASHTO Councils and/or Committees
NA

11. Submitted By
AASHTO Committee on Construction:

Jason Humphrey, P.E.
State Construction and Maintenance Engineer
South Dakota Department of Transportation
605-773-4391
Jason.Humphrey@state.sd.us

NCHRP Review of G-21

Reviewed By:
Camille Crichton-Sumners
ccrichton-sumners@nas.edu

Comments:
The use of radio frequency identification (RFID) for construction could be valuable for the optimization of construction processes (e.g., "Just In Time" delivery of materials would increase efficiency). State transportation agencies will be concerned with the potential for data loss if system is compromised, hacked or corrupted. Compensating for FRID blocking devices must be considered. The budget and schedule seem reasonable.

Review Date:
12/10/2018

FHWA Evaluation of G-21

Corrigan/ HRDI-20 - This is a need by agencies and will become increasingly important, especially to incorporate materials data and also locate elements within the rapidly emerging BIM use and adoption to facilitate monitoring of assets. The goals of the research, tasks, and anticipated deliverables need additional details and need to be further developed. The research objective cited is not clear. Is this project correctly categorized under G-Traffic? Or should it more correctly be placed under C-Design or D-Materials and Construction? Due to the emphasis on materials data tracking and
managment, it would appear to be a Materials and Construction item. Chris Schneider/HIF - We should move forward with this project. Fessmann/HRDS - In general, RFID technology has been used and seen a rapid increasing use in logistics chains. They allow for precise tracking of any goods, from tshirts to CDs. It seems that expanding the use of RFID technology in roadway construction is a good idea.

AASHTO Committee Evaluation for G-21

Submitted By:
Eric Kopinski
AASHTO Staff
Committee on Construction (COC)

Comments:
The Committee on Construction (COC) selected this as the second highest priority.
Problem No: 2020-G-22

1. **Problem Title**
   Attitudinal Study of Seat Belt Use in Rural Areas of Texas

2. **Background**
   National data shows a near split in fatalities among all drivers in rural and urban areas at approximately 48 percent, or 18,590 rural fatalities, compared to 17,656 urban fatalities of all vehicle types (FARS 2106). Of the 23,714 passenger vehicle occupants killed in 2016, 13,732, or 58 percent, were killed in rural areas and 9,366, or 39 percent, were killed in urban areas (Rural/Urban Comparison of Traffic Fatalities, DOT HS 812 521).

   In Texas, the data is very compatible. Out of the 3,721 fatalities in 2017, 1,950 fatalities were in rural areas while 1,771 occurred in urban areas.

   While Texas remains a Primary Use State, the messaging for seat belt use continues to resonate to keep Texas seat belt usage above 90 percent, according to observational studies conducted by Texas A&M Transportation Institute. Yet in 40 percent of roadway fatalities in 2017, occupants were not using a seatbelt. On closer observation, crash data splits the data such that in rural areas, motorists fail to use the seatbelt more frequently.

3. **Literature Search Summary**
   “Evaluation of a Rural Seat Belt Demonstration Project in Kansas and Missouri” was conducted in 2008. The data contained within this study might show some overlap, yet it is 10 years old and many factors including technology, vehicle safety, and material use has improved significantly within the last decade.

4. **Research Objective**
   The objective of this research is to survey the attitudes of road users in all age categories with passenger vehicle licenses on the belief that seat belts save lives, or that there are reasons to oppose such beliefs. The scope should include a split by age, ethnicity, primary vehicle type, miles of travel per period of time, typical time of day of vehicle use, travel with other occupants, such as children in child restraints or teens, and other factors to be determined. Output should also include types of outreach that resonate highest with groups with highest exposure and risk.
5. **Implementation Planning**
Texas Department of Transportation has a very aggressive outreach program for occupant protection. With our use of 402 and 405 funding from FAST Act, state funded programs such as an award winning child passenger safety program, rollover convincers over 20 TxDOT Districts, ongoing training, and our safety culture within the organization, implementation will be very fast.

6. **Estimate of Problem Funding and Research Period**
**Recommended Funding:**
- Data collection: $350,000
- Analysis and Reporting: $50,000

**Research Period:**
1 year for design and 1 year for survey and reporting.

If the problem statement is selected, this estimate may be adjusted by the project panel.

7. **Urgency and Potential Benefits**
Texas is a very large state, and the growth rate is among the highest in the nation. Industries such as oil and gas, technology, and international shipping, are a testament of why so many are attracted to Texas. Many of these industries are located in, or moving to, rural areas of the state. TxDOT is well staffed in these rural areas, and due to the nature of the organization, TxDOT can implement lifesaving countermeasures that will reduce a trend that has not been reduced in some time. A fatal crash is estimated to cost the state approximately $4,000,000 per event; consequently, Texas could see a dramatic cost savings as well for the outcomes of this survey.

8. **Person(s) Developing the Problem Statement**
Freddie Summer
Traffic Safety Program Lead
Texas Department of Transportation
(512) 416-3310
freddie.summer@txdot.gov

9. **Nomination for AASHTO Monitor**

10. **Potentially Interested AASHTO Councils and/or Committees**

11. **Submitted By**
Freddie Summer
Traffic Safety Program Lead
NCHRP Review of G-22

Reviewed By:
Camille Crichton-Sumners
crichton-sumners@nas.edu

Comments:
Not acceptable as written since it is specifically written for TXDOT, however since there is national interest in rural transportation systems this topic may garner widespread interest. According to the CDC (2017) rural Americans are less likely to use their seatbelts and more likely to die in a crash. Problem statement should have a more global perspective for all states. Surveying will require significant resources, so the budget should be increased to 450K or conduct a joint study with BTSCRCP.

Review Date:
12/7/2018

FHWA Evaluation of G-22

Anderson/HSA; Moyer/HRDS - Proposal lacks the details required to understand the project. I do not support it. Seat belt use is a critical issue. However, this problem statement does not demonstrate an understanding of the considerable knowledge and skill required to develop, administer, and interpret a survey. Converting results into successful outreach will involve a multidisciplinary team with a different set of skills. We do not support this effort at this time.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline

Problem No:  2020-G-23

1. **Problem Title**
   Effects of Automated/Connected Vehicles (AVs/CVs) on Freeway Capacity and Operations

2. **Background**
   With the latest investments made by the United States Department of Transportation (USDOT) and major vehicle manufacturers, automated and connected vehicle (AV/CV) technologies have evolved and are projected to be incorporated on our roadways within the next decade. AVs and CVs have some differentiating characteristics. CVs utilize sensors and the Internet Protocol (IP) suite, which is capable of exchanging information with other vehicles (V2V) or infrastructure (V2I) to communicate with each other and/or the infrastructure. Driver control is necessary for CVs since they do not have the self-driving capability. CVs contain a wireless system or other communication means to share information such as vehicle speed, distance from neighboring vehicles, distance to intersections, with some of the equipment located outside of the vehicle. This outside equipment includes roadside base stations, traffic signal controllers, and other surrounding vehicles. Furthermore, CVs provide the driver with precise information regarding his or her trip, such as the most efficient routes, travel duration, safety alerts, traffic signal phasing and timing information, and upcoming traffic situations.

In comparison, AVs are vehicles capable of operating with minimal to no human control. According to the National Highway Traffic Safety Administration (NHTSA) there are five levels of automation, ranging from zero - no automation to five - full automation. Some have already been achieved with the current technology. For example, the features for level two automation (combined-function automation; i.e., speed and lane position at the same time) are already included in some fleets of major automobile manufacturers. In addition, at least four U.S. states (Florida, Nevada, California and Michigan) already allow road-tests for AVs. The major car manufacturers, such as GM, Mercedes-Benz, Audi, Nissan, Volvo, and BMW all expect to sell automated cars at automation levels 3 and 4 by 2020. It is also anticipated that AVs will likely be connected, having direct communications to other automated vehicles and potentially the infrastructure.

Considering all of these rapid changes in the area of AVs/CVs, the Institute of Electrical and Electronics Engineers (IEEE) predicts that up to 75 percent of fleet vehicles in the United States will be self-driving at an automation level 4 by 2040.
Undoubtedly, the AV/CV technologies and the new vehicle capabilities will change traffic stream characteristics, which will impact the way transportation engineers design and evaluate roadways. There is an apparent need to address the operational and capacity impacts of AVs/CVs on freeways and revisit the freeway capacity values for different AV/CV market penetration rates in order for these capacity values to be accounted for in future revisions of the Highway Capacity Manual. AVs/CVs can influence parameters, such as vehicle headways, free flow speed, speed-flow-density relationships, cooperative merging characteristics, lane changing behavior, weaving characteristics, and the relationships of capacity with respect to lane widths, geometric design and clear zone.

3. Literature Search Summary

Limited work has been done to estimate AV/CV impacts on freeway capacity and operations. Ni et al. (2011) developed a methodology to estimate capacity impact due to CV technology in an article published in the International Journal of Vehicular Technology, and Bierstedt et al. (2014) looked at the effects of next-generation vehicles on travel demand and highway capacity in a Fehr and Peers Think Working Group initiative report. Studies by UC Berkeley PATH (1997) showed that, with full market penetration of automated vehicles, capacity could reach 4,000 vehicles per hour per lane. On the other hand, some applications of AV/CV technologies, such as Speed Harmonization, may actually decrease freeway capacity but improve and smooth the flow of freeway traffic. While changes in capacity remain unclear, the literature on AVs agrees that there will be an increase in vehicle kilometers travelled (VKT) (Horl et al. 2016).

Although the fast pace of this technology is bound to provide researchers with new and emerging datasets in the next couple of years, the current lack of field/empirical data poses a real challenge. Therefore, simulation models, if calibrated and applied properly, could serve as surrogates for the real world.

The U.S. DOT’s Analysis, Modeling, and Simulation (AMS) Testbed Development and Evaluation project developed six AMS testbeds that modeled a number of CV mobility-based freeway applications, including Queue Warning (Q-WARN), SPD-HARM (Speed Harmonization), freight-specific applications, and incident response applications. These testbeds and their supporting data are available for future use and testing at the U.S. DOT’s Research Data Exchange (RDE) and Open Source Application Development Portal (OSADP).

The U.S. DOT is currently developing an AMS framework for Connected and Automated Vehicle (CAV) systems. The framework will help understand and analyze the changes entailed by CAV technologies to the supply of mobility services, travel demand and behavioral changes, and network/facility operational performance. Future work with this framework will include developing new models and logic for a suite of CAV applications, using field data to the extent possible. This framework and new models and logic could potentially be leveraged for this proposed research.
4. Research Objective
Analyze the impacts of the AV/CVs on freeway capacity, particularly at bottleneck locations, such as merging, diverging, and weaving segments. This research will focus on both automated vehicles and connected vehicle technology and investigate the impact of the various vehicular operational characteristics (e.g., car-following discipline, vehicle and truck platooning, emergency braking, lane-changing and gap acceptance logic) on freeway operations. In addition, the research will consider a range of vehicular technology, namely automated passenger cars (considering different levels of automation), automated trucks, passenger cars and trucks that include V2V, and V2I technology, passenger cars and trucks with both automation and connectivity capabilities, as well as passenger cars and trucks with no automation or connectivity capabilities. In addition, the impact of dedicated CV/AV lanes (similar to managed lanes) on the traffic stream, especially at the egress/ingress locations will be evaluated. Different market penetration rates such as 10, 25, 50, 75, 90, and 100 percent, considering all possible connectivity and automation levels will be evaluated using traffic simulation. In addition, this research will report any adverse or positive impacts of AV/CV implementation on the traffic stream as observed through simulation. The results of this research will be used to improve methodologies related to freeways operational performance and quality of service in the Highway Capacity Manual.

5. Implementation Planning
As this research will result in adjustments to the Highway Capacity Manual methodologies, the target audience includes transportation engineers and planner, freeway management personnel, and educators. Ultimately, the addition of CV/AV will lead to more accurate analyses of future freeway systems and improved decision making.

6. Estimate of Problem Funding and Research Period
Recommended Funding:
$500,000
If the problem statement is selected, the level of funding provided may be adjusted by the AASHTO Special Committee on Research and Innovation.

Research Period:
36 months
If the problem statement is selected, this estimate may be adjusted by the project panel.

7. Urgency and Potential Benefits
High. This research will produce capacity adjustment factors and modifications to the HCM methodologies, as a function of automated and connected vehicle technology and market penetration. The proposed research will specifically address how CV/AV technologies are expected to alter planning and operational analysis procedures.

8. Person(s) Developing the Problem Statement
Seckin Ozkul, PhD, PE, University of South Florida, (813) 974-2530, sozkul@usf.edu
Alexandra Kondyli, Ph.D., University of Kansas, (785) 864-6521, akondyli@ku.edu
Alexander Skabardonis, PhD, University of California, Berkeley, (510) 642-9166, skabardonis@ce.berkeley.edu
Hani Ramezani, PhD, University of California, Berkeley, hani.ramezani@berkeley.edu

9. Nomination for AASHTO Monitor

10. Potentially Interested AASHTO Councils and/or Committees
TRB Standing Committee on Highway Capacity and Quality of Service Committee
Chair: Tom Creasey, Tom@caliper.com

11. Submitted By
Bill Knowles, P.E.
State Traffic Analysis Engineer
Transportation Planning and Programming Division
Texas Department of Transportation
512-517-6404
Bill.Knowles@txdot.gov

Brian G. Dunn, P.E.
Oregon Department of Transportation
Transportation Planning Analysis Manager
Mill Creek Office Building
555 13th St. NE, Suite 2
Salem, Oregon 97301-4178
brian.g.dunn@odot.state.or.us
(503) 986-4103

NCHRP Review of G-23
Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:

The proposed research is appropriate for the NCHRP and will be of great value to agencies as they analyze proposed freeway improvements. The Highway Capacity Manual methods and values are the default standard for these types of analysis and are also incorporated into simulation models used for these purposes. While it is likely that this research may need to be repeated as technologies advance, this initial work will serve as the foundation and provide planners with capabilities they currently need and lack.

Review Date:
11/28/2018

________________________________________

FHWA Evaluation of G-23

John Corbin/HOTM - The problem statement effectively recognizes anticipated interactions between connectivity and automation technologies, and the need to evaluate their variabled integrated effects on traffic flow and traffic operations. The research objectives are broad and desirable, but it is unclear what specific products or tools the project would generate. The problem statement lacks an association with an AASHTO committee, and should be coordinated with the Committee on Transportation System Operations. G-04 and G-23 should be combined. A prospectively integrated single problem statement should address the potential coordination with USDOT's Cooperative Automated Research Mobility Applications (CARMA) as well as the USDOT-funded CAMP LLC initiative to evolve a Cooperative Automated Driving System (CADS) research roadmap.

________________________________________
American Association of State Highway and Transportation Officials
Special Committee on Research and Innovation

FY 2020 NCHRP Problem Statement Outline

Problem No:  2020-G-24

1. Problem Title
Upgrade Existing Traffic Control Devices for Connected and Automated Vehicles

2. Background
The introduction of connected and automated vehicle (CAV) technologies on roads has the potential to bring a variety of benefits to the general traveling public. CAVs are using machine-vision systems to assist vehicles negotiating curves, reading static warning signs, regulatory signs, rumble strips, pavement markings, and dynamic message signs, as well traffic signals; however, existing traffic control devices are designed for human use, and may not be optimal for machine use. For example, there have been issues with CAVs being unable to read the road due to various conditions, such as missing reflectors, lanes not clearly delineated during construction, or faded paint stripes. Existing traffic control devices need to be upgraded to better serve the needs of CAVs; however, justifying the upfront investment in upgrading traffic control devices has been difficult for a variety of technology and policy reasons. The upfront investment for even a single type of upgrade, such as widening pavement markings from four inches to six inches is very large.

3. Literature Search Summary
CAVs have been evolving rapidly with advancements in sensing, information, and communications technologies. CAVs have drawn significant attention in recent years due to their potential safety, mobility, and environmental benefits. While connected vehicles (CVs) and automated vehicles (AVs) are two separate types of vehicles, convergence of these technologies could potentially maximize benefits of both and lead to a safer and more efficient transportation network. The U.S. Department of Transportation (USDOT), industry, and research institutes have conducted a wide range of research activities that focused on enhancements in communications and sensing technologies. A few CV applications are being developed, tested and deployed in three CV Pilot sites funded by USDOT. The expected benefits of these technologies have led some state and local departments of transportation to develop, pilot, and deploy CV technologies.

Automobile manufacturers and suppliers (Honda, GM and Ford) and technology firms (Apple, Google, Tesla and Uber) are advancing Automated Vehicle technologies that progressively reduce dependence on drivers. The Society of Automotive Engineers (SAE) standard J3016, the Taxonomy and Definitions for
Terms Related to Driving Automation Systems for On-Road Motor Vehicles, provides a taxonomy describing the full range of levels of driving automation (levels 0 through 5) based on the driving load distribution between the driver and the automated driving system (ADS). As the level of driving automation evolves from current SAE Level 1 (Driver Assistance) and Level 2 (Partial Driving Automation) to Level 4 (High Driving Automation) and Level 5 (Full Driving Automation), and the synergies between AVs and CVs become more obvious, future vehicles are expected to fully monitor the road conditions and perform much of the safety-critical driving functions.

A cooperative and automated transportation (CAT) system could change the principles of transportation engineering, the way people travel, and the way roadway infrastructure is planned, designed, constructed, operated and maintained. Infrastructure owners/operators (IOOs) must understand both the impact of CAV technologies on the systems they manage, as well as the effects of their policy, planning, and regulation; infrastructure design; and operations on technology development, adoption, and life-cycle costs. One impact is that traffic control devices, such as roadway markings, may be updated to support safer and more reliable adoption of CAVs in the roadway network.

The National Cooperative Highway Research Program (NCHRP) initiated the Program 20-102 to assess the impacts of CVs and AVs on state and local transportation agencies. The ongoing NCHRP Project 20-102(06) is to develop information on the performance characteristics of pavement markings that affect the ability of machine vision systems to recognize them; however, there has been limited collaboration between IOOs and ADS developers in the development of CAVs. IOOs are generally not clear about which traffic and roadway characteristics are critical to CAVs. A collaborative mechanism for IOOs to interact with CAV developers and automotive companies needs to be established to identify specific traffic and roadway characteristics influencing the safety, efficiency, and performance of CAVs.

Thus, it is critical to initiate a coordinated research effort that can identify and address the needs of state and local transportation agencies, and SAE in the area of traffic control devices.

4. Research Objective

The proposed research would investigate the needs of traffic control devices in the CAV environment, develop minimum performance levels for traffic control devices so that they can be maintained to support safe and reliable operations of CAVs, and provide data and recommendations to IOOs and SAE to develop standards, guidelines and policies. The research project would also explore and identify a sustainable mechanism for IOOs (and its supporting organizations such as the American Association of State Highway and Transportation Officials (AASHTO), SAE, and other standards organizations) to coordinate on activities that would support a safe and reliable adoption of CAVs.
It likely takes decades before the market penetration of fully connected and automated vehicles (i.e., ADS takes 100 percent driving load) reaches 100 percent; therefore, traffic control devices for both human drivers and ADS should be considered.

5. Implementation Planning
1. Target audience for research findings and products: IOOs, federal agency, SAE and ADS developers.
2. Key decision makers to champion implementation: Cooperative and Automated Transportation (CAT) Deployment Coalition.
3. AASHTO committees and others with responsibility for adoption: The CAV Working Group under AASHTO Committee on Transportation Systems Operations (CTSO), Connected Vehicle Pooled Fund Study (CV PFS), and CAT Deployment Coalition.
4. Early adopters: Texas Department of Transportation (DOT) and other state and local DOTS that are currently piloting and deploying CAV technologies.
5. Institutional and policy barriers: ADS developers may not be willing to share their proprietary approaches for CAVs.

6. Estimate of Problem Funding and Research Period
Recommended Funding:
$350,000.00

Research Period:
2 years

If the problem statement is selected, this estimate may be adjusted by the project panel.

7. Urgency and Potential Benefits
High. The research effort will support proactive policymaking on standardizing traffic control devices to support a safer and more reliable adoption of CAVs.

8. Person(s) Developing the Problem Statement
Brian Fariello, P.E.
Traffic Management Section Director
Traffic Safety Division
Texas Department of Transportation
Brian.Fariello@txdot.gov

Jianming Ma, Ph.D., P.E.
Project Manager
Traffic Management Section
Traffic Safety Division
9. Nomination for AASHTO Monitor

10. Potentially Interested AASHTO Councils and/or Committees
   TRB AHB30 Standing Committee on Vehicle-Highway Automation

11. Submitted By
   Jianming Ma, Ph.D., P.E.
   Project Manager
   Traffic Management Section
   Traffic Safety Division
   Texas Department of Transportation
   Jianming.Ma@txdot.gov
   (512) 506-5106

NCHRP Review of G-24

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:

The proposed research is appropriate for NCHRP. Current project 20-102(15) is looking at which aspects of transportation infrastructure will be impacted by CV and AV technologies. The scope includes traffic control devices but the broad scope will result in a fairly shallow effort. The proposed effort will delve more deeply into these devices and, perhaps more importantly, foster a deeper relationship between vehicle manufacturers and transportation agencies to jointly explore common issues. This would build upon the Cooperative Automated Transportation (CAT) Coalition and other efforts.

Review Date:
11/28/2018

FHWA Evaluation of G-24
HRDO - The research proposed (developing min performance level for traffic control devices in a CAV environment) is a good idea. It should be noted that there is already an existing group that brings together Infrastructure Owners and Operators (IOOs) and vehicle manufacturers (OEMs) as part of the CAT coalition. That may need expanded or extended, but it's a good place to build off rather than starting from scratch.
Research Field SP

SPECIAL PROJECTS
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement Outline  
Problem No: 2020-SP-01

1. Problem Title  
Development of Business Case and Communication Strategies for a State DOT Resilience Program

   How can state DOTs develop strategies to ensure the public supports resilient transportation systems and their organizations integrate resiliency into the project life cycle for both natural and human caused hazards?

2. Background  
Many State Departments of Transportation (DOTs) have faced significant disruptions to transportation system performance for a variety of reasons. Flooding, extreme heat, wildfires, cyberattacks, critical infrastructure failure, coastal erosion, and storm surge are just some of the hazards state DOTs have had to respond to along with many of their partners. A focus on system disruptions, the ability of the transportation system to anticipate and respond to such disruptions, and the subsequent consequences to transportation system performance and to a state and its communities are primarily perceived as system resilience and security concerns.

   The future portends even more disruptions from a variety of sources. The transportation sector is the 3rd most vulnerable sector to cyberattacks according to leading insurance magazine. Worldwide, transportation is the #1 target of terrorists. Future climate and extreme weather conditions are likely very different than historical trends (with expectations of greater impacts on the transportation system). Disruptions to transportation system have significant multiplier impacts to the economy and society. With an increasingly interconnected world, transportation systems are often dependent on assets and infrastructure over which transportation officials have no control (e.g., the electrical grid). And, of course, such disruptions are highly visible and the ability to mitigate them is often viewed as a measure of the effectiveness of an agency.

   In addition, the Fixing America’s Surface Transportation (FAST) Act included several requirements for transportation agencies that reflected an increasing concern for resilience and security. For example, statewide and metropolitan transportation planning processes were to consider projects/strategies to improve the resilience and reliability of the transportation system. It continued all prior National Highway Performance Program (NHPP) eligibilities, and added among four new eligible categories, one for projects to reduce the risk of failure of critical NHS infrastructure (defined to mean a facility, the incapacity or failure of which would have a debilitating impact in certain specified areas). It is apparent that
System resilience is becoming an ever more important concern for transportation officials at all levels of government.

TRB's Cooperative Research Programs have devoted substantial resources to investigating many different aspects of system resilience and security. However, as will be discussed in the literature review section, no research has been conducted on resilience-oriented communications strategies and how state transportation officials can make a business case for investing in resilience strategies. This was a key conclusion reached at a recent meeting of the AASHTO Committee on Transportation Security and System Resilience (CTSSR). A significant need exists in providing state transportation officials with such a framework and set of strategies.

This research topic will explore how a state DOT can institute formalized processes to ensure the public is aware of how resiliency is part of the organization’s overall mission and how to advocate for resiliency in the life cycle of a DOT’s planning, engineering, design, operations and construction activities. The proposed research would collect examples of state DOT communications best practices and lessons learned.

This research is directly related to the strategic plan/work plan for the Committee on Transportation Security and System Resilience (CTSSR), Committee on Performance-Based Management, Committee on Environment and Sustainability and other Program Delivery and Operations committees.

3. Literature Search Summary

CRP programs have devoted considerable resources to the resilience and security challenges facing transportation agencies (see TRB's periodic update review of such research at http://onlinepubs.trb.org/Onlinepubs/dva/SecurityActivities.pdf). A review of this literature shows that much of it focuses on physical or cybersecurity threats and how DOTs can prepare for, address, and respond to related disruptions. A good example of this type of research is Protection of Transportation Infrastructure from Cyber Attacks: A Primer (NCHRP 221/TCRP 67) that examines different functional areas of a DOT and how they can protect themselves against cyberattacks. Much of the literature focuses primarily on raising awareness of how important resilience is to the effective performance of transportation systems. When searching the research databases under "communications" and "resilience" labels, no references relating to the proposed research topic were returned (except as they related to communications technologies).

With respect to on-going or proposed research, the current NCHRP 20-117, "Deploying Transportation Resilience Practices in State DOTs" is focusing on guidance to state DOTs on how to become more resilient. Part of this project includes the development of a guidebook for state DOT officials on desired resilience actions, and one of the chapters in the guidebook presents the need for effective internal and external communications. However, the chapter will not provide detailed guidance on how to do so. The guidebook also suggests as part
of this communications strategy the need to develop a cogent business case on why state DOTs should be concerned about resilience. This business case is intended to explain to other government officials, legislators, and the public why the DOT should spend funds on a range of activities that are needed in the event of major disruptions.

Although not a research project, it is noteworthy that several Transportation Research Board Committees sponsored a competition, “Communicating the Unique Challenge of Transportation Resiliency and Sustainability.” The winner of this competition presented at the October 8-10th, 2018 National Resilience Summit. Many applications were submitted indicating the interest in the topic.

The research proposed by this problem statement will build upon the NCHRP 20-117 project as well as others that have mentioned the need for effective communications for enhancing transportation system resilience and supporting resilience-oriented DOT activities.

4. Research Objective

This research will 1) examine state DOT communication strategies and processes to make the public and stakeholders aware of how resiliency is part of the state DOT's overall mission, and 2) build a business case for investing in resilience strategies. It is expected that the research would examine best communications practices of transportation agencies relating to both the evolutionary nature of considering resilience in agency activities and the more immediate communications efforts in response to disruptions (e.g., Georgia DOT bridge deck fire, Caltrans wildfires, South Carolina DOT hurricane efforts, and Washington State DOT I-5 Skagit River bridge collapse). The intent would be to analyze best case applications of effective communications strategies (including the technology of information dissemination) and lessons learned from recent disruptions. In addition, the research would focus on how to build a business case for including resilience in a DOT's activities.

The desired outcomes would include a guideline on identifying and implementing effective communications strategies, and prototype business case descriptions.

5. Implementation Planning

The guideline is expected to be very clear on the steps necessary to develop communications strategies to facilitate, and thus the implementation results of this research could be implemented with a modicum of out too much additional support. However, presentations at AASHTO meetings, peer exchanges aimed at specific target audiences, and webinars would be helpful in disseminating project results.

6. Estimate of Problem Funding and Research Period

Recommended Funding:
$300,000 research support
$50,000 dissemination support
Research Period:
18 months

7. Urgency and Potential Benefits

This research topic was identified by the CTSSR as one of the most pressing needs for state DOT officials in fostering a resilience culture in their agencies. As noted, there is almost no attention given to this topic in past or current research. As DOTs and state transportation officials increasingly face more system disruptions, having an effective communications program will be a critical component of their success in response. Given the nature of the topic and the importance it has for all those involved with transportation system resilience at all levels of a DOT, the research will create significant benefits to state DOT officials. The likelihood of implementation of research results is extremely high.

8. Person(s) Developing the Problem Statement

Kim Avery  
Bureau of Field Services Director  
Michigan Department of Transportation  
269-337-3910  
Averyk@michigan.gov

Timothy Sexton  
Chief Sustainability Officer  
Minnesota Department of Transportation  
651-366-3622  
Timothy.sexton@state.mn.us

9. Nomination for AASHTO Monitor

Timothy Sexton  
Chief Sustainability Officer  
Minnesota Department of Transportation  
651-366-3622  
Timothy.sexton@state.mn.us

10. Potentially Interested AASHTO Councils and/or Committees

Communications Committee, Environment and Sustainability Committee, Committee on Planning, Committee on Performance-based Management,

11. Submitted By

Michael P. Lewis, Chair of AASHTO Committee on Transportation System Security and Resilience  
Executive Officer  
Colorado Department of Transportation  
303-757-9201
NCHRP Review of SP-01

Reviewed By:
Stephan A. Parker
saparker@nas.edu

Comments:

As noted in the problem statement, "The research proposed by this problem statement will build upon the NCHRP 20-117 project as well as others that have mentioned the need for effective communications for enhancing transportation system resilience and supporting resilience-oriented DOT activities."

The proposed project can also build on NCHRP 20-101, Guidelines to Incorporate the Costs and Benefits of Adaptation Measures in Preparation for Extreme Weather Events and Climate Change (publication anticipated 2019).

Review Date:
12/12/2018

FHWA Evaluation of SP-01

Bechy Lupes/HEPN Melanie Rigeway/HIF - We think this is a fantastic idea, and it's very well developed, with identifiable outputs. Resiliency is a major concern today, and should be at the forefront of transportation communications and business planning, as identified in the background. This is not a challenge that is going away tomorrow or the next day, and so we as an industry need to come up with ways to mitigate and reduce its impacts. Integrating resiliency into the project life cycle is essential, and part of that is educating both leadership and the public. Under No. 4, a variety of types of disruptions are identified for study, some natural, some caused by humans. That's great that the project plans to consider all kinds of disruptions. The Urgency/Benefits section clearly notes the lack of past research. Consider including both internal as well as external
communication in the research objective, consistent with the NCHRP 20-117 recommended action. As one of FHWA's Resilience and Durability Pilot Projects, Caltrans is currently developing a statewide communications plan to disseminate data and results of their vulnerability and risk assessments within the agency. While the results of this research would have been helpful for their efforts, Caltrans' work can now potentially inform this research.

AASHTO Committee Evaluation for SP-01

Submitted By:
Eric Kopinski
AASHTO Staff
Committee on Transportation System Security and Resilience (TSSR)

Comments:
This problem statement ranked fourth for AASHTO's Committee on Transportation System Security and Resilience

Submitted By:
Matthew Hardy
AASHTO staff
Performance-Based Management

Comments:
1. Please ensure these two efforts [B-15 and SP-01] are non-overlapping. I recognize the same people wrote both problem statements, and that both are intended to fill gaps in 20-117. However, I had to read them twice to ultimately understand the distinction between the efforts.
2. Please have the researchers address (or at least acknowledge) the uncertainty in the occurrence and magnitude of hazards or disruptive events that might test system resilience. Assuming that hazards *will* occur instead of *may* occur with some probability or frequency could lead to over-conservative (and therefore more expensive) decisions on how much resilience to incorporate during planning. With all the demands on our funding, we need to ‘right-size’ or optimize resilience spending. As an example, after 9/11 the US government sponsored many vulnerability studies for critical infrastructure. Those studies implicitly assumed the disruptive events would occur with 100% probability. As a result, we probably spent a lot of money to harden facilities that in reality will never see such disruptive events.
3. If selected please include representation from the CPBM Subcommittee on Risk Management on the project panel.
Problem No: 2020-SP-02

1. Problem Title
Organizational and Operational Models used by State DOTs for Emergency Response

How are state DOTs organized to support the demands of transportation emergencies and how do they transfer resiliency to mobilize Emergency Support Function 1 (ESF1) responsibilities for local communities?

2. Background
NCHRP Report 525, Volume 16: A Guide to Emergency Response Planning at State Transportation Agencies was adopted in 2012 as a guide to state DOTs on how emergency response should occur within transportation agencies. Since then, NCHRP has sponsored other research to add practical guidance to the emergency response function of DOTs (to be discussed below in the literature review). However, there is a gap in the research relating to recommended state DOT operational models for emergency response. The importance of the topic has been well established; the types of actions and related responsibilities have been identified; desire outcomes have been defined, but research is lacking on recommended ways DOTs should organize themselves for effectively participating in emergency response.

A key research need identified by the NCHRP Project 20-117 panel and research team is effective organizational structure for the Emergency Response activities of transportation agencies. The importance of Emergency Management activities to State DOTs is highlighted in AASHTO’s 2014 Fourth Generation Strategic Plan which helped form the basis for the new AASHTO Committee on Transportation System Security and Resilience; and, in fact, the following three of the six goals of AASHTO’s 2014 Fourth Generation Strategic Plan which helped form the basis for the new AASHTO Committee on Transportation System Security and Resilience (TSSR) are related emergency management.

- Goal 3: “Investigate, develop, and report on recent advances in infrastructure protection, security, and emergency management issues in urban and statewide environments, including consideration of their social and economic impacts.
- Goal 4: Advance the state-of-the-practice and awareness of transportation infrastructure protection and emergency management through training, technical assistance and technology transfer activities.
• Goal 5: Develop, promote and encourage effective working relationship among state transportation officials and other stakeholder responsible for various aspects of transportation infrastructure protection, emergency management and system operations.

Organizational structure can and does make a difference in the effectiveness of emergency response and related emergency activities and initiatives. As noted in 2017 AASHTO Understanding Transportation Resilience: A 2016–2018 Roadmap for Security, Emergency Management, and Infrastructure Protection in Transportation Resilience, emergency management is an essential component of resilience, but the current frameworks may not be ideal.

For decades, State DOTs have been developing and honing all-hazards emergency response procedures and protocols, and have become adept at responding to a range of emergencies and incidents, and fulfilling their federal responsibilities, namely ESF#1 responsibilities such as emergency access and evacuation support.

However, the increased frequency and intensity of disasters have galvanized the transportation community to start focusing on resilience and systematic resilience-based approaches to plan, prepare, respond, and recover from these costly events. Further, new federal guidance requirements such as the 2015 Fixing America’s Surface Transportation (FAST) Act incorporates the concept of resilience into transportation planning guidance, and evolving and expanding state, regional, and local requirements provide State DOTs with additional impetus to integrate resilience practices and initiatives into emergency response, and identify effective organizational and operational models for emergency response. This effort will help agencies save money as well as lives and support State DOTs in their path towards resilience.

3. Literature Search Summary

The TRB Cooperative Research Programs and the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM) have sponsored and produced relevant research products related to the topic of emergency management and emergency response. The 2015 AASHTO Fundamental Capabilities of Effective All Hazards Infrastructure Protection Resilience, and Emergency Management for State DOTs, adopted by AASHTO in 2015, covers all-hazards planning fundamentals including response, defined as “Capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.”

which recognized significant advances in the field of transportation emergency management including standards and guidance at the federal level through implementation of NIMS/ICS, National Preparedness Framework and National Transportation Recovery Strategy. The work focused on all-hazards emergency management, current practices in emergency response planning and maintaining a resilient transportation system during emergencies. The updated Guide includes the nature and degree of hazards and threats; institutional context of emergency management; steps required to develop an emergency preparedness program; stakeholders and regional collaboration; and, training and exercises. The updated Guide also contains a thorough review of relevant Emergency Management literature and broadens context to community, region, resilience, and sustainability.

Responsibilities for emergency response span the entire State DOT hierarchy from senior executives to frontline personnel. NCHRP Web-only Document 206: Managing Catastrophic Transportation Emergencies: A Guide for Transportation Executives is targeted towards transportation executives on managing catastrophic transportation emergencies and is useful for newly appointed executive level leaders of transportation organizations. This AASHTO guide supports agency’s emergency preparedness capabilities - preparing for, responding to and recovering from a major event – as they are critical to safe and efficient operation of the nation’s transportation network.

Coordination and public information/warning is very important during emergencies. Regional planning is discussed in NCHRP Report 777: A Guide to Regional Transportation Planning for Disasters, Emergencies, and Significant Events and TCRP Report 150: Communication with Vulnerable Populations.

Training including drills and exercises is essential in preparing emergency response personnel for their roles and can help ensure effective emergency response. Transportation Emergency Response Application or TERA, a web-based simulation system for training and exercising transportation emergency operations and response, was created through a joint TCRP/NCHRP project originally focused on transit emergency managers but later expanded to include State DOT roles as well. The project report is contained in the 2014 TCRP Web-Only Document 60 / NCHRP Web-Only Document 200: Command-Level Decision-Making for Transit Emergency Managers. NCHRP Web-Only Document 215 Incident Command System (ICS) Training for Field Level Transportation Supervisors and Staff generated NIMS/ICS field level training content on various media. NCHRP Synthesis Report 468: Interactive Training for All-Hazards Emergency Planning, Preparation, and Response for Maintenance and Operations Field Personnel highlights the importance of Maintenance and Operations personnel in emergency preparedness and response, and identifies interactive emergency training tools and sources that may be applied by the managers of maintenance and operations field personnel along with obstacles to their implementation. An older 2006 TCRP Report 86/NCHRP Report 525,
Guidelines for Transportation Emergency Training Exercises, contains useful information as well.

Cost recovery activities, an important responsibility of emergency response personnel, reimburses State DOTs for all or a portion of funds expended for eligible activities. Presented in the NCHRP Synthesis 472: FEMA and FHWA Emergency Relief Funds Reimbursements to State Departments of Transportation, 2015 are an overview of the federal disaster reimbursement programs: FHWA Emergency Relief (ER) and the Federal Emergency Management Agency (FEMA) Public Assistance (PA), challenges and effective practices of state DOTs and useful resources for the two federal programs.

Transportation aspects of large-scale, multi-jurisdictional evacuation for both notice and no-notice events are addressed in the NCHRP Report 740: A Transportation Guide for All-Hazards Emergency Evacuation.

The AASHTO 2016-2018 Resilience Research Program produced or is expected to produce research products relevant to this topic as it pertains to resilience:

- NCHRP Project 20-59(54) Resilience Research Roadmap (Pre- and Post-Summit versions) (2016–2018) – The Roadmap addressed the challenges in reconciling four interrelated topics: Critical Infrastructure; Risk Management; Protection; and All-Hazards Emergency Management by identifying resilience as the overarching strategy to unify the concepts.
- NCHRP Project 20-59(54) Transportation Resilience White Papers (2017) - White Papers providing an Economic Perspective, Environmental Perspective, and Cyber Perspective are written for transportation policy makers and executives to provide a mechanism by which they can engage their peers together with elected and appointed officials who may be unfamiliar with the conversation surrounding transportation resilience.
- NCHRP Project 20-59(55) CEO Primer on Transportation Resilience (2016) - The objectives of this project are to develop a primer and a series of briefings for state DOT CEOs and senior executives on transportation resilience. The literature review focused on theoretical and applied literature to gain an understanding of prior work, both domestic and international; its evolution into current transportation planning and policy; and the likely directions of resilience’s continued integration into DOT business practices.
- NCHRP Synthesis 20-05/Topic 48-13 Resilience in Transportation Planning, Engineering, Management, Policy, and Administration - The objective of this synthesis study was to document resilience efforts and how they are organized, understood, and implemented within transportation agencies’ core functions and services. The case studies provide insights on resilience policy, modeling, funding, and design standards and practice.
The literature review conducted through AASHTO’s Resilience Research Program and results of the projects listed above, namely, the 20-117 project, revealed several models and frameworks of organizational change (e.g., RAMCAP Plus Process being used by the Colorado DOT to incorporate resilience into its Transportation Systems Management and Operations (TSM&O) framework).

In addition, the NCHRP 20-116 project has been tentatively approved for funding and is in the initial stages of development. The project objectives are to develop and implement a comprehensive deployment and change management strategy to assist State DOTs in implementing the NCHRP 20-59(51)B Guide. Because the results of this Guide and 20-116 project contain information pertinent to organizational and operational frameworks and models for emergency response, they should be carefully mined to incorporate relevant findings and avoid duplication of work. However, the need for additional and more thorough research on best practice organizational/operational structure for emergency response still remains.

4. Research Objective

NCHRP currently has a project under development entitled "Emergency Management in State Transportation Agencies." This project is intended to more "effectively bridge the gap between all-hazards emergency response research and DOT practice and thereby improve the DOT’s response over a broad continuum of emergencies affecting the nation’s travelers, economy, and infrastructure."

The research objective of this requested project is to augment the purpose of the project currently in development. The project will examine how state DOTs utilize different organizational models to fulfill their Emergency Support Function 1 and related Emergency Response responsibilities, facilitate timely and effective emergency response on DOT assets and support communities impacted by different conditions that may require DOT resources to support response and recovery of operations. More specifically, the research is expected to:

- Analyze and capture the different organizational and operational models used by state DOTs
- Identify best practices and options
- Capture how the models were implemented, cost of implementation, how they were evaluated, and how they may have evolved

The methodology will likely include a survey of state DOTs and case studies of best practices implemented by state DOTs.
5. Implementation Planning
As discussed in a NCHRP 20-59(51)B Technical Memorandum, a recent survey of state DOTs, *2017 State Transportation Security and Emergency Management Survey Results*, (July 2017), identified preferred methods for the effective organizational mainstreaming of emergency management into their agencies with classroom and on-line training as significantly favored by state DOTs and indicated that a mix of learning-based approaches is most suitable for agencies.

Recommendations on How to Best Deploy the Updated 51B Emergency Response Research Findings/Products into Practice presented in the NCHRP 20-59(51)B Technical Memorandum should also be consulted. They include the following Tier 1, 2, and 3 recommendations:

- Tier 1 – Best recommendations - classroom instruction, regional workshops, and webinars.
- Tier 2 – Better - a National Symposium, and

6. Estimate of Problem Funding and Research Period
Recommended Funding:
$600,000

Research Period:
18 Months

7. Urgency and Potential Benefits
Because effective emergency response is a key component of a resilient transportation organization, understanding the influence of organizational and operational structures on emergency response and best practices and options with respect to those structures is important and ultimately affects the ability of the state DOT in providing the best possible response for a given situation. This translates into lives saved, injuries averted, and damage to transportation infrastructure and assets mitigated.

As natural disasters increase in frequency and intensity, the negative impacts of the disasters on transportation assets and infrastructure and systems will increase as well. Therefore, the urgency of this project cannot be overstated.

8. Person(s) Developing the Problem Statement
Kim Avery
Bureau of Field Services Director
Michigan Department of Transportation
269-337-3910
Averyk@michigan.gov

Timothy Sexton
Chief Sustainability Officer
Minnesota Department of Transportation
651-366-3622
Timothy.sexton@state.mn.us

9. Nomination for AASHTO Monitor
Kim Avery
Bureau of Field Services Director
Michigan Department of Transportation
269-337-3910
Averyk@michigan.gov

10. Potentially Interested AASHTO Councils and/or Committees
NA

11. Submitted By
Michael P. Lewis, Chair of AASHTO Committee on Transportation System Security and Resilience
Executive Officer
Colorado Department of Transportation
303-757-9201
michael.p.lewis@state.co.us

Lorenzo Parra, Vice-Chair of AASHTO Committee on Transportation System Security and Resilience
Director Highway Operations Center
Massachusetts Department of Transportation Highway Division
617-946-3029
Lorenzo.parra@state.ma.us

NCHRP Review of SP-02

Reviewed By:
Stephan A. Parker
saparker@nas.edu

Comments:
State DOTs have organized and re-organized their approaches for emergency response numerous times since 9/11. The proposed $600,000 research problem would examine current organizational models, focusing on how the DOTs carry out their Emergency Support Functions under the National Incident Management System in support of emergencies NOT on the state highway system.

NCHRP has produced guidance on how state DOTs can organize to carry out specific activities (e.g., NCHRP Report 833, Assessing, Coding, and Marking of Highway Structures in Emergency Situations; NCHRP Report 781: A Debris Management Handbook for State and Local DOTs and Departments of Public Works) but has not produced guidance recommending how to structure an organization overall.

The candidate problem statement is complementary to NCHRP 20-116, which is essentially structured as an implementation of A Guide to Emergency Management at State Transportation Agencies, 2nd Edition. The 20-116 panel will meet in March 2019 to scope that project.

Review Date:
12/12/2018

AASHTO Committee Evaluation for SP-02

Submitted By:
Eric Kopinski
AASHTO Staff
Committee on Transportation System Security and Resilience (TSSR)

Comments:
This problem statement ranked second for AASHTO's Committee on Transportation System Security and Resilience.
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation  

FY2020 NCHRP Problem Statement  

Comments: This problem statement was developed by the NCHRP 20-122 Rural Transportation Issues: Research Roadmap project team per panel direction. It is being submitted by the AASHTO Special Committee on Research and Innovation per action taken at their meeting on October 29-30, 2018.

Problem No: 2020-SP-03

1. Problem Title  
Effectiveness of Zero-Tolerance Drug & Alcohol Policies for Rural Transportation Agencies

2. Background  
Federal regulations (49 CFR 40) currently require all public transit agencies that receive federal funding to enforce zero-tolerance policies for employee use of alcohol, marijuana, cocaine, amphetamines, phencyclidine, and opioids. Similar policies are typically put in place by other transportation agencies such as state DOTs, county highway departments, and municipal public works agencies. Typically, these policies include random breath testing for alcohol intoxication, and urine testing for marijuana and illicit drugs.

Required random testing rates vary by mode. For example, at least 25% of public transit agency employees must be tested for drugs on a random date at least once annually, and 10% must be tested for alcohol (U.S. Department of Transportation 2018). Thus, the probability that an employee will not be screened is considerable. Consequently, the effectiveness of these protocols in deterring drug use is uncertain (Horno, González-Padrón et al. 2016).

A key distinction can be drawn between the alcohol test (which looks for signs of acute intoxication) and the marijuana and drug tests (which look for metabolites). This distinction is increasingly important as a result of marijuana legalization. Cannabis metabolites can remain in the body for up to four weeks (Phifer 2017). Thus, an employee could use marijuana legally during off-duty hours or a vacation, yet face sanctions for a positive metabolite test long after its intoxicating effects have diminished.

As of June 2018, recreational marijuana/cannabis had been legalized in 9 states, which together represent 21% of the U.S. population (Robinson, Berke et al. 2018, United States Census Bureau 2018). With recent public opinion polling showing that approximately 60% of Americans favor legalization (Geiger 2018), it appears likely that additional states will enact lenient marijuana laws in the future. Consumption of smokeable and smokeless cannabis products appears to be rising (SAMSHA 2014).

Rural highway and public transit agencies utilize substantial numbers of personnel in safety-critical occupations, including employees, contractors, and (in some cases) volunteers. While large agencies in metropolitan areas generally
have the resources required for intensive screening to enforce zero-tolerance policies, this is not always the case in small rural agencies. With lean staffing, an agency may face substantial operational problems if the number of available personnel is insufficient. As a result, front-line supervisors in rural agencies can face substantial pressure to turn a blind eye to suspected policy violations—especially violations perceived to be “minor.”

While marijuana use by agency personnel during working hours is unquestionably problematic, some states have existing statutes that prohibit employment discrimination based on the off-premises use of lawful products during nonworking hours. Additionally, many rural transportation personnel are deployed in remote locations where face-to-face contact with supervisory personnel is limited. Some rural public transportation strategies rely on volunteer drivers who are not motivated by the same factors or subject to the same regulations as paid employees. A further complication is that recent research indicates that blood tetrahydrocannabinol (THC) levels are not reliable predictors of acute marijuana intoxication (Logan, Kacinko et al. 2016). Thus, proving marijuana intoxication and consistently enforcing marijuana policies across a workforce that could include paid employees, third-party contractors, and volunteers presents a very complex set of policy issues for transportation agencies.

3. Literature Search Summary
While employer-based drug and alcohol screening programs are widely used in transportation, construction, and other industries, the academic literature includes surprisingly little research on the overall effectiveness of these programs. Conversely, the internet is abuzz with advice on various cheating methods, along with advertisements for commercial products designed to facilitate urine sample substitution, dilution, and adulteration—or to promote rapid detoxification (wikiHow n.d.). While drug testing laboratories have evidently become more sophisticated at detecting household products formerly used as adulterants (e.g., salt, vinegar, drain cleaner), research indicates that zinc sulfate reduces the sensitivity of the commonly-used ELISA urine testing method, and is not itself readily detectible in urine (Venkatratnam and Lents 2011).

“I cheated and passed” anecdotes abound on pro-drug websites, yet very little research appears to have been conducted on the proportion of employees who successfully evade drug testing. Moreover, anecdotes suggest that news of upcoming testing is sometimes leaked to employees; this form of cheating is conceivably more prevalent in rural transportation agencies (where testing is an occasional event) as compared to large urban agencies (where testing of randomly-selected employees can occur on an ongoing basis).

Alternatives to zero-tolerance policies are another important line of research. While current policies in the United States feature immediate and permanent termination of job duties based on a failed drug test, the prevalent practice in many other countries is to transfer drug-positive employees to probationary non-safety-critical duties and direct them to treatment programs (Horno, Gonález-Padrón et al. 2016). Another proposed policy is to focus solely on intoxication during working
hours through expanded use of expedient behavioral testing such as the Driving Under Influence of Drugs (DUID) protocol (Phifer 2017).

4. **Research Objective**
   A fundamental assumption of existing employee drug use policies is that random drug and alcohol screening (and the threat of loss of employment) is an effective deterrent to substance use. Since marijuana legalization is likely to force reconsideration of several elements of these policies, it is necessary to determine whether they are, in fact, effective in the rural transportation context. To achieve this objective the proposed research will:
   - Conduct confidential surveys and interviews to gather information about the prevalence of drug and alcohol use by rural transportation agency employees.
   - Compare attitudes toward employer zero-tolerance policies at the management, supervisory, and front-line employee levels.
   - Identify techniques used to circumvent tests and the prevalence of cheating.
   - Assess the interaction between employee drug and alcohol use and local/regional substance abuse rates.
   - Explore the extent to which rural transportation agencies employ medical officers, and the extent of their influence over employee drug/alcohol use and treatment.
   - Review the overall effectiveness of zero tolerance policies and random drug testing protocols intended to deter and detect personnel substance use in the rural transportation context.

An important aspect of the research will be to identify any differences between states where marijuana has been legalized and those where it remains illegal.

5. **Implementation Planning**
   The end product of this research will be information on the prevalence of rural transportation agency employee drug and alcohol use, attitudes toward zero-tolerance policies amongst agency employees (including front-line staff, middle management, and upper management), and the methods and prevalence of alcohol/drug test cheating. This data will provide useful baseline information to assess the effectiveness of zero-tolerance policies. Based on the outcomes of this research, future efforts could potentially include pilot studies of alternatives to zero-tolerance policies, methods for reducing cheating, and improved methods for detecting cannabis use.

6. **Estimate of Problem Funding and Research Period**
   Recommended Funding: $400,000  Recommended Research Period: 18 months

7. **Urgency and Potential Benefits**
   Benefits: The proposed research will be of immediate value to policy makers and rural transportation employers in understanding the effectiveness of existing zero-tolerance drug/alcohol policies, establishing the extent to which employees successfully evade tests, and developing updated policies.
Negative impacts if not funded:
  • Safety risks to agency customers and the public resulting from continuation of ineffective employee drug use policies.
  • Potential litigation such as wrongful termination claims by employees who legally used marijuana during off-duty hours but were not intoxicated at the time of testing.
  • Potential negative publicity resulting from “harsh” policies with respect to the legal use of medical cannabinoids and/or recreational marijuana.

8. **Person(s) Developing the Problem Statement**
   NCHRP 20-122 Rural Transportation Issues: Research Roadmap project team per panel direction.

9. **Nomination for AASHTO Monitor**
   TBD

10. **Potentially Interested AASHTO Councils and/or Committees**
    Public Transportation Council
    Special Committee on Research & Innovation
    Subcommittee on Safety, Environment, and Workforce Development

11. **Submitted By**
    AASHTO Special Committee on Research and Innovation

**References**


This is an important, urgent topic affecting all modes of transportation. Fleet operations depend on unimpaired equipment operators, whether they are driving snow plows, graders, or transit buses. With many states and Canada having legalized recreational use of cannabis, the issue will continue to grow in its impact on the ability to attract and retain workers.

This problem statement was developed by the NCHRP20-122 Rural Transportation Issues: Research Roadmap project team per panel direction after the Denver, Colorado workshop in September 2018.

Review Date:
12/12/2018
American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation

FY2020 NCHRP Problem Statement

Comments: This problem statement was developed by the NCHRP 20-122 Rural Transportation Issues: Research Roadmap project team per panel direction. It is being submitted by the AASHTO Special Committee on Research and Innovation per action taken at their meeting on October 29-30, 2018.

Problem No: 2020-SP-04

1. Problem Title
   Force Multiplier Toolkit for Rural Traffic Safety Enforcement

2. Background
   Traffic enforcement serves as both a punishment and a deterrent for offenses such as speeding, failure to use seatbelts and child restraints, and driving under the influence (DUI) of alcohol or other drugs. Rural officers also respond to crashes and traffic incidents, provide roadside assistance to travelers with disabled vehicles, and perform numerous law enforcement duties unrelated to traffic safety. Due to budget constraints, many rural counties, municipalities, and tribal governments only have a small number of law enforcement officers to cover substantial roadway mileages. For example:
   - Lake County, California has just five deputies to patrol an area the size of Rhode Island, while Amador County usually deploys three or four deputies over 612 square miles (Chabria, Sabalow et al. 2018).
   - In the Midwest it is not unusual for a rural county to have only two deputy sheriffs on duty at night to cover traffic enforcement on more than 1000 miles of roadways, along with numerous non-traffic law enforcement responsibilities, while small municipalities often have only one part-time police officer.
   - A survey of 25 urban and rural law enforcement agencies in Washington State found that due to funding and personnel shortages, traffic enforcement trended steadily downward from 2009-15, with decreases in citations and arrests for driving while intoxicated (-36%), other criminal traffic violations (-46%), and lesser infractions (-23%) (Dahl and Thompson 2017).
   
   Research indicates that in areas where there is no traffic enforcement, motorists drive faster, exceed speed limits more frequently, drive while intoxicated more often, commit aggressive and ordinary violations more frequently, and report being involved in more near-misses compared to similar areas with enforcement (Stanojević, Jovanović et al. 2013). Additionally, the long-term absence of enforcement appears to foster pro-speeding attitudes and general disdain for traffic laws. Since drivers do not need to self-monitor their speeds, they are less likely to be aware of unintentional speed violations.
3. Literature Search Summary

Previous research has identified several “force multipliers” with the potential to lighten the burden for rural law enforcement officers (Howard, Mooren et al. 2008). Examples include:

- Rural traffic calming strategies to make roadways more “self-enforcing.”
- Volunteer programs to engage citizens in alerting law enforcement to serious traffic safety issues and remind minor offenders of the importance of behaving responsibly.
- Deploying a combination of highly visible and stealth patrols at randomized locations to create the impression that law enforcement could be present anywhere, at any time.
- Automated speed enforcement (where allowed by state law).

Other force multiplier strategies include:

- Improving coordination between law enforcement agencies with neighboring or overlapping jurisdictional areas.
- Speed feedback signs.
- Gathering “Place of Last Drink” information to identify establishments that over-serve alcohol and train their servers to comply with laws regarding intoxicated patrons (such laws exist in 43 states and the District of Columbia) (NTSB 2012).
- Guaranteed ride home programs.

4. Research Objective

The objective of this research is to compile and document force multiplier techniques suitable for use in rural areas with limited law enforcement resources. To accomplish this objective the proposed project will:

- Identify relevant force multiplier techniques.
- Develop a guidebook describing the techniques and their potential benefits.
- Assemble case examples that describe the characteristics of successful and unsuccessful deployments.
- Summarize the available statistical data regarding the effectiveness and cost-effectiveness of various techniques.
- Prepare outreach and training materials to raise awareness of the force multiplier techniques, disseminate relevant information, and guide implementation at the local level.

5. Implementation Planning

The end product of this research will be a guidebook and training materials to assist rural law enforcement agencies in implementing force multiplier strategies. To support ongoing use of the guidebook, steps to implement training through organizations such as LTAP centers, universities, or the National Highway Institute should also be considered as part of the guidebook development process.
6. **Estimate of Problem Funding and Research Period**  
   **Recommended Funding:** $250,000  
   **Recommended Research Period:** 18 months

7. **Urgency and Potential Benefits**  
   Benefits: Staffing and budgetary shortages affect thousands of law enforcement agencies across the United States, resulting in sparse traffic enforcement in many rural areas. Wider deployment of force multiplier techniques could assist agencies in reducing common traffic violations. This is likely to improve roadway safety and allow agencies to focus the available staff on addressing serious violations.

   Negative impacts if not funded:
   - Continued and possibly accelerated rates of rural roadway crashes and casualties attributable to violations of fundamental traffic laws.
   - Monetary costs to drivers, employers, and the public (through insurance and taxpayer-sponsored medical programs) for treatment of crash-involved road users.
   - Monetary costs to transportation agencies for repair and replacement of transportation infrastructure damaged as a result of illegal driver behavior.

8. **Person(s) Developing the Problem Statement**  
   NCHRP 20-122 Rural Transportation Issues: Research Roadmap project team per panel direction.

9. **Nomination for AASHTO Monitor**  
   TBD

10. **Potentially Interested AASHTO Councils and/or Committees**  
    Standing Committee on Highway Safety  
    Committee on Traffic Engineering  
    Committee on Transportation System Operations  
    Special Committee on Research & Innovation

11. **Submitted By**  
    AASHTO Special Committee on Research and Innovation

**References**


---

**NCHRP Review of SP-04**

*Reviewed By:*
Stephan A. Parker
saparker@nas.edu

*Comments:*

This is an important topic for rural America. Significant implementable results can be obtained through a relatively small research effort.

This problem statement was developed by the NCHRP20-122 Rural Transportation Issues: Research Roadmap project team per panel direction after the Denver, Colorado workshop in September 2018.

*Review Date:*
12/12/2018