

Accelerating the Rate of Innovation Among State DOTs—Tracing Domestic Scan Impacts Report on NCHRP Project 20-68B(02)

Prepared for:

National Cooperative Highway Research Program
U.S. Domestic Scan Program

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Disclaimer

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Table of Contents

- Executive Summary 5
 - Background 5
 - Measuring success 6
 - Findings 8
- 1. Best Practices in Work Zone Assessment, Data Collection, and Performance Evaluation (Scan 08-04) 12**
 - Overview of technology transfer and implementation efforts 12**
 - Observations 12
 - Highlights of effective technology transfer 13
 - Implementation successes 14
 - Additional benefits of the scan 15
 - Scan best practices 15
 - Barriers and opportunities for improvements 16
 - Scan details 17**
 - Participant interviews 18**
 - Participant webinar 21**
 - Nonparticipant survey 24**
- 2. Best Practices in Quality Control and Assurance in Design (Scan 09-01) 29**
 - Overview of technology transfer and implementation efforts 29**
 - Observations 29
 - Highlights of effective technology transfer 30
 - Implementation successes 31
 - Additional benefits of the scan 31
 - Barriers and opportunities for improvements 32
 - Scan details 33**
 - Participant interviews 34**
 - Nonparticipant survey 39**
- 3. Leading Practices for Motorcyclist Safety (Scan 09-04) 45**
 - Overview of technology transfer and implementation efforts 45**
 - Observations 45
 - Highlights of effective technology transfer 46
 - Implementation successes 47
 - Additional benefits of the scan 48
 - Scan best practices 48
 - Barriers and opportunities for improvements 48
 - Scan details 49**
 - Participant interviews 50**
 - Nonparticipant survey 54**
- 4. Best Practices for Roadway Tunnel Design, Construction, Maintenance, Inspection and Operation (Scan 09-05) 59**

Overview of technology transfer and implementation efforts	59
Observations	59
Highlights of effective technology transfer	60
Implementation successes	61
Additional benefits of the scan	62
Scan best practices	62
Barriers and opportunities for improvements	62
Scan details	63
Participant interviews	64
Participant webinar	68
Nonparticipant survey	71
5. Domestic Scan Program Website	76
Developments	77
Site use and statistics	77
Appendices	
Appendix A - Scan 08-04 Implementation Plan	A-1
Appendix B - Scan 09-01 Implementation Plan	B-1
Appendix C - Scan 09-04 Implementation Plan	C-1
Appendix D - Scan 09-05 Implementation Plan	D-1

Executive Summary

Background

The U.S. Domestic Scan program (<http://domesticscan.org>), sponsored by NCHRP through a series of projects (<http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=654>), creates opportunities for hands-on information sharing among transportation professionals. This program takes advantage of face-to-face interaction as an effective learning method among engineers that helps promote more rapid acceptance and use of new ideas. On a typical scan, a core group of scan participants—typically eight to 12 from different state transportation agencies—travels to a number of host sites across the nation over a two-week period. These host state agencies have been identified as early adopters or technical experts in the area of interest for that scan.

The project oversight panel selects scan topics to highlight innovative technologies and practices used by only a limited number of departments of transportation but of potential benefit to many. Scans to date have addressed a range of DOT issues, from the technology-oriented (for example, Scan 07-02—Best Practices in Accelerated Construction Techniques) to those concerned with management practices (such as Scan 07-05— Best Practices in Bridge Management Decision-Making). After completion of two pilot scans funded in 2006, between two and five scans per fiscal year have been funded since 2007. A complete listing of all scans to date follows; the first two digits of the scan number denote the funding year. Consulting firm Arora and Associates, P.C. has facilitated all scans to date starting with the FY 2007 scans.

Scan number	Title
Pilot A	Best Practices in Transportation Asset Management
Pilot B	Best Practices in Right of Way Acquisition and Utilities Relocation
07-01	Best Practices in Project Delivery Management
07-02	Best Practices in Accelerated Construction Techniques
07-03	Best Practices in Winter Maintenance
07-04	Best Practices in Regional, Multi-Agency Traffic Signal Operations Management
07-05	Best Practices in Bridge Management Decision-Making
08-01	Best Practices in Managing State Transportation Improvement Program (STIPs), Transportation Improvement Program (TIPs), and Metropolitan Transportation Plans (MTPs) in Response to Fiscal Constraints
08-02	Best Practices in Maximizing Traffic Flow on Existing Highway Facilities
08-03	Best Practices in Addressing National Pollutant Discharge Elimination System (NPDES) and Other Water Quality Issues in Highway System Management
08-04	Best Practices in Work Zone Assessment, Data Collection, and Performance Measurements
09-01	Best Practices in Quality Control and Assurance Design
09-03	Best Practices in Solutions for Lane Departure Avoidance and Traffic Calming
09-04	Leading Practices for Motorcycle Safety
09-05	Best Practices for Roadway Tunnel Design, Construction, and Maintenance

10-01	Best Practices for Risk-Based Forecasts of Land Volatility for Corridor Management and Sustainable Communities
10-02	Best Practices for Addressing Access and Parking Needs of Non-Resident Users of Rail and Intermodal Transportation Stations in Transit-Oriented Developments
10-03	Best Practices in Performance Measuring for Highway Maintenance and Preservation
10-04	Best Practices Supporting Traffic Incident Management (TIM) through Integrated Communication Between Traffic Management Centers and Law Enforcement and Effective Performance-Measurement Data Collection
11-01	Best Practices in Privatization of Maintenance Functions
11-02	Best Practices Regarding Performance of Accelerated Bridge Construction (ABC) Connections in Bridges Subjected to Multi-Hazard and Extreme Events
12-01	Superload Permit Processes and Practices Used by State DOT Owners
12-02	Institutional Challenges of Implementing Integrated Corridor Management (ICM)
12-03	Noteworthy Practices of Zero Fatalities States
12-04	Best Practices in Transportation Agency Knowledge Management

Through formal and information presentations, discussions, and technology demonstrations, scan participants gather firsthand knowledge, make new contacts with their peers, and gain insights that can be put to use to improve practices at their home agencies. Moreover, the scan team members are charged with sharing the information they learned during the scan with the broader transportation community, both locally (within a participant’s own agency) and with state, regional, and national audiences through presentations, webinars, and other communication channels.

Measuring success

The transportation community recognizes the importance of technology transfer, both in the effective sharing of research results and the facilitation of ways to move the results into practice. However, measuring the effective transfer of information and technology—documenting the movement from research to practice—is not a simple proposition. The complex nature of information transfer and application often makes it difficult to trace the impact of research findings after they are published or presented. Electronic and on-demand access to research findings confounds the problem, making it often impossible to identify the consumers of research findings.

NCHRP Projects 20-68B(01) and (02), Accelerating the Rate of Innovation Among State DOTs—Tracing Domestic Scan Impacts (<http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2657>), sought to address a broad range of questions: What were effective methods of technology transfer in the U.S. Domestic Scan program? What technologies or practices did scan tour participants implement in their home agencies (or what were the barriers to successful adoption)? What people and organizations did they share this information with—and, in turn, what did they do with the information?

These questions center on two distinct and important types of technology transfer-related activities that follow every scan: *information dissemination* and *technology implementation*. The former is concerned with how widely and effectively information from a scan is spread, and the latter relates to how users of such information put it into practice. Throughout the scan process, participants are encouraged to help facilitate both types of activities.

Consulting firm CTC & Associates LLC was contracted to assess and measure the success of these activities and to gather additional constructive feedback on the U.S. Domestic Scan program’s technology

transfer model. Different types of collection instruments were used to gather input from a range of people involved in the scan process: scan tour participants, NCHRP project panelists, and individuals who later learned about the tour through formal or informal channels (“nonparticipants”).

Two reports have already been published on the efforts to measure and document the success of the technology transfer efforts for the U.S. Domestic Scan program:

- The first report (http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68B%2801%29_FR.pdf) traces the impacts of the first two pilot scans: Pilot A and Pilot B.
- The second report (<http://www.domesticscan.org/wp-content/uploads/NCHRP20-68B01-Final-Report-December-2011.pdf>) continues by tracing the impacts of the following six completed scans: 07-01, 07-02, 07-03, 07-05, 08-01, 08-03. The report presents evidence for the following broad conclusions about the scans:
 - Scans were valuable to participants, to participants’ own agencies, and to the nation.
 - The scans met timely needs.
 - States implemented technologies learned on the scan tour.
 - Scans had an impact on federal policy and practices.
 - The success of implementation efforts depended in part on each individual scan and the nature of the scan topic.
 - The scans revealed barriers to implementing new technologies and practices.
 - Participants were supportive of the domestic scan process.
 - Host states also benefited from the scans.
 - A significant benefit of the scans included participants’ learning from the lessons of others.
 - Across all scans, technology transfer efforts were conducted broadly and with significant success.
 - The scan had a reaching effect well beyond participants.

This document represents the third report in the series, documenting the impacts of the next four completed scans.

- Scan 08-04—Best Practices in Work Zone Assessment, Data Collection, and Performance Measurements
- Scan 09-01—Best Practices in Quality Control and Assurance Design
- Scan 09-04—Leading Practices for Motorcyclist Safety
- Scan 09-05—Best Practices for Roadway Tunnel Design, Construction, and Maintenance

Investigators used the following methods to collect input on the impacts of the scans. For each scan, the activities were initiated at least four-to-six months following the publication of the final scan report.

Participant Interviews. Investigators conducted one-on-one telephone interviews with scan tour participants to learn what kind of lasting effects might have resulted. Three open-ended questions were used to gather participants’ feedback about changes implemented at their agencies based on what they learned during the scan, information they shared with other professionals, and their characterization of the overall value of the scan tour. Participants also rated their perceived value of four scan outcomes on a five-point Likert scale.

Nonparticipant Survey. Investigators conducted an online survey of individuals identified as “nonparticipants.” This broadly defined group comprises people who learned about the scan secondhand. It includes those who received the report via an email distribution, those who attended a live or online presentation of the scan findings, and those who had meetings or informal discussions with the scan tour participants.

While the inherent difficulty in tracking the ripple effect of research has already been acknowledged, this project attempted to do so through this step. Since participants often kept records of presentation dates and attendees and mailing distributions, it was possible to conduct a survey of a sampling of individuals who learned about the scan tour findings. It is a best attempt to systematically gauge effectiveness and reach of this effort.

This survey asked nonparticipants how they learned about the scan findings, whether and how they made further inquiries, how they shared this information with others (who could be thought of as learning about this information “thirdhand” in the outward expansion of the ripple effect), and what actions they took to implement the practices or technologies identified in the scan.

Participant and Panel Webinar. For two of the four scans addressed in this report (Scan 08-04—Work Zones and Scan 09-05—Motorcyclist Safety), investigators facilitated a webinar among scan tour participants and the U.S. Domestic Scan program project panel. This provided opportunities for both groups to reflect on technology transfer and implementation successes and to review the findings from the nonparticipant survey.

Findings

For each scan, the information collected through these channels appears as a separate chapter of this report. Each chapter includes a summary overview and analysis followed by documentation of the interviews, survey, and where applicable, webinar. The final chapter of the report describes ongoing efforts related to the U.S. Domestic Scan program website.

Selected noteworthy findings and trends identified from the scans studied are presented below.

- **Information gathered from the four scans provides further support many of the key findings from the previous Tracing Scan Impacts report** (<http://www.domesticscan.org/wp-content/uploads/NCHRP20-68B01-Final-Report-December-2011.pdf>) as listed above. Scan participants remain very supportive of the scan process and find the process and the outcomes beneficial to their own agencies and to the larger transportation community. The anecdotal evidence provided by the participants and nonparticipants of the four scans—as reported in chapters 1 through 4 of this report—builds on the already extensive documentation of successful technology transfer and implementation of scan findings.
- **Among selected outcomes of the scan tour, most valuable to scan participants was the identification of one or more individuals, either at host state or on the scan team, to call on as a future resource.** This finding is based on the results of standard questions asked to scan participants of all four scans: “Please rate the following outcomes in terms of their contribution to the value of this scan tour, where **1** is ‘not important’ and **5** is ‘extremely important.’” Results are aggregated among 22 participants across all four scans:

Scan program outcome	Average rating (scale of 1 to 5)
Introduction to (or clearer understanding of) a new technology or practice	4.1
Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource	4.5
Information with which to <i>begin</i> implementation of a technology or practice at your agency	3.9
Information with which to <i>continue</i> implementation of a technology or practice at your agency	4.0

These ratings are consistent with comments provided by the scan participants during interviews. In some cases scan participants provided lower ratings to the final two outcomes above (“Information with which to *begin* implementation of a technology or practice at your agency” and “Information with which to *continue* implementation of a technology or practice at your agency”) not because the information from the scan lacked importance or relevance but because the agency didn’t have any implementations currently planned.

- **Scans are typically part of a larger national dialogue in the transportation community to address topics of high interest.** The scans are not conducted in a vacuum. Among the four scans studied here, participants and nonparticipants alike pointed to national efforts that the scans built upon, supported or complemented. An example from each of the four scans follows:
 - “One successful implementation activity was the submission of the research problem statement ‘Evaluation of the Effectiveness of Contract Incentives for Improving Work Zone Traffic Impacts and Performance,’ which was selected for funding by the Smart Work Zone Deployment Initiative pooled fund.” (08-04, Work Zones)
 - “This work coincided with the FHWA initiative for states to disclose their plan development QA/QC, which came about as a result of the Minnesota bridge collapse.” (09-01, Quality Control and Assurance)
 - The scan complemented the FHWA international scan on this topic, “Infrastructure Countermeasures to Mitigate Motorcyclist Crashes in Europe” (09-04, Motorcyclist Safety).
 - The timing of the scan was coordinated with several national efforts: The work of FHWA on the Tunnel Operations, Maintenance, Inspection and Evaluation (TOMIE) manual; research needs established by AASHTO’s Technical Committee T-20 (Tunnels); efforts of TRB Committee AFF60 (Tunnels and Underground Structures); NCHRP Project 14-27, “A Guide for the Preservation of Highway Tunnel Systems;” and NCHRP Project 12-89, “Recommended AASHTO LRFD Tunnel Design and Construction Specifications.” (09-05 Roadway Tunnels).

- **The face-to-face interaction afforded by scans reveals information and insights that are not commonly communicated in any other way.** This point is made by examples from two different scans.
 - Scan 09-01, Quality Control and Assurance, helped uncover what constitutes a best or leading practice in QA/QC design. A scan participant summarized what was learned on the topic: “It appeared that there was something better out there [for QA/QC], and this scan showed that there was. We saw some amazing examples. ... However, other states had practices that looked above-and-beyond on paper, but we learned through the scan that in some cases they weren’t much different from the norm.” This kind of insight was only possible through direct interaction with practitioners and processes.
 - A participant in Scan 09-04, Motorcyclist Safety, discussed how the scans also fostered candid dialogue about practices and technologies that may have been unsuccessful: “A benefit of scans is that by establishing face-to-face relationships with other practitioners and researchers, you’re much more likely to hear about approaches that might not have worked well. Everyone publicizes their successes, but it’s really only through one-on-one interaction that you can learn the full lessons of possible failures.”
- **Internet-based substitutes for face-to-face sharing have limitations.** While videoconference tools allow scans to reach broader groups than they could otherwise, participants acknowledged the drawbacks, including the lack of opportunities to have informal, one-on-one discussions after presentations. One participant does not see videoconference tools replacing face-to-face visits but instead supplementing them, and other stated that the depth of information exchange and participant attention are both much better when people participate in person.
- **In their scopes, the scans cannot equally address the interests and concerns of all participants.** Participants on two of the scans discussed challenges related to defining the scope of the scans.
 - “The original title of this scan was Best Practices in Quality Control and Quality Assurance of Bridge Plans and the original objectives were specific to bridge related items. The topics discussed on the scan were very unrelated to the actual topic, ranging from a Design-Build project discussion to construction inspection to specific department organizations.” Another person on the same scan noted: “I think value of the scan would vary from person to person depending on their area of interest and expertise. ... While it was not intended to solely address bridges, many participants had a bridge background and that’s what we tended to focus on during the scan.” (Scan 09-01, Quality Control and Assurance)
 - “[My agency] is a behavior agency and focused on vehicle operation; this scan is more engineering and infrastructure oriented, which is the primary concern of FHWA.” (Scan 09-04, Motorcyclist Safety)
 - Others expressed support of the scope: “Our effort was focused well, allowing us to connect with DOTs on the ‘bleeding edge’ of practice.” (Scan 08-04, Work Zones)
 - In some cases, participants felt the scope did not necessarily suggest scientific follow-up research. One participant stated: “I think it’s important not to go too far with recommending follow-up research, particularly for a nonscientific topic like plan development QA/QC. It can be counterproductive to take too scientific and too detailed a research approach” (09-01, Quality Control and Assurance).

- **Among nonparticipants, scans have more of an impact in terms of information sharing compared with implementation support.** An NCHRP project panel member noted during a post-scan webinar that the influence of the scan on nonparticipants attenuates somewhat from knowledge transfer to practice: Interest in the findings among respondents is high, but actual rate of implementation is lower. The trend can be observed among several of the nonparticipant surveys.
- **NCHRP Project 20-68B to trace scan impacts (whose findings are reported in this document) itself served as a tool for technology transfer.** As noted in chapter 5, the most common referring website to the U.S. Domestic Scan program site is SurveyMonkey.com. SurveyMonkey was the online survey tool used for the nonparticipant surveys, and the introduction to each survey began with prefatory text and a link back to the appropriate final scan report and the U.S. Domestic Scan program website.

1

Best Practices in Work Zone Assessment, Data Collection, and Performance Evaluation (Scan 08-04)

The purpose of the scan was to investigate best practices in work zone assessment, data collection and performance measurement and to learn how these practices are being used to ensure safety and minimize congestion in work zones. The scan team targeted these topics:

- How do agencies assess work zones safety, congestion and operational performance?
- How do agencies collect and use data to make improvements in work zone performance and management?
- What processes, methods, and tools do agencies use to assess impacts during various stages of project development?

The findings of the scan are documented in the final scan report, available online at http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_08-04.pdf.

Overview of technology transfer and implementation efforts

The following observations, conclusions and recommendations are based on information that CTC & Associates gathered during participant interviews, a participant webinar, and a nonparticipant survey. A complete description of findings associated with each of these collections methods follows later in this chapter.

Observations

- A repeated theme among the comments of scan participants was that the scan helped define the state of the practice and the scope of work zone data, assessment and evaluation issues, including those that are being addressed as well as those that remain a challenge:
 - “I think it was very valuable for both finding out what states and a toll authority are doing in the subject area of the scan and for confirming that this is still an area in need of more development in practice.”
 - “The scan tour was great in helping us better understand the state-of-the-practice. It allowed us to focus in on the lead practitioners to better understand and capture their approaches and practices and share this information with others.”
 - “This scan helped address the question of how to get the best value out of work zone data. That has been a question that many states have struggled with, and it was helpful to see what states were and weren’t doing and where the greatest needs are.”
- This scan made use of videoconferencing and webinars at hub locations around the country, and several host states participated remotely via webinar. Scan team members and project panelists later addressed some of the challenges presented by webinar discussions.

- A scan participant noted: “In-person meetings and demonstrations seemed much more effective than information presented in the webinar format. Communication was more effective in the in-person setting.” A panelist noted further that time is often lost at the start of Web conferences setting up connections.
- One participant stated that the U.S. Domestic Scan program should exercise caution in considering any switch to completely virtual meetings.
- Nevertheless, one participant who shared these concerns about webinars also said that he has kept in contact with and sought further information from state representatives who only participated via webinar.
- The impact of this scan on nonparticipants follows a pattern similar to what has been seen with other scans: More nonparticipants indicated that they sought more information about the scan or discussed it with others compared with the number who reported planned or actual implementation efforts. Project panelists and scan team members agreed that type of falloff is to be expected from relatively low commitment follow-up activities (seeking more information about a scan) to high commitment activities (implementation of findings).
- When scan participants were asked to rate the importance of four aspects of the scan on a scale of 1 (not important) to 5 (extremely important), the average rating of each of these was near an average value of **4.5**.
 - Introduction to (or clearer understanding of) a new technology or practice: **4.4**
 - Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource: **4.8**
 - Information with which to *begin* implementation of a technology or practice at your agency: **4.5**
 - Information with which to *continue* implementation of a technology or practice at your agency: **4.3**

Highlights of effective technology transfer

- The scan fostered dialogue at participants’ own agencies:
 - “I have shared this information numerous times. Reports are posted on our agency’s website in several places.”
 - “I shared the highlights of the tour with our team of district work zone traffic managers.”
 - “Information learned on this scan was presented to our state’s traffic engineers group. That group’s meetings also include representatives from ITS, department of transportation development, and maintenance.”
- A participant described how the dialogue extended to nearby states as well:
 - “We shared some of the data with a neighboring state to link work zone systems between two major metropolitan areas. We see significant user benefit in this type of data sharing—including travel time and delay—which we started earlier this year.”
- The scan team also shared these findings with national and regional audiences (more information on these appear in the “Participant interviews” section of this chapter and in the scan team’s implementation plan, [Appendix A](#), provided by Arora and Associates):
 - An email distribution to the AASHTO Subcommittee on Traffic Engineering and its Work Zones Technical Team

- Conference presentations (2011 TRB meeting, 2010 AASHTO SCOTE meeting, Ohio ATSSA Chapter Meeting)
- A webinar as part of the National Highway Institute’s Innovation webinar series
- The 19 respondents to the nonparticipant survey, representing 16 state agencies and FHWA, described the reach of technology transfer to secondary audiences.
 - The most common way that nonparticipants learned about this scan was through a conversation or email with a scan participant or host state member.
 - Follow-up activities among nonparticipants included reading the scan report (9 respondents), visiting the website www.domesticscan.org (5 respondents), and contacting a scan participant (2 respondents).
 - Detailed findings from the nonparticipant survey are presented later in the “Nonparticipant survey” section of this chapter.

Implementation successes

- Scan participants cited topics they learned about during the scan and brought back to their home agencies:
 - Project review processes: “Based in part on what we saw with highly developed and organized systems like those in Ohio and Michigan, we created our own traffic control committee to ensure that all projects are reviewed on a systematic and regular basis. Being able to point to how other states do this helped augment the final-rule process in our state.”
 - Enforcement prioritization: One participant’s agency had been pursuing ways to prioritize enforcing on its work zone areas, and Indiana’s presentation on its algorithm for this purpose proved particularly helpful.
 - Smart work zone technology and control devices. “We are starting to implement some of the things we saw. We recently approved the iCone [sensor-equipped traffic barrel] in our state and ran several tests. We are looking into using it further once the device is able to count vehicles across multiple lanes... I saw many technologies on the tour that I think we will take a serious look at implementing here at our agencies.”
 - Costing and valuation: “We did notice that our state’s user cost values appear to be out of line with other states’ values. We are looking into revising our figures, possibly through a research project to address this issue.”
- Two federal representatives on the scan team described how the scan had an impact on the federal level:
 - One successful implementation activity was the submission of the research problem statement “Evaluation of the Effectiveness of Contract Incentives for Improving Work Zone Traffic Impacts and Performance,” which was selected for funding by the Smart Work Zone Deployment Initiative pooled fund.
 - Some effect of this scan has been seen more generally at FHWA. It was observed that work zone funding proposals and problem statements that the agency receives have been more commonly referencing the issues addressed in this scan.

- Among nonparticipants, four surveyed respondents reported proposed implementation based in part on the scan findings:
 - One state’s efforts include “collection of crash and speed data for the development of performance measures to assist the DOT in applying effective traffic management strategies during construction.”
 - Another is working with a university partner in “developing work zone performance measures and will be using the information in the scan report to assist [them.]”
- In addition, four nonparticipants surveyed reported in-progress implementation efforts:
 - One agency has “set work zone safety goal as part of statewide strategic highway safety plan. [It is] collecting additional field data at freeway work zones on lane capacity and traffic diversion[, and] using Bluetooth technology to collect data. Intend to collect additional sampling/monitoring of predicted and actual work zone delays.”
 - Another state is standardizing its lane closure database and “developing PeMS [Highway Performance Measurement System] training to district traffic managers for real time data evaluation.”

Additional benefits of the scan

- Participants commented on the importance of direct, one-on-one knowledge transfer through the scan process:
 - “It was valuable to me to know what other states are doing. It can be difficult to scan other website to find out what they’re doing. To learn about processes, hear information firsthand and get feedback is extremely valuable.”
 - “Participating on the tour did keep us informed of what other agencies are doing. We can now go into projects with a larger toolbox and understanding of what other states are doing.”
- Scan team members detailed how they made individual contacts and built their professional network with practitioner experts:
 - “It is very helpful to have a personal contact in other states to discuss specific topics that we might want to explore further. For example, I know who to contact in Ohio to discuss queue length treatment or in Indiana to discuss that state’s use of Bluetooth technology for work zone ITS.”
 - “I have three times the number of personal contacts than I did in the past, and these are people working directly in the same area as me.”
 - “Our organization will greatly benefit from my participation on this scan and accessing information that doesn’t often show up on other DOT’s websites or in paper scans. Being able to contact people directly is a much faster way of getting the information I need as well.”

Scan best practices

- A participant commented that the scope of the scan was well defined and appropriate: “Our effort was focused well, allowing us to connect with DOTs on the ‘bleeding edge’ of practice.”

Barriers and opportunities for improvements

- Participants cited different reasons for their inability to implement findings:
 - “Our state was ahead of the curve in many areas that the scan tour was looking at, so I don’t think we made any policy or practice changes.”
 - “We don’t directly implement the practices at FHWA headquarters.”
- There were some concerns about the discussion formats. Questions about the effectiveness of webinars for the purpose of open discussion are summarized in the “Observations” section above and addressed in more detail in the “Participant webinar” summary below. In addition, it was noted that an auditorium-style presentation to a large audience at one locale had limited effectiveness for dialogue and discussion.
- A scan participant asked whether scan facilitators have and share guidance on effective host state practices. A project panelist suggested that it might be appropriate for the panel and past scan participants to review any such materials to help make the visits more meaningful.
- A significant challenge is keeping participants focused on implementation and outreach activities after the scan. A participant observed that this appears not to be a role of the scan coordinators, who are closely involved in scan activities before and during the tour but not afterward. More ongoing support in the short term after a scan might lead to a more robust outreach effort to push implementation.
 - During the post-scan webinar, the participants and panel discussed successful follow-up efforts as well as those efforts that might have been pursued had there been dedicated funding (a video and an article are two examples).

Scan details

Scan team members

- J. Stuart Bourne, North Carolina DOT, Scan Co-Chair
- Chung Eng, FHWA, Scan Co-Chair
- Diana Gomez, Caltrans
- David L. Holstein, Ohio DOT
- Ronald D. Lipps, Maryland SHA
- Denise L. Markow, New Hampshire DOT
- K.C. Matthews, Colorado DOT
- Tracy A. Scriba, FHWA
- Reynaldo Stargell, Ohio DOT
- Brian Zimmerman, Michigan DOT
- Gerald L. Ullman, Texas Transportation Institute, Subject Matter Expert

Sites visited

Hub states

- California DOT
- Maryland DOT
- Michigan DOT
- New Jersey DOT
- Ohio DOT

Invited to hub state or webinar

- Florida DOT
- Illinois Tollway
- Indiana DOT
- Missouri DOT
- New Hampshire DOT
- New York State DOT
- Oregon DOT
- Pennsylvania DOT
- Washington State DOT
- Wisconsin DOT

Scan dates

Conducted March 7-13 and March 21-28, 2010

Final report

October 2010, http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_08-04.pdf

Participant interviews

CTC & Associates conducted interviews with participants shortly after the publication of the scan report. Interviews were conducted either by telephone or via email based on the each respondent's preference.

Two of the 10 highway agency scan participants have retired since the time of the scan. Among the remaining eight, five participated in the interviews. Responses to each of four questions are summarized and compiled below.

As appropriate, this information has been supplemented with information provided in the scan team's implementation plan ([Appendix A](#)).

1. How have you implemented changes to your agency's policies, practices or technologies based on what you learned from participating in this scan tour? What implementation activities do you have planned?

- I don't believe we've made any changes as a direct result of the tour. Participating on the tour did keep us informed of what other agencies are doing. We can now go into projects with a larger toolbox and understanding of what other states are doing.
- We did notice that our state's user cost values appear to be out of line with other states' values. We are looking into revising our figures, possibly through a research project to address this issue.
- We don't directly implement the practices at FHWA headquarters.
- This question is more appropriate for the state DOT participants. The scan did influence the focus and scope of several research projects that FHWA initiated since the scan.
- My focus in my agency and on the scan has been work zone ITS. There are four components of implementation activities that we have done in our state:
 - We have developed standard guidelines, including a smart work zone ITS toolbox.
 - We have developed and conducted targeted training for our design and construction staff on work zone ITS.
 - We have looked at the different types of data types we can capture—primarily travel time and delay data—and how such sensor data can be used to better compute delay and work zone travel times.
 - We have looked at how we can start to do quarterly reporting in work zones that have ITS.
- Based in part on what we saw with highly developed and organized systems like those in Ohio and Michigan, we created our own traffic control committee to ensure that all projects are reviewed on a systematic and regular basis. Being able to point to how other states do this helped augment the final-rule process in our state.
- Our state was ahead of the curve in many areas that the scan tour was looking at, so I don't think we made any policy or practice changes.
- With respect to technology, we are starting to implement some of the things we saw. For example, smart work zone technology and control devices. We recently approved the iCone [sensor-equipped traffic barrel] in our state and ran several tests. We are looking into using it further once the device is able to count vehicles across multiple lanes.

2. We will be surveying “secondary” audiences to assess the reach of the scan program beyond the participants themselves. Have you shared information you learned or contacts you made during the scan tour with others—either in your agency or beyond? Can you provide contact information or meeting names and dates?

- September 2010 webinar presented as part of the National Highway Institute’s Innovation webinar series (<https://connectdot.connectsolutions.com/n134083201009/>).
- January 2011 TRB workshop (<http://pressamp.trb.org/conferenceinteractiveprogram/EventDetails.aspx?ID=20226>)
- I shared the highlights of the tour with our team of district work zone traffic managers.
- We presented this to vendors and contractors at the Ohio ATSSA Chapter Meeting.
- I have shared this information numerous times. Reports are posted on our agency’s website in several places.
- I have communicated with the points of contact for some other FHWA projects. For example, I am using the findings from one of the subquestions of the scan in a Web discussion on transportation management plans.
- We shared some of the data with a neighboring state to link work zone systems between two major metropolitan areas. We see significant user benefit in this type of data sharing—including travel time and delay—which we started earlier this year.
- Information learned on this scan was presented to our state’s traffic engineers group. That group’s meetings also include representatives from ITS, department of transportation development, and maintenance.

3. How would you characterize the overall value of this scan tour? What comments would you like to share for the summary report on this project?

- It was valuable to me to know what other states are doing. It can be difficult to scan other states’ websites to find out what they’re doing. To learn about processes, hear information firsthand and get feedback is extremely valuable.
- In-person meetings and demonstrations seemed much more effective than information presented in the webinar format. Communication was more effective in the in-person setting.
- Overall the scan was beneficial.
- I think it was very valuable for both finding out what states and a toll authority are doing in the subject area of the scan and for confirming that this is still an area in need of more development in practice.
- The scan tour was great in helping us better understand the state-of-the-practice. It allowed us to focus in on the lead practitioners to better understand and capture their approaches and practices and share this information with others.
- This scan helped address the question of how to get the best value out of work zone data. That has been a question that many states have struggled with, and it was helpful to see what states were and weren’t doing and where the greatest needs are.

- As a way of characterizing delay, the scan homed in on the parameter of “delay per vehicle per traveler per mile” to capture delay at the driver level.
- The overall value of the scan is tremendous.
- It is very helpful to have a personal contact in other states to discuss specific topics that we might want to explore further. For example, I know who to contact in Ohio to discuss queue length treatment or in Indiana to discuss that state’s use of Bluetooth technology for work zone ITS.
- I have three times the number of personal contacts than I did in the past, and these are people working directly in the same area as me.
- Our effort was focused well, allowing us to connect with DOTs on the “bleeding edge” of practice.
- I thought the tour was excellent. I saw many technologies on the tour that I think we will take a serious look at implementing here at our agencies.
- Our organization will greatly benefit from my participation on this scan and accessing information that doesn’t often show up on other DOT’s websites or in paper scans. Being able to contact people directly is a much faster way of getting the information I need as well.

4. Please rate the following outcomes in terms of their contribution to the value of this scan tour, where 1 is “not important” and 5 is “extremely important.”

	Not Important 1	2	3	4	Extremely Important 5	Average
Introduction to (or clearer understanding of) a new technology or practice				3	2	4.4
Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource				1	4	4.8
Information with which to <i>begin</i> implementation of a technology or practice at your agency				2	2	4.5
Information with which to <i>continue</i> implementation of a technology or practice at your agency			1	1	2	4.3

Participant webinar

Available scan tour participants and NCHRP project panel members took part in a webinar following the participant interviews. The purpose of the webinar was to discuss the initial findings of the scan, to review technology and implementation efforts to date and to plan follow-up activities. Details on the webinar follow.

Date

April 25, 2012

Attendees

Facilitators

- Patrick Casey, CTC & Associates, LLC
- Brian Hirt, CTC & Associates LLC

Scan Team Members

- Chung Eng, FHWA, Scan Co-Chair
- Denise L. Markow, New Hampshire DOT
- Tracy A. Scriba, FHWA
- Reynaldo Stargell, Ohio DOT

Panel Members

- Marsha Fiol, Virginia DOT
- Rick Kreider, Kansas DOT
- Glenn Roberts, New Hampshire DOT
- Amy Schutzbach, Illinois DOT

Presentation

- <http://domesticscan.org/wp-content/uploads/Scan08-04Webinar.pdf>

Discussion of Nonparticipant Survey Results

During discussion of the nonparticipant survey results, scan participant Tracy Scriba inquired about the process of how the nonparticipant survey distribution list was created. Facilitator Brian Hirt explained how the list was compiled with scan participants' assistance from available event attendance records and material distribution lists. Scriba noted that the responses to question "How did you hear about the scan?" will necessarily be a function of which subset of nonparticipants was actually surveyed.

Scan participant and co-chair Chung asked how the survey data compared with other scans. Hirt said that the responses followed a pattern similar to other scans, with significant numbers of respondents indicating they sought more information about the scan or discussed it with others, but relatively fewer reporting planned or actual implementation efforts.

Open Discussion Summary

Scan participant Reynaldo Stargell said that he found it beneficial to visit DOT staff in person and discuss the issues face-to-face. He said he learned several things that he brought back to his own agency that were implemented into existing processes. Stargell said he found some of the scan webinars less effective than

face-to-face meetings. Nevertheless, he has kept in contact with and sought further information from state representatives who only participated via webinar.

Eng said that videoconferencing tools allowed the scan to reach a broader group than it could have otherwise. He acknowledged the drawbacks as well, including the lack of opportunities to have informal, one-on-one discussions after presentations. He also noted that time was often lost at the start of web conferences setting up connections. He said he doesn't see this replacing face-to-face visits, but instead supplementing them. Scriba seconded Eng's observation, saying that the U.S. Domestic Scan program should exercise caution in considering any switch to completely virtual meetings. She said that the depth of information exchange and participant attention are both much better when people participate in person.

Eng also noted variability in how host states prepared for the scan, with some facilitating the exchanges better than others. The group discussed one auditorium-style presentation to a large audience that had limited effectiveness for dialogue and discussion. Panelist Marsha Fiol said that holding such a presentation for multiple audiences—the scan team as well as others—seemed like it would be a significant distraction. Eng asked whether scan facilitators have and share guidance on effective host state practices. Panelist Amy Schutzbach suggested that perhaps it would be appropriate for the panel and past scan participants to review any such materials to help make the visits more meaningful.

Scriba discussed post-scan challenges, most notably how to keep participants focused on implementation and outreach activities after the scan. She said that providing support in this area appears not to be a role of the scan coordinators, who are closely involved in scan activities before and during the tour but not afterward. More ongoing support in the short term after a scan might lead to a more robust outreach effort to push implementation. Despite this challenge, though, she said the team's TRB session was a success story with very good participation from scan team and host state participants. She noted that these workshop presentations included pairings of participants and host state representatives to address a series of topics.

Panelist Rick Kreider asked the team whether during the process they had any "aha moments" that brought ideas of solutions to light. Stargell said that Ohio has been pursuing ways to prioritize enforcing on its work zone areas, and Indiana's presentation on its algorithm for this purpose was an "aha moment" for him. Kreider commented on the value of these kinds of individual success stories.

Panelist Glenn Roberts asked whether the team's implementation plan was available on the website. Hirt noted that there is a members-only location on the website for implementation plans; it could be made available to the public if desired by the scan team and panel.

Roberts noted that the panel has been considering dedicating additional funding toward implementation. He asked if information dissemination efforts possibly could have been improved if additional funding had been available.

- Eng said that the group "did what it could" with funding available, including the development of a brochure and facilitation of a webinar.
- Stargell recalled that at the end of the scan, the team discussed a number of communication options, but several were dismissed due to funding limitations.
- Scriba noted that the team's final implementation plan included a number of in-state presentations and a limited number of national efforts: a TRB workshop, a national webinar, and

Pennsylvania’s transportation engineering conference. A proposed video was dismissed as too expensive. A planned article was not pursued due to lack of available time among team members.

Scriba noted that one successful implementation activity was the submission of the research problem statement “Evaluation of the Effectiveness of Contract Incentives for Improving Work Zone Traffic Impacts and Performance,” which was selected for funding by the Smart Work Zone Deployment Initiative pooled fund.

Eng said that he has seen some effect of this scan at FHWA, with more of the work zone funding proposals and problem statements that the agency receives referencing the issues addressed in this scan. The scan findings have helped forward the dialogue in this area.

Nonparticipant survey

To gather more information about the reach of the scan tour findings and to trace the paths through which information about the scan findings spread beyond the initial participants, CTC & Associates conducted an online survey of nonparticipants—individuals who did not participate in the scan but who were identified as having received information about it.

Based on participant interviews and input as well as the implementation plan for this scan compiled by Arora and Associates, we identified the activities—meetings, presentations and report distributions—through which the scan likely reached secondary audiences. We contacted the organizers of those activities and searched the Web to obtain attendee lists and distribution rosters. From these lists we surveyed representatives of state DOTs, other highway agencies, and federal agencies, totaling 108 names from the following two lists:

- A distribution to the AASHTO Subcommittee on Traffic Engineering and its technical team on Work Zones
- Participants in the September 2010 NHI webinar

Scan team members provided nine additional names of colleagues with whom they spoke about the scan findings.

The results of the nonparticipant survey (question 6, “If you talked to colleagues or peers about the scan tour results, we would appreciate it if you could share their names and agencies.”) provided three additional names of DOT staff who had been involved in an implementation of scan technology or whom they had spoken to about the scan findings. Surveys were sent to these two individuals as well.

In all, CTC & Associates sent the nonparticipant survey to 120 individuals. Recipients received the following email, modified as appropriate to indicate the venue of the scan presentation they attended:

Hello,

The National Cooperative Highway Research Program is conducting research to evaluate how the innovative technologies and practices identified through its U.S. Domestic Scan Program (<http://domesticscan.org>) are being used by transportation practitioners beyond the initial scan participants.

*You were identified as having received information about **Scan 08-04: Work Zone Assessment, Data Collection and Performance Measurements**. We would appreciate a few minutes of your time to complete a brief survey (7 questions) on your use of the scan findings. Your responses will help NCHRP evaluate the reach of this scan and the overall value of the U.S. Domestic Scan Program.*

The survey is available at <http://www.surveymonkey.com/s/ZMYN29W>.

If you have any questions about this NCHRP research effort, please feel free to contact me at the phone number or email below. You can also contact TRB Senior Program Officer Andrew Lemer at ALemer@nas.edu or (202) 334-3972. Thank you for your time and your participation.

The survey itself also included the following introductory text:

The National Cooperative Highway Research Program sponsors the [U.S. Domestic Scan Program](#) to facilitate technology transfer among state DOTs. As part of the program, CTC & Associates is conducting this survey on behalf of NCHRP to evaluate how the technologies and practices identified through the scans are being used by transportation practitioners beyond the scan participants.

*You were identified as having received information about **Scan 08-04: Work Zone Assessment, Data Collection and Performance Measurements** (see the [project Web page](#) or [final scan report \[PDF\]](#)). Your feedback about how you learned about this scan—and how the scan findings are being used at your agency—will be of great value to NCHRP and the transportation community.*

Thank you for taking the time to complete this short seven-question survey.

Responses

A total of 19 people responded to the survey, a 16 percent response rate. These responses are compiled below.

1. (Required) Please provide your name and organization. This information will not be published.

18 of the 19 survey respondents represented state DOTs, and one represented FHWA.

Among state respondents, accounting for multiple responses from the same agency, respondents represented a total of 16 different agencies.

- Two of these agencies were the same as those agencies represented in the Scan Team membership.
- Seven of these agencies were the same as those who participated as scan host states. Host states include “hub states” as well as states invited to participate by webinar or to attend meetings at hub states.

2. HOW YOU LEARNED ABOUT THIS SCAN. The scan findings were disseminated and presented through a number of channels. How did you learn about the scan results? (Check all that apply.)

	Number responding	Percent responding
Conversation or email with a colleague at my organization	3	16%
Conversation or email with a scan participant or host state member	5	26%
Received final scan report from an email distribution	4	21%
TRB Annual Meeting	1	5%
AASHTO SCOTE meeting (June 2010, Chicago)	4	21%
NHI webinar (September 2010)	1	5%
Another national or regional conference (please describe in the “Other” box below)	2	11%
Journal paper or trade publication article	0	0%
I don’t remember learning about this scan tour prior to this survey	4	21%
Other (open-ended) <ul style="list-style-type: none"> • Assisted host state member to present California’s practices. • This was some time ago. We did not have the resources to get involved. • INDOT participated in the scan webinar, providing information on our queue analysis and queue data collection methods. • WSDOT participated in the scan. • National Work Zone Safety Clearinghouse. • The scan was mentioned during the Web conference on Work Zone Transportation Management Plan Changes During Construction. • Our department participated. • My director informed me that NJ was participating in the work zone safety scan. • Asked another in this office if he was aware of the scan. He wasn’t either. 	9	47%

3. SOUGHT MORE INFORMATION. If you sought more information about the findings of the scan tour, please indicate how. (Check all that apply.)

	Number responding	Percent responding
Obtained or read the scan report	9	47%
Visited the website domesticscan.org	5	26%
Contacted a scan participant	2	11%
Contacted someone from one of the states visited in the scan	1	5%
Other	0	0%
Specific technologies or practices discussed (open-ended) <ul style="list-style-type: none"> • Examination of the sensor data reliability from NHDOT Smart Work Zone data review study • What stood out in my mind was 1) the need to collect crash data specific to work zones beyond what the current NJTR-1 crash report collects, and 2) the need for quicker data collection. 		

4. SHARED INFORMATION WITH OTHERS. If you shared information about one or more of the technologies or practices identified through the scan, please describe how. (Check all that apply.)

	Number responding	Percent responding
Shared information with a colleague at my organization	11	58%
Shared information with other stakeholders in my state	5	26%
Recommended a change in practice at my organization	2	11%
Other	0	0%
Specific technologies or practices discussed (open-ended) <ul style="list-style-type: none"> • Set work zone safety goal as part of statewide strategic highway safety plan. Collecting additional field data at freeway work zones on lane capacity and traffic diversion. Using Bluetooth technology to collect data. Intend to collect additional sampling/monitoring of predicted and actual work zone delays. • We are in the process of establishing work zone performance measures now. • Referenced the data reliability/accuracy from side-fire radar traffic detectors. • 1. Discussed about piloting an additional appendix to the NJTR-1 for work zone crashes. 2. Discussed modifying NJTR-1 crash report to include additional fields of data associated with work zones. 		

5. IMPLEMENTED SCAN FINDINGS. If you used information from the scan tour to make or recommend a change to your agency’s practices, please indicate how.

	Number responding	Percent responding
Proposed implementation	4	21%
Planned implementation	0	0%
In-progress implementation	4	21%
Completed implementation	0	0%
Please provide details on the implementation (open-ended) <ul style="list-style-type: none"> • See response to question 4 (“Set work zone safety goal as part of statewide strategic highway safety plan....”) • Standardizing Lane Closure database, developing PeMS [Highway Performance Measurement System] training to district traffic managers for real time data evaluation. • Working with University of Virginia in developing work zone performance measures and will be using the information in the scan report to assist us. • Collection of crash and speed data for the development of performance measures to assist the DOT in applying effective traffic management strategies during construction. • As indicated by the scan, our department is involved in the work zone scan methods. • FHWA does not have the ability to implement changes—just influence the partner agencies to see the benefits and make changes. • No progress has been made as of yet. 		

6. CONTACTS. If you talked to colleagues or peers about the scan tour results, we would appreciate it if you could share their names and agencies. This information will not be published.

A total of three names were provided. Each of these individuals was later sent this nonparticipant survey.

7. OTHER COMMENTS. Please use this space to provide any additional comments about your use of the findings of the scan tour.

	Number responding	Percent responding
Open-ended response	3	16%
<ul style="list-style-type: none">• I assisted my supervisor, Diana Gomez (a scan member), to present California's practices in May 2010. However, with other workload and absence from the job for three months due to health in 2011, I did not read the final results or consciously begin to develop a plan. Thank you for this survey as it raised the flag again. I realize we are developing some items to assist in work zone assessment, but more is needed and I hope to establish goals and objectives for Work Zone Safety and Mobility.• None at this time• As the person responsible for evaluation of work zone impacts for all projects that are administered by this state, I sought information on ways that others may have undertaken that effort.		

2

Best Practices in Quality Control and Assurance in Design (Scan 09-01)

Although many quality assurance/quality control programs exist within the U.S., there was significant interest in exploring the most effective of these to identify successful QA/QC practices that can be readily incorporated by other agencies. A scan of QA/QC practices and procedures was conducted to identify methods, techniques, and approaches to improving and maintaining a high quality of designs being prepared by consulting engineering firms. The expanded use of these practices will assure that the highest possible quality is achieved in design of the nation’s highway and bridge projects.

The findings of the scan are documented in the final scan report, available online at http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_09-01.pdf.

Overview of technology transfer and implementation efforts

The following observations, conclusions and recommendations are based on information that CTC & Associates gathered during the participant interviews and the nonparticipant survey. A complete record of findings through these channels follows later in this chapter.

Observations

- The timing of this scan was aligned well with other QA/QC efforts. A participant noted that this was true at the national level: “This work coincided with the FHWA initiative for states to disclose their plan development QA/QC, which came about as a result of the Minnesota bridge collapse.” A nonparticipant stated that the scan “comes indirectly from recommendations of NTSB. The AASHTO Subcommittee on Bridges and Structures was actively involved/interested in the scan.”

The scan similarly aligned well with efforts of the scan participants at the state level:

- “MnDOT has had several challenges over the past years on plan quality. It is the main reason we decided to create a manual for designers on the process for plan quality. The scan tour on QA/QC was perfect timing for our process and for best practices that could be used throughout the country.”
- “The PennDOT Bureau of Design is undergoing a major reorganization. One of the objectives is to bring the areas of materials, construction, and design review into closer proximity to allow better communication to identify problem areas related to quality and track the resolution more efficiently.”

A nonparticipant also commented on the current relevance of this effort: “Very timely report—good to have an independent source. There is a need to improve uniformity nationally for owners’ QA/QC activities for alternate contracting methods, such design-build and CM/GC.”

- The scan was successful in discovering firsthand what did—or did not—constitute a best or leading practice in QA/QC design. One scan participant succinctly outlined the issue and what was revealed on the scan: “I had wanted to participate in this scan because I recognized that what my state was calling best practices for roadway design and project development were in fact ad hoc collections of practice that were not based on any focused policy effort. It appeared that there was something better out there, and this scan showed that there was. We saw some amazing examples: Kentucky was one state whose overall quality approach has been taken to a level we hadn’t imagined. However, other states had practices that looked above-and-beyond on paper, but we learned through the scan that in some cases they weren’t much different from the norm.”
- When participants were asked to rate the importance of four aspects of the scan on a scale of 1 (not important) to 5 (extremely important), the average rating of each of these was between 3.2 and 4.3:
 - Introduction to (or clearer understanding of) a new technology or practice: **3.8**
 - Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource: **4.3**
 - Information with which to *begin* implementation of a technology or practice at your agency: **3.2**
 - Information with which to *continue* implementation of a technology or practice at your agency: **4.0**

Highlights of effective technology transfer

- The scan fostered ongoing dialogue at participants’ own agencies and in their states:
 - “One of our team’s implementation strategies was to have each member make a presentation to their local agency. I believe a majority of our members have done that, including myself. A colleague and I made a formal presentation to the secretary of our department and our chief engineer and briefed them on the findings of the scan tour.”
 - “Our documents are available to other agencies and other transportation owners who tap into our QA/QC practices, such as county engineers or the U.S. Army Corps of Engineers.”
 - “I have shared this information with our state design engineer and assistant design engineers.”
- The scan team presented the findings to a large number of audiences (more information on these appear in the detailed sections of this report):
 - AASHTO Annual Subcommittee on Bridges and Structures Meeting (May 2011)
 - Joint meeting of the AASHTO Right of Way Subcommittee and Utilities & Design Subcommittee (2011)
 - A technical paper presentation at the Western Bridge Engineers’ Seminar (September 2011)
 - A detailed three-hour presentation during the Sunday workshops of the 2012 TRB Annual Conference
 - Utah DOT 2011 Annual Conference
 - MnDOT Design Engineers 2011 annual meeting

- The 32 respondents to the nonparticipant survey represented 24 states.
 - The most common way that nonparticipants learned about this scan was through an email distribution (56 percent of respondents). The next most common channel was the AASHTO Subcommittee on Bridges and Structures annual meeting (44 percent).
 - Follow-up activities among nonparticipants included reading the scan report (66 percent), visiting the website www.domesticscan.org (13 percent), and follow-up contacts with scan team members (9 percent).
 - Detailed findings from the nonparticipant survey are presented later in this chapter.

Implementation successes

- Scan participants cited instances of learning about topics on the scan and bringing these back to their home agencies to implement:
 - ‘We tried to blend the best practices we learned during the scan tour with the QA/QC documentation for our state, both for in-house and consultant projects. We are in the process of rewriting our LRFD-compliant bridge design manual, and that manual will spell out steps and varying degrees of QA/QC for different kinds of projects.’
 - “During this period, MnDOT was in the process of putting together a QA/QC process manual. The manual was assembled by a consultant, who incorporated some of the best practices we discovered during our scan.”
 - “At our agency headquarters, implementation and evaluation of improving agency practices and policies are in progress. My colleagues at headquarters were glad when the final scan report was published; they were in ‘learning mode’ pending its arrival.”
 - “When I took over as director of the Columbia River Crossing project, the project already had QA/QC in place. Based on what I learned in the scan tour, we did an internal evaluation to implement some of the best practices that were applicable to this megaproject.”
- Nonparticipants surveyed also reported planned and completed implementation.
 - Process improvements
 - Review checklists
 - Consultant ratings
 - Decisions about the amount and type of review
 - Third-party consultant reviews
 - Plan signoffs/PE stampings
 - Consideration of Design-Build practices
- A nonparticipant also used the report as a way to confirm existing practices: “Many of the findings corroborated practices that we use at MDT.” Another stated: “We were attempting to tighten up our QA/QC and this document was helpful.”

Additional benefits of the scan

- As with previous scans, participants highlighted the overall value of the scan process:

- “For those interested in selecting from the realm of best practices and implementing successful solutions, I think scan was a great way of amassing that information in one place.”
- “The scans are a great opportunity for engineers to get together, both the traveling team members as well as the hosts. I think host state participants learned as much as we did.”
- Nonparticipants also provided positive feedback:
 - “I enjoyed reading the final document. We still have our hands full with getting our QA Branch off the ground. We are keeping this report in our pocket for use in the future!”
 - “Domestic scans are useful as they identify best practices that are worthy of nationwide implementation.”
- One participant cited an interesting outcome of the scan. Upon taking assuming management of a mega-project after the scan, the participant “hired a person for a project originally interviewed on the scan tour.”

Barriers and opportunities for improvements

- A scan participant noted the difficulty in measuring the changes in practice based on the scan tour “When it comes to gauging implementation, it’s almost too soon to assess outcomes. If anyone is embracing this and implementing this, it might not be something you can see in just a year’s time. It probably takes longer to see the results of implementation efforts.”
- This particular scan faced a few issue related to its scope:
 - A participant commented on concerns regarding the scope of this scan, and in particular the focus on bridges versus other types of projects: “The original title of this scan was Best Practices is Quality Control and Quality Assurance of Bridge Plans and the original objectives were specific to bridge related items. The topics discussed on the scan were very unrelated to the actual topic, ranging from a Design-Build project discussion to construction inspection to specific department organizations.” The participant suggested a solution: “I think it would be helpful for the problem statements to be generalized (or at least focus on the discussion topics), as the discussion never seemed to focus on the objective.”

Another participant viewed this same concern (bridge vs. non-bridge focus of the scan) from another perspective: “I think value of the scan would vary from person to person depending on their area of interest and expertise. For example, the topic of our scan was plan QA/QC, and while it was not intended to solely address bridges, many participants had a bridge background and that’s what we tended to focus on during the scan. This made the discussions and findings less meaningful to those participants who aren’t bridge people.”
 - Also related to the scope of this scan, a scan participant cautioned against taking too scientific approach to this topic: “I think it’s important not to go too far with recommending follow-up research, particularly for a nonscientific topic like plan development QA/QC. It can be counterproductive to take too scientific and too detailed a research approach (For example, trying to quantify: “How much QA/QC is enough—or too much?”). In my opinion the scan accomplished what it was supposed to without need for more research of this type.”

Scan details

Scan team members

- Hossein Ghara, Louisiana DOTD, Scan Chair
- Nancy Boyd, Washington State DOT
- Richard Dunne, New Jersey DOT
- Robert Healy, Maryland SHA
- Tim Swanson, Minnesota DOT
- Carmen Swanwick, Utah DOT
- Robert Watral, Pennsylvania DOT
- Kelley Rehm, Subject Matter Expert

Sites visited

- California DOT
- Georgia DOT
- Illinois DOT (participation via webinar)
- Kentucky Transportation Cabinet
- Minnesota DOT
- New York State DOT
- Ohio DOT (participation via webinar)
- Oregon DOT
- Pennsylvania DOT
- Washington State DOT

Scan dates

October 24–31 and December 5–11, 2010

Final report

July 2011, http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_09-01.pdf

Participant interviews

CTC & Associates conducted interviews with participants approximately four months following the publication of the scan report. Interviews were conducted either by telephone or via email based on the each respondent's preference.

One of the eight highway agency scan participants has retired since the time of the scan. Among the remaining seven, six participated in the interviews. Responses to each of four questions are summarized and compiled below.

As appropriate, this information has been supplemented with information provided in the scan team's implementation plan ([Appendix B](#)) provided by Arora and Associates.

1. How have you implemented changes to your agency's policies, practices or technologies based on what you learned from participating in this scan tour? What implementation activities do you have planned?

- Our agency updated QA/QC procedures with a revised project delivery network. Our structures division has had a detailed QA/QC program for many years.
- Very little changed at my agency as a result of the scan tour. I was not with the agency much past the time of the scan, and there was even less time since the time that the scan report was published. I didn't have much opportunity to try to get the agency's leadership to become aware of the results or ask for briefings.
- When it comes to gauging implementation, it's almost too soon to assess outcomes. If anyone is embracing this and implementing this, it might not be something you can see in just a year's time. It probably takes longer to see the results of implementation efforts.
- One of our team's implementation strategies was to have each member make a presentation to their local agency. I believe a majority of our members have done that, including myself. A colleague and I made a formal presentation to the secretary of our department and our chief engineer and briefed them on the findings of the scan tour.
- This work coincided with the FHWA initiative for states to disclose their plan development QA/QC, which came about as a result of the Minnesota bridge collapse.
- We tried to blend the best practices we learned during the scan tour with the QA/QC documentation for our state, both for in-house and consultant projects. We are in the process of rewriting our LRFD-compliant bridge design manual, and that manual will spell out steps and varying degrees of QA/QC for different kinds of projects. We're making good progress in our state.
- The PennDOT Bureau of Design is undergoing a major reorganization. One of the objectives is to bring the areas of materials, construction, and design review into closer proximity to allow better communication to identify problem areas related to quality and track the resolution more efficiently. For example, a new high performance concrete deck was developed in order to reduce deck cracking. The review of overall PennDOT QA/QC practices showed that the policies and procedures already in-place were adequate; however, some areas for improvement were noted, such as managing "low bid" contractors better instead of restricting/evaluating bidders to obtain the "best bid" (must follow state law).

- During this period, MnDOT was in the process of putting together a QA/QC process manual. The manual was assembled by a consultant, who incorporated some of the best practices we discovered during our scan. The manual was implemented last year with full compliance by July 2012.
- At our agency headquarters, implementation and evaluation of improving agency practices and policies are in progress. My colleagues at headquarters were glad when the final scan report was published; they were in “learning mode” pending its arrival.
- My role changed at my agency shortly after the scan tour. When I took over as director of the Columbia River Crossing project, the project already had QA/QC in place. Based on what I learned in the scan tour, we did an internal evaluation to implement some of the best practices that were applicable to this megaproject. The team includes both Washington State DOT and Oregon DOT employees, and I hired an ODOT person who I originally interviewed on the scan tour. Among other things, he’s spearheading QA/QC improvements.

2. We will be surveying “secondary” audiences to assess the reach of the scan program beyond the participants themselves. Have you shared information you learned or contacts you made during the scan tour with others—either in your agency or beyond? Can you provide contact information or meeting names and dates?

- I presented findings from the scan at the Utah DOT Annual Conference 2011 in association with the update of the UDOT QA/QC procedures.
- I participated in two events where we presented the results of the scan tour:
 - I gave a presentation about the scan findings with another scan participant at the AASHTO Annual Subcommittee on Bridges and Structures Meeting, May 15-19, 2011 (<http://www.transportation.org/meetings/314.aspx>). The audience included the 50 state bridge engineers among others in a large audience.
 - Five scan team members gave a detailed three-hour presentation during the Sunday workshops of the January 2012 TRB meeting (<http://pressamp.trb.org/conferenceinteractiveprogram/EventDetails.aspx?ID=22484>) (Also in 2011, presentation during the General Structures Committee meeting: <http://pressamp.trb.org/conferenceinteractiveprogram/EventDetails.aspx?ID=18173>)
- No, I believe that the Scan material was confidential.
- I made presentations of the information to MnDOT Design Engineers at our annual meeting in 2011.
- I presented scan findings at the 2011 Joint AASHTO Right of Way and Utilities and Design Subcommittees meetings and 2012 TRB annual meeting. I did not make any contact during the out of state meetings.
- I can’t say I have personally reached outside of my agency. Our time and schedule don’t allow more personal outreach at this time.
- Our documents are available to other agencies and other transportation owners who tap into our QA/QC practices, such as county engineers or the U.S. Army Corps of Engineers.
- A technical paper presentation was given at the September 2011 Western Bridge Engineers’ Seminar (<ftp://ftp.wsdot.wa.gov/public/Bridge/WBES2011/C%5C2C3%5C2C3.pdf>). “This

seminar is a biennial cooperative effort by the Federal Highway Administration Western Resource Center and the Transportation Departments of Alaska, Arizona, California, Idaho, Nevada, Oregon, and Washington. Its purpose is to facilitate the exchange of information between practicing bridge engineers in government agencies, consultants, contractors, educators, and suppliers on subjects of current importance to the design, construction, and maintenance of bridges.”

- I have shared this information with our state design engineer and assistant design engineers.
- I had wanted to participate in this scan because I recognized that what my state was calling best practices for roadway design and project development were in fact ad hoc collections of practice that were not based on any focused policy effort. It appeared that there was something better out there, and this scan showed that there was. We saw some amazing examples: Kentucky was one state whose overall quality approach has been taken to a level we hadn't imagined. However, other states had practices that looked above-and-beyond on paper, but we learned through the scan that in some cases they weren't much different from the norm.
- For those interested in selecting from the realm of best practices and implementing successful solutions, I think scan was a great way of amassing that information in one place.

3. How would you characterize the overall value of this scan tour? What comments would you like to share for the summary report on this project?

- I found the overall value extremely beneficial when addressing QA/QC from a global perspective. I think it would be helpful for the problem statements to be generalized (or at least focus on the discussion topics) as the discussion never seemed to focus on the objective. For example, the original title of this scan was Best Practices is Quality Control and Quality Assurance of Bridge Plans and the original objectives were specific to bridge related items. The topics discussed on the scan were very unrelated to the actual topic, ranging from a Design-Build project discussion to construction inspection to specific department organizations. It appears the problem statements get funding and the scans take on a meaning of their own.
- It is difficult to implement change if discussions focus on information items. In some cases, the topic may be worth discussing without implementing a change.
- I thought the scan tour had value. There's a wide range of quality control and assurance going on around the country. Everyone is doing something, but not everyone's doing it the same way, and some are doing it better than others.
- We purposely chose to visit states representing a good variety of geography, organizational types (centralized versus decentralized) and use of consultants (high use of consultants for quality activity versus in-house). Those findings proved valuable—some states are doing very well under a range of different circumstances.
- People have more and more to do with little resources. It takes dedicated resources—time, personnel and money—to do quality well and implement some of the changes discussed in this scan.
- At our TRB event in January, two other participants talked about implementation efforts in their own states. A common attitude is that people would like to do better when it comes to quality. All states know that quality is important and believe they're addressing it to some degree, but nobody feels like they're doing it as best they can.

- It boils down to managing risk and assigning responsibilities to qualified professionals. When those in responsible charge perform their duties properly, risk is minimized. There is no easy solution to guaranteeing that the quality of the engineering provided meets expectations; however, a good QA/QC program improves the probability that any errors or omissions will be detected and corrected.
- MnDOT has had several challenges over the past years on plan quality. It is the main reason we decided to create a manual for designers on the process for plan quality. The scan tour on QA/QC was perfect timing for our process and for best practices that could be used throughout the country.
- From the outside it might look like fun, but I can tell you it isn't: It's a privilege, but it's hard work. They are cumbersome on the people who attend them, given participants personal and work obligations.
- I think value of the scan would vary from person to person depending on their area of interest and expertise. For example, the topic of our scan was plan QA/QC, and while it was not intended to solely address bridges, many participants had a bridge background and that's what we tended to focus on during the scan. This made the discussions and findings less meaningful to those participants who aren't bridge people.
- A fellow scan member observed that it appears that quality people produce quality results, perhaps independent of the QA/QC. As an example, look at the high quality Mississippi river bridges built 50, 60 or 70 years that are still standing, which were built without any QA/QC documentation. Those builders had the discipline and know-how in their own heads. Yet I think it becomes necessary to institutionalize and document procedures with younger and less experienced staff who don't have the background and experience to make the best decisions on their own.
- The scans are a great opportunity for engineers to get together, both the traveling team members as well as the hosts. I think host state participants learned as much as we did.
- I think it's important not to go too far with recommending follow-up research, particularly for a nonscientific topic like plan development QA/QC. It can be counterproductive to take too scientific and too detailed a research approach (For example, trying to quantify: "How much QA/QC is enough—or too much?"). In my opinion the scan accomplished what it was supposed to without need for more research of this type.

4. Please rate the following outcomes in terms of their contribution to the value of this scan tour, where 1 is “not important” and 5 is “extremely important.”

	Not Important 1	2	3	4	Extremely Important 5	Average
Introduction to (or clearer understanding of) a new technology or practice			2	3	1	3.8
Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource			1	2	3	4.3
Information with which to <i>begin</i> implementation of a technology or practice at your agency		1	2	3		3.2
Information with which to <i>continue</i> implementation of a technology or practice at your agency			2	2	2	4.0

Nonparticipant survey

To gather more information about the reach of the scan tour findings and to trace the paths through which information about the scan findings spread beyond the initial participants, CTC & Associates conducted an online survey of nonparticipants—individuals who did not participate in the scan but who were identified as having received information about it.

Based on participant interviews and input as well as the implementation plan for this scan compiled by Arora and Associates, we identified the activities—meetings, presentations and report distributions—through which the scan likely reached secondary audiences. We contacted the organizers of those activities and searched the Web to obtain attendee lists and distribution rosters. From these lists we surveyed representatives of state DOTs, other highway agencies, and federal agencies, totaling 259 names from the following three lists:

- AASHTO Subcommittee on Bridges and Structures
- AASHTO Subcommittee on Design
- AASHTO Subcommittee on Right of Way, Utilities, and Outdoor Advertising Control

Scan team members provided five additional names of colleagues with whom they spoke about the scan findings.

The results of the nonparticipant survey (question 6, “If you talked to colleagues or peers about the scan tour results, we would appreciate it if you could share their names and agencies.”) provided four additional names of DOT staff who had been involved in an implementation of scan technology or whom they had spoken to about the scan findings. Surveys were sent to these individuals as well.

In all, CTC & Associates sent the nonparticipant survey to 253 individuals. Recipients received the following email:

Hello,

The National Cooperative Highway Research Program is conducting research to evaluate how the innovative technologies and practices identified through its U.S. Domestic Scan Program (<http://domesticscan.org>) are being used by transportation practitioners beyond the initial scan participants.

*You were identified as having received information about **Scan 09-01: Quality Control and Assurance in Design** (<http://www.domesticscan.org/09-01-qcqa-of-design-plans>). We would appreciate a few minutes of your time to complete a brief survey (7 questions) on your use of the scan findings. Your responses will help NCHRP evaluate the reach of this scan and the overall value of the U.S. Domestic Scan Program.*

The survey is available at <http://www.surveymonkey.com/s/scan-09-01>.

If you have any questions about this NCHRP research effort, please feel free to contact me at the phone number or email below. You can also contact TRB Senior Program Officer Andrew Lemer at ALemer@nas.edu or (202) 334-3972. Thank you for your time and your participation.

The survey itself also included the following introductory text:

The National Cooperative Highway Research Program sponsors the [U.S. Domestic Scan Program](#) to facilitate technology transfer among state DOTs. As part of the program, CTC & Associates is conducting this survey on behalf of NCHRP to evaluate how the technologies and practices identified through the scans are being used by transportation practitioners beyond the scan participants.

*You were identified as having received information about **Scan 09-01: Quality Control and Assurance in Design** (see the project [Web page](#) or [final scan report \[PDF\]](#)). Your feedback about how you learned about this scan—and how the scan findings are being used at your agency or organization—will be of great value to NCHRP and the transportation community.*

Thank you for taking the time to complete this short seven-question survey.

Responses

A total of 32 people responded to the survey, a 13 percent response rate. These responses are compiled below.

1. (Required) Please provide your name and organization. This information will not be published.

All 32 survey respondents represented state DOTs.

Accounting for multiple responses from the same agency, respondents represented a total of 24 different agencies.

- Four of these agencies were the same as those agencies represented in the Scan Team membership.
- Five of these agencies were the same as those who participated as host states.

2. HOW YOU LEARNED ABOUT THIS SCAN. The scan findings were disseminated and presented through a number of channels. How did you learn about the scan results? (Check all that apply.)

	Number responding	Percent responding
Conversation or email with a colleague at my organization	8	25%
Conversation or email with a scan participant or host state member	7	22%
Received final scan report from an email distribution	18	56%
TRB Annual Meeting and workshops (January 2011, January 2012)	3	9%
AASHTO Annual Subcommittee on Bridges and Structures Meeting (Norfolk, Virginia, May 2011)	14	44%
Joint AASHTO Subcommittee on Design and Subcommittee on Right of Way & Utilities Meeting (St. Louis, May 2011)	3	9%
Bridge Engineering Distinguished Speaker Series (University at Buffalo, April 2011)	0	0%
Western Bridge Engineers' Seminar (Phoenix, September 2011)	2	6%
Another national or regional conference (please describe in the "Other" box below)	0	0%
Journal paper or trade publication article	0	0%
I don't remember learning about this scan tour prior to this survey	3	9%
Other (open-ended) <ul style="list-style-type: none"> • I responded to the initial scan for NYSDOT and was a member of the NYSDOT interview team. • My supervisor was on the scan team. 	2	6%

3. SOUGHT MORE INFORMATION. If you sought more information about the findings of the scan tour, please indicate how. (Check all that apply.)

	Number responding	Percent responding
Obtained or read the scan report	21	66%
Visited the website domesticscan.org	4	13%
Contacted a scan participant	3	9%
Contacted someone from one of the states visited in the scan	0	0%
Other	0	0%
Specific technologies or practices discussed (open-ended) <ul style="list-style-type: none"> • Georgia was a state visited in the scan. I wanted to know how Georgia compared to the other states. • Overall findings and recommendations. 		

4. SHARED INFORMATION WITH OTHERS. If you shared information about one or more of the technologies or practices identified through the scan, please describe how. (Check all that apply.)

	Number responding	Percent responding
Shared information with a colleague at my organization	18	56%
Shared information with other stakeholders in my state	3	9%
Recommended a change in practice at my organization	2	6%
Other <ul style="list-style-type: none"> • Considering information for improving our processes as we document our own QA/QC procedures. 	1	3%
Specific technologies or practices discussed (open-ended) <ul style="list-style-type: none"> • QA/QC plan, Peer review methods. • How Georgia compared to other states. • Checklists; Consultants are rated; Decisions about the amount and type of review; Third-party consultant reviews are done for specialty projects or where DOTs do not have expertise or enough staff to meet deadlines; Plan signoffs or PE stampings • We were attempting to tighten up our QA/QC and this document was helpful. • COMMUNICATION! • Importance of QA/QC programs; value added by offering training specifically on QC. • Specialty contracting (design-build, CM/GC [Construction Manager/General Contractor]). Increased VE (Value Engineering). 		

5. IMPLEMENTED SCAN FINDINGS. If you used information from the scan tour to make or recommend a change to your organization’s practices, please indicate how.

	Number responding	Percent responding
Proposed implementation	1	3%
Planned implementation	5	16%
In-progress implementation	6	19%
Completed implementation	3	9%
<p>Please provide details on the implementation (open-ended)</p> <ul style="list-style-type: none"> • Checklists—we have established review checklists and have been using them for quite a while; Consultants are rated—we have redone our rating system to include all divisions; Decisions about the amount and type of review; Third-party consultant reviews are done for specialty projects or where DOTs do not have expertise or enough staff to meet deadlines; Plan signoffs or PE stampings. • Completed our plan for management. • General principles were considered in developing policies. • See answer to question 4 [“Considering information for improving our processes as we document our own QA/QC procedures.”] • As part of the scan, NYSDOT is currently implementing many of the scan recommendations. In addition, we have considered some of the scan results concerning Design-Build practices for implementation on our design-build projects. We have also discussed the need for additional training in QC. • Design-Build; PE stamping • No significant changes made; however, SD DOT’s processes/practices were formally documented for the Office of Bridge Design. • No implementations planned. 		

6. CONTACTS. If you talked to colleagues or peers about the scan tour results, we would appreciate it if you could share their names and organizations. This information will not be published.

A total of seven names were provided.

7. OTHER COMMENTS. Please use this space to provide any additional comments about your use of the findings of the scan tour.

	Number responding	Percent responding
Open-ended response	8	25%
<ul style="list-style-type: none"> • The tour group seemed very happy with Georgia DOT’s performance in this area. They used Georgia DOT’s plan title block in their presentation at AASHTO. • Enjoyed reading the final document. We still have our hands full with getting our QA Branch off the ground. Keeping this report in our pocket for use in the future! Thank you. • Many of the findings corroborated practices that we use at MDT. • I am sure I saw the report. It was a while ago. I vaguely remember discussing one or two of the report’s findings with others in my office. I was convinced that our process was satisfactory. • Very timely report - good to have an independent source. There is a need to improve uniformity nationally for owners’ QA/QC activities for alternate contracting methods, such design-build and CM/GC. • Used information from scan tour and state that had implemented details for an IBRD (Innovative Bridge Research and Deployment Program) application. • Scan comes indirectly from recommendations of NTSB. The AASHTO Subcommittee on Bridges and Structures was actively involved/interested in the scan. • Domestic scans are useful as they identify best practices that are worthy of nationwide implementation. 		

3

Leading Practices for Motorcyclist Safety (Scan 09-04)

Reducing motorcycle fatalities requires a comprehensive approach that includes behavioral and infrastructure-related strategies. The main objective of this scan was to determine the successful infrastructure and behavior-related countermeasures that are being implemented nationwide in order to develop best practices for the country.

The findings of the scan are documented in the final scan report, available online at http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_09-04.pdf.

Overview of technology transfer and implementation efforts

The following observations, conclusions and recommendations are based on information that CTC & Associates gathered during the participant interviews and the nonparticipant survey. A complete record of findings through these channels follows later in this chapter.

Observations

- This scan illustrated how the U.S. Domestic Scan program model is not limited to spreading new technologies but includes sharing innovative practices and policies.
 - One participant noted this distinction, highlighting how new safety rules in Florida, unrelated to any particular technology advancement, were making a difference there: “We saw a successful standard practice that prohibits opening milled, grooved surfaces to traffic; these roadway surfaces are particularly dangerous to motorcyclists.”
 - Another discussed the importance of collaboration of advocacy groups and government agencies. In states with major rallies (Wisconsin, Florida, South Dakota), this kind of collaboration helped establish a best practice of systematically “identifying motorcycle obstacles in advance of these events and pre-clearing them.”
- It appears each scan has its own limits on its usefulness to scan team members or to the wider audience practitioners. One scan participant represented the National Highway Traffic Safety Administration, and stated that NHTSA did not have any planned policy changes as a result of the scan. The explanation was that “NHTSA is a behavior agency and focused on vehicle operation; this scan is more engineering and infrastructure oriented, which is the primary concern of FHWA.” However, on this same topic another participant noted: “This scan was an invaluable process for us to better understand how specific states are handling motorcycle safety, related not only to infrastructure issues but also behavioral issues.”

- Several participants noted the complementary FHWA international scan on this topic (“Infrastructure Countermeasures to Mitigate Motorcyclist Crashes in Europe,” <http://international.fhwa.dot.gov/scan/12028/12028.pdf>) and compared their outcomes.
 - A participant on both scans said that “the international one was perhaps more enlightening in terms of seeing completely new approaches (such as ridges at stop bars or epoxy friction surfaces on roadways). However, there was no true ‘Aha! moment’ with that scan that we were perhaps expecting.”
- For most scans, nonparticipant survey audiences include federal, state and local government agency representatives. For this scan, the nonparticipant survey reached out to a wider audience through the TRB Committee ANF30 on Motorcycles and Mopeds and the national Motorcycle Safety Network. As a result, the survey respondents included government representatives as well as university researchers and state and national advocacy groups.
- When participants were asked to rate the importance of four aspects of the scan on a scale of 1 (not important) to 5 (extremely important), the average rating of each of these was between 4 and 5:
 - Introduction to (or clearer understanding of) a new technology or practice: **3.6**
 - Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource: **4.4**
 - Information with which to *begin* implementation of a technology or practice at your agency: **3.6**
 - Information with which to *continue* implementation of a technology or practice at your agency: **3.6**

Highlights of effective technology transfer

- The scan fostered ongoing dialogue at participants’ own agencies:
 - “We will be distributing the findings within our agency.”
 - “I shared the report with two people my agency in key positions related to road quality and design.”
 - “I would like to present the scan findings at future meeting of state DOT’s regional engineers meeting.”
 - “I made this presentation to executive staff at my agency, which included our commissioner, deputy commissioner, the division heads at our central office, and our state’s nine district administrators.”
- The scan team presented the findings to national and regional audiences (more information on these appear in the detailed sections of this report):
 - AASHTO Subcommittee on Maintenance
 - WASHTO Subcommittee on Maintenance
 - TRB Committee ANF30 on Motorcycles and Mopeds
 - National Association of State Motorcycle Safety Administrators
 - National Motorcycle Safety Network
 - State Harley Davidson owners rally

- One participant made several presentations in the state of Colorado:
 - Colorado DOT’s Motorcycle Operators Safety Training
 - Evergreen (Colorado) Ride Smart Motorcycle Coalition
 - Colorado DOT Maintenance Superintendents and Traffic Engineers
- The 28 respondents to the nonparticipant survey, represented 15 state DOTs; 2 other state agencies (Highway Patrol; Department of Public Safety); 1 federal agency; 2 universities; 3 state safety advocacy groups; and 4 national advocacy groups or companies.
 - The most common way that nonparticipants learned about this scan was through an email distribution. Other common methods were conversations or emails with a scan participant or host state member, the TRB Committee ANF30 meeting, and the Motorcycle Safety Network meeting.
 - The most common follow-up activities among nonparticipants included reading the scan report (61 percent) and visiting the website www.domesticscan.org (25 percent).
 - Detailed findings from the nonparticipant survey are presented later in this chapter.

Implementation successes

- Practices and technologies discussed during this scan have been implemented or are under consideration among scan team members:
 - “We are evaluating the measures and implementation strategies presented in the scan to determine what we can do beyond what we’re currently doing. Many of the scan recommendations are still under review.”
 - “We are considering the use of the motorcyclist specific signing when and where appropriate. Other measures have not been finalized yet.”
 - “In the scan, it came up that motorcycle data were not getting collected correctly using traditional collection devices, which is why we weren’t getting good crash statistics. The scan participants and hosts identified this as a common concern that we are continuing to address.”
 - “We have implemented signing in work zones for motorcycles, particularly for pavement mill-and-fill rehabilitation projects where lane elevations changes are particularly hazardous to motorcyclists.”
- Nonparticipants also discussed implementation efforts that were under consideration, in process, or completed.
 - “Signage, roadway assessments and customer call-in numbers.”
 - “Feasibility of radar for data collection.”
 - “The California Highway Patrol is deeply involved in motorcycle safety efforts. Its programs and responsibilities cover much, if not all, of the recommendations listed in this document.”
 - Pennsylvania “already does outreach to the motorcycle riding audience through the award-winning Live Free Ride Alive web site (www.livefreeridealive.com) and attendance at motorcycle rallies over the course of the year. Pennsylvania also manages an extensive motorcycle training program at more than 60 sites and at no extra charge to riders.” In addition, the state has “talked about areas it has already implemented and possible improvements to roadway design.”

- “Considering issues noted in report for possible implementation.”
- “Additional emphasis to maintenance crews.”
- “I am discussing the need for a statewide coalition on motorcycle safety”
- “We are in the initial stages of putting our program together”

Additional benefits of the scan

- Participants commented on the overall value of the scan tour:
 - “This scan had a great overall value and brought us to the key safety advocates in this area who have a lot of knowledge related to the safety problem associated with motorcycles.”
 - “It is valuable to learn what other states are doing.”
- A participant explained that scans provide a unique way to learn about potential solutions that proved less than successful: “A benefit of scans is that by establishing face-to-face relationships with other practitioners and researchers, you’re much more likely to hear about approaches that might not have worked well. Everyone publicizes their successes, but it’s really only through one-on-one interaction that you can learn the full lessons of possible failures.”
- One participant stated that “motorcycles have been by far less explored in terms of safety issues compared with cars and trucks.” The resulting “need for deeper study of motorcycle safety made this scan particularly valuable and necessary.”

Scan best practices

- Hands-on learning is often cited as a benefit of technology scans. One participant noted the benefit of experiential learning for this scan: “During this scan, we met with motorcycle manufacturers and had an opportunity to see the physical testing on the simulators. This helped us better visualize and understand the hazards; it was very insightful.”

Barriers and opportunities for improvements

- As noted in the initial observations for this scan (see above), the specific topics addressed in this scan proved to have a varying degree of relevance to the different participants in the scan tour.
- A participant commented on the inherent challenges of quantifying safety issues: “At the end of the day, some measurements in highway safety are beyond our grasp: There’s no way to measure what a life lost—or saved—means to the person’s family, and there’s no way to capture injuries or fatalities avoided. As practitioners we stay committed to finding ways to continually improve safety.”

Scan details

Scan team members

- Dennis Heuer, Virginia DOT, Scan Co-Chair
- Dick Schaffer, FHWA, Scan Co-Chair
- Joe Foglietta, New York State DOT
- Michael Jordan, National Highway Traffic Safety Administration
- Daniel Lonsdorf, Wisconsin DOT
- Pradeep Tiwari, Arizona DOT
- David Wieder, Colorado DOT
- Frances Bents, Westat, Subject Matter Expert

Sites visited

- Florida
- Idaho
- Maryland
- South Dakota
- Wisconsin

Scan dates

March 13–17, 2011 and April 3–9, 2011

Final report

September 2011, http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_09-04.pdf.

Participant interviews

CTC & Associates conducted interviews with participants approximately four months following the publication of the scan report. Interviews were conducted either by telephone or via email based on the each respondent's preference.

Two of the seven scan participants have retired since the time of the scan. The remaining five participated in the interviews. Responses to each of four questions are summarized and compiled below.

As appropriate, this information has been supplemented with information provided in the scan team's implementation plan ([Appendix C](#)) provided by Arora and Associates.

1. How have you implemented changes to your agency's policies, practices or technologies based on what you learned from participating in this scan tour? What implementation activities do you have planned?

- Our agency covers the infrastructure safety program for motorcycles, and as such we are evaluating the measures and implementation strategies presented in the scan to determine what we can do beyond what we're currently doing. Many of the scan recommendations are still under review.
- We will coordinate with the entire scan team about how to implement the recommendations of the scan. We have a budget for this effort, and as a team we must determine our next steps.
- More than focusing on new technologies, this scan highlighted practices that promote motorcycle safety. For example, we saw in Florida a successful standard practice that prohibits opening milled, grooved surfaces to traffic; these roadway surfaces are particularly dangerous to motorcyclists.
- We are considering the use of the motorcyclist specific signing when and where appropriate. Other measures have not been finalized yet.
- Right now there are no planned policy changes. NHTSA is a behavior agency and focused on vehicle operation; this scan is more engineering and infrastructure oriented, which is the primary concern of FHWA.
- My personal area of emphasis is data collection. In the scan, it came up that motorcycle data were not getting collected correctly using traditional collection devices, which is why we weren't getting good crash statistics. The scan participants and hosts identified this as a common concern that we are continuing to address. An NCHRP research project is currently under way on this topic ("Improving the Quality of Motorcycle Travel Data Collection," <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2956>).
- I have tried to see what part of the scan tour findings could be implemented.
- We have implemented signing in work zones for motorcycles, particularly for pavement mill-and-fill rehabilitation projects where lane elevations changes are particularly hazardous to motorcyclists.

2. We will be surveying “secondary” audiences to assess the reach of the scan program beyond the participants themselves. Have you shared information you learned or contacts you made during the scan tour with others—either in your agency or beyond? Can you provide contact information or meeting names and dates?

- The scan report has been distributed to all members of the scan. We meet with the Motorcycle Safety Network twice a year, and presented the scan findings to this group of motorcycle industry representatives and motorcycle safety and rider organizations. It is too early to have heard anything back from that group. The meetings are coordinated by the Motorcycle Safety Foundation. Participants include a number of advocacy groups: the American Motorcyclist Association, the Motorcycle Riders Foundation, the Motorcycle Safety Foundation, the Motorcycle Industry Council, the National Association of State Motorcycle Safety Administrators, and other groups.
- The scan findings were presented to members of the TRB Committee ANF30 on Motorcycles and Mopeds during that committee’s January 2012 meeting.
- We will be distributing the findings within our agency.
- I presented the PowerPoint presentation to several groups so far:
 - Trainers for Colorado DOT’s Motorcycle Operators Safety Training
 - The Evergreen (Colorado) Ride Smart Motorcycle Coalition
 - Meeting of the WASHTO Subcommittee on Maintenance (SCOM) in San Francisco, March 25-28, 2012
 - Meeting of AASHTO SCOM in Seattle in July 2012
 - I plan on presenting to a joint meeting of the CDOT Maintenance Superintendents and Traffic Engineers in October 2012.
- I shared the report with two people my agency in key positions related to road quality and design.
- I would like to present the scan findings at future meeting of state DOT’s regional engineers meeting.
- I made this presentation to executive staff at my agency, which included our commissioner, deputy commissioner, the division heads at our central office, and our state’s nine district administrators.
- I made a joint presentation on this scan and the complementary international scan to the National Association of State Motorcycle Safety Administrators
- I made a presentation a state Harley Davidson owners rally.

3. How would you characterize the overall value of this scan tour? What comments would you like to share for the summary report on this project?

- This scan was an invaluable process for us to better understand how specific states are handling motorcycle safety, related not only to infrastructure issues but also behavioral issues. We have a number of recommendations that we’d like to share around the country and all states. Motorcycle fatalities are down but still high compared with pedestrians and motor vehicles, and we want to reduce those—one fatality is too many. This scan supports zero-death efforts around the country

to truly reduce motorcycle fatalities even more. The efforts to do that in the states we surveyed were quite successful.

- Motorcycle safety efforts can't be successful in reducing fatalities if they're done just once or only for a limited length of time. They need to be pursued persistently on an ongoing basis to succeed.
- We were impressed by the states we visited on the tour: Florida, South Dakota, Wisconsin, Maryland, and Idaho. In the future we'll certainly be calling on the people we met.
- We learned a great many things including how much we still have to learn and do. I have already implemented a few of the "best practices" and we are reviewing others. It has also gotten us thinking about how we can improve what we are already doing in this regard.
- I think overall that this scan has value with respect to DOTs, and there is information that they can use. For my agency, the scan only lightly touched on behavioral aspects. It was interesting, but it's hard to quantify the value since it was beyond the scope of our agency. We were still happy to participate in this scan and provide what value we could to the process.
- This scan had a great overall value and brought us to the key safety advocates in this area who have a lot of knowledge related to the safety problem associated with motorcycles. All that wisdom was distilled into this report, which is a valuable summary of different types of research and efforts initiated by different groups. Moreover, the report was developed by input and feedback of all the scan tour members whose focus is on different areas: data, highway design, operation, and vehicle design. The many issues examined will have great value for anyone who wants to address motorcycle safety
- I believe motorcycles have been by far less explored in terms of safety issues compared with cars and trucks. Many issues applicable to those other modes are applicable to motorcycles (such as banking curves), whereas other issues are unique to motorcycles (such as the difficulty to measure their volume in traffic). This need for deeper study of motorcycle safety made this scan particularly valuable and necessary.
- During this scan, we met with motorcycle manufacturers and had an opportunity to see the physical testing on the simulators. This helped us better visualize and understand the hazards; it was very insightful.
- It is valuable to learn what other states are doing.
- In states with special motorcycle events (Florida's Daytona Bike week and Biketoberfest, South Dakota's Sturgis rally, and Wisconsin's "Ride Home" every 5 years), we saw the important of collaboration among the highway officials, transportation authorities, and motorcycle advocacy and enthusiast groups. For example, employing a systematic approach for identifying motorcycle obstacles in advance of these events and pre-clearing them was a best practice we identified.
- A benefit of scans is that by establishing face-to-face relationships with other practitioners and researchers, you're much more likely to hear about approaches that might not have worked well. Everyone publicizes their successes, but it's really only through one-on-one interaction that you can learn the full lessons of possible failures.
- Comparing the NCHRP domestic scan and FHWA international scan, the international one was perhaps more enlightening in terms of seeing completely new approaches (such as ridges at stop bars or epoxy friction surfaces on roadways). However, there was no "Aha! moment" with that scan that we were perhaps expecting.

- At the end of the day, some measurements in highway safety are beyond our grasp: There’s no way to measure what a life lost—or saved—means to the person’s family, and there’s no way to truly injuries or fatalities avoided. As practitioners we stay committed to finding ways to continually improve safety.

4. Please rate the following outcomes in terms of their contribution to the value of this scan tour, where 1 is “not important” and 5 is “extremely important.”

	Not Important 1	2	3	4	Extremely Important 5	Average
Introduction to (or clearer understanding of) a new technology or practice			3	1	1	3.6
Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource				3	3	4.4
Information with which to <i>begin</i> implementation of a technology or practice at your agency		1	1	2	1	3.6
Information with which to <i>continue</i> implementation of a technology or practice at your agency		1	1	2	1	3.6

Nonparticipant survey

To gather more information about the reach of the scan tour findings and to trace the paths through which information about the scan findings spread beyond the initial participants, CTC & Associates conducted an online survey of nonparticipants—individuals who did not participate in the scan but who were identified as having received information about it.

Based on participant interviews and input as well as the implementation plan for this scan compiled by Arora and Associates, we identified the activities—meetings, presentations and report distributions—through which the scan likely reached secondary audiences. We contacted the organizers of those activities and searched the Web to obtain attendee lists and distribution rosters. From these lists we surveyed representatives of state DOTs, other highway agencies, federal agencies, and motorcycle advocacy groups. We distributed the survey to a total of 205 names from the following lists:

- Members of the AASHTO Subcommittee on Maintenance
- Attendees of the AASHTO Subcommittee on Maintenance meeting held July 2012 in Seattle
- TRB Committee ANF30: Motorcycles and Mopeds
- Members of the National Association of State Motorcycle Safety Administrators

In addition, Tim Buche, president of the Motorcycle Safety Foundation, sent the survey link on CTC & Associates' behalf to participants of the April 2012 Motorcycle Safety Network meeting.

Scan team members provided seven additional names of colleagues with whom they spoke about the scan findings.

The results of the nonparticipant survey (question 6, “If you talked to colleagues or peers about the scan tour results, we would appreciate it if you could share their names and agencies.”) provided two additional names of DOT staff who had been involved in an implementation of scan technology or whom they had spoken to about the scan findings. Surveys were sent to these two individuals as well.

In all, CTC & Associates sent the nonparticipant survey to 214 individuals. These people plus the additional Motorcycle Safety Network meeting attendees received the following email:

Hello,

The National Cooperative Highway Research Program is conducting research to evaluate how the innovative technologies and practices identified through its U.S. Domestic Scan Program (<http://domesticscan.org>) are being used by transportation practitioners beyond the initial scan participants.

*You were identified as having received information about **Scan 09-04: Leading Practices for Motorcyclist Safety** (<http://www.domesticscan.org/09-04-leading-practices-for-motorcycle-safety>). We would appreciate a few minutes of your time to complete a brief survey (7 questions) on your use of the scan findings. Your responses will help NCHRP evaluate the reach of this scan and the overall value of the U.S. Domestic Scan Program.*

The survey is available at <http://www.surveymonkey.com/s/09-04-motorcyclist-safety>.

If you have any questions about this NCHRP research effort, please feel free to contact me at the

phone number or email below. You can also contact TRB Senior Program Officer Andrew Lemer at ALemer@nas.edu or (202) 334-3972. Thank you for your time and your participation.

The survey itself also included the following introductory text:

The National Cooperative Highway Research Program sponsors the [U.S. Domestic Scan Program](#) to facilitate technology transfer among state DOTs. As part of the program, CTC & Associates is conducting this survey on behalf of NCHRP to evaluate how the technologies and practices identified through the scans are being used by transportation practitioners beyond the scan participants.

*You were identified as having received information about **Scan 09-04: Leading Practices for Motorcyclist Safety** (see the [project Web page](#) or [final scan report \[PDF\]](#)). Your feedback about how you learned about this scan—and how the scan findings are being used at your organization and by others—will be of great value to NCHRP and the transportation community.*

Thank you for taking the time to complete this short seven-question survey.

Responses

A total of 28 people responded to the survey, a 13 percent response rate. These responses are compiled below.

1. (Required) Please provide your name and organization. This information will not be published.

Respondents represented a range of groups, including but extending beyond DOTs:

- 15 state DOTs (16 respondents total)
- 2 other state agencies (Highway Patrol; Department of Public Safety)
- 1 federal agency
- 2 universities
- 3 state safety advocacy groups
- 4 national advocacy groups or companies

Among the DOT respondents, three of the agencies were the same as those who participated as host states.

2. HOW YOU LEARNED ABOUT THIS SCAN. The scan findings were disseminated and presented through a number of channels. How did you learn about the scan results? (Check all that apply.)

	Number responding	Percent responding
Conversation or email with a colleague at my organization	1	4%
Conversation or email with a scan participant or host state member	4	14%
Received final scan report from an email distribution	8	29%
National Association of State Motorcycle Safety Administrators meeting (Des Moines, Iowa, August 2011)	4	14%
TRB Annual Meeting session or workshop (Washington, D.C., January 2012)	1	4%
TRB Committee ANF30 (Motorcycles and Mopeds) meeting (Washington, D.C., January 2012)	4	14%
WASHTO Subcommittee on Maintenance meeting (San Francisco, March 2012)	2	7%
Motorcycle Safety Network meeting (Washington, D.C., April 2012)	4	14%
AASHTO Subcommittee on Maintenance meeting (Seattle, July 2012)	3	11%
Another national or regional conference or webinar (please describe in the “Other” box below)	1	4%
Journal paper or trade publication article	0	0%
I don’t remember learning about this scan tour prior to this survey	6	21%
Other (open-ended) <ul style="list-style-type: none"> • My state hosted and participated in an actual scan. • I was a scan participant (presented to the scan team) 	2	7%

3. SOUGHT MORE INFORMATION. If you sought more information about the findings of the scan tour, please indicate how. (Check all that apply.)

	Number responding	Percent responding
Obtained or read the scan report	17	61%
Visited the website domesticscan.org	7	25%
Contacted a scan participant	2	7%
Contacted someone from one of the states visited in the scan	1	4%
Other (open-ended) <ul style="list-style-type: none"> • I participated in the scan. • I visited the website and read the scan. • I did not seek other information. 	3	11%
Specific technologies or practices discussed (open-ended) <ul style="list-style-type: none"> • Infrastructure issues. • Florida discussed best practices and successful implementation which included EVAC Ambulances Look Twice Save a Life Campaign in Daytona, FL; an EMS and Trauma Project with Ryder Trauma Center in Miami, FL; Data and Analysis/Program Evaluation with the University of South Florida’s Center for Urban Transportation Research; and Florida’s Motorcycle Safety Coalition, specifically how we used our NHTSA Motorcycle Safety Program Assessment to write a plan and build an implementation team. 		

4. SHARED INFORMATION WITH OTHERS. If you shared information about one or more of the technologies or practices identified through the scan, please describe how. (Check all that apply.)

	Number responding	Percent responding
Shared information with a colleague at my organization	12	43%
Shared information with other stakeholders in my state	7	25%
Recommended a change in practice at my own organization	3	11%
Recommended a change in practice at an organization I work with	3	11%
Other <ul style="list-style-type: none"> • We have presented on this topic to other states and at national conferences. • I did not share information. 	2	7%
Specific technologies or practices discussed (open-ended) <ul style="list-style-type: none"> • Infrastructure issues. • Signage, roadway assessments and customer call-in numbers. • Talked about the areas that Pennsylvania has already implemented and possible improvements to roadway design. • Feasibility of radar for data collection. • I am in the process of asking what our state programs know about the scan and am asking if they are doing anything with this information. 		

5. IMPLEMENTED SCAN FINDINGS. If you used information from the scan tour to make or recommend a change to practices at your organization or an organization you work with, please indicate how.

	Number responding	Percent responding
Proposed implementation	6	21%
Planned implementation	1	4%
In-progress implementation	3	11%
Completed implementation	1	4%
<p>Please provide details on the implementation (open-ended)</p> <ul style="list-style-type: none"> • Considering issues noted in report for possible implementation. • Louisiana is putting our program together. We are in the initial stages. • We have formed a Motorcycle Safety Coalition, and Highway Engineering and Infrastructure is one of the components • Did not implement anything at this time. • Pennsylvania has a stakeholder advisory committee, and we are planning on holding a meeting before the end of the year. We already do outreach to the motorcycle riding audience through the award-winning Live Free Ride Alive web site (www.livefreeridealive.com) and attendance at motorcycle rallies over the course of the year. Pennsylvania also manages an extensive motorcycle training program at more than 60 sites and at no extra charge to riders. Pennsylvania has a dedicated Motorcycle Fund that pays for the training, managed by the Motorcycle Safety Foundation. • Did not implement. • Additional emphasis to maintenance crews. • I am discussing the need for a statewide coalition on motorcycle safety • Proposed we look at developing a coalition in Wisconsin. Wisconsin currently has a group (MoSAC—Motorcycle Safety Advisory Council) that meets once or twice a year. I spoke to the chair who said there are other issues taking precedence. 		

6. CONTACTS. If you talked to colleagues or peers about the scan tour results, we would appreciate it if you could share their names and agencies. This information will not be published.

A total of four names were provided.

7. OTHER COMMENTS. Please use this space to provide any additional comments about your use of the findings of the scan tour.

	Number responding	Percent responding
Open-ended response	4	14%
<ul style="list-style-type: none"> • Great document • I just received a copy of the scan and will share the recommendations with others. • Will maintain as published resource document • The California Highway Patrol is deeply involved in motorcycle safety efforts. Its programs and responsibilities cover much, if not all, of the recommendations listed in this document. Further, the CHP’s involvement with the California Strategic Highway Safety Plan, Challenge Area 12, Motorcycle Safety, enhance the Department’s and California’s efforts to improve motorcycle safety for riders and all motorists. 		

4

Best Practices for Roadway Tunnel Design, Construction, Maintenance, Inspection and Operation (Scan 09-05)

While codes and regulations governing design, construction, operation and maintenance of most other highway facility components have been well established by AASHTO and FHWA, this is not similarly true for tunnels. Recent events have brought considerable attention to this fact, and the National Transportation Safety Board recommended the need to develop national standards for roadway tunnels.

This scan addresses the need for national tunnel standards and a national tunnel inventory. Scan topics included:

- Current criteria that owners and states use to identify tunnels in their inventory
- Standards, guidance, and best practices for existing and new roadway tunnels in the United States
- Specialized technologies currently used for existing and new U.S. roadway tunnel design, construction, maintenance, inspection, and operations

The findings of the scan are documented in the final scan report, available online at http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_09-05.pdf.

Overview of technology transfer and implementation efforts

The following observations, conclusions and recommendations are based on information that CTC & Associates gathered during the participant interviews, the participant webinar, and the nonparticipant survey. A complete record of findings through these channels follows later in this chapter.

Observations

- The timing of this scan was good with respect to several other complementary and overlapping efforts that were under way or recently completed when the scan was scoped, developed and conducted. These efforts included:
 - The work of FHWA on the Tunnel Operations, Maintenance, Inspection and Evaluation (TOMIE) manual
 - Research needs established by AASHTO’s Technical Committee T-20 (Tunnels)
 - Efforts of TRB Committee AFF60 (Tunnels and Underground Structures)
 - NCHRP research efforts (Project 14-27, “A Guide for the Preservation of Highway Tunnel Systems” and Project 12-89, “Recommended AASHTO LRFD Tunnel Design and Construction Specifications”)

- A related 2005 FHWA International Scan, “Underground Transportation Systems in Europe: Safety, Operations, and Emergency Response”
- Even in light of all these efforts, the scan met a perceived need to help tie these efforts together:
 - One participant said, “The scan was very much needed because tunnel operators have not had a good national venue to share ideas and best practices.”
 - Another said that the scan was “the only thing I know of that pulled the information from major tunnel operators in the United States into one document.”
- When participants were asked to rate the importance of four aspects of the scan on a scale of 1 (not important) to 5 (extremely important), the average rating of each of these was between 4 and 5:
 - Introduction to (or clearer understanding of) a new technology or practice: **4.7**
 - Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource: **4.6**
 - Information with which to *begin* implementation of a technology or practice at your agency: **4.4**
 - Information with which to *continue* implementation of a technology or practice at your agency: **4.2**
- Based on the nonparticipant survey results, a panel member noted that the influence of the scan on nonparticipants attenuates somewhat from knowledge transfer to practice: Interest in the findings among respondents is high, but actual rate of implementation is lower. This is perhaps not unexpected. As discussed during the webinar, the scan and its findings serve to forward the national dialogue and evolve the state of practice for this topic rather than to present a catalog of implementation-ready solutions.

Highlights of effective technology transfer

- The scan fostered ongoing dialogue at participants’ own agencies:
 - “I brought back a number of ideas to internal discussions, which allowed us to keep asking: ‘Have we considered this?’ Some ideas make sense for us, and others don’t, but we always talked about them.”
 - “The information the scan produced was very valuable to our agency. We have a strong vested interest in the information synthesized in this report.”
 - “I furnished some information to our program manager for Seattle’s Alaskan Way tunnel project.”
 - “I have shared scan information with other tunnel operators within the state, with transportation officials within the state, and with engineering consultants.”
 - “We were in a unique position as both a host and participant state. I discussed the scan with a number of colleagues involved in major tunnel projects.”
- The scan team presented the findings to a large number of audiences (more information on these appear in the detailed sections of this report):
 - Two consecutive years at the Sunday workshops of the annual TRB conference
 - A TOMIE Manual Workshop
 - Webinars as part of the National Highway Institute’s “Real Solutions” seminar series

- Conference presentations (2010 International Bridge Conference, July 2011 New York City bridge conference, Pittsburgh chapter of the Association for Bridge Construction & Design)
- The 24 respondents to the nonparticipant survey represented 22 states, including four that were involved in the scan itself either as participants or hosts.
 - The most common way that nonparticipants learned about this scan was through an AASHTO distribution.
 - Follow-up activities among nonparticipants included reading the scan report, follow-up contacts with scan team members, visiting the website www.domesticscan.org, and discussions with colleagues at their own agencies, including recommendations for changes in practice.
 - A number of respondents noted that their states did not have tunnels, and as such the scan findings were not relevant to them.
 - Detailed findings from the nonparticipant survey are presented later in this chapter.

Implementation successes

- Scan participants cited topics they learned about during the scan and brought back to their home agencies, including:
 - Fire safety and design (“We’re implementing the green, text-free ‘running man’ exit signs;” “We are exploring the possibility of a tunnel fire suppression system we learned about.”)
 - Supervisory Control and Data Acquisition (“We took advantage of a lot of the information gleaned from this report on major tunnels in our state. This was particularly true for rapidly changing technologies like SCADA systems and information technology systems.”)
- A participant from the federal government implemented the findings by incorporating them as appropriate into FHWA’s TOMIE manual and the National Tunnel Inspection Standards.
- Nonparticipants surveyed also reported planned and completed implementation.
 - One state reports that it is “currently reviewing [its] tunnel inspection/maintenance guidelines and may incorporate some of the best practices identified.”
 - A respondent reported on a completed implementation: “Soil loadings [were] better understood and applied.”
 - The following are among other implementations proposed, planned or in-progress reported in the nonparticipant survey:
 - Emergency response plan
 - Development and sharing of inspection practices
 - Development of seismic design criteria
 - Development of standards and guidance for tunnels

Additional benefits of the scan

- Participants commented on the importance of gaining direct knowledge through the scan process:
 - “This was a very valuable tour to do to see firsthand how things are done in the field and learn what issues tunnel owners are facing to keep these facilities in good order. Seeing so many different tunnels showed us a wide variety of problems as well as solutions.”
 - “Being able to observe practices of major tunnel operators and builders was of great value.”
- The value of establishing professional relationships was also stressed: “Having a real-time contact for someone who is dealing with the same issues as you makes the scan enormously valuable.”
- It was noted that the scan findings will be used on an ongoing basis by AASHTO Technical Committee T-20 as future guidance for defining research needs for tunnels. It is expected to be used for years to come.
- A participant noted the surrogate role that participants play for others in their field: “You really do learn from talking to other people and finding out firsthand what their problems are. Not everyone can go on these trips, so we’re doing this work for those who can’t.” Another echoed that the scan findings will prevent others from having to repeat similar fact-finding efforts.

Scan best practices

- A participant lauded the efforts of the subject matter expert: “Due to the sensitive nature of much of the materials shared on the tour, the approval processes to be able to make this information public was a difficult process, and we owe thanks to a very detail-oriented subject matter expert.”
- A project panel member, noting that the scan results were used both for implementation and for further research, called this a “great example” of the scan program.

Barriers and opportunities for improvements

- The same security concerns noted above led to delays in approvals of materials for publication. This issue was discussed during the participant and panel webinar, and strategies were discussed for making all parties aware of potential security issues upfront. It might make sense to “red flag” this issue for future panels.
- One state was unable to arrange desired follow-up activity: “We tried to get a host state representative to speak at our state after the tour but were unable to arrange it.”
- A participant thought there was room for improvement for implementation: “I wish we could do better about not just implementing but getting the word out. A lot of time is spent writing reports, but few people have time to read them—often they just end up sitting on a shelf. This is why I think it would be good if the program budget included funding for webinars to go over scan highlights.”

Scan details

Scan team members

- Kevin Thompson, California DOT (co-chair)
- Jesus Rohena, FHWA (co-chair)
- Alexander Bardow, Massachusetts DOT
- Barry Brecto, FHWA Washington state office
- Bijan Khaleghi, Washington state DOT
- Louis Ruzzi, Pennsylvania DOT
- Michael Salamon, Colorado DOT
- Fulvio Tonon, University of Texas, Liaison to TRB Tunnels and Underground Structures Committee
- Mary Lou Ralls, Ralls Newman, LLC (subject matter expert)

Sites visited

- Alaska DOT (participation via webinar)
- California DOT
- Chesapeake Bay Bridge and Tunnel District
- Colorado DOT
- District of Columbia DOT (participation via webinar)
- Massachusetts DOT
- Pennsylvania DOT (participation via webinar)
- Port Authority of New York and New Jersey
- Seattle DOT
- Seattle Fire Department
- Sound Transit, Seattle
- Virginia DOT
- Washington State DOT

Scan dates

August 30–September 5, 2009; September 13–19, 2009

Final report

April 2011, http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_09-05.pdf

Participant interviews

CTC & Associates conducted interviews with participants shortly after the publication of the scan report. Most of the interviews were conducted by telephone, with a few respondents submitting answers via email instead.

Among the eight highway agency scan participants contacted, six participated in the interviews, including one individual who had retired from the public sector since the time of the scan. Responses to each of four questions are summarized and compiled below.

As appropriate, this information has been supplemented with information provided in the scan team's implementation plan ([Appendix D](#)) provided by Arora and Associates.

1. How have you implemented changes to your agency's policies, practices or technologies based on what you learned from participating in this scan tour? What implementation activities do you have planned?

- In general, we have tried to implement anything learned on the scan tour as part of the ongoing rehabilitation efforts of the tunnels in our district. As issues are raised during our design meetings, I have mentioned items I saw on the tour that might be appropriate to implement. As an example, we're implementing the green, text-free "running man" exit signs. On the scan we learned the importance of signage color: during a fire green signs are more visible than red ones. Overall we learned a great deal about fire safety, and I discussed this at length with our tunnel manager.
- I brought back a number of ideas to internal discussions, which allowed us to keep asking: "Have we considered this?" Some ideas make sense for us, and others don't, but we always talked about them.
- We tried to get a host state representative to speak at our state after the tour but were unable to arrange it.
- We made very few changes as a result of this scan, but we are exploring the possibility of a tunnel fire suppression system we learned about.
- Not yet; we were expecting the final report for implementation discussion.
- The information the scan produced was very valuable to our agency. We have a strong vested interest in the information synthesized in this report.
- We took advantage of a lot of the information gleaned from this report on major tunnels in our state. This was particularly true for rapidly changing technologies like Supervisory Control and Data Acquisition (SCADA) systems and information technology systems.
- FHWA's participation in this scan helped us see firsthand how tunnel owners are inspecting, maintaining and operating their facilities. After the tour we came back and FHWA developed guidelines in the form of the Tunnel Operations, Maintenance, Inspection and Evaluation (TOMIE) manual, now in a draft state.
- We used some of the information we learned, incorporating it into an existing project in our state.
- We incorporated the results we learned in the scan into the national tunnel inspection standards being developed for use by states and local agencies.

2. We will be surveying “secondary” audiences to assess the reach of the scan program beyond the participants themselves. Have you shared information you learned or contacts you made during the scan tour with others—either in your agency or beyond? Can you provide contact information or meeting names and dates?

- We sent the published scan report to all state bridge engineers via the AASHTO Subcommittee on Bridges and Structures.
- The scan was presented in two consecutive years at the Sunday workshops of the annual TRB conference. The January 2010 workshop focused on scan findings, and the January 2011 workshop addressed planned next steps of AASHTO’s Technical Committee T-20 (Tunnels) of the AASHTO Subcommittee on Bridges and Structures.
- A TOMIE Manual Workshop was held in March 2010 by AASHTO Technical Committee T-20.
- The scan team members presented two webinars as part of the National Highway Institute’s “Real Solutions” seminar series: Part 1 in March 2010 (<http://fhwa.na3.acrobat.com/p65975219/>) and part 2 in June 2010 (<http://fhwa.na3.acrobat.com/p21314576/>). This was conducted just a few months after the scan tour, and we advertised it through an FHWA publication.
- I made a presentation to the Pittsburgh chapter of the Association for Bridge Construction & Design in fall 2009.
- A presentation was made at the May 2010 International Bridge Conference in Pittsburgh.
- A presentation was given at the New York City bridge conference in July 2011.
- I spoke with a number of people in my agency.
- I have shared scan information with other tunnel operators within the state, with transportation officials within the state, and with engineering consultants.
- We are planning to discuss the scan outcome and report with others within our agency and our state.
- We were in a unique position as both a host and participant state. I discussed the scan with a number of colleagues involved in major tunnel projects.
- FHWA’s participation in this scan helped us see firsthand how tunnel owners are inspecting, maintaining and operating their facilities. After the tour we came back and FHWA developed guidelines in the form of the Tunnel Operations, Maintenance, Inspection and Evaluation manual, now in a draft state.
- I furnished some information to our program manager for Seattle’s Alaskan Way tunnel project, and I believe he was invited to a scan debrief on technologies for new tunnels. I also provided information to the FHWA representative in charge of developing national tunnel inspection standards.

3. How would you characterize the overall value of this scan tour? What comments would you like to share for the summary report on this project?

- The scan is valuable input to NCHRP project 14-27, “A Guide for the Preservation of Highway Tunnel Systems” (<http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3173>), now in its early stages.
- This effort dovetails with FHWA’s TOMIE manual. Items developed in the scan were beneficial in putting the TOMIE Manual together. It is in its final stages of rulemaking and has not yet been released. These efforts go hand-in-hand.
- Much of the work in the implementation plan went into AASHTO’s Technical Committee T-20 (Tunnels) planned research list. We had over 20 recommendations to do research as part of NCHRP 20-07, “Research for AASHTO Standing Committee on Highways” (<http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=509>)
- The scan’s implementation plan also identified the research need for the three-year NCHRP project 12-89, “Recommended AASHTO LRFD Tunnel Design and Construction Specifications” (<http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2967>) which is well under way. This research was developed in close collaboration between AASHTO T-20 and TRB Committee AFF60 (Tunnels and Underground Structures).
- The scan came at a good time when several groups had recognized the need for the development of standards for roadway tunnels through research. The scan was incredibly valuable and ultimately improved the scope of new research now in progress.
- Having a real-time contact for someone who is dealing with the same issues as you makes the scan enormously valuable.
- You really do learn from talking to other people and finding out firsthand what their problems are. Not everyone can go on these trips, so we’re doing this work for those who can’t. That’s a reason I support the U.S. Domestic Scan Program.
- I wish we could do better about not just implementing but getting the word out. A lot of time is spent writing reports, but few people have time to read them—often they just end up sitting on a shelf. This is why I think it would be good if the program budget included funding for webinars to go over scan highlights.
- The better we can disseminate this information, the more value the scans would have.
- In response to bad publicity for FHWA’s International Scan Tour Program, I would state that these reports were far from being a junket—quite the opposite, in fact. They were hard work, involving late nights and early mornings at airports, working weekends, and through all of it finding time to fit in your own work. It was difficult but worth it.
- I thought the scan was highly informative.
- The scan was very much needed because tunnel operators have not had a good national venue to share ideas and best practices.
- Being able to observe practices of major tunnel operators and builders was of great value.
- The scan tour was very valuable, and lessons learned from the scan are beneficial to current tunnel design construction, maintenance, inspection, and operations practices.

- The subject matter expert was outstanding. Due to the sensitive nature of much of the materials shared on the tour, the approval processes to be able to make this information public was a difficult process, and we owe thanks to a very detail-oriented subject matter expert.
- The scan report was an incredibly value piece of information. It’s the only thing I know of that pulled the information from major tunnel operators in the United States into one document.
- This was a very valuable tour to do to see firsthand how things are done in the field and learn what issues tunnel owners are facing to keep these facilities in good order. Seeing so many different tunnels showed us a wide variety of problems as well as solutions.
- I thought the scan was very informative. It provided information on existing tunnel operations and considerations—what worked and what didn’t, and that information isn’t available anywhere else. It was a successful information and technology sharing effort.

4. Please rate the following outcomes in terms of their contribution to the value of this scan tour, where 1 is “not important” and 5 is “extremely important.”

	Not Important 1	2	3	4	Extremely Important 5	Average
Introduction to (or clearer understanding of) a new technology or practice				2	4	4.7
Identification of one or more individuals, either at host state or on the scan team, to call on as a future resource				2.5	3.5	4.6
Information with which to <i>begin</i> implementation of a technology or practice at your agency				3.5	2.5	4.4
Information with which to <i>continue</i> implementation of a technology or practice at your agency		1		2	3	4.2

Participant webinar

Available scan tour participants and NCHRP project panel members took part in a webinar following the participant interviews. The purpose of the webinar was to discuss the initial findings of the scan, to review technology and implementation efforts to date and to plan follow-up activities. Details on the webinar follow.

Date

March 9, 2012

Attendees

Facilitators

- Patrick Casey, CTC & Associates, LLC
- Brian Hirt, CTC & Associates LLC

Scan Team Members

- Kevin Thompson, California DOT (scan co-chair)
- Jesus Rohena, FHWA (scan co-chair)
- Alexander Bardow, Massachusetts DOT
- Bijan Khaleghi, Washington state DOT

Panel Members

- Shane Brown, Washington State University
- Mike Burk, FHWA
- Nancy Chinlund, California DOT
- Rick Kreider, Kansas DOT

Guest

- Batia Wiesenfeld

Presentation

- <http://domesticscan.org/wp-content/uploads/Scan09-05Webinar.pdf>

Open Discussion Summary

Scan participant Kevin Thompson commented that the timing for this scan was particularly good with respect to the efforts of Technical Committee T-20 (Tunnels) of the AASHTO Subcommittee on Bridges and Structures. The starting point was 2005 with the international tunnel scan, which highlighted the lack of standards in the United States. Shortly thereafter T-20 developed a manual with guidance though not standards. Later, T-20 members did significant preparatory work for this Domestic Scan, including identifying the right participants.

Thompson also noted how the timing of the scan dovetailed with related efforts, such as NCHRP Project 12-89, “Recommended AASHTO LRFD Tunnel Design and Construction Specifications” and 14-27, “A Guide for the Preservation of Highway Tunnel Systems.” He noted that the scan findings were presented at the May 2010 International Bridge Conference in Pittsburgh, which included an hour-long workshop on the findings, and at the 2010 and 2011 annual TRB meetings. Two NHI webinars on the scan findings were also conducted in 2010.

Thompson stressed that the Domestic Scan findings are a product that T-20 continues to use as guidance for future research on tunnels. Exploration of research ideas from the scan will go on for years; he considers this part of the ongoing implementation of this scan.

Scan participant Jesus Rohena said that FHWA is continuing research and will keep moving forward with its efforts. He said the National Tunnel Inspection Standard is a key initiative and that FHWA incorporated what it learned in the scan. He noted that the final rule is under review right now, and he expects it to be available to the public soon.

Rohena mentioned the Tunnel Operations, Maintenance, Inspection and Evaluation (TOMIE) manual, which after two years is in draft form and is nearly complete. He said that what he learned in the scan were very valuable for FHWA regarding topics addressed by the TOMIE manual.

As a participant of both the international and domestic scans on this topic, Rohena noted that many of the issues in the domestic scan were similar to those in the European one. It was informative for him to be part of both and to observe the parallels.

Scan participant Alex Bardow commented on his perspective both as a host state (Massachusetts' "Big Dig") and scan participant. He said that interacting with other tunnel owners and learning about their issues—how they deal with aging equipment, what are their capital and maintenance needs—were a "wealth of information" and very important to him.

He summarized the value of the report as twofold:

- There is a lot of information about tunnel and tunnel ownership that we can build upon here at MassDOT—or that other owners could do likewise—without having to do a similar query like the tour or repeat the scan's efforts
- The scan is a roadmap for T-20 in identify the need for research, manuals and other guidance

On the topic of scan tour challenges and what might be done differently in the future, Thompson said that the subject matter expert, Mary Lou Rawls, struggled with getting technical materials from hosts, or in getting approval to publish these materials, due to security issues. It caused a significant delay in the publication of the report, though Thompson praised Rawls' efforts.

Project panelist Rick Kreider asked whether anything could be done to address this concern for other scans (he gave intelligent transportation systems as an example where this could arise again). The call attendees discussed this topic at length, noting that what staff on the host teams considered sensitive and what people with final agency approval considered sensitive were often not the same. Webinar guest Batia Wiesenfeld suggested possibly making only some materials available to individuals who are first vetted rather than to the public at large, though it was unknown if such measures could be enforced. Scan participant Bijan Khaleghi said that it was important to the team that the information in the report would be made available to the public and would be usable by others. Thompson suggested that making all parties aware upfront of security issues may be the best available course of action. It might make sense to "red flag" this issue for future panels.

Project panelist Nancy Chinlund said that she did not have any specific questions, but she enjoyed hearing about the scan. She said it sounded like it was timely, that there was a good foundation laid for it, and that the results were used for implementation and for further research. She called it a "great example" of the scan program.

Project panelist Mike Burk said that based on the conversation during this webinar, he was coming to conclude that the greatest value of the report is forwarding the dialog among professionals on these topics, leading to further peer review and evolution of technologies and practices. Burk said, “It’s not just a standalone document,” drawing a distinction between a project that delivers just-in-time knowledge with one that moves practice and technology forward through continued discussion and debate.

Chinlund agreed, noting the how the influence of the scan seems to attenuate when it comes to actual implementation: Based on the nonparticipant survey, interest in the findings is high but implementation is lower. Nevertheless, the scan serves to moves the whole body of practice forward.

Nonparticipant survey

To gather more information about the reach of the scan tour findings and to trace the paths through which information about the scan findings spread beyond the initial participants, CTC & Associates conducted an online survey of nonparticipants—individuals who did not participate in the scan but who were identified as having received information about it.

Based on participant interviews and input as well as the implementation plan for this scan compiled by Arora and Associates, we identified the activities—meetings, presentations and report distributions—through which the scan likely reached secondary audiences. We contacted the organizers of those activities and searched the Web to obtain attendee lists and distribution rosters. From these lists we surveyed representatives of state DOTs, other highway agencies, and federal agencies, totaling 116 names from the following two lists:

- A distribution to the AASHTO Subcommittee on Bridges and Structures and its Technical Committee T-20 on Tunnels
- Participants in the March 2010 Tunnel Operations, Maintenance, Inspection and Evaluation Workshop

Scan team members provided the 10 additional names of colleagues with whom they spoke about the scan findings.

The results of the nonparticipant survey (question 6, “If you talked to colleagues or peers about the scan tour results, we would appreciate it if you could share their names and agencies.”) provided two additional names of DOT staff who had been involved in an implementation of scan technology or whom they had spoken to about the scan findings. Surveys were sent to these two individuals as well.

In all, CTC & Associates sent the nonparticipant survey to 128 individuals. Recipients received the following email, modified as appropriate to indicate the venue of the scan presentation they attended:

Hello,

The National Cooperative Highway Research Program is conducting research to evaluate how the innovative technologies and practices identified through its U.S. Domestic Scan Program (<http://domesticscan.org>) are being used by transportation practitioners beyond the initial scan participants.

*You were identified as having received information about **Scan 09-05: Roadway Tunnel Design, Construction and Maintenance**. We would appreciate a few minutes of your time to complete a brief survey (7 questions) on your use of the scan findings. Your responses will help NCHRP evaluate the reach of this scan and the overall value of the U.S. Domestic Scan Program.*

The survey is available at <http://www.surveymonkey.com/s/ZMYN29W>.

If you have any questions about this NCHRP research effort, please feel free to contact me at the phone number or email below. You can also contact TRB Senior Program Officer Andrew Lemer at ALemer@nas.edu or (202) 334-3972. Thank you for your time and your participation.

The survey itself also included the following introductory text:

The National Cooperative Highway Research Program sponsors the [U.S. Domestic Scan Program](#) to facilitate technology transfer among state DOTs. As part of the program, CTC & Associates is conducting this survey on behalf of NCHRP to evaluate how the technologies and practices identified through the scans are being used by transportation practitioners beyond the scan participants.

*You were identified as having received information about **Scan 09-05: Roadway Tunnel Design, Construction and Maintenance** (see the [project Web page](#) or [final scan report \[PDF\]](#)). Your feedback about how you learned about this scan—and how the scan findings are being used at your agency—will be of great value to NCHRP and the transportation community.*

Thank you for taking the time to complete this short seven-question survey.

Responses

A total of 24 people responded to the survey, a 19 percent response rate. These responses are compiled below.

1. (Required) Please provide your name and organization. This information will not be published.

All 24 survey respondents represented state DOTs.

Accounting for multiple responses from the same agency, respondents represented a total of 22 different agencies.

- Three of these agencies were the same as those agencies represented in the Scan Team membership.
- Four of these agencies were the same as those who participate as host states (including those who joined this scan via webinar rather than as an on-site host).

2. HOW YOU LEARNED ABOUT THIS SCAN. The scan findings were disseminated and presented through a number of channels. How did you learn about the scan results? (Check all that apply.)

	Number responding	Percent responding
Conversation or email with a colleague at my organization	5	21%
Conversation or email with a scan participant or host state member	3	13%
Received final scan report from an AASHTO distribution	10	42%
TRB Annual Meeting	1	4%
National Highway Institute webinars (March and June 2010)	1	4%
Another national or regional conference (please describe in the “Other” box below)	3	13%
Journal paper or trade publication article	0	0%
I don’t remember learning about this scan tour prior to this survey	5	25%
Other (open-ended) <ul style="list-style-type: none"> • E-mail from AASHTO • AASHTO SCOBS Meeting Western Bridge Engineers’ Seminar in Phoenix • AASHTO Subcommittee on Bridges and Structures • As an assistant to the T-20 Chair and a host state, I help the scan team with information on California tunnels 	4	17%

3. SOUGHT MORE INFORMATION. If you sought more information about the findings of the scan tour, please indicate how. (Check all that apply.)

	Number responding	Percent responding
Obtained or read the scan report	8	33%
Visited the website domesticscan.org	1	4%
Contacted a scan participant	2	8%
Contacted someone from one of the states visited in the scan	0	0%
Other (open-ended) <ul style="list-style-type: none"> • FDOT only has one tunnel and one under construction, so not a top priority • Did not need any further information • N/A (<i>two respondents</i>) 	4	17%
Specific technologies or practices discussed (open-ended) <ul style="list-style-type: none"> • Tunnel lighting, various coatings or liner systems and radio reception systems • None 		

4. SHARED INFORMATION WITH OTHERS. If you shared information about one or more of the technologies or practices identified through the scan, please describe how. (Check all that apply.)

	Number responding	Percent responding
Shared information with a colleague at my organization	8	33%
Shared information with other stakeholders in my state	1	4%
Recommended a change in practice at my organization	1	4%
Other <ul style="list-style-type: none"> N/A (<i>two respondents</i>) 	2	8%
Specific technologies or practices discussed (open-ended) <ul style="list-style-type: none"> Tunnel lighting, various coatings or liner systems and radio reception systems Emergency exit procedures 		

5. IMPLEMENTED SCAN FINDINGS. If you used information from the scan tour to make or recommend a change to your agency’s practices, please indicate how.

	Number responding	Percent responding
Proposed implementation	1	4%
Planned implementation	1	4%
In-progress implementation	1	4%
Completed implementation	1	4%
Please provide details on the implementation (open-ended) <ul style="list-style-type: none"> Our agency does not have tunnels it maintains so the information was not needed No planned implementation at this time Not yet implemented (<i>response: proposed implementation</i>) (1) Emergency response plan; (2) Develop and share inspection practices; (3) Develop seismic design criteria; (4) Develop standards and guidance for tunnels (<i>response: proposed, planned and in-progress implementation</i>) MoDOT is currently reviewing our tunnel inspection/maintenance guidelines and may incorporate some of the best practices identified (<i>response: proposed implementation</i>) Soil loadings better understood and applied (<i>response: completed implementation</i>) N/A Still reviewing findings Fire and safety exits 		

6. CONTACTS. If you talked to colleagues or peers about the scan tour results, we would appreciate it if you could share their names and agencies. This information will not be published.

A total of three names were provided. One of these was a scan tour participant. The other two were state DOT representatives who were later sent this nonparticipant survey.

7. OTHER COMMENTS. Please use this space to provide any additional comments about your use of the findings of the scan tour.

	Number responding	Percent responding
Open-ended response	8	33%
<ul style="list-style-type: none"> • Delaware has no tunnels • Our State does not have tunnels. • Michigan DOT is not currently proposing any tunnel applications or projects. • Very helpful source of information for tunnel systems. • NH does not have any tunnels, so, although I may have seen this information, I would not have paid any attention to it. • We have a tunnel project coming up in the future. This was an information gathering attempt. • Illinois does not have any tunnels as defined in the definition, therefore this report and information is not necessary at this time. • Upcoming Rehab at Squirrel Hill Tunnel will implement standard emergency exits. 		

5

Domestic Scan Program Website

In addition to tracking the reach and implementation successes six scans in the U.S. Domestic Scan program, another part of NCHRP project 20-68B was continued development and maintenance of the program’s website. CTC & Associates developed the program’s site, <http://domesticscan.org>, which originally launched in August 2010. A screen shot of the website’s home page, current as of October 2012, is shown in Figure 7.1.

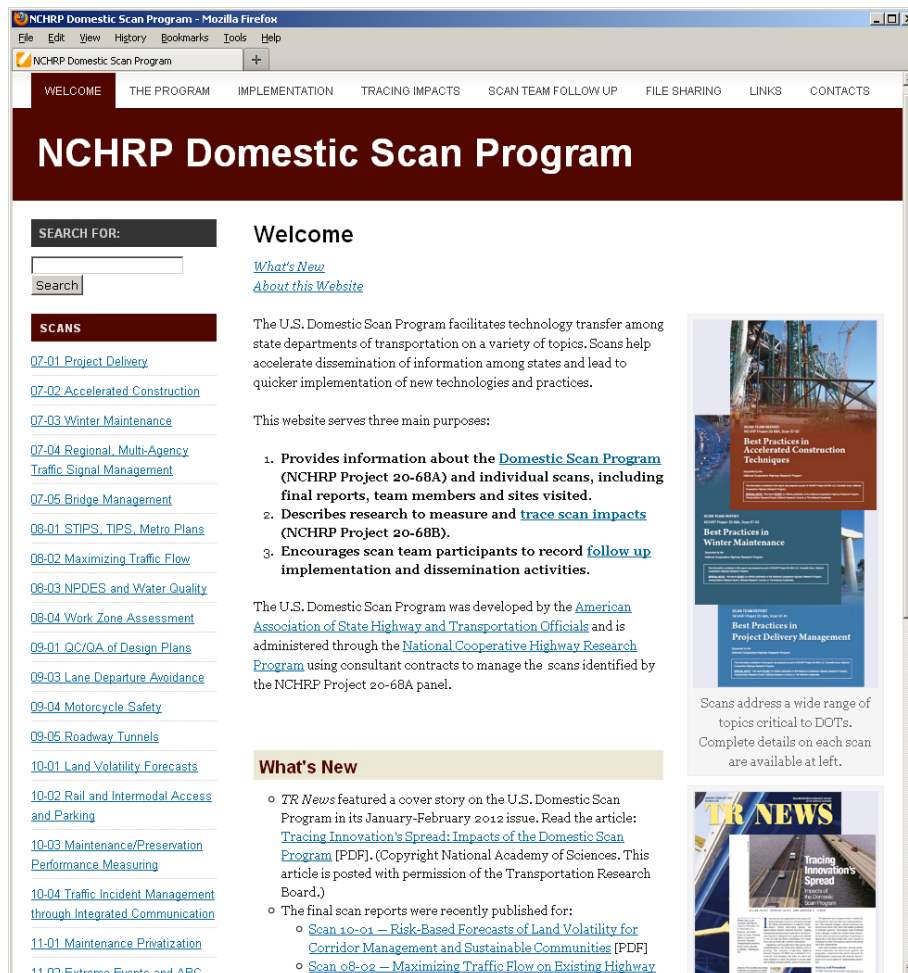


Figure 7.1. The U.S. Domestic Scan program website.

The site was designed to serve multiple purposes:

- To provide overview information on the U.S. Domestic Scan program.
- To provide summary information on all scans conducted through the U.S. Domestic Scan program, whether completed, in-progress, or planned.
- For completed scans, to provide a page with collateral documentation of interest to scan team members, stakeholders, and the public.
 - For a given scan, this typically includes information on the scan itself (prospectus, final report, executive summary, and final presentation) as well as documentation related to the follow-up technology transfer and dissemination activities described in this report (the participant webinar presentation and the memorandum on the webinar and participant interviews)
- To provide a forum for discussion of follow-up technology transfer and implementation activities.

Developments

Over the past year, several upgrades and additions have been made to the website, based on input from the NCHRP project panel and discussions with scan facilitator Arora and Associates:

- The content of the home page and the main subordinate pages was reordered, streamlined and updated.
- The site was restructured and reorganized to accommodate 13 of the later scans that previously did not have dedicated pages in the earlier builds of the website.
- At the request of an NCHRP project panelist, a page titled Implementation (<http://www.domesticscan.org/implementation>) was created. The page lists several methods for disseminating scan information and for implementing findings, both at the state and national levels, that previous scan members found successful. These can serve as useful illustrations for members of new scan teams.
- The general “Participant Blog” was replaced with two member-only web tools. (Both have a common user name and password shared with all scan team participants and NCHRP project panel members):
 - A “File Sharing” page for individuals to share scan-related files: implementation plans, desk scans, presentations, etc. Arora and Associates has used this page to post relevant files for in-progress scan.
 - A “Scan Team Follow Up” page for scan team members to report specific instances of information dissemination or implementation of scan findings.

Site use and statistics

Web activity for the U.S. Domestic Scan program website remains steady. A summary of site activity in the 13-month period from September 2011 to October 2012 follows.

- 979 visitors with a total of 5,983 page view. (By comparison, during the previous 13-month period of August 2010 to September 2011 as reported in the last “Tracing Scan Impacts” report, the site had 915 visitors and a total of 3,304 page views).
- The most commonly visited pages in this time period were:
 - Home page (1,613 page views)
 - File sharing page (593 page view)
 - Domestic Scan program overview page (296 page views)
- The most commonly visited scan pages in this time period were:
 - Scan 09-01—QC/QA of Design Plans (205 page views)
 - Scan 09-04—Motorcyclist Safety (187 page views)
 - Scan 09-05—Roadway Tunnels (134 page views)
- The United States was the greatest source of visitors (936 visits). Canada was a distant second (8 visits).
- The most common referring website was SurveyMonkey.com (174 visits), followed by trb.org (150 visits).

Appendix A

Compiled by Arora and Associates

Domestic Scan 08-04 Implementation Strategy

The scan team identified 7 potential dissemination avenues for the results of this scan. These avenues are listed below.

- Presentation of scan findings at relevant conferences and meetings
- Publication of summary article(s) regarding the scan findings in pertinent journals and trade publications
- Development and presentation of webinars
- Development of research problem statements and inserting them as appropriate into the funding cycles of various r
- Development of a summary brochure that can help “market” the scan report and its findings to agencies
- Development of demonstration workshops highlighting innovative practices and technologies identified through th
- Development of a marketing video that would raise the awareness of the scan report and its findings amongst agen

Scan Findings Presentations

As of 10/18/10

Coordinator: Tracy Scriba and Denise Markow

Venue	Date	Location	Team Member Presenting	Status	Audience
National Events					
AASHTO SSOM Meeting	May 2-5, 2010	Houston	Tracy	Done	State Ops folks, Consultants, FHWA
AASHTO SCOTE	June 27-30, 2010	Chicago	KC	Done - presented to WZ task force with subsequent discussion, and to whole SCOTE. Summary report distributed to overall SCOTE chair and SCOTE WZ task force chair	State Traffic folks, Consultants, FHWA
AASHTO Construction AASHTO Design AASHTO Maintenance ITE ARTBA IMSA AGC I-95 Corridor Coalition AGC		Vancouver, BC			
TRB 1/2 Day Workshop	Jan 23, 2011	Washington, DC	Multiple team members plus a couple of States we scanned	Done. Agenda developed by Jerry, Tracy, Denise	Researchers, Consultants, State DOTs
Regional Events					
NC/SC ATSSA Chapter			Stuart	Tentative	
Southeast Regional ITE Meeting			Stuart	Tentative	
Transportation Engineering & Safety Conference	December	Penn State Univ	Reynaldo	Scheduled - will cover what Ohio shared with the team during the scan	
State Events					
Virginia ATSSA Chapter			Stuart	Tentative	
NCSITE			Stuart	Tentative	Private Engineering Firms, Municipalities, NCDOT staff
CA ATSSA Meetings			Diana	Tentative	
Ohio ATSSA Chapter Meeting	June		Dave/Reynaldo	Tentative	
Internal Meetings					
NHDOT Quarterly TCC Meeting	April		Denise	Done	
District WZ Traffic Managers meeting	May		Dave/Reynaldo	Planned	
NC Traffic Safety and Mobility Division	May/June		Stuart	Planned	
NC Chief Engineer's Staff Meeting	June		Stuart	Planned	

Scan Articles

As of 5/6/10

Coordinator: . Gerald Ullman and Diana Gomez

Publications	Article Title	Date	Resources	Task Lead	Status	Note
ITE Journal						
Roads						
Bridges						
FHWA Focus						
Public Roads						
TRB Transportation News						

Scan Webinars

As of 10/18/10

Coordinator: Chung Eng and K.C. Mathews

Webinar Title	Date	Resources	Task Lead	Status	Note
Best Practices in Work Zone Assessment, Data Collection, and Performance Measurement	Sept 16 2:30–4pm Eastern	FHWA webconferencing system	Chung	Done	Webinar invitation provided to overall SCOTE chair and SCOTE WZ task force chair Recording of webinar is available at http://fhwa.na3.acrobat.com/n134083201009/

Problem Statements

As of 10/18/10

Coordinator: Gerald Ullman and Stuart Bourne

Topic	Date	Funding Sources	Task Lead	Status	Note
Evaluation of the Effectiveness of Contract Incentives for Improving WZ Traffic Impacts and Performance	9/28/2010	Smart WZ Deployment Initiative Pooled Fund	Tracy	Submitted	Submitted for consideration for 2011 research projects; may not get selected.

Summary Brochure

As of 11/29/10

Coordinator: Stuart Bourne and Chung Eng

Date	Funding Sources	Task Lead	Status	Note
11/22/2010		Stuart Bourne and Chung Eng	The draft brochure is being reviewed by the scan team	

Workshop

As of 5/6/10

Coordinator: Chung Eng and Diana Gomez

Topic	Date	Location	Task Lead	Status	Note

Summary Brochure

As of 5/6/10

Coordinator: Brian Zimmerman and Denise Markow

Date	Funding Sources	Task Lead	Status	Note

Domestic Scan 09-01 Best Practices in Quality Control and Quality Assurance in Design

Planned Implementation Activities

V 4.4.12

Implementation Strategy

The Team is committed to implementing the findings of this Scan. Many important programs, strategies and solutions were identified in the Scan that would be of benefit if implemented at other DOTs. The Team plans to initiate implementation activities such as the following immediately upon completion of the Scan Report:

- Presentations at AASHTO committees, TRB sessions, ASCE, and other conferences.
- Use of the project PowerPoint® developed for the scan trip for in-house DOT presentations and presentation to local transportation organizations by the Scan Team members.
- Development of Educational Webinars and an Information Website
- Publication of articles in journals and other industry related publications such as *Roads and Bridges*, *CE News*, *FHWA FOCUS Newsletter*, etc.
- Communication with the FHWA on successful solutions.

The above are general options the Team will use as opportunities are identified.

Implementation Activities

The Scan Team has developed a roster of specific implementation activities to publicize the information from the Scan. The activities, a description and a target completion date listed in chronological order are:

- Presentation at the Transportation Research Board (TRB) Annual Meeting covering the Scan Summary Report. The Scan Team PowerPoint and Summary Report will be presented at the TRB Annual Meeting during the session of the General Structures Subcommittee. The TRB is one of six major divisions of the

- National Research Council— a private, nonprofit institution that is the principal operating agency of the National Academies in providing services to the government, the public, and the scientific and engineering communities.
Target date: January, 2011.
Lead: Richard Dunne
Status: Completed – the Scan Summary was presented to the participants.
- Lecture and Webinar at the University at Buffalo. The Bridge Engineering Distinguished Speaker Series engages experts from the national bridge community to share their knowledge on a variety of themes, including specialized technical topics, project development, public policy and management issues. The series began in November 2009, in collaboration with AASHTO’s Subcommittee on Bridges & Structures, and with the support of the Federal Highway Administration. Held on Mondays starting at 5:00 p.m. ET, these lectures are part of a new masters program in the Department of Civil, Structural and Environmental Engineering at the University at Buffalo that focuses on bridges. In addition, professional engineers can receive NYS PE professional development credit by either attending the seminar in person or by attending the webinar. More information can be found at:
http://mceer.buffalo.edu/education/Bridge_Speaker_Series/default.asp
Target Date: April 11, 2011
Lead: Hossein Ghara
Status: Completed
 - Letter to the FHWA Office of Bridge Technology. As a result of the 2007 collapse of the I35W Bridge in Minneapolis, the National Transportation Safety Board issued a recommendation that FHWA and AASHTO work together to develop guidance to States on QC/QA processes in Bridge Design. FHWA plans to release this guidance memo in June of 2011. The Scan Team will provide the summary report and a recommendation letter to FHWA to aid them in the finalization of this guidance memo.
Target Date: April 30, 2011
Lead: Hossein Ghara, Kelley Rehm
Status: Completed – the letter was sent to Myint Lwin on April 15, 2011
 - AASHTO Annual Subcommittee on Design Meeting. The conference convenes over 100 AASHTO Subcommittee members including all 50 State Design Engineers as well as Highway Design Consultants, Contractors and Suppliers. The presentation will be given at the meeting in St. Louis, MO in conjunction with the AASHTO Subcommittee on Right of Way. Estimated travel funding needed is \$1000.
Target date: May 9, 2011
Lead: Tim Swanson

Status: Completed

- AASHTO Annual Subcommittee on Bridges and Structures Meeting. The conference convenes over 100 AASHTO Subcommittee members including all 50 State Bridge Engineers as well as over 400 Bridge Design Consultants, Contractors and Suppliers. The presentation will be giving at the General Session of this meeting in Norfolk, VA. The cost of travel is being covered by other travel funding.

Target date: May 15-19, 2011.

Lead: Robert Healy

Status: Completed – Approximately 48 states were represented and a total of 500 people were in attendance.

- Webcast through the Federal Highway Administration or the National Highway Institute, or through the scan contractor Aurora and Associates. Possible administration costs for the webinar are estimated at \$500.

Target date: Summer 2011.

Lead: TBD

Status: IN DEVELOPMENT

- Technical Paper Presentation at the Western Bridge Engineers' Seminar. The Summary Report and PowerPoint have been submitted and accepted for presentation at the Western Bridge Engineers' Seminar. This seminar is a biennial cooperative effort by the Federal Highway Administration Western Resource Center and the Transportation Departments of Alaska, Arizona, California, Idaho, Nevada, Oregon, and Washington. Its purpose is to facilitate the exchange of information between practicing bridge engineers in government agencies, consultants, contractors, educators, and suppliers on subjects of current importance to the design, construction, and maintenance of bridges. The 2011 Western Bridge Engineers' Seminar will be hosted by the Arizona Department of Transportation.

Target date: September 25, 2011

Lead: Michael Wright

Status: Confirmed on the agenda: Session 2C, Monday, September 26, 2011.

- Develop a National Cooperative Highway Research Program (NCHRP) 20-07 Proposal or full NCHRP research project proposal. The NCHRP conducts research relative to highway planning, design, construction, operation, and maintenance nationwide. The NCHRP program is operated by the TRB. Potential research topics are provided in the Recommendations section of this report and could involve more in-depth investigation into metrics of quality.

Target date: October 2011.

Lead: TBD

Status: IN DEVELOPMENT

- Development of a Website to house quality document examples and act as a clearinghouse for quality research and tools. It may be possible to use the AASHTO website for this purpose. The Scan team will help with population of the site and the site will be linked to other relevant quality sites.

Target Date: Fall 2011

Lead: Kelley Rehm

Status: IN DEVELOPMENT

- Workshop at the Transportation Research Board (TRB) Annual Meeting. A Workshop sponsored by the General Structures Subcommittee has been submitted for the TRB Annual Meeting. General overviews of the scan will be given along with in depth presentations from scan team members and invited host states on successful solutions. Four to five scan team members and host state representatives will participate in Washington D.C. Travel costs are estimated at \$3500 for half of the participants (others will be paid for with alternate travel funding)

Target date: January, 2012.

Lead: Richard Dunne

Status: completed

- Work with AASHTO Publications to update the AASHTO Quality in Preconstruction guide document to represent what has been implemented within the scan and to help fulfill the NTSB Recommendation that FHWA and AASHTO work together to provide QC/QA guidance to the states.

Target date: Summer 2012

Lead: Kelley Rehm

Status: IN DEVELOPMENT

Other Recommendations

The Scan Team developed supporting recommendations supporting the primary recommendations which may be implemented through future research. The scan team found that in many cases it is hard to quantify the benefit of quality control and assurance procedures. In the future, it would be useful to identify the marginal benefit of more quality control. For example, if you spend another hour reviewing a set of plans, how much quality does that add to the overall project? This also requires determination of how to measure that incremental increase in quality and identification of useful performance measures.

- **Collect accurate cost data** – Identify States and other agencies that are measuring time spent on quality control and assurance efforts and quantify the costs versus the benefits of these efforts.

- **Development of metrics to measure quality** - investigate ways that States and other agencies are measuring quality in their designs and identify useful performance measures for quality.

Budget

Event	Unit	Budgeted Cost
AASHTO Subcommittee on Design – St. Louis, MO	1 Person	\$1500
TRB Workshop 2012	3 people	\$3000
Webinar and Website	Administrative	\$500

TOTAL = \$5000.00

Scan 09-04

Implementation

The scan program is dedicated to disseminating the scan results to the broadest possible audience. Team members will implement an outreach phase that includes promoting the key findings through this final report, in related publications, by giving presentations, and by sharing ideas with colleagues. The benefits of the scan can only be realized if stakeholders adopt and implement the team's recommendations.

Scan team members will serve as catalysts to encourage and promote broader awareness of motorcycling safety issues and adaptation of the successful practices identified through their efforts. Specific plans include the following:

- Conduct outreach to FHWA, AASHTO, TRB, ITE, MIC and other national organizations for support in improving motorcycle VMT estimates.
Plan: Develop a problem statement for submission to the NCHRP on the lack of valid and reliable motorcycle VMT data.
- Develop guidelines and materials to improve the awareness and training of transportation design, construction, maintenance, and operations staff. Provisions should be made in roadway design guidelines regarding motorcyclist safety.
Plan: Make presentations to appropriate AASHTO, SASHTO, WASHTO, NACTO, TRB, and ITE committees to encourage the FHWA to work with states to develop useful materials and guidelines.
- Implement outreach to encourage states to create MSCs.
Plan: Obtain details from Florida, Wisconsin, and Idaho on the development and operation of their coalitions. Request that Florida prepare a webinar on the topic. Team members will work within their own states to form coalitions, while also identifying other outreach opportunities. Coordinate with the international scan team, which is developing a toolbox on this topic.
- Develop an NCHRP Problem Statement to establish guidelines for pavement marking friction standards. Recommend that a synthesis be performed under NCHRP Project 20-5.
- Deliver Webinars to states and local jurisdictions on the following topics:

- Communication, that is, publish all roadway construction, maintenance, and hazardous location information on state DOT Web sites and social media outlets (e.g., Facebook and Twitter); send the information directly to motorcycle rider advocacy groups. Allow riders and motorists to report hazardous conditions to a state Web site using a 511 network, social media, or similar approach. Share and customize motorcycle safety outreach materials from other states and the federal government.
- Share information about successful strategies with city and county engineering, construction, maintenance, and traffic operations staff.

Plan: Create PowerPoint presentations, distribute the FHWA brochure, and invite the visited states to develop materials for topical Webinars.

- Create an e-document to enhance awareness of motorcycle safety-related issues in construction and maintenance practices.
Plan: Collect and highlight successful strategies in an easy-to-read document, then disseminate it electronically through the NCHRP newsletter, AASHTO newsletter, and FHWA Web site.
- Recommend to the AASHTO National Committee on Uniform Traffic Control Devices¹ that the use of the motorcycle placard language be changed from “may” to “should”.
Plan: Ask a statewide traffic engineer to make this recommendation.

¹ National Committee on Uniform Traffic Control Devices, <http://www.ncutcd.org/execboard.shtml>

**NCHRP 20-68A, Scan 09-05
U.S. Domestic Scan Program**

**Best Practices for Roadway Tunnel Design, Construction,
Maintenance, Inspection, and Operations**

Scan Team Implementation Plan (STIP)

Introduction

The scan team identified a number of highway tunnel initiatives or practices of interest for nationwide implementation or for further evaluation for potential nationwide implementation. The implementation of the scan team's top eight recommendations will be a step in the process of developing national standards and guidance. Scan findings will also provide data for consideration in the development of a national tunnel inventory. These activities will assist the AASHTO Highway Subcommittee on Bridges and Structures (HSCOBs) Technical Committee for Tunnels (T-20) and FHWA in developing best practices for roadway tunnel design, construction, maintenance, inspection, and operations of existing and new tunnels.

The lead group for implementation of scan recommendations is anticipated to be T-20 in conjunction with FHWA and the TRB Tunnels and Underground Structures Committee, and working with the National Fire Protection Association (NFPA) and other tunnel organizations. The scan team will present its findings and recommendations to T-20 during the January 2010 TRB Annual Meeting. Initial scan team efforts also include distribution of the FHWA Tunnel Safety brochure that was developed following the 2005 international tunnels scan and providing additional information on the FHWA tunnels website. Other planned activities include coordination and development of research statements related to tunnel needs. The scan team also plans technical presentations, webinars, and written papers in various publications and at national meetings and conferences sponsored by FHWA, AASHTO, and other organizations to disseminate information from the scan.

Strategies and Actions

The implementation plan strategies and activities for the scan team's top eight recommendations are described below.

1. Develop standards, guidance, and best practices for roadway tunnels.

Background

Design criteria for new roadway tunnels should consider:

- Performance-based construction specifications

- Design recommendations for extreme events (manmade and natural) and tunnel security and blast, lifeline, etc.
- Design criteria for vertical, horizontal clearances, and sight distance
- Criteria for tunnel design life and future maintenance for structural, mechanical, electrical, and electronic systems
- Criteria for new tunnel load rating
- Seismic design criteria for one-level versus two-level design events
- Americans with Disabilities Act (ADA) requirements for emergency egress
- Placement and layout of the tunnel operations center

Rehabilitation of existing tunnels should consider obsolescence, tunnel design life, high-performance materials, and existing geometry to maximize safety and system operation.

Tunnel systems are generally complex and expensive in terms of capital costs. The use of peer review teams and technical advisory panels with subject matter expertise should be considered in developing site-specific criteria. Risk management of complex systems is important. Redundancy of systems, e.g., using the Supervisory Control and Data Acquisition (SCADA) system, is important.

Develop contract procurement guidelines for roadway tunnels to include design-bid-build, design-build, design-build-operate-finance, etc., considering to the extent applicable the Underground Construction Association's "Recommended Contract Practices for Underground Construction."

Develop design and construction standards and guidelines for tunnel construction methods such as the use of Tunnel Boring Machines versus conventional tunneling, design criteria including seismic design, and lifeline requirements. Conventional tunneling methods include the Sequential Excavation Method (SEM), the New Austrian Tunneling Method (NATM), the Analysis of Controlled Deformations (ADECO), and cut-and-cover.

Some of the above topics will be addressed in a proposed research project to develop LRFD design specifications and guidance for new and existing tunnels that was submitted to NCHRP in 2009 by the AASHTO Subcommittee on Bridges and Structures.

Implementation Strategies (Kevin)

The implementation strategy for developing national design standards, guidance, and best practices for roadway tunnels will include research, technical presentations, workshops, and coordination with multiple agencies and tunnel owners. Strategies developed for implementation will include structural, mechanical, electrical, and roadway tunnel geometric needs identified in the domestic scan for roadway tunnels. Coordination with the National Fire Protection Association (NFPA) will be essential in developing standards and guidance, especially in the area of electrical and mechanical systems used in roadway tunnels. Strategies will be developed for both new and existing roadway tunnels. Strategies for preliminary design of roadway tunnels will include developing guidance for site specific design criteria, national standards, and construction methods. Design standards, guidance, and best practices should include consideration of maintenance, inspection and operation of roadway tunnels.

Strategy 1.1: Present findings of the U.S Domestic Tunnel Scan (NCHRP 20-68A, Scan 09-05).

Action 1.1.1: TRB Presentations - Present scan findings at the Jan 2010 TRB meeting. Presentations will be given to the TRB and T-20 technical committee on Tunnels. Scan findings will also be presented during scheduled workshop presentations on Sunday, and Monday evenings.

Responsible Party: Domestic Scan Co-Chairs

Timeline: January 2010. Completed.

Resources Needed: Scan team members

Action 1.1.2: AASHTO Presentations - Present scan findings at the Annual Highway Subcommittee on Bridges and Structures (HSCOBS), general session meeting in 2010. Request for scan findings to be presented at the Standing Committee on Highways (and other subcommittees such as Maintenance and Design) meeting in 2010.

Responsible Party: Domestic Scan Team Members

Timeline: HSCOBS May 2010 meeting, and 2010 for other opportunities. Completed.

Resources Needed: Scan Team Co-Chairs

Action 1.1.3: Educational Presentations – Present tunnel scan findings as part of an emerging technology at the State University of Buffalo in New York. Similar presentations can be given at the DOT and tunnel owner arena. Examples may include presentations to local consultants working on tunnel projects.

Responsible Party: Domestic Scan Team Members

Timeline: Spring and fall semesters of 2010 and 2011. This will be included in the Caltrans DES education seminar in 2010.

Status: Partially completed. Barry Brecto and Louis Ruzzi made presentations to local engineering groups or at conferences about the scan itself with some discussion about recommendations from the Domestic Scan

Resources Needed: Scan Team Co-Chairs (K. Thompson)

Strategy 1.2: Conduct Workshops with focus on developing roadway tunnel design standards, guidance, and best practices.

Action 1.2.1: Assist with holding a “Tunnel Operations, Maintenance, Inspection and Evaluation (TOMIE) Manual Workshop” in 2010. This will be sponsored by FHWA with AASHTO and other agency participation. The results of this workshop will be considered in developing AASHTO roadway tunnel design standards, guidance, and best practices.

Responsible Party: AASHTO T-20

Timeline: The initial workshop was held in March 2010 and T20 members participated

Resources Needed: AASHTO T-20 and others

Action 1.2.2: Conduct a workshop sponsored by AASHTO and NFPA. AASHTO T-20 will solicit interest and support from NFPA, and then propose a workshop setting with agenda and topics focused on developing national standards for roadway tunnels. This workshop will focus primarily on mechanical and electrical systems used in roadway tunnels.

Responsible Party: AASHTO T-20 with NFPA and FHWA

Timeline: 2010 - 2011

Resources Needed: AASHTO T-20 and others

Strategy 1.3: Develop NCHRP research proposals, participate in tunnel related research panels, and implement research results. AASHTO T-20 has proposed research problem statements on various roadway tunnel design, maintenance and inspection needs. Some of the research initiated by T-20 has been completed, some is ongoing, and some in the proposal stage, i.e., not yet funded. The focus of this strategy is to continue research efforts though implementation.

Action 1.3.1: Consider findings from NCHRP 20-07, Task 261 focused on tunnel inspection best practices, for developing roadway tunnel design guidance. Results from this research will be combined with the workshop results of Action 1.2.1, for the purpose of considering tunnel maintenance and inspection needs in the design stage.

Responsible Party: AASHTO T-20 with NFPA (FHWA?)

Timeline: 2010 - 2011

Resources Needed: AASHTO T-20 and others

Action 1.3.2: Implement findings from NCHRP 20-07, Task 276 focused on the rehabilitation of roadway tunnels. Results from this research (which is ongoing at the time of this action being developed) will

be used in developing design guidance for the rehabilitation of existing roadway tunnels.

Responsible Party: AASHTO T-20 with NFPA (FHWA?)

Timeline: 2010 - 2011

Resources Needed: AASHTO T-20 and others

Action 1.3.3: Develop and propose research in support of AASHTO LRFD roadway tunnel specifications. Currently, AASHTO T-20 has submitted a research proposal, approved by T-11 in 2009, for developing LRFD Specifications for roadway tunnels, but has not yet been funded. This action is focused on coordinating this research with other roadway tunnel related efforts, such as maintenance, inspection, etc., for implementation of AASHTO LRFD roadway tunnel design specifications.

Responsible Party: AASHTO T-20 with support from FHWA and the TRB Tunnel Committee.

Timeline: 2010 - 2012

Resources Needed: AASHTO T-20 and others

Strategy 1.4: Develop design guidance for consideration of roadway tunnel construction methods.

Action 1.4.1: Develop design guidance for efficient construction methods, such as SEM and NATM used in roadway tunnels.

Responsible Party: AASHTO T-20 with support from the TRB Tunnel Committee.

Timeline: 2010 - 2012

Resources Needed: AASHTO T-20 and others

2. Develop an emergency response system plan unique to each facility which takes into account human behavior, facility ventilation, and fire mitigation.

Background

A fire ventilation study should be performed and a fire ventilation plan developed and adopted for each facility. The design of a tunnel to adequately address emergencies should take into account the realistic spread of fire and smoke in the tunnel including toxic gases and heat, and the effect of different types of ventilation systems on the fire, including fire suppression and deluge systems if so equipped.

In general, the scan team finds that facilities should improve their procedures to direct the public to safety. The fire plan should be consistent with users' instinctive response to a fire,

and the operation of all tunnel fire response systems should be consistent with this behavior. Consider better signage, intelligible public address systems, etc., including recommendations for these from the 2005 international tunnels scan.

Further study and research is needed on how fire and smoke spreads in a tunnel and how people react in emergencies. Consider the research topics related to fire that were developed during the AASHTO workshop on tunnel safety and security research needs held November 2007 in Irvine, California.

Implementation Strategies (Alex)

The implementation strategy includes assembling available information from around the world on tunnel fires, the spread of smoke and human behavior during such instances, both from actual tunnel fires and from research conducted on these topics. Once this has been assembled, areas that need further study will be identified and research conducted to fill these knowledge gaps. Example emergency response plans will be prepared that incorporate and illustrate the application of this knowledge base. These example emergency response plans will be shared with FHWA, tunnels owners, NFPA, academia, and industry. Training programs need to be made available to existing tunnel owners based on this research and on the example plans to help them understand their tunnel operating environment and the potential dangers that may be found there so that they can assess the effectiveness of their current emergency response plans and could adjust them and improve the visual and audible guidance that the tunnels users are provided in an emergency.

Strategy 2.1: Assemble existing information from around the world.

Action 2.1.1: Propose a NCHRP 20-05 synthesis problem statement to assemble information from around the world on actual tunnel fires and people's behavior during them; research into the spread of fires; and human behavior during fires, particularly tunnel fires.

Responsible Party: AASHTO T-20 assisted by TRB AFF60

Timeline: January 2010 T-20 mid-year meeting to finalize statement and prioritize all statements for possible submission to T-11 in advance of May 2010 HSCOBs Annual Meeting

Resources Needed: to be determined

Strategy 2.2: Identify additional areas of research.

Action 2.2.1: Propose an NCHRP 20-07 project to review the NCHRP 20-05 synthesis and to identify any gaps that may exist either for fire and smoke spread in tunnels and the effect of ventilation and fire mitigation on them or for human behavior to emergencies and their response to visual and audible guidance during such emergencies. Anticipate results will be used for further development of roadway tunnel specifications.

Responsible Party: AASHTO T-20 assisted by AFF60

Timeline: Following completion of NCHRP 20-05 project

Resources Needed: NCHRP 20-05 product

Strategy 2.3: Conduct research on existing emergency plans including a checklist for consideration by tunnel owners.

Action 2.3.1: Propose an NCHRP 20-07 project to conduct this research and develop the checklist

Responsible Party: AASHTO T-20 assisted by AFF60

Timeline: January 2010 T-20 mid-year meeting to finalize statement and prioritize all statements for possible submission to T-11 in advance of May 2010 HSCOBs Annual Meeting

Resources Needed: to be determined

Strategy 2.4: Share research results and example emergency plans with FHWA, tunnel owners, NFPA, academia, and industry.

Action 2.4.1: Submit a recommendation for an NHI course that will provide existing tunnel owners training on evaluating their tunnels and the adequacy and effectiveness of their existing plans and on developing emergency response plans based on this research and the example emergency plans.

Responsible Party: AASHTO T-20 in conjunction with FHWA

Timeline: further develop this concept and address timeline at January 2010 T-20 mid-year meeting

Resources Needed: course development would be after standards and guidance have been developed

Action 2.4.2: Share the results of this research and the example emergency response plans on the FHWA tunnel website.

Responsible Party: FHWA in conjunction with AASHTO T-20

Timeline: after research is completed and response plans developed

Resources Needed: to be determined

Action 2.4.3: Facilitate the incorporation of the results of this research into university programs on tunneling.

Responsible Party: AFF60 in conjunction with AASHTO T-20

Timeline: after research is completed

Resources Needed: to be determined

Action 2.4.4: Assemble teams of experts to be available to assist owners in reviewing their existing emergency response plans and to advise them and prospective owners in the development of new or revised ones.

Responsible Party: AASHTO T-20 in conjunction with FHWA

Timeline: after research is completed

Resources Needed: to be determined

3. Develop and share inspection practices among tunnel owners.

Background

The scan team found the best tunnel inspection programs have been developed from bridge inspection programs. Therefore, the team recommends that tunnel inspection programs be as similar as possible to bridge inspection programs. In many cases, bridge inspectors also perform the structural inspection of tunnels.

Those components of the tunnel that carry or affect traffic should be load rated in accordance with the AASHTO Manual for Bridge Evaluation to the extent possible, e.g., roadway slabs and floor systems that carry traffic. In the analyses, consider different operational conditions. Structural analyses should be performed on non-traffic-carrying components such as plenums, plenum walls, and hangers as their physical conditions change, as they are modified, or as the loads that they are to be subjected to change, such as air forces if fans are upgraded.

Develop recommended practices for inspection frequencies, minimum coding requirements, and a federal coding manual. Current practice is one-to-five years for structural inspections, and daily to yearly for mechanical and electrical inspections depending on the level of inspection. Maximum frequencies should be set, and owners should be encouraged to develop actual frequencies based on a risk-based analysis of hazards due to condition, deterioration, and performance history.

Develop a baseline data inventory for tunnels for submission to the FHWA in conjunction with NCHRP 20-07, Task 261, Task 4.

Inspection practices need to be shared among tunnel owners in five areas. First, the scan team identified a best practice for the inspection of submerged tunnels using multi-beam sonar scans. Second, tunnel inspection training needs to be developed taking into consideration all aspects of the tunnel structure and systems. Third, tools need to be developed to find voids behind tunnel linings. Fourth, coordinated closing of the tunnel overnight to do as much maintenance and inspection as possible. Fifth, share inspection manuals, e.g., the manuals of the Massachusetts Turnpike Authority and the Port Authority of New York and New Jersey.

Implementation Strategies (Lou & Jesus)

The implementation strategy will focus on working with FHWA to create a highway tunnel inspection program for the country that is on the same level as the existing National Bridge Inspection Standards for highway bridges. This includes providing input to the Proposed Rule Making for the National Tunnel Inspection Standards during the comment period, assisting FHWA in developing a federal coding guide, developing a federal inspector training manual as well as updating previously published manuals, developing a federal computer data system and initial tunnel data base from previous studies, and developing a manual for tunnel evaluation.

Strategy 3.1: Develop a tunnel inspection program that includes a baseline data inventory, inspection frequencies, minimal coding requirements, recommended inspection techniques and equipment, and a federal coding manual.

Action 3.1.1: Provide input into the Proposed Rule Making (PRM) for the National Tunnel Inspection Standards based on the Tunnel Inspection Workshop and a review of the findings from the 2009 Domestic Tunnel Scan.

Responsible Party: FHWA, AASHTO T-20 and T-18, and scan team member states

Timeline: Completion by closing date of PRM's comment period

Resources Needed: Published Proposed Rule Making

Action 3.1.2: Develop a federal coding guide for tunnels which includes minimal required data and condition and appraisal code descriptions that are similar to the bridge inspection program. Utilize findings from the 2009 Domestic Tunnel Scan, in particular existing tunnel inspection manuals, and current FHWA publications to develop this federal coding guide.

Responsible Party: FHWA with assistance from AASHTO T-20

Timeline: Completion in 1.5 years

Resources Needed: Manual outline from February 2010 Road Tunnel Operation, Maintenance, Inspection and Evaluation Manual (TOMIE) Workshop; copies of FHWA, MTA, PANYNJ, and CBBT inspection manuals; final NTIS in order to finalize coding guide

Action 3.1.3: Develop tunnel inspector training manual similar to the Bridge Inspection Reference Manual, for use in training and for conducting inspections.

Responsible Party: FHWA with assistance from AASHTO T-20 and T-18

Timeline: Completion after NTIS and coding manual

Resources Needed: NTIS, tunnel federal coding guide

Action 3.1.4: Utilize the tunnel inventory data from NCHRP 20-07, Task 261 to develop the initial inventory of the nation's tunnels. This data would need to be reviewed by the states for accuracy and coded properly for submission to FHWA's computer database (currently undeveloped).

Responsible Party: FHWA, the States and US Territories, AASHTO T-20

Timeline: Completion in 2 years (one year after final tunnel federal coding guide)

Resources Needed: final NTIS and final tunnel federal coding guide

Action 3.1.5: Develop a federal computer data system to accept tunnel inspections.

Responsible Party: FHWA with help from the States and AASHTO T-20

Timeline: Completion in 3 years (simultaneously with tunnel federal coding guide)

Resources Needed: software development

Action 3.1.6: Update current FHWA publications to include findings from the 2009 Domestic Tunnel Scan (inspection techniques and equipment used to do tunnel inspections).

Responsible Party: FHWA and AASHTO T-20

Timeline: Completion in 1.5 years

Resources Needed: FHWA consultant to update HRTTIM

Action 3.1.7: Develop a manual for tunnel evaluation similar to AASHTO Manual for Bridge Evaluation.

Responsible Party: AASHTO T-20 and T-18

Timeline: In conjunction with NTI and its coding guide

Resources Needed: NTIS

4. Consider inspection and maintenance operations during the design stage.

Background

The scan team found that during the design phase, inviting all disciplines into the design results in a better product. The design of a tunnel should address future inspection and maintenance of all tunnel systems and equipment by providing for adequate, safe and unimpeded access to all components. This can be accomplished by bringing together all engineering disciplines that will have to be accommodated in the tunnel. While the scan team understands that tradeoffs must be made between access and a practical design, these tradeoffs could have cost and safety impacts for maintenance and inspection over the life of the tunnel.

Implementation Strategies (Alex)

The implementation strategy focuses on educating prospective tunnel owners and tunnel designers on the inspection and routine maintenance needs that a tunnel will require once it is built to keep it safe and operational. Specific strategies include assembling best practices and lessons learned to be shared among owners and designers, incorporating discussions of inspection and maintenance in guidelines and documents, such as the AASHTO *Technical Manual for Design and Construction of Road Tunnels* and the proposed tunnel design code, providing technical presentations on this topic, and by providing a panel of experts who could be called upon to assist designers to review preliminary plans for tunnels and provide recommendations for improving access.

The work effort of implementation strategy for this recommendation also feeds into the Scan Team's implementation strategies for recommendation #1 (developing standards and guidance), recommendation #3 (develop and share inspection practices) and recommendation #7 (share existing technical knowledge about tunnel design).

Strategy 4.1: Identify typical maintenance and inspection needs required for tunnels as well as best practices and lessons learned from existing tunnel owners.

Action 4.1.1: Propose an NCHRP 20-07 task to survey tunnel owners with special emphasis on those maintenance and inspection access issues that could have been improved had they been addressed during design. (See also Action 6.1.2)

Responsible Party: AASHTO T-20 assisted by FHWA

Timeline: January 2010 T-20 mid-year meeting to finalize statement and prioritize all statements for possible submission to T-11 in advance of the May 2010 HSCOBS Annual Meeting

Resources Needed: \$100,000

Strategy 4.2: Provide guidance regarding inspection and maintenance needs to tunnel owners and designers through manuals, code and technical presentations and require that a tunnel maintenance and inspection access plan be developed as part of the design process for all new tunnels.

Action 4.2.1: Update the AASHTO *Technical Manual for Design and Construction of Road Tunnels* Chapter 2 to discuss inspection and maintenance issues and the best practices and lessons learned from the

NCHRP 20-07 Task report and which would also incorporate the National Tunnel Inspection Standards requirements and FHWA training on the subject.

Responsible Party: AASHTO T-20 in conjunction with FHWA

Timeline: Upon completion of the NCHRP 20-07 task

Resources Needed: a consultant to summarize the NCHRP 20-07 task findings and to do the actual writing of the proposed revisions to the Manual

Action 4.2.2: Provide the information contained in the NCHRP 20-07 Task report to the consultant developing the Tunnel Design code (recommendation #1), the implementation strategy for recommendation #7

Responsible Party: AASHTO T-20

Timeline: Upon completion of the NCHRP 20-07 task

Resources Needed:

Action 4.2.3: Conduct workshops with focus on typical tunnel maintenance and inspection needs and lessons learned from existing tunnel owners.

Responsible Party: AASHTO T-20

Timeline: Upon completion of the NCHRP 20-07 task and the update to the Tunnel Technical Manual.

Resources Needed: AASHTO T-20 and consultant working on the Manual update.

Strategy 4.3: Provide assistance to prospective tunnel owners and designers of new tunnels to review and evaluate tunnel designs and draft maintenance and inspection access plans and provide recommendations for improving access.

Action 4.3.1: Assemble teams of experts to be available to assist owners in reviewing their existing emergency response plans and to advise them and prospective owners in the development of new or revised ones.

Responsible Party: AASHTO T-20 in conjunction with FHWA

Timeline: after Strategy 4.2 is fully implemented

Resources Needed: to be determined

5. Develop site-specific plans for the safe and efficient operation of roadway tunnels.

Background

Develop a concise site-specific operations manual that includes tunnel incident response procedures and training; safe ventilation procedures; safe traffic control guidelines; and general maintenance procedures such as tunnel washing guidelines, fan and bearing maintenance, etc. The manual should include training guidelines and training schedules for all personnel.

Tunnel owners should implement state-of-the-art video surveillance and communication systems. These systems provide numerous benefits, e.g., incident response, traffic management, and increased security. The scan team found a best practice of lane closure or changing traffic direction, e.g., pneumatically-activated lane delineators and zipper barriers that provide for reversible lanes and barriers through tunnels and tunnel approaches. The owners should have an operating procedure that considers safety for the public and owner personnel.

A separate incident response manual should be developed to outline procedures that will require various community, police, fire, and emergency services response in the event of catastrophic incidents. Perform periodic drills including table-top exercises with appropriate agencies.

The scan team findings support restricting hazardous cargo through tunnels. In the event of no alternate route, a well-defined emergency response and fire ventilation plan should be in place. Restricted hours of tunnel operation for hazardous cargo are an option, e.g., hours from 3 a.m. to 5 a.m. under controlled conditions.

Implementation Strategies (Mike)

The implementation strategy includes contacting the owners of our nation's major tunnels in order to provide guidance regarding site-specific needs related to tunnel operations and tunnel incident management. Specific activities will include assistance in developing a concise site-specific operations manual that will outline the recommended best practices of tunnel operations. Assist in the development of a separate incident response manual to facilitate effective communication and performance during emergency conditions, and make recommendations regarding drills and table-top exercises with local entities relative to incident response. Assist in the development of fire response and fire ventilation plans. Describe and emphasize the importance of video surveillance and effective communication systems in major tunnels. Recommendations on proposed guidance for above mentioned activities will be provided to the AASHTO T-20 Technical Committee on Tunnels.

Strategy 5.1: Develop a concise site-specific operations manual that includes tunnel incident response procedures and training; safe ventilation procedures; safe traffic control guidelines; and general maintenance procedures such as tunnel washing guidelines, fan and bearing maintenance, etc. The manual should include training guidelines and training schedules for all personnel. The scan team findings support restricting hazardous cargo through tunnels. In the event of no alternate route, a well-defined emergency response and fire ventilation plan should be in place. Restricted hours of tunnel operation for hazardous cargo are an option, e.g., hours from 3 a.m. to 5 a.m. under controlled conditions.

Action 5.1.1: Propose an NCHRP 20-05 synthesis on best practices related to site-specific operational procedures.

Responsible Party: T-20 assisted by AFF60 and other appropriate AASHTO and TRB committees

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

Action 5.1.2: Propose an NCHRP 20-07 research project to develop comprehensive guidelines for a site-specific operations manual that owners can tailor to their specific needs and that includes training guidelines.

Responsible Party: T-20 assisted by AFF60 and other appropriate AASHTO and TRB committees

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

Strategy 5.2: Develop a separate incident response manual to outline procedures that will require various community, police, fire, and emergency services response in the event of catastrophic incidents. The manual should include guidance on periodic drills including table-top exercises with appropriate agencies.

Action 5.2.1: Propose an NCHRP 20-05 synthesis of existing best practices, to provide the background in developing a separate incident response manual

Responsible Party: T-20 in coordination with NFPA 502

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

Strategy 5.3: Develop an operating procedure that implements state-of-the-art video surveillance and communication systems for enhanced safety to the public and owner personnel. These systems provide numerous benefits, e.g., incident response, traffic management, and increased security. The scan team found a best practice of lane closure or changing traffic direction, e.g., pneumatically-activated lane delineators and zipper barriers that provide for reversible lanes and barriers through tunnels and tunnel approaches.

Action 5.3.1: Propose an NCHRP 20-05 synthesis on state-of-the-art video surveillance and communication systems.

Responsible Party: T-20 assisted by AFF60 and other appropriate AASHTO and TRB committees

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

Action 5.3.2: Evaluate research already conducted on tunnel security through TRB, to determine if there are additional needs and to pass information to owners.

Responsible Party: T-20 working with T-1

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

Action 5.3.3: Send email to owners after report is completed and post Caldecott tunnel zipper barrier video on FHWA tunnel website to share information with tunnel owners on lane closure or changing traffic direction, e.g., pneumatically-activated lane delineators and zipper barriers that provide for reversible lanes and barriers through tunnels and tunnel approaches.

Responsible Party: T-20 through email to owners after report is completed

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

6. A tunnel includes a long-term commitment to provide funding for preventive maintenance, upgrading of systems, and training and retention of operators.

Background

The decision to build a tunnel is a long-term commitment on the part of the owner. The tunnels which include functional systems such as ventilation, fire suppression, and electrical/mechanical components are complex structures with more intensive needs for maintenance and operation than traditional transportation facilities. A proactive operational financial plan, considering life-cycle costs, must be developed to address needs for preventive maintenance, upgrading of systems, and training and retention of operators. A target level of condition, system reliability, and performance should be established for the facility to guide operators and owners for current and future decisions which will require manpower or funding.

System components become obsolete and replacement parts will be difficult to find as equipment ages. In particular, electronic equipment such as computers, SCADA systems, and sensors become obsolete or are no longer supported by their original manufacturers sooner than mechanical equipment. Periodic upgrades are vital to keep all systems functioning reliably. Funding should include the ability to buy replacement parts when the tunnel is being built.

Owner agencies should develop tunnel preservation guidelines for funding purposes, e.g., for concrete repair and washing of walls.

A separate fund should be dedicated for tunnels. Agencies should work with local planning organizations to accomplish this task. The financial management plan for tunnels should not

only include first costs for construction, but should also address future preservation and upgrading needs. The scan team found that without this dedicated fund, the funding for tunnel upgrades does not compete well with system-wide needs for traffic signals, pavement preservation, etc.

Training, retention, and a succession plan should be developed for tunnel operators. The scan team found best practices that fostered pride of ownership, a “home away from home” culture and can-do-anything attitude.

Implementation Strategies (Barry & Jesus)

A tunnel is an underground highway that in many cases is equipped with a conglomerate of interrelated systems and components that need to be properly inspected, maintained, and tested to ensure the tunnel is kept open and performing reliably as designed. A preventive maintenance plan, which considers future upgrading of systems, should be developed prior to initial construction to insure operators of the tunnel are aware of those needs. Decision makers can then provide the necessary staffing and capital expenditure budget to insure the continued viability of the tunnel and its systems.

The implementation strategy includes reaching out to tunnel owners of existing and new tunnels describing the importance of planning for future tunnel expenses and the retention of well qualified personnel. Specific activities will include presentations, webinars, articles, and proposed draft specifications. Recommendations on proposed guidance for the tunnel design specifications to address this issue will be provided to the AASHTO T-20 Technical Committee on Tunnels, T-20.

Strategy 6.1: Reach out to tunnel owners of existing and new tunnels to describe the importance of planning for future tunnel expenses.

Action 6.1.1: Propose an NCHRP research project to develop an operational financial plan model including input from State DOTs, state transportation committees, and local metropolitan planning organizations which identifies future operational and upgrading needs for tunnels and addresses present and future funding mechanisms to adequately meet those needs. This model should consider tunnel complexity, presence of functional systems, routine maintenance and inspection requirements, but should emphasize consideration of other less recognized but critical items such as expected service lives of systems and components, need for preventive maintenance and upgrades, training of operators, and life-cycle costs.

Responsible Party: T-20 coordinating with AASHTO Subcommittees on Design and Maintenance (Bridge).

Timeline: Discuss at January 2010 mid-year meeting.

Resources Needed: TBD – Funding for research. FHWA tunnel website for posting progress updates on project, plus final report when available.

Action 6.1.2: Propose an NCHRP project to develop guidelines for a comprehensive preventive maintenance plan for tunnel owners and operators. Guidelines should address breadth of tunnel functional systems, recognized industry standards for type and frequency of diagnostic testing, servicing, and system upgrades. (See also Action 4.1.1)

Responsible Party: T-20 coordinating with AASHTO Subcommittee on Maintenance (Bridge).

Timeline: Discuss at January 2010 mid-year meeting.

Resources Needed: TBD – Funding for research. FHWA tunnel website for posting progress updates on project, plus final report when available.

Strategy 6.2: Identify the essential role that knowledgeable, well-trained and motivated maintenance and operations personnel have on the successful long-term operation of a complex tunnel. The training and retention of well qualified personnel, including succession planning, provides significant benefit to the motoring public and extends the service lives of tunnels.

Action 6.2.1: Propose an NCHRP 20-07 project to survey existing tunnel maintenance and operations personnel in the U.S. to determine best practices for sources of training, amount of training, recommended training by position, and employee retention methods.

Responsible Party: T-20 consulting with AASHTO Subcommittee on Human Resources

Timeline: Discuss at January 2010 mid-year meeting.

Resources Needed: TBD – Funding for research. FHWA tunnel website for posting progress updates on project, plus final report when available.

Strategy 6.3: Identify the importance of establishing target levels of condition, system reliability, and performance for each tunnel which will guide future funding and staffing decisions. Employing these standards in existing tunnels has been proven to be very effective in preserving the long-term viability of tunnels, and extends their useful service lives.

Action 6.3.1: Propose an NCHRP 20-07 project to survey existing tunnel owners to determine best practices for establishing and maintaining target levels of condition, system reliability and performance. The results will be shared with DOTs and other tunnel owners. (see 4.1.1)

Responsible Party: T-20 coordinating with AASHTO Standing Committee on Performance Management, and Subcommittee on Maintenance

Timeline: Discuss at January 2010 mid-year meeting.

Resources Needed: TBD – Funding for research. FHWA tunnel website for posting progress updates on project, plus final report when available.

7. Share existing technical knowledge within the industry to design a tunnel.

Background

Technical knowledge that exists within the industry should be shared with tunnel owners to provide them with a range of practical tunnel design options. This would include using domestic and international tunnel scan information, past project designs, construction practices, emergency response best practices, and subject matter experts. Value engineering can improve technology transfer with limited owner experience in tunnel systems, e.g., Value Engineering / Accelerated Construction Technology Transfer (VE/ACTT).

Design documents including calculations and as-built documents should be filed electronically and be easily retrievable by the controlling owner, with appropriate back-up copy, e.g., on microfilm.

Recognizing security concerns of tunnel owners, the scan team believes that actual details and best practices used in tunnels should be shared with prospective and existing tunnel owners without identifying the specific facilities where these details and practices are used.

Implementation Strategies (Bijan)

Strategy 7.1: Develop a concise tunnel design procedures and training manual. This should incorporate findings from domestic and international tunnel scan information, past project designs, construction practices, and input from subject matter experts. Emphasis should be given to design guidelines for roadway tunnels in moderate to high seismic zones and liquefiable soil conditions. The design guidelines should become available to AASHTO T-20 committee to develop the roadway tunnel design guide specifications.

Action 7.1.1: Propose a NCHRP 20-07 research project to survey and gather comprehensive tunnel design guidelines to update the AASHTO *Technical Manual for Design and Construction of Road Tunnels – Civil Elements*. Propose NHI training on tunnel design and construction.

Responsible Party: AASHTO T-20 assisted by AFF60 and other appropriate AASHTO and TRB committees. AASHTO T-3 and T-10 committees

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

Strategy 7.2: Develop a concise tunnel construction procedures and training manual. This should incorporate findings from domestic and international tunnel scan information, past project designs, construction practices, and subject matter experts. Emphasis should be given to the innovative construction methods, and the Accelerated Construction Technology. Emphasis should also be given to construction guidelines for tunnels in moderate to high seismic zones and liquefiable soil conditions requiring soil improvement.

Action 7.2.1: Propose an NCHRP 20-07 research project to survey and gather comprehensive tunnel construction guidelines to update the AASHTO *Technical Manual for Design and Construction of Road Tunnels – Civil Elements*. Propose NHI training on tunnel design and construction.

Responsible Party: AASHTO T-20 assisted by AFF60 and other appropriate AASHTO and TRB committees. AASHTO T-3 and T-4 committees

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

Strategy 7.3: Develop a concise document on roadway tunnel procurement methods. This should incorporate findings from domestic and international tunnel scan information, past project designs, construction practices, and subject matter experts. Emphasis should be given to the conventional and innovative contracting methods, design-bid-build, design-build, and other options including finance, operate and maintenance.

Action 7.3.1: Propose an NCHRP 20-07 research project to develop design guidance and best practices for tunnel procurement methods to create comprehensive tunnel contracting guidelines. Procurement methods to be considered are Design-Build, Design-Bid-Build, etc. Results of the project will be combined with the procurement guidelines, "Recommended Contract Practices for Underground Construction" edited by B. Edgerton and published by the Underground Construction Association (UCA) of the Society for Mining Engineering (SME).
Responsible Party: AASHTO T-20 and TRB AFF60 with support from the Underground Construction Association

Timeline: Discuss at January 2010 mid-year meeting

Resources Needed: To be determined

8. Provide education and training in tunnel design and construction.

Background

The scan team findings support training and development for owner agencies. Currently, there are few Civil Engineering programs in the U.S. that offer a graduate course in

tunneling. It is very likely that civil engineers are not exposed to tunneling. Many DOTs do not have tunnels in their transportation systems, others built their last tunnel 20-30 years ago and, therefore, the in-house expertise is either non-existent or out of date. The number and magnitude of tunneling projects is projected to increase dramatically in the next few years. The current offering of short courses allows engineers to acquire the nomenclature in tunnel projects.

Highway tunnel owners and FHWA should provide their engineers with access to education and training on tunnels available through academia and industry. This involvement would also help direct academic research on tunneling. On-line courses and certificates on tunneling of international reputation would allow one to acquire up-to-date information and working knowledge in design and construction of tunnels.

Implementation Strategies (Fulvio)

Currently, owner agencies are considering, designing or managing the construction of road tunnels. Some of these projects are exceedingly demanding from the design of management viewpoint. In order for owner agencies' engineers to acquire working knowledge and education in tunneling, it is necessary to first provide them with a database of available education and training venues on tunnels. Owners and engineers must know where to acquire funds to allocate to this effort, and the current and projected needs for education and training in tunnels. At the same time, a nation-wide recommendation on minimum education and training requirements will help owner agencies and engineers to make the case for this effort.

Strategy 8.1: Assemble information on education and training venues, funding opportunities and needs.

Action 8.1.1: Propose NCHRP 20-05 synthesis problem statements to assemble information: 1) from around the world on education and training venues on tunnels available through academia and industry; 2) nationally on possible funding opportunities for owner agencies and for engineers within those agencies to be used for education and training on tunnels; 3) nationally on current and projected needs for education and training on tunnels within owner agencies.

Responsible Party: AASHTO T-20 in conjunction with TRB AFF60

Timeline: 2010-11

Resources Needed:

Strategy 8.2: Recommend specialized training on tunnels

Action 8.2.1: Solicit interest in academia to further tunnel training opportunities, e.g., universities augment their curriculum to include tunnel training including certificate programs for engineers involved with the design or construction management of tunnels within owner agencies.

Responsible Party: FHWA, AASHTO T20, TRB AFF60

Timeline: 2010-11

Resources Needed:

Process for Following Up on Status of Implementation Actions

The process that will be used to ensure timely completion of the actions under each strategy includes having discussion of the STIP on the agenda of each AASHTO T-20 meeting. This discussion will be led by the T-20 Chair, who is also the AASHTO Co-Chair of the scan team, in cooperation with FHWA. The STIP activities will be included as part of the T-20 Strategic Plan.

****Webinars completed by the scan team**

- 3-25-10, SCAN 09-05 Best Practices for Roadway Tunnel Design, Construction, and Maintenance, Part One
Conducted through NHI,
- 6-25-10, SCAN 09-05 Best Practices for Roadway Tunnel Design, Construction, and Maintenance, Part Two
- Conducted through NHI,

**** Workshop completed by the scan team**

- International Bridge Conference 2010
ROAD TUNNEL DOMESTIC SCAN WORKSHOP
May 8th, 2010 1pm – 5pm