NCHRP 25-25, Task 111

ENVIRONMENTAL MANAGEMENT SYSTEM PERSPECTIVES FOR STATE DEPARTMENTS OF TRANSPORTATION

Final Report

Prepared for:

AASHTO Committee on Environment and Sustainability

Prepared by:

The Louis Berger Group, Inc.
Raleigh, NC

McVoy Associates, LLC
Slingerlands, NY

Wayne W. Kober
Dillsburg, PA

January 2, 2019

The information contained in this report was prepared as part of NCHRP Project 25-25, Task 111, National Cooperative Highway Research Program.

Acknowledgements

This study was conducted for the AASHTO Committee on Environment and Sustainability, with funding provided through the National Cooperative Highway Research Program (NCHRP) Project 25-25, Task 111, *Environmental Management System Perspectives for State Departments of Transportation*. The NCHRP is supported by annual voluntary contributions from the state Departments of Transportation. Project 25-25 is intended to fund quick response studies on behalf of the Committee on Environment and Sustainability. The report was prepared by Dr. Gary R. McVoy, McVoy Associates, LLC; Robin Maycock, Douglas Parker, Kerri Snyder, Rebecca Reints, and Susan Van Dyke of the Louis Berger Group, Inc.; and Wayne Kober. The work was guided by a technical working group that included:

- Dr. Gail Anne D'Avino, Georgia DOT
- Jane N. Hann, Colorado DOT
- Timothy Hill, Ohio DOT
- Shawna Secord, Oregon DOT
- Timothy V. Sexton, Minnesota DOT
- Colleen M. Turner, Maryland DOT
- David Wilson, Virginia DOT
- Dr. Heather Dylla, the Federal Highway Administration (FHWA) liaison for this research
- Christine Gerencher, the Transportation Research Board (TRB) liaison for this research

The project was managed by Ann Hartell NCHRP Senior Program Officer.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

EXECUTIVE SUMMARY

An Environmental Management System (EMS) is a systematic process for planning, executing, checking, revising, and improving environmental stewardship. Most commonly expressed in terms of a Plan-Do-Check-Act (PDCA) approach, an EMS is the standard means for effective environmental compliance. This National Cooperative Highway Research Program (NCHRP) study examines how transportation agencies (i.e., state departments of transportation [DOTs]) created, developed, are currently using, and can improve their use of EMSs in the context of International Organization for Standardization (ISO) 14001.

The research effort used a structured website review, literature review, survey, and interview process, with each step informing the next based on a structured set of queries. Based on the survey results, 10 state DOTs were selected for in-depth interviews to capture a representative spectrum of EMS application. The subjects of the queries and conclusions are presented in the numbered list below.

1. General EMS Framework and History at DOTs
    a. Most state DOTs initiated their EMS as the result of apparent environmental shortcomings revealed through incidents or external pressures. Among the external drivers was a Federal Highway Administration (FHWA) initiative to ensure that National Environmental Policy Act (NEPA) commitments, made during project planning and design, were carried through to construction, maintenance, and operations.
    b. Individual units within DOTs (including capital program NEPA compliance, equipment maintenance, highway maintenance facilities, highway maintenance activities, and bridge maintenance) have incorporated EMS elements into their standard procedures.
    c. Most state DOT operational units have developed and implemented their own processes and procedures, with varying degrees of support and leadership from their environmental units and limited input from outside agencies or information sources.
2. Current Applications
    a. Although application of EMS elements across various state DOT operations has expanded over the past few decades to become a standard business practice, application of the complete PDCA approach is not common.
    b. Virtually all state DOTs are using elements of the ISO 14001 EMS standard within applicable program areas. However, DOTs generally prefer to tailor components of the ISO system to their own particular needs, and only a few have attempted certification for even a fraction of their operational scope due to administrative requirements and a lack of drivers.
    c. EMS programs have been a factor in streamlining regulatory approvals and other efficiencies. EMS programs have also benefited in varying degrees from the development of a PDCA approach across other DOT functions.
    d. Environmental units are commonly involved in EMS for NEPA compliance. However, they may or may not have an agency-wide EMS leadership role and sometimes lack a clear understanding of the EMS procedures employed in Maintenance and Operations.

e. EMS procedures for highway maintenance activities are practically universal, with record keeping, training, and reporting utilized by most, and audit and audit follow-up employed by almost a third of those reporting.

3. Analysis Methods/Drivers

   a. Most state DOTs rely on manual review of their limited EMS data.

   b. EMS improvement activities tend to be incident driven. Cyclic (annual or other) performance reviews are often lacking.

4. Cost/Benefit and Funding

   a. Although clearly important, funding has generally not been a driving (or a limiting) issue.

   b. State DOTs generally feel that EMS processes are highly cost effective for the monetary, stewardship, and especially the NEPA compliance benefits received. Preparation of detailed cost/benefit analyses has not been a priority.

   c. Although special allocations and initiatives have occurred, most state DOT EMS efforts were initiated with, and virtually all continue to operate under, regular combined internal program budgets.

   d. Costs to establish and maintain EMSs are reported to range from several hundred thousand to several million dollars.

5. EMS Spinoffs to Other Programs

   a. Environmental streamlining is a common EMS spinoff application. Regulatory agencies seem willing to reduce their level of intervention and oversight in direct proportion to their confidence in DOT EMS implementation.

   b. Use of the PDCA approach in EMS may encourage its use in other areas – just as use of PDCA in areas such as asset management tends to encourage its application to environmental concerns.

6. Best Practices/Lessons Learned

   a. Integration with other processes is clearly an important theme. State DOTs appear to have learned through experience that program area ownership allows for the synergistic integration of environmental factors with other standard procedures.

   b. Engagement and training of employees together with a cooperative outreach to regulatory agencies can enhance EMS acceptance and performance.

   c. Utilization of the full PDCA EMS cycle can avoid adverse environmental impacts and improve performance or compliance.

   d. Lack of a documented agency-wide EMS can restrict streamlining and other benefits.

Practitioner Needs and Challenges

   a. Many DOTs have gaps in their understanding and application of EMS and its PDCA underpinnings due to a variety of factors, such as the press of day-to-day business and loss of institutional memory.

b. State DOTs generally lack a method for conducting systematic assessments of their EMSs and with it the ability to proactively identify and rectify gaps and shortcomings.

c. Violations and incidents that slip through process gaps can consume more resources in a less efficient way than proactively evaluating the data associated with EMS application within their departments. Identification and awareness of these gaps through systematic EMS evaluation (the "check" step) should be encouraged.

EMS Information Array

To help DOTs familiarize themselves with the full PDCA EMS cycle and realize the benefits of a fully functioning EMS, an EMS Information Array (IA) was developed, and a prototype DOT EMS benchmarking tool is included for use by state DOT environmental units and other organizations to gain a fuller appreciation of EMS improvement needs, means, and methods. The tool is linked to literature references, examples, and resources assembled from state DOTs for use in addressing gaps and shortcomings revealed through benchmarking. The EMS IA may be found at: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4335.

With its embedded reference links and examples, the EMS IA:

- Provides practitioners with a convenient means for assembling an agency-wide view of EMS as practiced by individual program areas.
- Assists practitioners in identifying EMS gaps and shortcomings as measured against a complete PDCA system.
- Facilitates efforts to make EMS improvements by providing ready access to proven policies, procedures, tools, and references.

The EMS IA organizes state DOT practices by area of application (i.e., equipment maintenance, highway maintenance facilities, highway maintenance activities, bridge maintenance, NEPA/environmental compliance, and other). The benchmarking tool in the EMS IA can assist state DOTs in identifying areas within their EMS programs that could be improved, and the tool provides examples of actions taken by other state DOTs.

Application of the EMS IA should enable state DOTs to operate more efficiently through improved environmental stewardship.

1.0 INTRODUCTION

As expressed in the initial National Cooperative Highway Research Program (NCHRP) Project 25-25 (111) Research for the Committee on Environment and Sustainability Problem Statement, an Environmental Management System (EMS) is:

> *A set of processes and practices for managing an organization's environmental programs in a manner that systematically reduces an agency's environmental impacts and improves efficiency. EMS's seek to reduce usage of resources such as water, energy and materials along with reducing wastes, pollution and violations. EMS's are being applied at transportation agencies across the country to help manage and optimize environmental services provided… However, there are few comprehensive reviews/studies that documented on the actual experiences/benefits/ knowledge gained from those transportation agencies that implemented an EMS… To bridge this gap, this research will review state DOT EMS program documents (including summary reports on targets/goals) and supplement that data with interviews of state DOT EMS leaders.*

With this objective in mind, the primary audience for this research product is state department of transportation (DOT) leadership and staff tasked with environmental compliance and stewardship. These practitioners understand the practical realities of day-to-day DOT administration and appreciate the need for practical tools and resources. Accordingly, the key deliverable for this project is the freestanding EMS Information Array (EMS IA) with its prototype DOT EMS benchmarking reference tool.[1] Appendix A includes an illustrated guide on how to use the EMS IA by showing an example search.

Virtually all state DOTs already use at least some elements of an EMS–that is, some means of planning, executing, checking, revising, and improving efficiencies and performance in environmental compliance and/or stewardship. Although EMSs are believed by most transportation agencies to be important primarily from an environmental stewardship perspective, other benefits include the cost savings from fines or delays associated with regulatory violations.

As described in this report, the NCHRP Project 25-25 (Task 111) research effort used a structured website review, literature review, survey, and interview process, with each step informing the next based on a structured set of queries relating the EMS RFP tasks to:

1. General EMS Framework and History at DOTs
2. Current Applications
3. Analysis Methods/Drivers
4. Cost/Benefit, and
5. EMS as a Foundation for Other Programs

After the survey was completed, literature findings were revisited, and interviews were conducted as described to resolve questions and delve into deeper operational concerns. Conclusions were then formulated by topic (see Appendix B). This report documents the research process and presents a summary of the conclusions from the detailed survey and interview results provided in Appendix B.

[1] The EMS IA is located at: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4335.

1.1 PLAN-DO-CHECK-ACT

EMSs are based on the Plan-Do-Check-Act (PDCA) process developed by and published in Dr. Walter Shewhart's 1939 book, "Statistical Methods from the Viewpoint of Quality Control." During the 1950s, Dr. Shewhart's colleague, Dr. W. Edwards Demming, introduced the PDCA process to the automobile manufacturing industry in Japan (Johnson 2016). In March 1992, BSI Group, headquartered in the United Kingdom, published the first EMS standard, BS 7750, based on the PDCA process. In 1994, Maine and Massachusetts DOTs began using an EMS. The International Organization for Standardization (ISO) 14000 EMS series was published in 1996 using BS 7750 as a template (BSI 2016). NY City Transit became the first ISO 14001 certified DOT in 1999, and, in 2002, Pennsylvania became the first state DOT to obtain ISO 14001 certification (in one district). In 2003, the American Association of State Highway and Transportation Officials (AASHTO) Center for Excellence, in partnership with the Federal Highway Administration (FHWA), formally launched its EMS technical assistance program with a workshop.

The PDCA (or as some prefer—Improve) system is a basic management approach used under a variety of titles with differing semantic variations, all of which recommend work that is:

1. planned in accord with some well-described written process,
2. performed in a documented manner according to plan as practicable,
3. reviewed using quantifiable metrics and experience, and
4. improved in light of experience, emerging knowledge, and new technologies.

The 2003 AASHTO Center for Environmental Excellence Online EMS Implementation Guide, "Using an Environmental Management System to Meet Transportation Challenges and Opportunities An Implementation Guide"(AASHTO and Solitis 2003), defines the PDCA system as:

> *A common, well accepted framework for any management system that strives for continual improvement …. proven over a number of years in a wide variety of applications in both government and industry… easily adapted for a management system, be it environmental or otherwise.*

To be effective, an EMS must be suited to the unique circumstances of the particular transportation organization involved, be it a transit agency, an equipment shop, maintenance facility, or a state DOT. Exact format and structure can vary depending on regulatory and political climate, organizational culture, organizational capacity, and stakeholder interest. However, in all cases "ownership" of the system and mainstream execution of all aspects of the PDCA system as exemplified by the ISO 14001 system (ISO 2015) is essential for optimal implementation and improvement.

Figure 1-1 shows the PDCA framework. This basic PDCA approach is the foundation for EMSs and is referenced repeatedly throughout this study.

Figure 1-1: Plan-Do-Check-Act Framework

Source: Exhibit 3-1 in the 2003 AASHTO Center for Environmental Excellence Online EMS Implementation Guide

2.0 LITERATURE REVIEW

2.1 METHODOLOGY

The literature review had three primary goals:

1. Provide an IA or resource "library" for practitioners interested in benchmarking EMS practices.
2. Organize and compile pertinent information in a format that lends itself to immediate identification of gaps and inconsistencies.
3. Inform the development of a draft survey and associated survey distribution list.

To accomplish these goals, the research team, under the direction of the principal investigator (PI) and consultant team subject matter experts (SMEs), reviewed the available literature, consulted with SMEs, and searched state DOT websites.

The literature review had three phases. Phase One entailed compiling documents based on a keyword search. Initial keywords included ISO 14001*, environmental management systems, EMS, management systems, and management process.* As the literature review progressed, additional keywords, such as *environmental, stormwater, pollution prevention, hazardous materials, solid waste, monitoring,* and *stewardship*, were added. Online resources were then searched in a hierarchical fashion. Large research organizations (e.g., the Center for Environmental Excellence, AASHTO, Transportation Research Board [TRB]) were searched first. The search then progressed to university transportation research centers followed by DOT websites. Phase One was finalized with a general online search using Google and the keywords.

In Phase Two, the PI and SMEs reviewed the compiled documents to identify gaps and conducted a more in-depth document review using a color-coded system. Based on feedback from the PI and SMEs, the research team added additional documents to the list. In addition, the PI and SMEs created a list of questions to be considered during the in-depth review. Phase Three entailed the in-depth review of the compiled documents based on the PI and SME prioritization. If relevant information was not found for a source, a notation was made. As each document was reviewed, a summary of the document, relevant to EMS, was composed to aid future users of the EMS IA in finding topics of interest. In addition, where available, contact information was included with the reference. The in-depth document review also yielded additional references that were incorporated into the overall list.

An EMS IA query worksheet was also developed to advance survey design and distribution. The research team refined draft survey queries for accuracy and completeness as informed by literature review findings. As the literature review advanced, the initial EMS IA query worksheet was expanded to include additional questions and options for consideration by the technical working group.

2.2 LITERATURE FINDINGS—GENERAL

The literature review revealed information gaps, with 26 states lacking published information. Of these, 11 states have only limited information, and 13 states have information that is more robust but still lacking in specific details. The remaining 24 states have sufficient information from which to draw the following general conclusions.

Although large manufacturing companies such as Ford Motor Company rely on ISO 14001 certified EMS as their environmental management tool, ISO 14001 certification is rare even for limited applications

within the DOT community. The literature review suggests that 26 states appear to have created an EMS program, but not a formal ISO 14001 EMS.

Organizations often start with a compliance-focused EMS and move toward a quality assurance program that incorporates environmental and stewardship criteria and measures. Most state DOTs that have EMSs appear to have initiated them as a result of violations or compliance orders from state or federal regulatory agencies. It appears that most state DOTs that started an EMS in response to ISO 14001 standard have continued to use EMS precepts as they evolved their environmental management tools, albeit without full-scale ISO certification.

Federal transportation and environmental agencies encourage EMS use at the state, regional, and local level through funding, training, and technical assistance. Many regional and local transit and aviation agencies use a fairly comprehensive EMS approach, and most state DOTs employ at least some aspects of the EMS PDCA continuum—especially when it comes to training. Among state DOT programs, EMS application tends to be most developed in equipment maintenance.

2.3 LITERATURE FINDINGS—SPECIFIC

Detailed findings from the literature review have been updated and combined with survey and interview results as described in Section 5.0, *Findings and Conclusions*, and further detailed in Appendix B, *Detailed Findings and Conclusions*.

Literature resources are organized for practitioner use within the EMS IA, under the following tabs.

1. **Literature Review (LR) by Source**: A complete listing of all sources starting with the overarching transportation research organizations, followed by university-oriented transportation centers, and review of state DOT webpages. Keywords and phrases include: *ISO 14001, Environmental Management Systems, EMS, management systems, management process, environmental, stormwater, pollution prevention, hazardous materials, solid waste, monitoring,* and *stewardship.* References are color-coded to reflect relevance to DOTs and whether the reference represents guidance, a case study, a regulatory document, a plan, or research.
2. **LR by Location**: Information for each state by topic. If no information was found in the literature, the related cell is blank. As such, this tab provides a way to quickly identify gaps in the published information, such as chronological gaps in research or publications, geographical patterns or gaps, or subject matter gaps.
3. **LR Previous Surveys**: Compares information from previous surveys that captured state-specific EMS information. Five surveys were found in the literature that were conducted in 2003, 2006, 2007 (2), and 2009 by various organizations.
4. **LR EMS History**: A chronological list of DOT EMS milestone events found in the literature. The chronology illustrates the changes in state DOT interest in EMS over time.

3.0 SURVEY

3.1 METHODOLOGY

Based on the literature review and refined conceptual draft EMS IA, the research team developed a web-based stakeholder survey using “Survey Gizmo” to collect additional data and examine initial research conclusions. Appendix C includes a copy of the survey.

The survey collected responses to the posted queries and identified sources of additional information to be secured through follow-up emails and interviews. Particular care was taken to fill information gaps identified in the literature review and identify contacts and champions willing to participate in follow-up calls. Efforts were also made to identify individuals willing to advance EMS within their organizations and/or assist fellow practitioners.

Survey Distribution

AASHTO, TRB, American Public Transportation Association–Environmental Subcommittee, and the National Association of State Aviation Officials supported use of their membership email lists for the survey distribution with the AASHTO Standing Committee on Environment and Sustainability as the primary target recipient.

A total of 11 AASHTO/TRB committees provided their committee membership email lists for survey distribution:

- AASHTO
    - Standing Committee on Environment and Sustainability
    - Subcommittee on Construction
    - Subcommittee on Design
    - Subcommittee on Maintenance
- TRB
    - ADC10 Standing Committee on Environmental Analysis in Transportation
    - ADC60 Standing Committee on Resource Conservation and Recovery
    - ADD40 Standing Committee on Transportation and Sustainability
    - AHD10 Standing Committee on Maintenance and Operations Management
    - AHD50 Standing Committee on Roadside Maintenance and Operations
    - AHD60 Standing Committee on Maintenance Equipment
    - AHD65 Standing Committee on Winter Maintenance

Each committee's online membership list was used, resulting in a list with 675 unique emails covering all 50 states and the District of Columbia. State DOTs received 509 (75.4%) of these emails, and the remaining 166 (24.6%) consisted of a combination of other government agencies, universities, private companies, municipalities, or foreign entities.

Survey Distribution and Response

Following approval by the technical working group, each member on the committee email list received an invitation to participate in the survey with a request to respond within 3 weeks. Appendix C includes a generic version of the invitation letter. After follow-up prompts, the survey closed with 47 state DOT responses (46 states and the District of Columbia) and 27 other transportation organizations.

Additionally, responses were received from 27 non-state DOTs and other transportation-related organizations of which 9 were transit agencies, 1 regulatory agency, 1 highway authority, 2 federal transportation agencies, 1 county, 2 local transportation agencies, and 11 other private businesses or universities. Only 11 of those 27 organizations completed the survey.

In comparing the results for the non-state DOTs and non-DOTs, the main difference appears to be a somewhat higher prevalence of ISO 14001 certification and usage and a difference in administrative processes (who is in charge, funding, and costs).

Survey Format

The survey was web-based and consisted of 20 questions (see Appendix C). The survey used response logic so that subsequent questions were asked depending on the respondent's answers to the primary question.

3.2 RESULTS

Survey results for the state DOTs were incorporated in the EMS IA. Appendix B presents final conclusions compiled from web searches, literature review, survey, and interviews. A summary of these conclusions follows in Section 5.0, *Findings and Conclusions*. State-specific examples of internal EMS guidance, process, and training materials were solicited from any and all states. Pursuant to the responses to each of the survey questions, email solicitations were sent requesting internal background materials for inclusion in the EMS IA.

4.0 INTERVIEWS

4.1 METHODOLOGY

Follow-up questions and candidate interview states were suggested for each survey question, as applicable. After survey results were analyzed, the following supplemental questions were developed to advance project objectives:

1. How are environmental streamlining benefits being realized through EMS?
2. How can integration with other processes be used to improve EMS performance?
3. How do states with risk-based analysis and follow-up manage their systems?
4. Why is formal use of ISO 14001 the rare exception?
5. A few states claim not to use EMS or an EMS-like system. Why?
6. How do leading DOTs realize EMS efficiencies?
7. What are the methods, benefits, and costs of EMS applications outside NEPA compliance?
8. What are the methods, benefits, and costs of some of the more advanced EMS processes, such as performance monitoring and agency compliance roll up?
9. How do states with continuous EMS database updates manage their systems?
10. How can states build on the systems they have, and what help do they need to do so?

To address these and other, more general, questions in depth, interviews were conducted with DOTs in 10 states: Alabama, California, Colorado, Maine, Oregon, Pennsylvania, South Carolina, Virginia, Washington, and Wisconsin.

Interview Protocol

Prior to each interview, individual lists of proposed questions were provided to each state as a template for discussion and reporting. To promote a candid exchange of views, interviewees were assured that their comments would not be attributed on either an individual or state-specific basis.

4.2 RESULTS

Interview notes were shared with participants, and findings were incorporated into study conclusions. Supplemental materials gathered through interview and email solicitations are included in the EMS IA.

Interviews were exceptionally valuable for assessing both the current state of EMSs in DOTs and suggesting opportunities for improvement. Results keyed to survey questions are reflected in the *Summary* conclusions, the Section 5.0, *Findings and Conclusions*, and further detailed in Appendix B. In addition to providing background and detail on specific survey questions, these discussions suggested some very basic and important findings:

1. Although virtually all DOTs employ aspects of EMS, comprehensive PDCA EMSs operating across all applicable activities are rare.
2. Systematic assessment of performance (the check/act part of PDCA) is often lacking and with it the ability to proactively act on improvements. Instead, improvements tend to be incident driven.
3. Environmental units are generally using at least some aspects of EMS to ensure compliance with NEPA commitments; however, they often do not have a firm documented grasp of EMS as applied in other operational units.

5.0 FINDINGS AND CONCLUSIONS

This section presents summary findings and conclusions as compiled from the literature review, survey, and interviews broken down by survey queries. Information from the literature is presented first, followed by conclusions made from the survey and interview results. Further detail is provided in the EMS IA and Appendix B, *Detailed Findings and Conclusions*.

5.1 GENERAL FRAMEWORK AND HISTORY

In 1994, Maine and Massachusetts DOTs began using EMS. The ISO 140001 EMS series was published in 1996 using BS 7750 as a template. During the late 1990s, the U.S. Environmental Protection Agency (EPA) began conducting pilot test studies. NY City Transit became the first ISO 14001 certified DOT in 1999, and, in 2002, Pennsylvania became the first state DOT to obtain ISO 14001 certification (in one district). In 2003, the AASHTO Center for Excellence, in partnership with FHWA, formally launched its EMS technical assistance program with a workshop. The literature review shows increased activity from 2003 to 2007. In 2006, Pennsylvania and Massachusetts achieved ISO 14001 certification for all their maintenance districts. From 2007 to the present, however, the literature review suggests EMS activity is decreasing over time.

Regulatory pressure was a consideration in the past. Most DOT operational units developed and implemented their own processes and procedures in response to actual or potential regulatory violations with varying degrees of support and leadership from their environmental units and limited input from outside agencies or information sources. Although the application of EMS elements across various state DOT operations has expanded over the past few decades to become a standard business practice, the

application of the complete PDCA approach is not common. According to our research, virtually all state DOTs are using elements of the ISO 14001 EMS standard. EMS programs have been a factor in the streamlining of regulatory approvals and other efficiencies. EMS programs have also benefited in varying degrees from the development of a PDCA approach across other DOT functions. Although clearly important, funding has generally not been a driving (or a limiting) issue.

5.2 PRESENCE OF EMS

In March 1992, BSI Group headquartered in the United Kingdom published the first EMS standard, BS 7750, based on the PDCA process. In 1994, Maine and Massachusetts DOTs began using EMS. The ISO 14000 EMS series was published in 1996 using BS 7750 as a template. During the late 1990s, EPA began conducting pilot test studies. New York City Transit became the first ISO 14001 certified DOT in 1999, and, in 2002, Pennsylvania became the first state DOT to obtain ISO 14001 certification (in one district). In 2003, the AASHTO Center for Excellence, in partnership with FHWA, formally launched its EMS technical assistance program with a workshop.

Results of the literature review indicate that 24 state DOTs with some type of EMS program appear to have used or are using an incremental approach to applying EMS. Four state DOTs appear to have had a statewide/program-wide EMS. The literature review revealed information gaps, including that 26 state DOTs lack published information. Of these, 11 state DOTs have only limited information, according to the literature review, and 13 state DOTs have information that is more robust but still lacking in specifics. The remaining 24 state DOTs have sufficient information from which to draw tentative conclusions on EMS application.

EMS use is the standard rather than the exception. Application of EMS components has become so pervasive within state DOTs that it is often no longer understood to be an EMS or an EMS-type process, but simply “the way we do our job.” A PDCA approach to management is common in DOTs, and environmental concerns are no exception.

The 2006 AASHTO survey and 2009 NCHRP 25-25, Task 37, survey indicate that 23 state DOTs had no EMS or similar programs. According to the current survey, some 19 of these state DOTs have gone on to create an EMS-type program. In total, the current survey indicates 44 state DOTs use at least some elements of an EMS-type program (Question 6a, Appendix B).

The degree of EMS usage in terms of both process rigor and application across organizational units seems to vary significantly depending upon a history of regulatory pressure, management initiative, and organizational capacity. Most operational units within state DOTs have developed and implemented their own processes and procedures with varying degrees of support and leadership from their environmental units with limited input from outside agencies or information sources.

5.3 DEVELOPMENT AND IMPLEMENTATION OF EMS

Most, but certainly not all, state DOTs seem to have started their EMS (focused on their capital program, maintenance yards, stormwater, or compliance) as the result of apparent shortcomings that were revealed through incidents or external pressures. Principal among these reasons appears to be an FHWA initiative to ensure that NEPA commitments, made during design, were carried through to construction, maintenance, and operations.

Focus of Initial Effort

The literature review provided information about 24 state DOTs on where their initial focus for EMS development was and why they initiated their EMS program. The responses were as follows:

Area of Initial Focus

- Nine state DOTs focused their initial EMS efforts on maintenance yards.
- Five state DOTs focused their initial efforts on stormwater.
- Six state DOTs focused on environmental compliance.
- Four state DOTs had single-issue areas of initial focus: winter stockpiles, highway paint, greenhouse gas emissions, and the ferry system, respectively.

Reason for Initiation of EMS

- Seven state DOTs initiated their EMS programs due to either EPA consent decrees or state regulatory agency enforcement action.
- Five state DOTs initiated their EMS programs due to state government action (legislation or governor decree).
- Two state DOTs initiated their EMS programs because of internal management leadership.
- One state DOT initiated an EMS program as a pilot project.
- Nine state DOTs initiated their EMS programs for undisclosed reasons.

The current survey provided information from 40 state DOTs. Table 5-1 summarizes the initial EMS development efforts.

Table 5-1. Focus of Initial Effort in EMS Development

Focus of Initial Effort	Number of Responses	Percent
Highway maintenance	16	20.3%
Equipment management	4	5.1%
NEPA design commitments	33	41.8%
Stormwater	32	40.5%
Other	14	17.7%
Not sure/no answer	13	16.5%
Total	95	100%

A comparison of the results from the literature review and the current survey indicates a possible shift in the focus of EMS development from maintenance to NEPA compliance. This same finding is seen in the shift in initial champion from maintenance departments to environmental departments or units. Such a shift could be related to the preponderance of environmental staff as survey respondents, or the early adoption of EMS by maintenance units in contrast with the more recent effort to use EMS during project development.

Cost/Benefit and Funding Considerations

State DOTs find EMS processes to be highly cost effective for the monetary, stewardship, and especially the compliance benefits received. Formal benefit/cost analysis of EMS is not a focus for in-depth investigation within DOTs because benefits seem self-evident, and avoided costs are difficult to quantify.

The current survey yielded a wide range of costs associated with EMS development, with nearly 30% indicating that the cost was unknown. Costs to establish and maintain EMS appear to range from several hundred thousand dollars to several million dollars.

Although most EMS efforts were initiated with special funding or grants in response to violations or incidents, virtually all continue to be funded by the state DOTs' standard operating budgets as opposed to special allocations or separate budgetary items. This supports the conclusion that, in general, state DOTs find EMS cost effective and have adopted EMS efforts as their standard operating procedures. However, state DOTs have indicated that they do not desire to pursue complete ISO 14001 certification in part based on the high cost of documentation and auditing that might not yield commensurate benefits.

Implementation

As with most management programs, training and written procedures, followed by audits, seem to have factored strongly in the development of initial strategies to implement EMS. Of the 33 state DOTs that provided survey responses, all use either training, written procedures (standard operating procedures/manual), or audits.

ISO Certification

Although ISO certification has been a model for several state DOTs, full formal implementation of ISO 14001 is rare. Even DOTs that achieved limited certification in the past have backed away from the formal process in favor of a more customized approach that is more in keeping with their standard unit-oriented quality assurance norms and results-oriented audits. Certification costs as reflected in dollar costs and staff time were cited as reasons for discontinuance, and a lack of drivers in terms of increased efficiency, regulatory relief, and public perception also were cited as contributing factors.

Agency Involvement

According to the literature, development and implementation of EMS was typically in response to violations or compliance orders from state or federal regulatory agencies. However, the current survey indicates that regulatory pressure from federal and state agencies was not a prominent driver in state DOTs' use of EMS—which may be true, or may reflect a loss of institutional memory. The current survey also lists seven state DOTs in cooperative EMS development efforts with other agencies, with one in an enforcement action.

FHWA's promotion of NEPA commitment tracking more than 20 years ago continues as a common feature of EMSs within most state DOTs. Three state DOTs were 2006 Center for Environmental Excellence EMS Technical Assistance Pilot Projects.

Expansion and Reduction of Environmental Management Systems

The utility of EMS is highlighted by the fact that most agencies have expanded their programs. The literature review generally suggested that state DOTs were expanding their EMS programs; reasons for expanding EMS may include increased compliance assurance and cost-effectiveness, adoption and

development of best management practices and sustainability practices, enhanced land and resource use planning and management, accelerating and streamlining the project delivery processes, and improved intergovernmental relationships and stakeholder confidence (2010 NCHRP 25-25, Task 63 Report).

The survey results for the current study confirm that many state DOTs have expanded their EMS programs after initial rollout: of the 42 responding states, 26 indicated they expanded their EMS program while 6 reported their programs remained unchanged and only 1 state indicated their program was diminished (9 responding state DOTs did not answer this question).

Results of the survey indicate the reasons for not expanding EMS may include violation satisfied, no interest, not needed, low priority, lack of funds, lack of perceived value, or lack of advocacy.

5.4 CURRENT APPLICATION OF EMS

Environmental units are commonly involved in EMSs for NEPA compliance, and most other DOT units (including equipment maintenance, highway maintenance facilities, highway maintenance activities, and bridge maintenance) have at least some rudimentary EMS applications of their own. However, few, if any, have complete, mature, proactive PDCA systems.

EMS processes generally include written procedures, record keeping, reporting, and training as core EMS processes, but application of the complete PDCA approach is rare. To illustrate, EMS procedures for highway maintenance activities are practically universal with most using record keeping, training, and reporting, and audit and audit follow-up used by almost a third of those reporting. However, less than a third seem to have performance targets, and only 10% use the full PDCA system. Despite advancements in environmental expertise, field availability of geographic information systems (GIS), just-in-time training, and a developing stewardship ethic; EMS as applied to Highway Maintenance Activities tends to be incomplete, and gaps in the full suite of PDCA components are common.

Equipment Maintenance

Written procedures, record keeping, and training followed by audits are core EMS processes, and their predominance suggests serious interest in EMS for equipment maintenance. However, less than half of the organizations responding have performance targets, and less than one-quarter report PDCA capabilities.

Highway Maintenance Facilities

EMS procedures for highway maintenance facilities are common and mainly include written procedures, record keeping, reporting, and training followed closely by audit and audit follow-up. Of those reporting, less than half seem to have performance targets, and less than one-third use the full PDCA system.

Highway Maintenance Activities

EMS procedures for highway maintenance activities are nearly universal with record keeping, training, and reporting. Audit and audit follow-up are employed by almost one-third of those reporting. However, less than one-third seem to have performance targets, and only about 10% use the full PDCA system.

Innovation and advancement of EMS are occurring in this area with field availability of GIS resource mapping, timely training, and a developing stewardship ethic among the most promising developments. With GIS resource mapping, two state DOTs provide tablets to their maintenance fleets with GPS that automatically identifies DOT assets (e.g., culverts) or environmentally sensitive issues (e.g., endangered

plant species) and allows for reporting on any maintenance issues, or, during construction, pulling up the design files. Another state DOT uses a system that loads programmatic agreements both directly into their commitment tracking system and aids in converting the programmatic agreements to contract and permit language. Yet another state DOT has found its EMS-rooted stewardship ethic has resulted in cleaner and safer maintenance compounds with fewer safety and environmental violations.

Bridge Maintenance

Although probably under-reported due to survey mechanics, EMSs for bridge maintenance activities seem fairly robust. Written procedures, training, record keeping, and audit activities are common among those reporting.

NEPA/Environmental Compliance

Use of EMSs in NEPA compliance, specifically to track implementation of commitments made during the NEPA process, is common. The primary focus of EMS application in this realm is related to environmental compliance quality assurance procedures. Written procedures, record keeping, reporting, and training followed by audits are core EMS processes. EMS elements are used to track environmental commitments and compliance with those commitments on a project-by-project basis. State DOTs did not indicate the use of feedback mechanisms (the "check" and "act" parts of the EMS PDCA cycle) to identify recurring environmental commitments among projects or types of projects where they might make use of programmatic agreements with regulatory agencies to streamline their projects at the program level.

Other

EMS application to other areas is common among state DOTs. However, application of the full PDCA cycle is rarely seen. Based on the literature review, seven state DOTs applied EMS to other areas. The other areas include application of highway paint, greenhouse gas emissions, ferry systems, endangered species management, laboratory, and vegetation management. The current survey shows that nine state DOTs apply EMS to other areas. Other areas for which EMS is applied were not specified in the survey.

5.5 EMS MONITORING

The vast majority of state DOTs rely on manual or incident-driven EMS data analysis, and only a few reported routine systematic review of EMS data. Moreover, as suggested by interviews and data from other survey questions on the scope and depth of EMS across the full complement of DOT functions, it seems that systematic assessment of performance (the "check" part of PDCA) is often limited and with it the ability to proactively act on needed improvements.

5.6 EMS IMPROVEMENT

The literature review, survey, and interviews led to the identification of several measures to improve EMSs.

Integration with other processes is an important theme. State DOTs appear to have learned through experience that program-area ownership allows for the synergistic integration of environmental factors with companion procedures such as safety to strengthen day-to-day compliance. From the interviews, one state DOT commented that having buy-in from the maintenance crews at the beginning was one of the things that made their program successful. Another state DOT commented that maintenance crews took pride and "bragging rights" for not having audit findings. One state DOT made a series of small changes

that have helped it integrate an EMS approach into its daily procedures. Examples of these individually small changes that yielded substantial improvement include:

- using payroll codes on timesheets to allow crews to demonstrate that EMS-type work had been completed
- bringing maintenance into the design phase to ensure that what is designed can be maintained
- keeping a list of all records needed to be kept on hand (and in one place) for audits and inspections, and
- making drum waste storage simpler with a policy of the shortest storage limit date applying to all waste.

Nearly all state DOTs engage and train their employees in EMS applications used in their units. Additionally, cooperative outreach to regulatory agencies can enhance EMS acceptance and performance. From the interviews, one state DOT uses a compliance matrix dashboard to maintain transparency with the agencies and promote positive dialogue. Although virtually all state DOTs employ some form of EMS data analysis, few, if any, seem to have a comprehensive system with robust PDCA elements across all applicable activities. Without systematic assessment of performance, the ability to proactively "act" on improvements to EMS is impeded. Additionally, lack of a documented agency-wide EMS can restrict streamlining and other benefits.

5.7 SPINOFF APPLICATIONS

The literature review yielded information on seven state DOTs with spin-off applications for highway paint, greenhouse gas emissions, a ferry system, endangered species management, materials testing laboratory operations, and vegetation management. Additionally, the current survey results indicated that these spin-off applications have become more prevalent. For example, vegetation and endangered species management using EMSs is common among state DOTs.

5.8 ADDITIONAL EMS BENEFITS

The literature review and survey identified additional EMS benefits through survey questions. Environmental streamlining is a common benefit of an EMS approach. More than 40% of the survey respondents indicated that environmental streamlining was improved by EMS use. For example, EMSs can be used through all phases of a project. The environmental commitments identified during the NEPA process can be entered into the EMS, and compliance with these commitments can be tracked through design, construction, and operation of a project. Regulatory agencies seem willing to reduce their level of intervention and oversight in direct proportion to their confidence in state DOT EMS implementation. The interviews and survey indicate that many state DOTs are using Memorandums of Understanding, Memorandums of Agreement, and Programmatic Agreements as a method of standardizing interactions with agencies and building confidence. During the interviews, two state DOTs reported they have successfully achieved a level of trust with regulatory agencies that has allowed them, on low impact projects, to only have to report on a six-month basis. In addition, coordination with resource agencies often results in state DOTs funding dedicated resource agency positions, at agencies such as the U.S. Fish and Wildlife Service and USACE, which only process DOT projects, resulting in expedited returns.

6.0 EMS INFORMATION ARRAY

The information gathered from the literature review, surveys, and interviews was used to create the EMS IA. It is intended for use by DOT environmental staff, design managers, maintenance engineers, operation managers, and executive staff to improve EMS performance by understanding:

- what an EMS is,
- how to successfully initiate/expand/benchmark an EMS,
- how to improve EMS effectiveness using peer resources, and
- how to quickly access EMS literature and survey data.

Appendix A is an illustrated guide on how to use the EMS IA by showing an example search. The EMS IA may be found at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4335.

7.0 CONCLUSIONS

This research reviewed the history and status of EMSs in DOTs across the United States and found that the formal ISO 14001 EMS has not been practicable on a wide-range, long-term basis across an entire DOT. Rather, individual operational units within the DOTs (including capital program NEPA compliance, equipment maintenance, highway maintenance facilities, highway maintenance activities, and bridge maintenance equipment management) are incorporating EMS elements into their standard procedures resulting in considerable individual variation. In most cases, these procedures model the "plan" and "do" parts of PDCA but do not fully incorporate the "check" and "act" aspects; as such, the state DOTs' capacity to systematically improve EMS performance is limited.

To help DOTs become familiar with the full PDCA EMS cycle and realize the benefits of a fully functioning EMS, an EMS IA was developed, and a prototype DOT EMS benchmarking tool is included for use by state DOTs environmental units and other organizations to gain a fuller appreciation of EMS improvement needs, means, and methods. The tool is linked to literature references, examples, and resources assembled from state DOTs for use in addressing gaps and shortcomings revealed through benchmarking. Application of the EMS IA should result in improved performance and increased efficiency in conducting day-to-day work in conformance with environmental requirements.

If state DOTs can begin to expand their EMS applications to include the full PDCA cycle, they should be better positioned to proactively manage their operations and improve their stewardship of both the environment and the public they serve.

8.0 SELECTED REFERENCES

AASHTO Center for Environmental Excellence and Solitis, D. (2003). Using an environmental management system to meet transportation challenges and opportunities: An implementation guide [Online]. Available at: https://environment.transportation.org/pdf/programs/ems_manual.pdf.

BSI (2016). Introducing ISO 14001:2015: Continually improving environmental performance. April 2016. [Online] Available at: https://www.bsigroup.com/LocalFiles/en-GB/iso-14001/resources/ISO--14001-Client-Guide-FINAL-April-2016.pdf.

International Standards Organization (ISO) 14001 (2015). Environmental management systems–requirements with guidance for use [Online]. Available at: https://www.iso.org/obp/ui/#iso:std:iso:14001:ed-3:v1:en.

Johnson, C. (2016). The benefits of PDCA: Use this cycle for continual process improvement. Back to basics [Online]. Available at: http://asq.org/quality-progress/2002/05/problem-solving/the-benefits-of-pdca.html.

For additional references, please see the Literature Review (LR) by Source Tab (Tab 8) in the EMS IA.

9.0 ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
DOT	Department of Transportation
EMS	Environmental Management System(s)
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
IA	Information Array
ISO	International Organization for Standardization
LR	Literature Review
NEPA	National Environmental Policy Act
NCHRP	National Cooperative Highway Research Program
PDCA	Plan-Do-Check-Act (improve)
PI	Principal Investigator
SME	subject matter expert
TRB	Transportation Research Board

Appendix A

An Illustrated Guide to Using the Information Array

This appendix illustrates the purpose of the Environmental Management System Information Array (EMS IA) and explains its use with an example. The EMS IA is available at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4335 and is self-contained with separate tabs for instructions, benchmarking, and references. The EMS IA is presented in Excel and can be downloaded and modified for local, customized use by enabling edits.

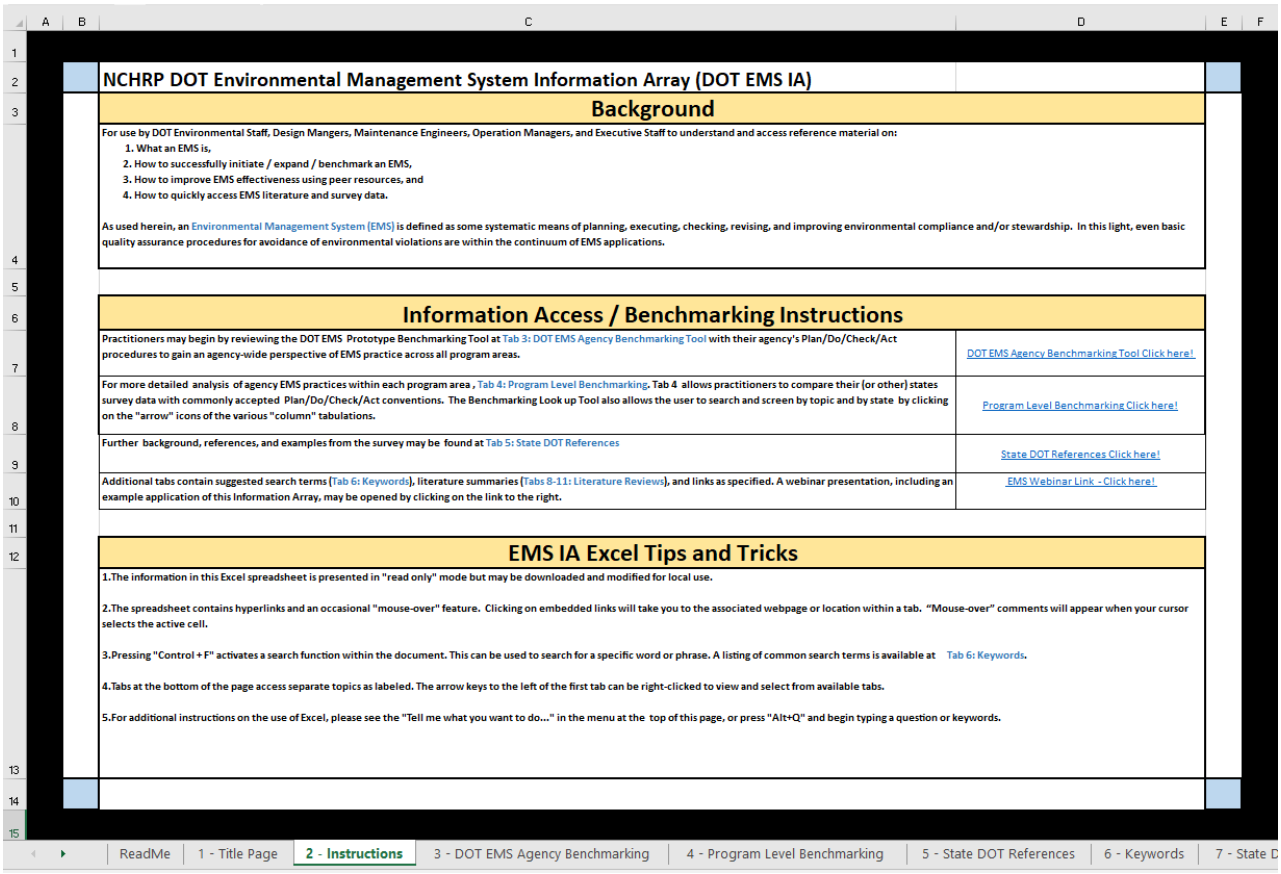
TABLE OF CONTENTS

LIST OF FIGURES

1 Accessing the EMS Information Array (IA)

1. Download the EMS IA Zip file found at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4335
2. Open
3. Extract/unzip the initial folder, which contains all the files in a subfolder. Note: extracting/unzipping the EMS IA file directly from the subfolder may corrupt the built-in hyperlinks.
4. Double click resulting file
5. Open first Excel spreadsheet
6. Click on "Tab 2 – Instructions" which is shown in Figure A-1

Figure A-1. EMS IA Tab 2: Instructions

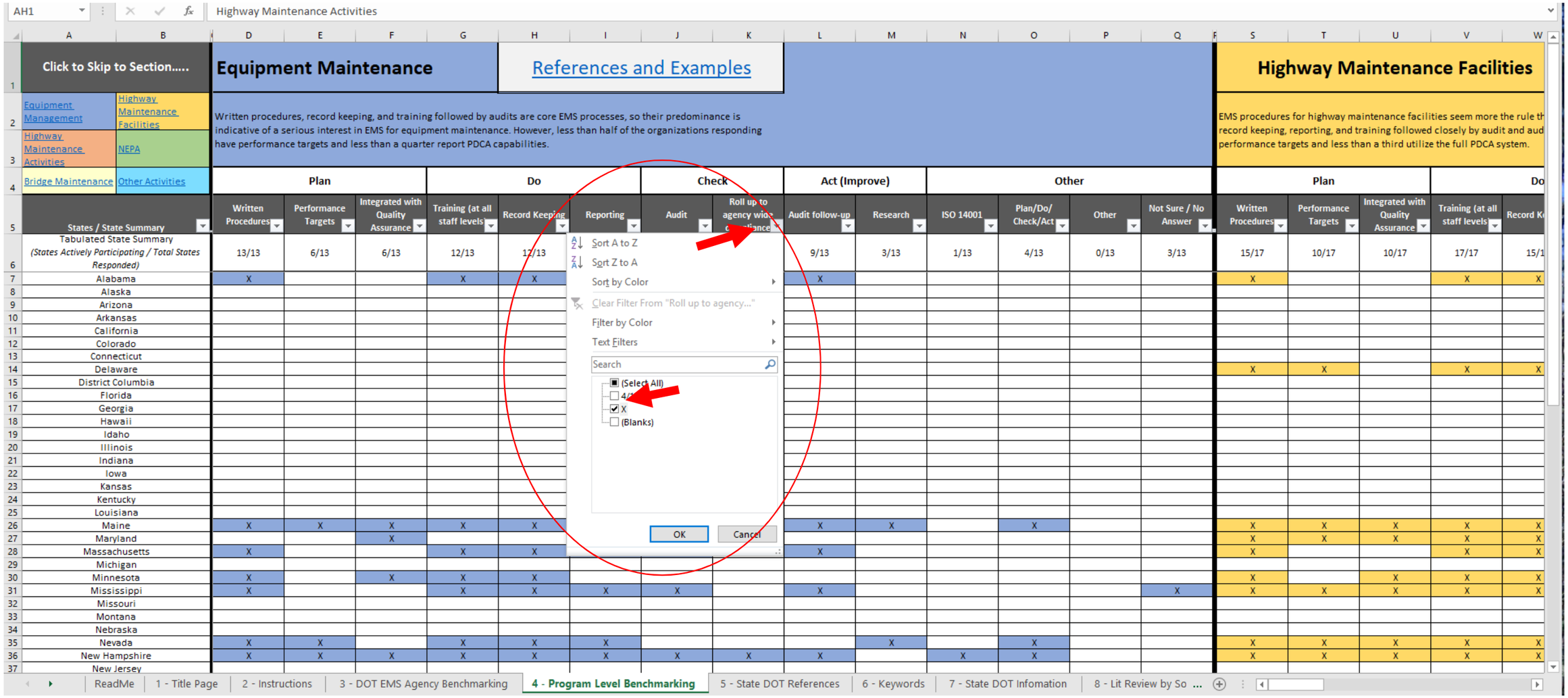


2 Additional Guidance

- The information in this Excel spreadsheet as downloaded will be in "read only" mode but may be modified for local use.
- The spreadsheet contains hundreds of hyperlinks. Clicking on embedded links will take you to the associated webpage, document, or location within a tab.
- Pressing CTRL-F activates a search function within the document, which can be used to search for a specific word or phrase. A listing of common search terms is available at Tab 7: Keywords.
- Tabs at the bottom of the page access separate topics as labeled. The arrow keys to the left of the first tab can be right-clicked to view and select from available tabs.
- This Excel spreadsheet uses the column sort function indicated by the small, drop-down menu icon at the top of the column. The top red arrow in Figure A-2 shows an example of the location of the drop-down menu icon. Clicking on that icon brings up the sorting popup menu circled in red on Figure A-2. In the sorting popup menu, you can select or unselect the choices. In the Figure A-2 example, the bottom red arrow shows the "X" for that column as selected.

Additional instructions on the use of Excel may be found through the "Tell me what you want to do..." menu at the top of the screen.

Figure A-2. How to use the Excel sort function



3 Tab 3: DOT EMS Agency Benchmarking

Using the DOT agency benchmarking tool, shown in Figure A-3, practitioners may begin by comparing their existing processes with the listed range of Plan-Do-Check-Act (PDCA) components to identify gaps and/or to formulate a rough, agency-wide perspective of EMS practice across all program areas. This may be done through the available Excel spreadsheet or the printable Word and PDF templates linked to icons at this tab. Note that, as with any part of the EMS IA, the user may customize the benchmarking tool by "edit enabling" after download. Among other advantages, flexibility to edit and customize the tool can help accommodate variations in local program structure and process.

Figure A-3. DOT EMS Agency Benchmarking

Benchmarking Tool		Plan			Do			Check		Act (Improve)	
Program Area	**Special Features**	Written Procedures	Performance Targets	Integrated with Quality Assurance	Training (of all staff levels)	Record Keeping	Reporting	Audit	Roll up to Agency Wide Compliance	Audit Follow-Up	Research
Equipment Management	Materials recycled, good housekeeping practiced.										
Highway Maintenance Facilities	Materials, fuels, stormwater, wastes under active management.										
Highway Maintenance Activities	Sensitive resources factored into planning, training, audit and support.										
NEPA	Commitments tracked through construction and maintenance.										
Bridge Maintenance	Sensitive resources, factored into planning, training, audit and support.										
Other Activities	Specialized support engaged.										

4 Tab 4: Program Level Benchmarking

The program level benchmarking tool, shown in Figure A-4, allows for a more detailed analysis of agency EMS practices within each DOT program area by allowing the user to filter by answer and by state by clicking on the drop-down, “sorting” menus ("arrow" icons) of the various “column” tabulations (see Figure A-2). It also contains a “Tabulated State Summary” indicating how many state DOT respondents indicated use of each PDCA feature in the survey.

For example, if the practitioner observes an improvement opportunity in “Roll up to Agency Wide Compliance,” a quick sort on that column (see Figure A-2) will yield a list of states that report that feature for the subject program area (see Figure A-5).

Other program-area information may be accessed by scrolling to the right and/or clicking on the subject program area hyperlink in the upper left-hand corner “Click to Skip to Section” where these same features will be available for the other program areas.

Figure A-4. EMS IA Tab 4: Program Level Benchmarking

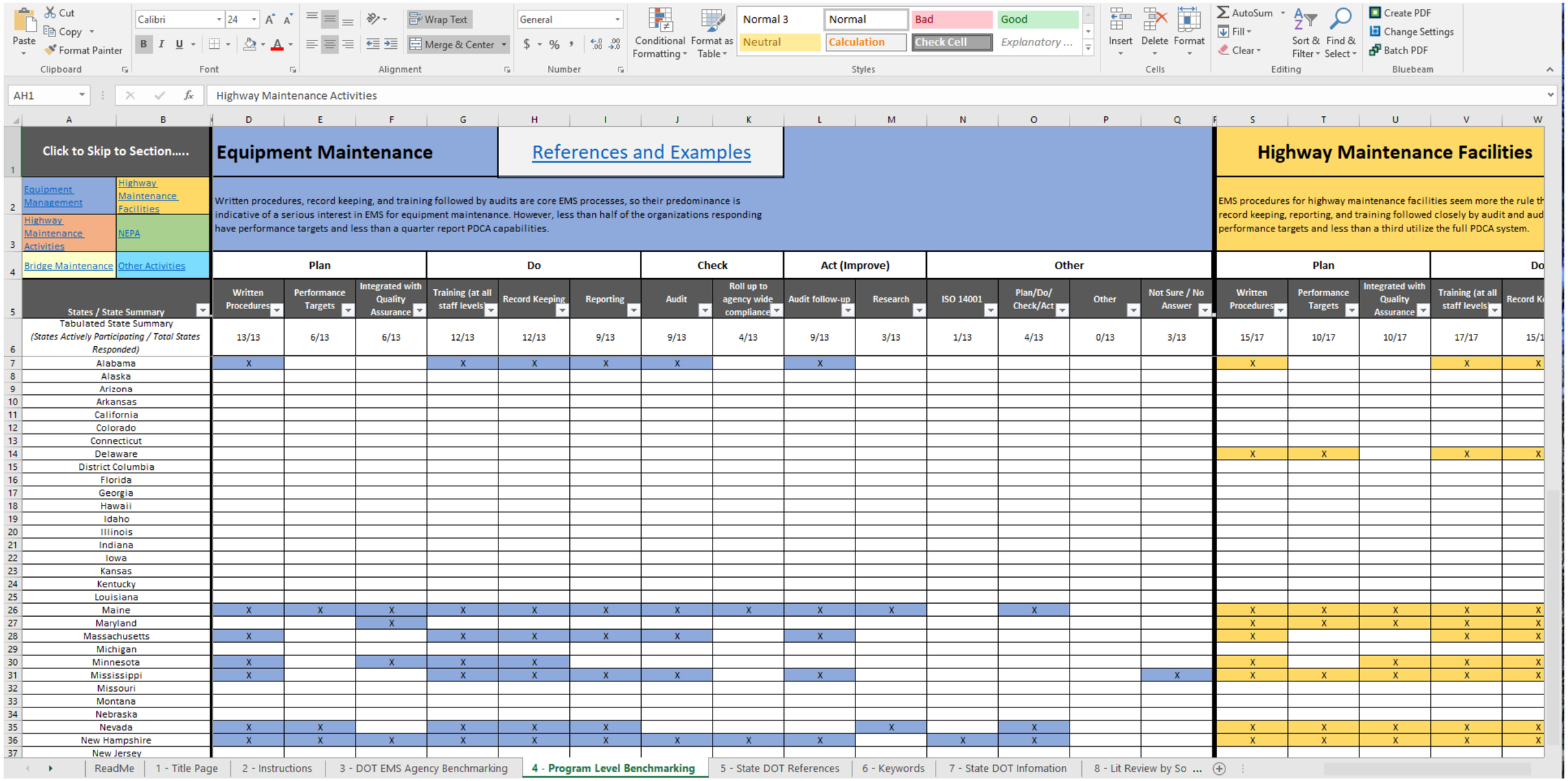
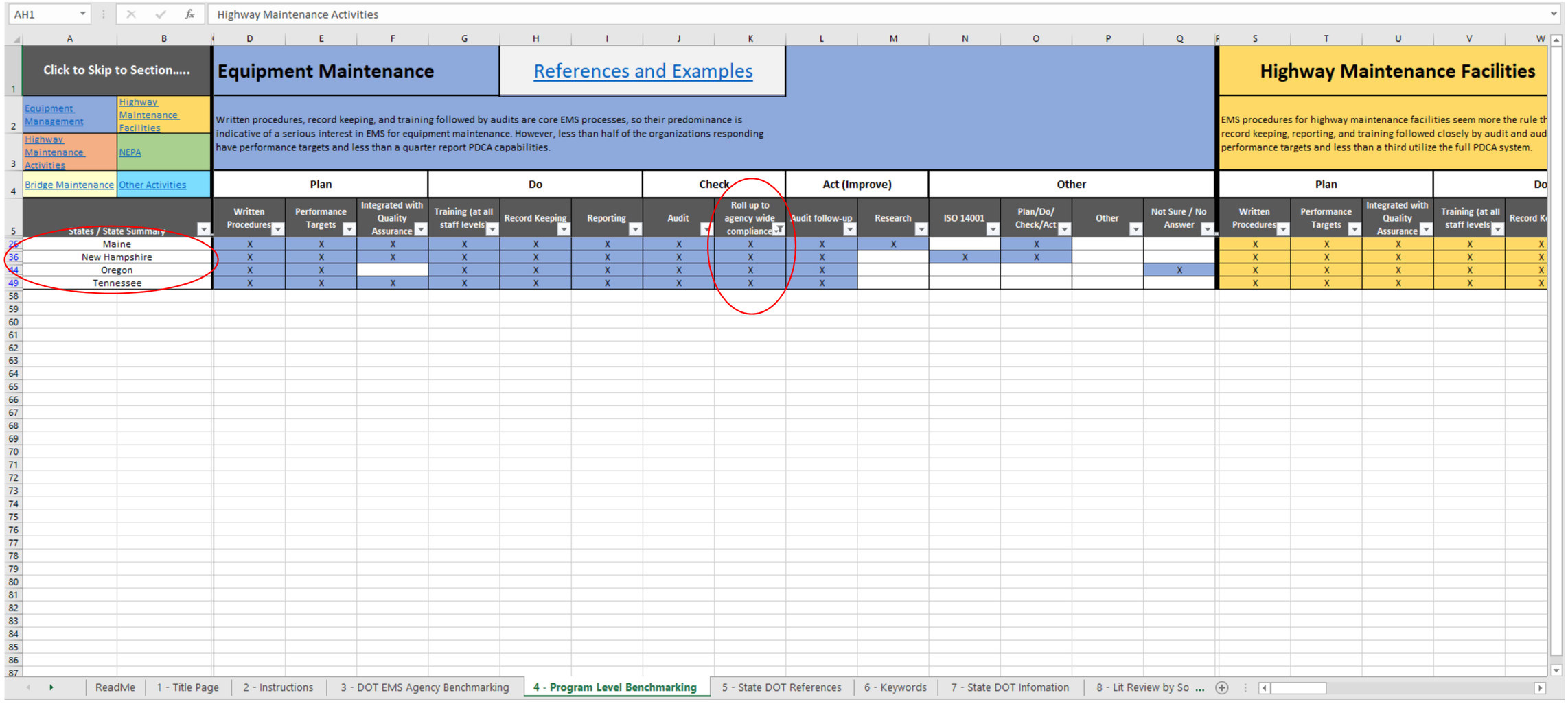


Figure A-5. EMS IA Tab 4: Program Level Benchmarking - example sort for Equipment Maintenance



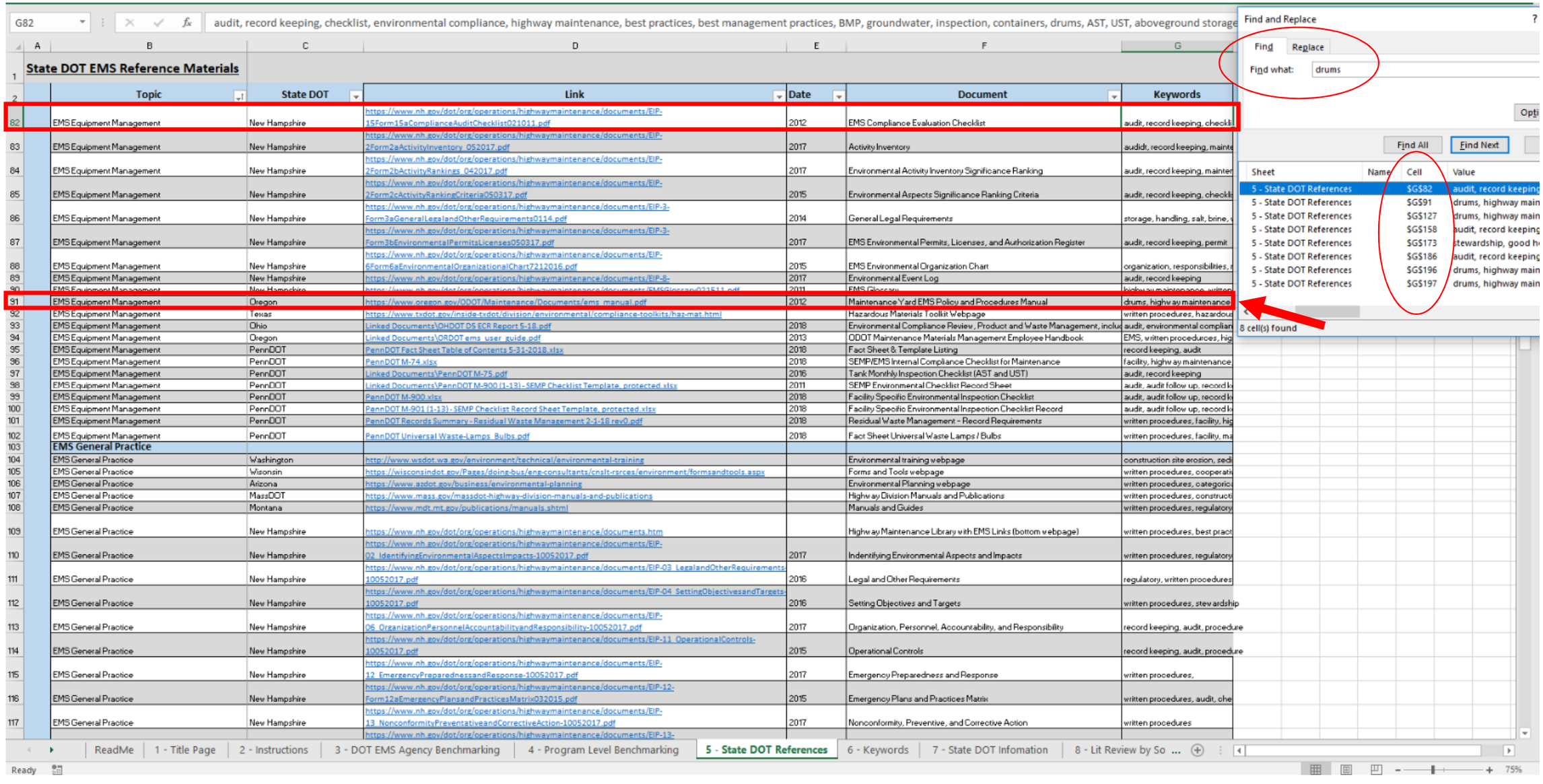
5 Tab 5: State DOT References

Tab 5 is the most valuable tab in the EMS IA for filling gaps and shortcomings. With some 260 state DOT EMS-related hyperlinked examples and reference materials, it provides a wealth of information for EMS improvement. The documents may be sampled by topic section and or identified by keyword search by hitting CTRL F.

For example, suppose a state DOT is cited for a drum storage violation and wishes to improve its storage procedures (see Figure A-6). Using the CTRL F function to search for "drum" and hitting "Find All," you'll see that eight cells, through the keywords column, are indicated. Those cells match to references to documents from New Hampshire and Oregon.

When we look at the document titles for the first two references, we note that New Hampshire's document is a checklist and Oregon's document is a procedure manual. Based on the titles, you may decide to initially exam Oregon's document on line #91: Maintenance Yard EMS Policy Procedures Manual.

Figure A-6. EMS IA Tab 5: State DOT References



6 Example Reference

Clicking on the hyperlink for Oregon's document on line #91: Maintenance Yard EMS Policy Procedures Manual (see Figure A-6) brings up the referenced document (see Figure A-7).

Figure A-7. EMS IA Drum Storage Example Reference

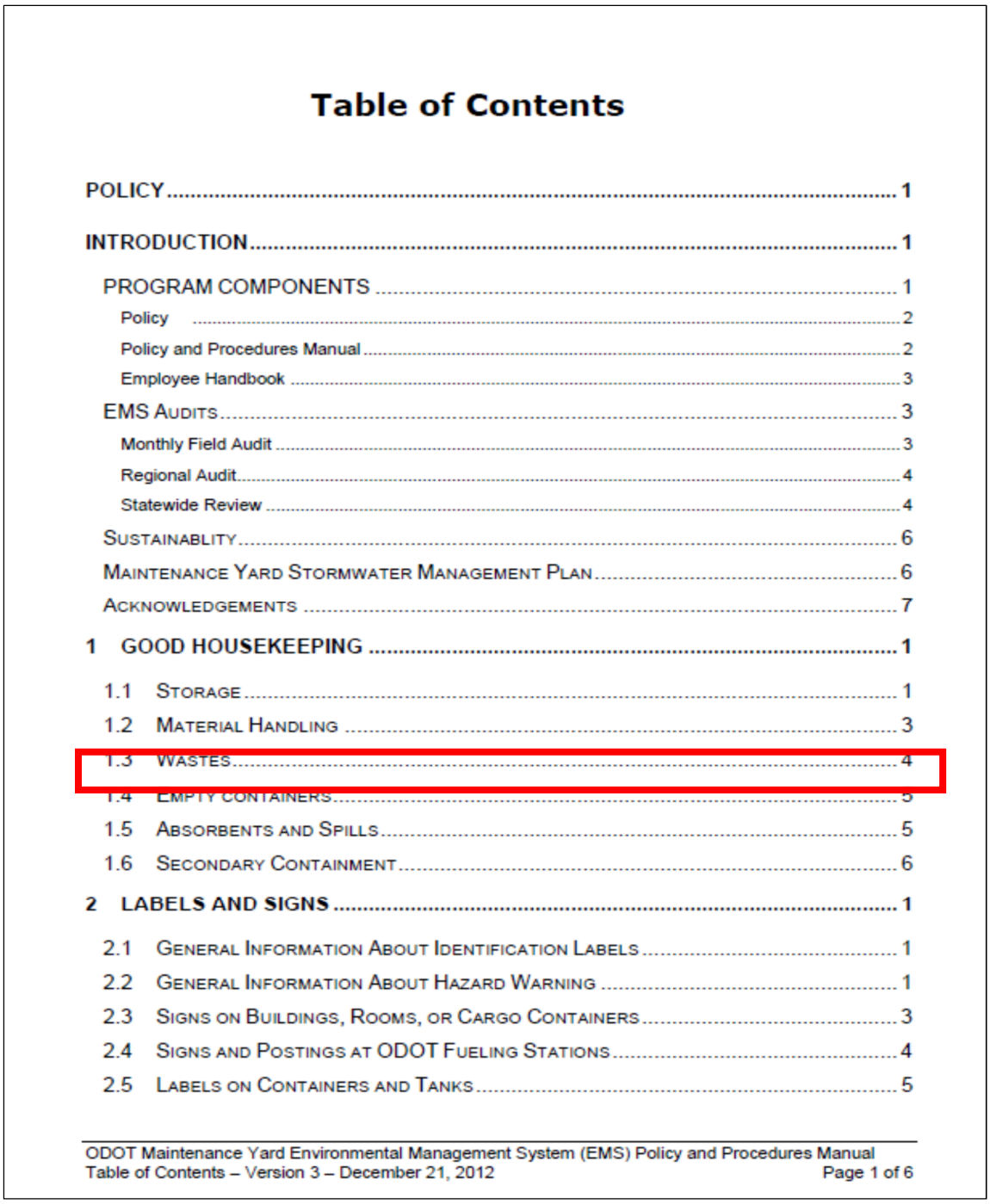


Table of Contents

In Section 1.4, of Oregon's Maintenance Yard EMS Policy Procedures Manual (see Figure A-7), the practitioner then could find Oregon DOT's drum storage procedures (see Figure A-8).

Figure A-8. EMS IA Drum Storage Example Benchmark Procedure

1.4 EMPTY CONTAINERS

- **Empty drums should be stored in a manner that indicates the drum is empty.** Examples of ways to show the drum is empty include storing the drum sideways with the bungs horizontal, labeling the drum "empty," or keeping the drum in an area signed "empty drums" or similar wording. Refrain from storing drums that previously contained liquids upside-down.

Figure 1-1: Examples of ways to store a drum that indicate the drum is empty.

Sideways with bungs horizontal

Label container "empty"

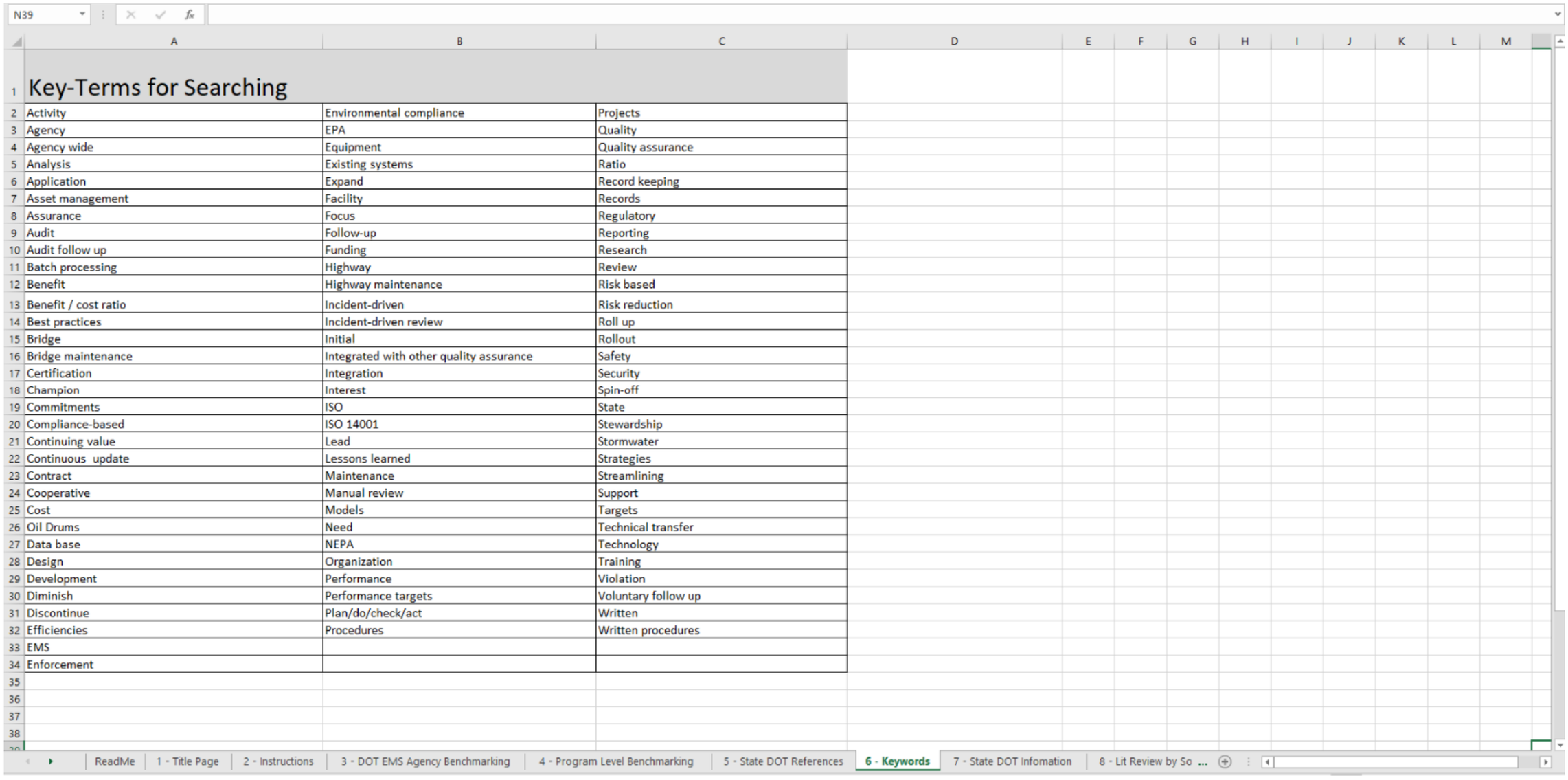
Label storage area

- If an *empty container* will be reused, the original label should be removed. The container should be relabeled with the intended contents, such as "trash" or "metal parts."
- Empty drums should be returned to the vendor for reconditioning, where available.
- Where available, recycling is recommended for *empty containers* that are not reused or returned to the vendor (e.g. recycling unwanted metal drums and cans as scrap metal),. Contact local recyclers for availability and requirements.
- *Empty containers* that are not recycled, reused, or returned to the vendor should be managed as *solid waste* (i.e. trash). A list of permitted municipal landfills and transfer stations is located in Appendix J. Plastic drums should be cut into two separate pieces prior to disposal. Contact the local landfill for specific requirements.

7 Tab 6: Keywords

Tab 6 (see Figure A-9) lists other possible keyword search terms. Additional references and examples may be accessed by clicking on the "References and Examples" link in the top center of the Tab 4 "Program Level Benchmarking" tab or by clicking on another tab as labeled.

Figure A-9. EMS IA Tab 6: Keywords



N39

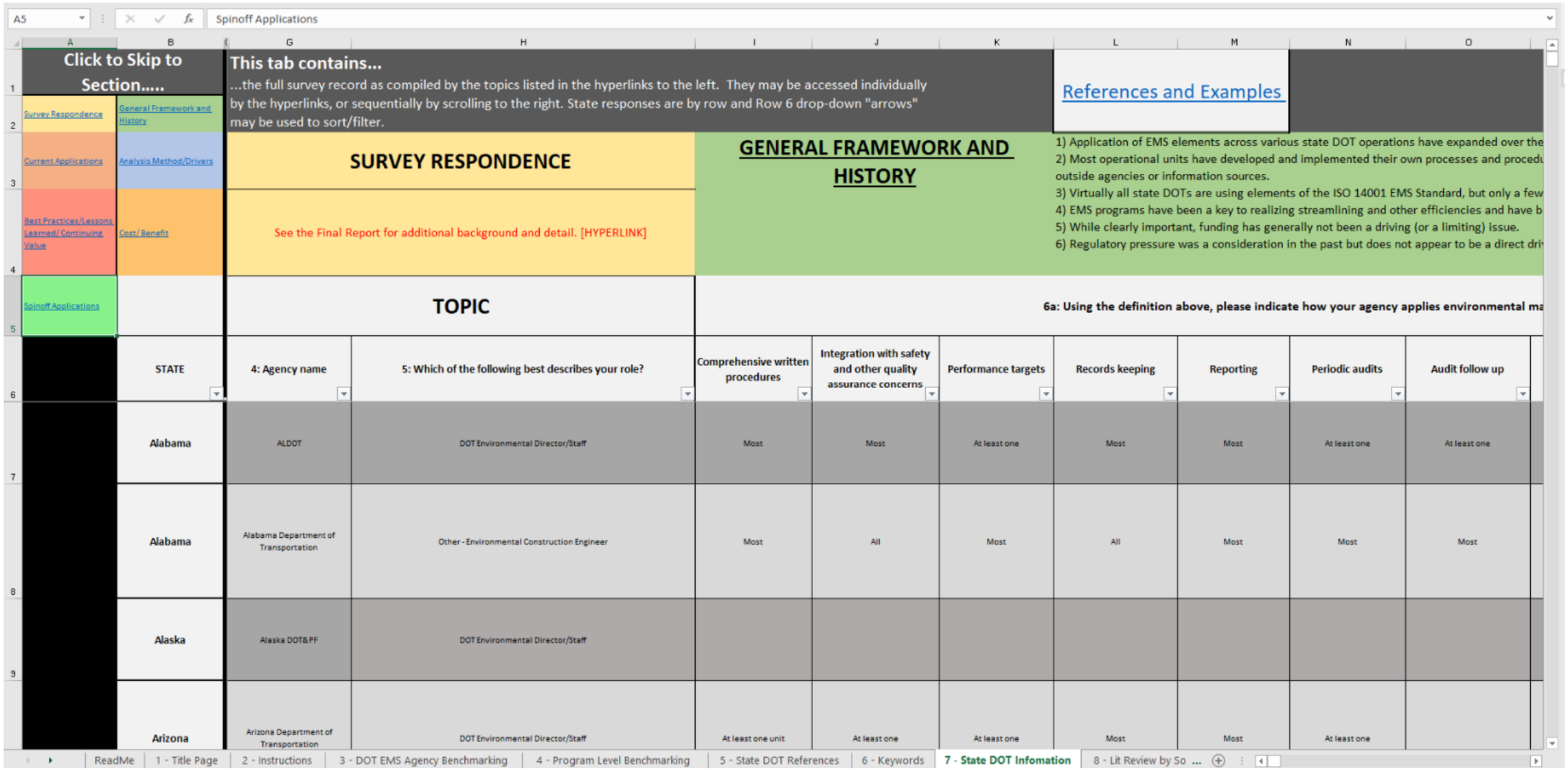
	A	B	C
1	Key-Terms for Searching		
2	Activity	Environmental compliance	Projects
3	Agency	EPA	Quality
4	Agency wide	Equipment	Quality assurance
5	Analysis	Existing systems	Ratio
6	Application	Expand	Record keeping
7	Asset management	Facility	Records
8	Assurance	Focus	Regulatory
9	Audit	Follow-up	Reporting
10	Audit follow up	Funding	Research
11	Batch processing	Highway	Review
12	Benefit	Highway maintenance	Risk based
13	Benefit / cost ratio	Incident-driven	Risk reduction
14	Best practices	Incident-driven review	Roll up
15	Bridge	Initial	Rollout
16	Bridge maintenance	Integrated with other quality assurance	Safety
17	Certification	Integration	Security
18	Champion	Interest	Spin-off
19	Commitments	ISO	State
20	Compliance-based	ISO 14001	Stewardship
21	Continuing value	Lead	Stormwater
22	Continuous update	Lessons learned	Strategies
23	Contract	Maintenance	Streamlining
24	Cooperative	Manual review	Support
25	Cost	Models	Targets
26	Oil Drums	Need	Technical transfer
27	Data base	NEPA	Technology
28	Design	Organization	Training
29	Development	Performance	Violation
30	Diminish	Performance targets	Voluntary follow up
31	Discontinue	Plan/do/check/act	Written
32	Efficiencies	Procedures	Written procedures
33	EMS		
34	Enforcement		
35			
36			
37			
38			

ReadMe | 1 - Title Page | 2 - Instructions | 3 - DOT EMS Agency Benchmarking | 4 - Program Level Benchmarking | 5 - State DOT References | 6 - Keywords | 7 - State DOT Infomation | 8 - Lit Review by So ...

8 Tab 7: State DOT Information

Tab 7 (see Figure A-10) contains all survey information from all responding states; like other tabs, Tab 7 may be navigated by scrolling up/down–left/right and filtered by using the column heading drop-down menus (see Figure A-2). Note listing of findings as applicable in upper rows.

Figure A-10. EMS IA Tab 7: State DOT Information



A5 | Spinoff Applications

Click to Skip to Section.....

Survey Respondence | General Framework and History | Current Applications | Analysis Method/Drivers | Best Practices/Lessons Learned/ Continuing Value | Cost/ Benefit | Spinoff Applications

This tab contains...

...the full survey record as compiled by the topics listed in the hyperlinks to the left. They may be accessed individually by the hyperlinks, or sequentially by scrolling to the right. State responses are by row and Row 6 drop-down "arrows" may be used to sort/filter.

References and Examples

SURVEY RESPONDENCE

See the Final Report for additional background and detail. [HYPERLINK]

GENERAL FRAMEWORK AND HISTORY

1) Application of EMS elements across various state DOT operations have expanded over the
2) Most operational units have developed and implemented their own processes and proced outside agencies or information sources.
3) Virtually all state DOTs are using elements of the ISO 14001 EMS Standard, but only a few
4) EMS programs have been a key to realizing streamlining and other efficiencies and have b
5) While clearly important, funding has generally not been a driving (or a limiting) issue.
6) Regulatory pressure was a consideration in the past but does not appear to be a direct dri

TOPIC

6a: Using the definition above, please indicate how your agency applies environmental ma

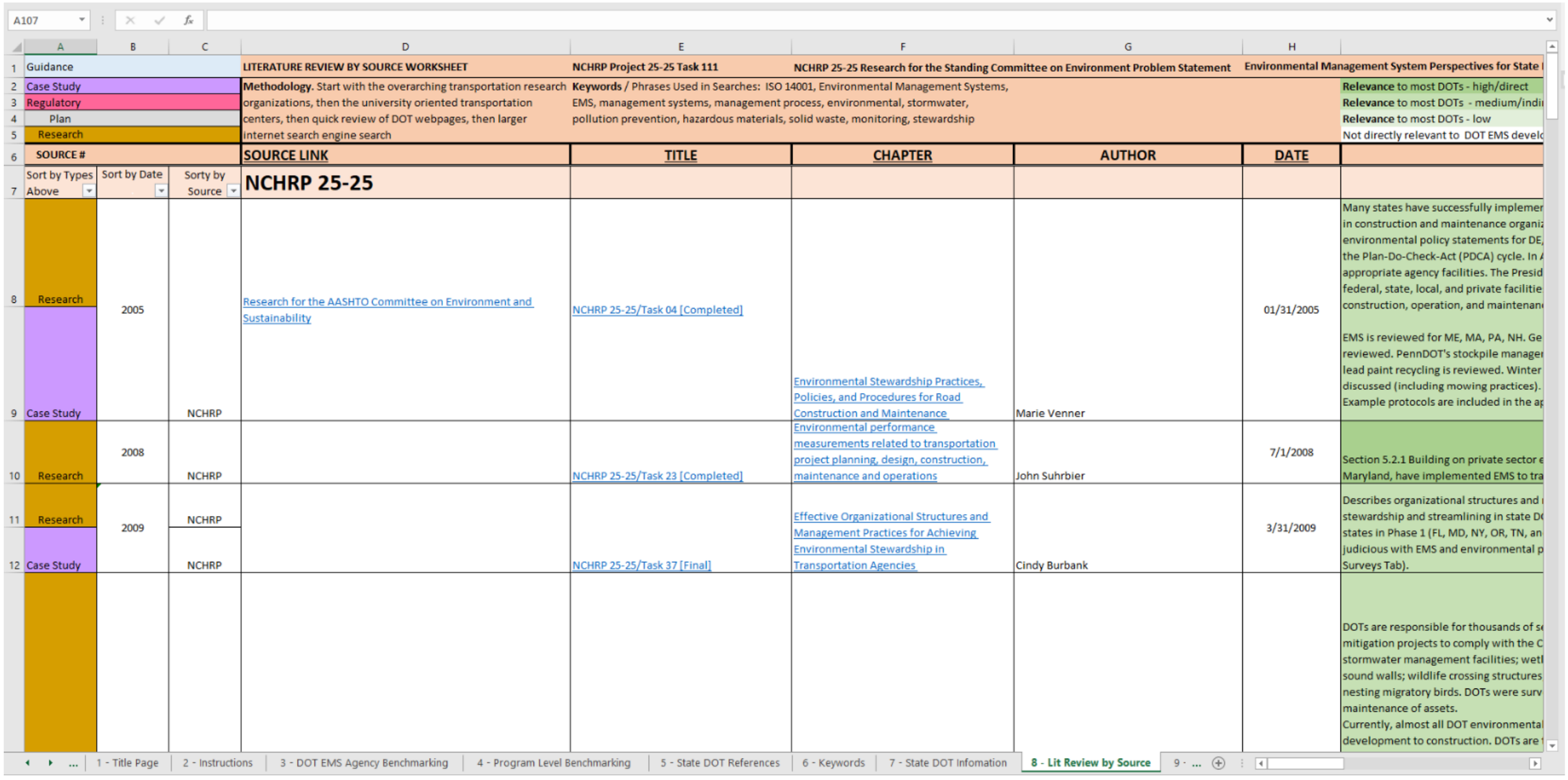
STATE	4: Agency name	5: Which of the following best describes your role?	Comprehensive written procedures	Integration with safety and other quality assurance concerns	Performance targets	Records keeping	Reporting	Periodic audits	Audit follow up
Alabama	ALDOT	DOT Environmental Director/Staff	Most	Most	At least one	Most	Most	At least one	At least one
Alabama	Alabama Department of Transportation	Other - Environmental Construction Engineer	Most	All	Most	All	Most	Most	Most
Alaska	Alaska DOT&PF	DOT Environmental Director/Staff							
Arizona	Arizona Department of Transportation	DOT Environmental Director/Staff	At least one unit	At least one	At least one	Most	Most	At least one	

ReadMe | 1 - Title Page | 2 - Instructions | 3 - DOT EMS Agency Benchmarking | 4 - Program Level Benchmarking | 5 - State DOT References | 6 - Keywords | 7 - State DOT Infomation | 8 - Lit Review by So ...

9 Tabs 8-11: Background Literature Resources

Tabs 8, 9, 10, and 11 contain linked background literature resources as organized by source, location, previous surveys, and history (see Figure A-11 for Tab 8). By accessing these materials along with using the benchmarking process described above, practitioners can improve their EMS performance.

Figure A-11. EMS IA Tab 8: Literature Review by Source



	A	B	C	D	E	F	G	H	
1	Guidance			LITERATURE REVIEW BY SOURCE WORKSHEET	NCHRP Project 25-25 Task 111	NCHRP 25-25 Research for the Standing Committee on Environment Problem Statement		Environmental Management System Perspectives for State	
2	Case Study			**Methodology.** Start with the overarching transportation research	**Keywords** / Phrases Used in Searches: ISO 14001, Environmental Management Systems,				**Relevance** to most DOTs - high/direct
3	Regulatory			organizations, then the university oriented transportation	EMS, management systems, management process, environmental, stormwater,				**Relevance** to most DOTs - medium/indi
4	Plan			centers, then quick review of DOT webpages, then larger	pollution prevention, hazardous materials, solid waste, monitoring, stewardship				**Relevance** to most DOTs - low
5	Research			internet search engine search					Not directly relevant to DOT EMS develo
6	SOURCE #			SOURCE LINK	TITLE	CHAPTER	AUTHOR	DATE	
7	Sort by Types Above	Sort by Date	Sorty by Source	NCHRP 25-25					
8	Research	2005		Research for the AASHTO Committee on Environment and Sustainability	NCHRP 25-25/Task 04 [Completed]			01/31/2005	Many states have successfully implemer in construction and maintenance organiz environmental policy statements for DE, the Plan-Do-Check-Act (PDCA) cycle. In A appropriate agency facilities. The Presid federal, state, local, and private facilitie construction, operation, and maintenan
9	Case Study		NCHRP			Environmental Stewardship Practices, Policies, and Procedures for Road Construction and Maintenance	Marie Venner		EMS is reviewed for ME, MA, PA, NH. Ge reviewed. PennDOT's stockpile manage lead paint recycling is reviewed. Winter discussed (including mowing practices). Example protocols are included in the ap
10	Research	2008	NCHRP		NCHRP 25-25/Task 23 [Completed]	Environmental performance measurements related to transportation project planning, design, construction, maintenance and operations	John Suhrbier	7/1/2008	Section 5.2.1 Building on private sector e Maryland, have implemented EMS to tra
11	Research	2009	NCHRP			Effective Organizational Structures and Management Practices for Achieving Environmental Stewardship in Transportation Agencies	Cindy Burbank	3/31/2009	Describes organizational structures and stewardship and streamlining in state D states in Phase 1 (FL, MD, NY, OR, TN, an judicious with EMS and environmental p Surveys Tab).
12	Case Study		NCHRP		NCHRP 25-25/Task 37 [Final]				
									DOTs are responsible for thousands of s mitigation projects to comply with the C stormwater management facilities; wetl sound walls; wildlife crossing structures nesting migratory birds. DOTs were surv maintenance of assets. Currently, almost all DOT environmental development to construction. DOTs are

1 - Title Page | 2 - Instructions | 3 - DOT EMS Agency Benchmarking | 4 - Program Level Benchmarking | 5 - State DOT References | 6 - Keywords | 7 - State DOT Infomation | **8 - Lit Review by Source** | 9 - ...

Appendix B

Detailed Findings and Conclusions

This appendix presents detailed findings and conclusions as broken down by the survey questions keyed to the RFP for this project. Information from the web survey, literature review, survey, and interviews is included in this appendix as background material for the practitioner and as a supplement to the *Environmental Management System Information Array*.

TABLE OF CONTENTS

B-1.0 GENERAL FRAMEWORK AND HISTORY

Environmental Management Systems (EMSs) are based on the Plan-Do-Check-Act (PDCA) process developed by and published in Dr. Walter Shewhart's 1939 book, "Statistical Methods from the Viewpoint of Quality Control." During the 1950s, Dr. Shewhart's colleague, Dr. W. Edwards Demming, introduced the PDCA process to the automobile manufacturing industry in Japan.[1] In March 1992, BSI Group (headquartered in the UK) published the first EMS standard, BS 7750, based on the PDCA process.[2] In 1994, Maine and Massachusetts Departments of Transportation (DOTs) began using EMS. The ISO 140001 EMS series was published in 1996 using BS 7750 as a template. During the late 1990s, the U.S. Environmental Protection Agency (EPA) began conducting pilot test studies. NY City Transit became the first ISO 14001 certified DOT in 1999, and, in 2002, Pennsylvania (PennDOT) became the first state DOT to obtain ISO 14001 certification (in one district). In 2003, the American Association of State Highway and Transportation Officials (AASHTO) Center for Excellence, in partnership with the Federal Highway Administration (FHWA), formally launched its EMS technical assistance program with a workshop. The literature review shows increased activity from 2003 to 2007. In 2006, PennDOT and MassDOT achieved ISO 14001 certification for all their maintenance districts. From 2007 to the present, the literature review suggests a tapering off of EMS activity.

Regulatory pressure was a consideration in the past. Most DOT operational units developed and implemented their own processes and procedures in response to actual or potential regulatory violations with varying degrees of support and leadership from their environmental units and limited input from outside agencies or information sources. Although the application of EMS elements across various state DOT operations has expanded over the past few decades to become a standard business practice, the application of the complete PDCA approach is not a common practice. According to our research, virtually all state DOTs are using elements of the ISO 14001 EMS standard. EMS programs have been a key factor in realizing streamlining of regulatory approvals and other efficiencies. EMS programs have also benefited in varying degrees from the development of a PDCA across other DOT functions. Finally, although clearly important, funding has generally not been a driving (or a limiting) issue.

B-2.0 SURVEY MECHANICS

Survey Gizmo is an online survey platform that was used to build and conduct the survey. The survey consisted of 20 primary questions, of which the first 5 questions were strictly demographic. Results of the first five demographic questions are not presented in this analysis. The first five survey questions were as follows:

- Question 1: Survey respondent's name.
- Question 2: Survey respondent's email.
- Question 3: Which of the following best describes your agency? (state DOT; transit agency; regulatory agency; resource agency, highway authority; federal transportation agency; city transportation agency, county; local transportation agency; and other (please specify))

[1] Johnson, C. (2016) The Benefits of PDCA: Use this cycle for continual process improvement. *Back to Basics* [Online]. Available: http://asq.org/quality-progress/2002/05/problem-solving/the-benefits-of-pdca.html

[2] BSI (2016, April) Introducing ISO 14001:2015: Continually improving environmental performance [Online]. Available: https://www.bsigroup.com/LocalFiles/en-GB/iso-14001/resources/ISO--14001-Client-Guide-FINAL-April-2016.pdf

- Question 4: Agency name.
- Question 5: Which of the following best describes your role? (DOT environmental director/staff; executive/executive staff; design director/staff; construction director/staff; highway maintenance director/staff; equipment maintenance director/staff; transit agency director/staff; field staff; other (please specify).

The survey program used logic, which allowed subsequent follow-up questions to the primary questions. Thus, all respondents were presented the primary questions but not all respondents were presented with all the follow up questions. Primary questions are either numbered only, if not a logic question, or include a letter "a" after the number if it is the primary question of a logic series. The subsequent follow up questions in the series are lettered "b, c,…" after the primary number. The Total Number of Respondents presents how many respondents were presented that question.

Survey questions contained a combination of single choice and multiple choice responses with the tables herein indicating the response type with "choose one" or "choose all that apply" after the question. The survey required all presented questions to be answered, thus a "Not sure/no answer" option was provided to allow the respondent to continue the survey if they did not wish to provide an answer to the question being asked. A complete copy of the survey questions is presented in Appendix C of this report.

The survey was widely distributed (as outlined in the body of the report), resulting in multiple respondents from state DOT, respondents from non-state DOTs, and respondents from non-transportation entities. As this report focuses on state DOTs, the non-state DOTs and non-transportation respondents were eliminated from this analysis. Of the resulting in 108 state DOT respondents, there were 79 completed surveys and 29 partially completed surveys. The 29 partially completed surveys were reviewed and either marked completed or discarded based on the whether the respondent answered Question 6 (or beyond). Of the 29 partially completed surveys, 16 respondents answered at least Question 6. This resulted in 95 respondents representing 47 state DOTs (including the District of Columbia DOT).

Because there were multiple respondents from some state DOTs, the data were analyzed to determine if the multiple respondents affected the results. This analysis showed that the number of respondents did not skew the results, and the answer percentages were generally consistent when comparing the 95 respondents' answers to the answers from the represented state DOTs. This consistency can be seen in the subsequent tables in which the ranking of the responses general do not change when presented as either Number of Responses – Count or Number of Response – State.

Thus, for ease of understanding by the primary audience, summary tables and figures are based on the complete 95 state DOT respondents. The multiple state responses were retained to better inform the analysis. Data testing concluded that metrics based on one entry per state are essentially the same as those presented in this summary.

To facilitate synthesis of survey responses, the data are organized and presented as follows:

- **Number of Respondents**: Of the initial 95 survey respondents, this is the number of survey respondents who were presented this question.
- **Number of States Represented**: Of the initial 47 state DOTs represented, this is the number of state DOTs who were presented this question.

- **Number of States Not Represented**: Of all 51 states (includes DC), this is the number of state DOTs who were not presented this question. This includes the 4 states who did not participate in the survey.
- **Percent Count**: "Number of Responses – Count" divided by "Number of Respondents." This number is the primary result for the survey question.
- **Number of Responses – Count:** This is the raw number of survey responses for the answer. For "Choose One" answers, this number will total to "Number of Respondents." For "Select all that apply" answers, this number can exceed the "Number of Respondents."
- **Number of Responses – State**: This takes the "Number of Responses" above and eliminates duplicate state respondents within those responses. DC is counted as a state.
- **Not Sure/No Answer**: The survey required that every question be answered in order to continue. This was the option respondents could choose in order to continue, without providing an answer to that question.

Findings and conclusions for the web survey, literature review, survey, and interviews (as keyed to specific survey questions) are presented below.

B-3.0 DETAILED FINDINGS AND CONCLUSIONS

B-3.1 Question 6a: How Agencies Apply Environmental Management

Conclusions

EMS use is the standard rather than the exception. Application of EMS components has become so pervasive within state DOTs that it is often no longer understood to be an EMS or EMS-type process, but simply "the way we do our job." A PDCA approach to management is common in DOTs, and environmental concerns are no exception. That said, most operational units have developed and implemented their own processes and procedures with varying degrees of support and leadership from their environmental units with limited input from outside agencies or information sources.

Detailed Literature Review Findings

Results of the literature review indicate that 24 state DOTs with some type of EMS program appear to have used or are using an incremental approach to applying EMSs. Four state DOTs appear to have a statewide/program-wide EMS.

The literature review revealed information gaps, including that 26 state DOTs lack published information. Of these, 11 state DOTs have only limited information, according to the literature review, and 13 state DOTs have information that is more robust but still lacking in specifics. The remaining 24 state DOTs have sufficient information from which to draw tentative conclusions on the application of EMSs.

Detailed Survey findings

The current survey provided information from 95 respondents representing 47 state DOTs. Four states were unrepresented because no respondents from that state participated in the survey. Of the 47 states responding, 3 states only answered "I'm not sure or…" of which 2 states had no respondents that answered any additional survey questions. One state only answered, "None of the above applies."

The question was structured to allow respondents to select from whether they thought their DOT applied environmental management to at least one unit, most units, or all units, with units. When the number of responses to Question 6a is considered collectively, the responses support the nearly ubiquitous implementation of elements of EMS even when the state DOTs do not identify it as such. For example, high percentages of respondents chose training (83.2%) and record keeping (82.1%) as the means of application. Note that this ranking is consistent whether by count or state, indicating that the multiple respondents did not affect results.

An EMS is some means of planning, executing, checking, revising, and improving efficiencies and performance in environmental compliance and/or stewardship. In this light, even basic quality assurance procedures for avoidance of environmental violations are within the continuum of EMS applications as applied to the various program areas and geographical extent of DOT operations.

Question 6a: Using the definition above, please indicate how your agency applies environmental management, using the following means, to your operational units, e.g. Sub-units within Operations, Design, Construction, Maintenance, Equipment Management, Regions, etc.

(Please check all that apply).

Number of Respondents	**95**		
Number of States Represented	**47**		
Number of States Not Represented	**4**		
Means of Application	**Percent Count**	**Number of Responses**	
		Count	**State**
Comprehensive written procedures	77.9%	74	42
Integration with safety and other quality assurance concerns	72.6%	69	40
Performance targets	70.5%	67	41
Record keeping	**82.1%**	**78**	**43**
Reporting	80.0%	76	42
Periodic audits	67.4%	64	38
Audit follow-up	64.2%	61	38
Training	**83.2%**	**79**	**43**
Research	65.3%	62	38
I'm not sure or I don't know how our agency applies environmental management	17.9%	17	15
None of the above applies to our agency	5.3%	5	5
	Totals	**652**	**385**

With regard to the means of application, when the number of responses is broken out by at least one unit, most units, and all units (second table), most units (44.3%) is ranked higher than one unit or all units. When the means of application is looked at across units, most units have comprehensive written procedures (50%), integration with safety and other quality assurance concerns (53.6%), record keeping (43.6%), reporting (42.1%), Audit follow-up (42.6%), and training (43%). At least one unit has performance targets (43.3%), periodic audits (45.3%), or research (50%). Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

		Means of application									
		Comprehensive written procedures	Integration with safety and other quality assurance concerns	Performance targets	Record keeping	Reporting	Periodic audits	Audit follow-up	Training	Research	Totals
All units	Percent Count	23.0%	21.7%	14.9%	35.9%	28.9%	17.2%	16.4%	6.5%	6.5%	**22.7%[2]**
	Count	17	15	10	28	22	11	10	26	4	**143**
	State	11	14	8	22	16	9	7	19	4	**110**
Most Units	Percent Count	**50.0%**	**53.6%**	41.8%	**43.6%**	**42.1%**	37.5%	**42.6%**	**43.0%**	43.5%	**44.3%[2]**
	Count	37	37	28	34	32	24	26	34	27	**279**
	State	28	30	23	27	24	20	22	27	23	**224**
At least one unit	Percent Count	27.0%	24.6%	**43.3%**	20.5%	28.9%	**45.3%**	41.0%	24.1%	**50.0%**	**33.0%[2]**
	Count	20	17	29	16	22	29	25	19	31	**208**
	State	18	15	24	15	18	23	21	16	25	**175**
Total Count[1]		**74**	**69**	**67**	**78**	**76**	**64**	**61**	**79**	**62**	

[1]Total Count here matches Number of Response – Count in above table.

[2]Percents in this column are Count in the cell below divided by 630. The 630 is the Total Number of Responses – Count of 652 less the 22 for "I'm not sure…" and "None of the above applies…" responses.

Despite some apparent confusion over the definition of EMS, data suggest that EMS-type elements in most if not all program areas are at least common, if not pervasive. Even if a state DOT did not identify the use of an EMS program, elements of EMSs appear across various program areas.

Question 6a: Please provide further explanation

Response
We do not have all this in a comprehensive "EMS" for all areas.
Written procedures for obtaining off-site restraining condition clearances and procedures for storm water pollution prevention monitoring and reporting. Record keeping procedures for the same. Annual training for Stormwater Pollution Prevention Plan for resident engineer offices and maintenance forces required by our permit with the Department of Environmental Quality.
Although our Agency does not have a specific EMS (as defined above), we do have several systems, policies, and procedures to implement broad environmental management across all disciplines.
Don't have EMS for this operational unit and cannot answer for other units. Although this unit does not have EMS, the unit does track specific performance goals, keeps project database and records, reports on goals, and trains staff.
We have a process of facility audits where we perform environmental, safety and operational audits annually on a sampling of our maintenance facilities.

Question 6a: Please provide further explanation
Response
Our current EMS is geared towards our Maintenance Facility Operations. The other offices in our Agency have SOPs to ensure compliance but do not fall directly under.
We have the framework of our EMS established as an agency are still capturing the elements we have department-wide necessary to make it comprehensive for the agency. There are still various elements being managed without a collective assessment of that management.
We have a robust Research Section with a number of geology, stormwater, and environmental discipline research. We also have a Construction Inspector's training program which includes a lot of environmental information, and where inspectors must obtain a certification. We also have two consultant certification programs: one for Endangered Species Act (ESA) and one for cultural resources.
The agency has implemented a statewide EMS program.
As it relates to the Construction Division, policies and procedures are in place for complying with the environmental laws and regulations. Construction staff is involved in implementation of these policies and in reporting to program administrators on performance and compliance.
DOT does not currently have a formal EMS but has many EMS elements within our Construction and Maintenance/Operation Facilities. DOT is currently participating in a research institute and preparing an EMS for a Residency Complex Facility. Construction Program- DOT has a well-developed Environmental Program were environmental impacts are evaluated during the construction project development phase. Identified Environmental Commitments are addressed within the construction contracts via permits and special provisions. Specialized Environmental Commitment Inspectors (ECI) can be assigned to inspect the project during the construction phase to evaluate project compliance with the commitments. Similarly, specialized National Pollutant Discharge Elimination System (NPDES) Inspectors can be assigned to projects to evaluate compliance with Construction General Permit and MS4 Permit requirements. The ECI and NPDES inspections are part of our Environmental Performance Program. Any compliance deficiencies are noted and relayed to the project team for corrective action and the project scored. Maintenance and Operations Facilities- DOT has an Environmental Compliance Program for Facilities which includes periodic compliance assessments (audits) of maintenance facilities. Any compliance findings are conveyed to Facility management for corrective actions. To supplement the compliance assessments, we also have a compliance training program. As noted above, we are currently working to develop a formal EMS for one Residency Complex.
DOT does not have an "EMS" program. Elements of EMS are built into each of our functional areas. For example, our Pavements Section recycles tons of pavement each year. My environmental unit has an Environmental Commitments form that follow a project from cradle to grave.

B-3.2 Question 6b: Why Agencies do not Apply Environmental Management

Conclusions

As mentioned previously, EMSs or similar programs appear to be the standard rather than the exception. Of the three states that answered this question, all indicated some sort of system for monitoring compliance but did not identify the system as an EMS. The degree of EMS usage in terms of both process rigor and application across organizational units varied significantly depending upon a history of regulatory pressure, management initiative, and organizational capacity.

Detailed Literature Review Findings

The 2006 AASHTO survey and 2009 NCHRP 25-25, Task 37, survey indicate that 23 state DOTs had no EMS or similar program. The current survey indicates that, of those 23 state DOTs, 19 state DOTs have gone on to create an EMS-type program. The other four state DOTs did not express an interest in previous surveys. The literature pointed to the reasons for not pursing an EMS as:

- not considered
- lack of funds
- low priority
- not needed
- negligible benefits
- under consideration
- value lacking for a small DOT

Detailed Survey Findings

To arrive at this question, the respondents would have had to answer "None of the options apply" to Question 6a but had the option to hit return and continue with the survey. As noted in the response to Question 6a, five states selected "None of the options apply." Two of those states returned to Question 6a and continued without answering Question 6b. Two states answered this question with "Considered, not pursued," and other respondents completed the survey for their state. One state answered "Other," and no respondents for that state answered any additional questions in the survey for that state.

Question 6b: Answering "None of the options apply" (to Question 6a) implies your operational units do not use any form of EMS or environmental quality assurance. If this is not true, please hit the back button and select the closest option for what your organization does. If this is true, please answer why not? *(Please check all that apply.)*

Number of Respondents		**3**	
Number of States Represented		**3**	
Number of States Not Represented		**48**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Not considered	0%	0	0
Considered, not pursued	66.7%	2	2
Considered, no available funds/ budget	0%	0	0
No knowledge/ability	0%	0	0
No perceived need/benefit/value	0%	0	0
Other	33.1%	1	1
Totals	**100%**	**3**	**3**

Question 6b: Please provide further explanation:

Response
We monitor our environmental items without the use of EMS. The only thing close is a monitoring system for Stormwater on construction projects.
We handle our environmental management and quality assurance through several systems, policies, procedures, guidebooks, not a single EMS system as defined.

B-3.3 Question 7: What was the Initial Focus for EMS Development

Conclusions

Most state DOTs seem to have started their EMS (focused on their capital program, maintenance yards, stormwater, or compliance) as the result of apparent shortcomings that were revealed through incidents or external pressures. Principal among these reasons was an FHWA initiative to ensure that NEPA commitments, made during design, were carried through to construction, maintenance, and operations.

Detailed Literature Review Findings

The literature review provided information about 24 state DOTs on where their initial focus for EMS development was and why they initiated their EMS program. Responses were as follows:

Area of Initial Focus

- Nine state DOTs focused their initial EMS efforts on maintenance yards.
- Five state DOTs focused their initial efforts on stormwater.
- Six state DOTs focused on environmental compliance.
- Four state DOTs had single-issue areas of initial focus: winter stockpiles, highway paint, greenhouse gas emissions, and the ferry system, respectively.

Reason for Initiation of EMS

- Seven state DOTs initiated their EMS programs due to either EPA consent decrees or state regulatory agency enforcement action.
- Five state DOTs initiated their EMS programs due to state government action (legislation or governor decree).
- Two state DOTs initiated their EMS programs because of internal management leadership.
- One state DOT initiated an EMS program as a pilot project.
- Nine state DOTs initiated their EMS programs for undisclosed reasons.

Additional information on regulatory involvement is presented in Section B-3.9.

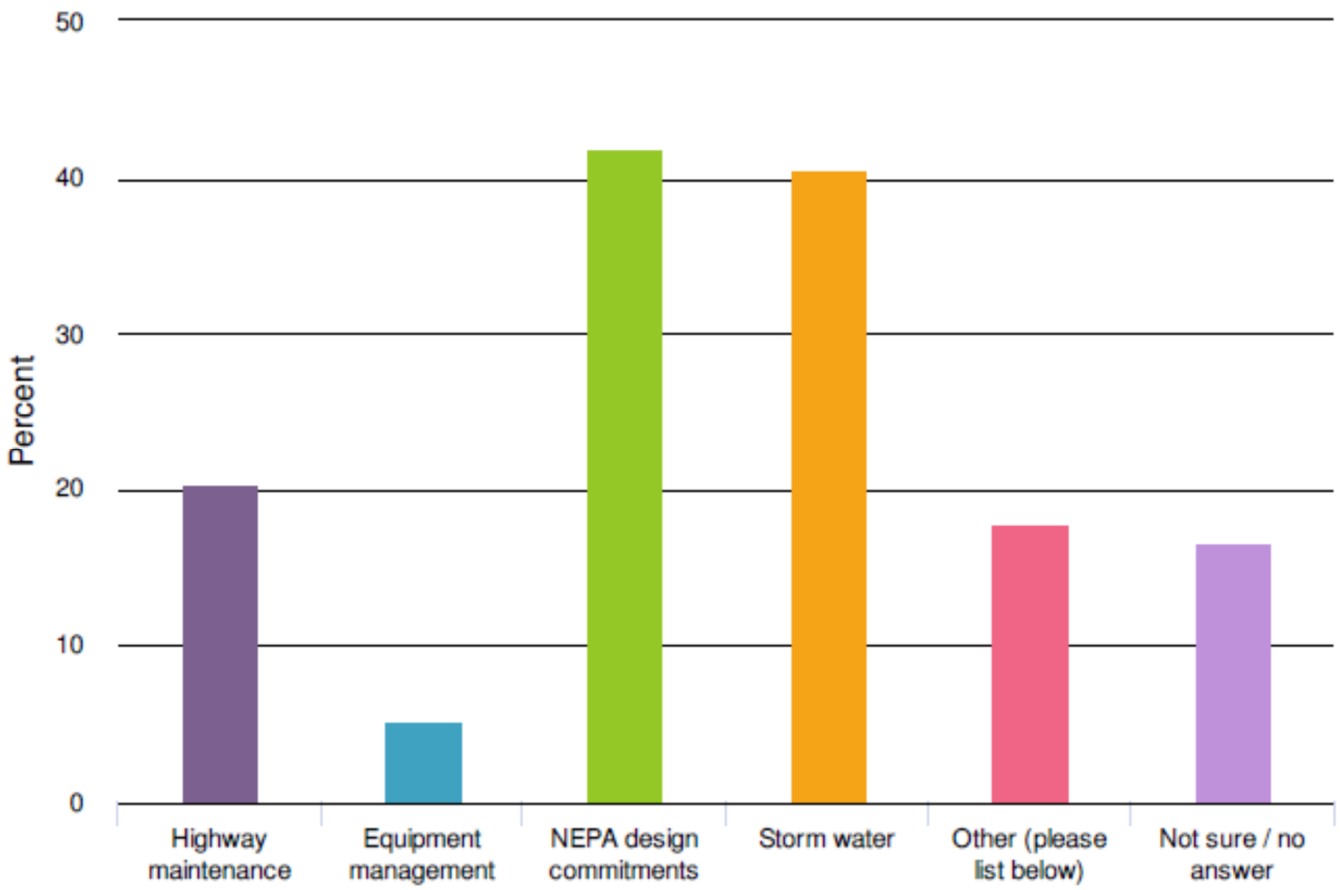
Detailed Survey Findings

The current survey provided information from 44 state DOTs (7 states were unrepresented). Four states only answered “Not sure/no answer.” The highest ranked answer was NEPA design commitments. Of the 28 states that selected NEPA design commitments, 14 also selected stormwater, eleven also selected highway maintenance, and 4 also selected equipment maintenance. Seven states only selected stormwater, two states only selected highway maintenance, and three states only selected other. NEPA compliance has been differentiated from stormwater because stormwater in this context is related to compliance with NPDES permits. In NEPA documents, there are typically general statements about stormwater compliance, such that an NPDES permit will be obtained or a Stormwater Pollution Prevention Plan will be prepared. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 7: What was the initial focus for EMS development?
(choose all that apply)

Number of Respondents		**79**	
Number of States Represented		**44**	
Number of States Not Represented		**7**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Highway maintenance	20.3%	16	13
Equipment management	5.1%	4	4
NEPA design commitments	41.8%	33	28
Stormwater	40.5%	32	21
Other	17.7%	14	12
Answered “Not sure/no answer”	16.5%	13	11
Totals		**112**	**89**

Graph of Number of Responses by Count



Question 7: Please provide further explanation
Response
Consent decree initiated a lot of stormwater changes.
Tracking environmental analysis and commitment compliance throughout project delivery.
Permit commitments/compliance
EMS development began with the NPDES Phase I Permit requirements which require annual reporting and periodic audits. The training requirements are built into the permit and touch most of the Department. Several applications have been built to document and record compliance.
DOT has two NPDES stormwater permits, as well as 17 industrial stormwater permits for each maintenance yard. These permits affect nearly all aspects of the agency.
Continuous Improvement Process
Environmental compliance was the initial focus. Equipment, safety and operational items were added after.
EMS is embedded within DOT's programs and not necessarily a standalone program in of itself. Different aspects are managed by Human Resources, Maintenance & Operations, and Environmental Office staff.
The initial focus of our EMS was the Highway Maintenance Facilities, which did not include the roadways.
DOT is still in the development stages of an EMS.
Majority of initial efforts evolved around NEPA and Permitting (primarily storm water) requirements. Additional effort also applied to maintenance operations in general, then adding NEPA compliance due to Federal reimbursement of some Maintenance activities and Waste Minimization efforts also evolved to include equipment maintenance.
DOT Operations Division including Highway Maintenance, Bridge Maintenance, Traffic, and Mechanical Services
To ensure compliance with all applicable environmental laws/regulations at our Operations facilities.
Rather than implementing an EMS, we focus on establishing policies to ensure environmental compliance.
Initial focus was for EMS to start during NEPA, develop commitments based on NEPA decisions, and then ensure those commitments are implemented during planning, construction, or post-construction (and document that compliance). In addition to environmental training, we have additional outreach with other units within DOT, and provide training on environmental compliance to highway maintenance crews and DOT construction inspectors.
Our agency has separate environmental programs for construction projects that include NEPA and storm water. I am an SME for Maintenance. My familiarity with the development and implementation of EMS programs for construction is limited.
The NEPA Design commitments are also carried through and tracked in construction and maintenance.
NEPA and U.S. Army Corps of Engineers (USACE) 404 Permitting Conditions Compliance
The initial focus for the EMS was MS4 compliance. Each check-list item addresses Industrial General Permit requirements, because DOT had agreed to maintain Industrial General Permit coverage for each maintenance facility as one of several "Task Items" in the Department's MS4 Permit.
Highway construction from conception to completion includes maintenance.
Reducing potential impacts to resources and thus the corresponding environmental regulatory processes. Avoidance of impacts to resources and thus the regulatory permitting that would result from impacts.
DOT's current effort to develop a formal EMS is associated with a one Residency Complex where the aspects and impacts are representative of most of our operating maintenance facility. Our current strategy related to the EMS development will be to pilot it at the Complex then progressively expand to additional locations and potential other operating Divisions using the lessons learned from the pilot project.
The decision makers evaluated a statewide implementation of EMS principles for all units in all modes. But they realized DOT is so massive that it just wasn't practical and would not have the intended results. So, a decision was made to thoroughly apply EMS principles to highway capital improvement projects. DOT has done this since about 2002. Shortly after that, however, the State Ferries adopted a Safety Management System, which employs the same Plan, Do, Check, Act principles but for maritime safety and environmental compliance is an element of that. Additionally, the DOT Maintenance & Operations Division applies an EMS approach to their ESA compliance.

B-3.4 Question 8: Who was the Initial Champion for EMS Development

Conclusions

State DOT environmental units are commonly, but not exclusively, engaged in EMS leadership because of executive initiative and support.

Detailed Literature Review Findings

The literature review shows that the initial champions of EMS were maintenance departments, while the current survey indicates that the initial champions of EMS were the environmental departments or units within state DOTs.

The shift in responses from maintenance to environmental departments could result from several different reasons. First, this survey received more responses from environmental departments, so there may be a bias in favor of that response. Second, as noted in the previous question, application of an EMS approach has become standard operating procedure such that it is no longer viewed as EMS within the maintenance departments. This potential cause points to another potential explanation—the possible loss of institutional memory as to why an EMS was developed or applied. Third, an EMS is viewed as a tool to solve a specific problem; once the solution is integrated to the point of being a standard procedure, the solution is no longer seen as an EMS. NEPA design commitments are the current application of EMS as a tool, and the environmental unit is seen as the champion.

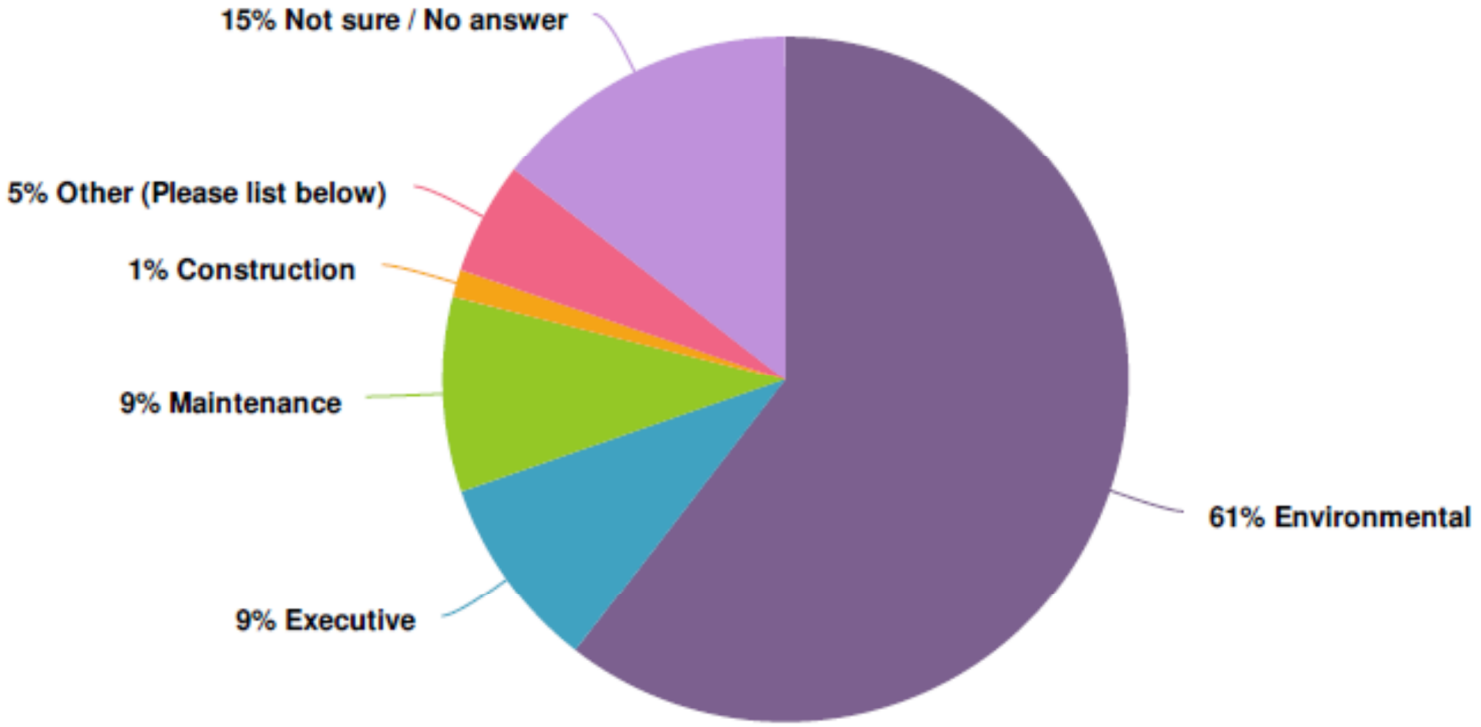
Detailed Survey Findings

The current survey provided information from 44 state DOTs (7 states were unrepresented). Three states only answered "Not sure/no answer." Environmental (60.5%) received the most responses. Of the 33 states that selected environmental, two also selected executive, two also selected maintenance, one also selected other, and four answered "not sure/no answer." Of the three states that selected executive (but not environmental), one also selected construction. Of the two states that selected maintenance (but not environmental or executive), one also selected other. Of the three states that selected other (but not environmental, executive, or maintenance), one also selected "Not sure/no answer." Note that rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 8: What part of your agency was the initial champion for EMS development? (choose one)

Number of Respondents		**76**	
Number of States Represented		**44**	
Number of States Not Represented		**7**	
Response	**Percent Count**	**Number of Responses**	
		Count	**States**
Environmental	60.5%	46	33
Executive	9.2%	7	5
Maintenance	9.2%	7	4
Construction	1.3%	1	1
Other	5.3%	4	4
Answered "Not sure/no answer"	14.5%	11	9
Totals	**100%**	**76**	**56**

Graph of Number of Responses by Count



Question 8: Please provide further explanation
Response
A water resource compliance unit was developed years ago. While we have no formal "plan", we do have a unit dedicated to construction compliance.
The NPDES Phase I Permit Team is housed in DOT's Division of Maintenance and Operations. This may differ from other states. At DOT this seemed appropriate since many of the permit requirements deal with post construction Stormwater facility maintenance and the drainage system inventory maintenance and retrofits of the system.
The NPDES program is housed under Maintenance and Operations.
Environment and Highway Maintenance developed the program jointly back in the late 90s. This is how the program is still administered today.
At the time, the DOT Environmental Services Bureau was part of the Engineering Division. It is now part of the Planning Division, although the scope of services has not changed.
EMS implementation was a result of an agreement between our agency and the Department of Environmental Services
We have considered developing an EMS in the past. We found that it would be very difficult to implement. The EMS did not differentiate between compliance versus stewardship. We do not intend to implement and EMS and are not interested in ISO 14001 certification.
DOT developed a program to minimize impacts to water quality from routine road maintenance activities in 1995. In 1999 this evolved into the DOT Routine Road Maintenance Water Quality and Habitat Guide. In 2004, Maintenance developed an EMS program for management of materials typically kept at maintenance yards.
We do not call our procedure EMS. It is just what is integrated in our project development and maintenance activities protocol.
Regarding the EMS development project at the Residency Complex, our core team is comprised of the District Engineer, the Residency Administrator, Asst. Residency Administrator, Residency Maintenance Operations Manager, and Environmental Compliance Program Manager and the Facility Compliance Program Manager.
The initial champions were equally the Environmental and Executive portions of DOT.
EMS elements are an integral part of each DOT Division/Bureau/Section. It is a philosophy which everyone champions, not just a specific functional area.

B-3.5 Question 9a: Initial Sources of Funding

Conclusions

Most EMS efforts were started with existing funds, although special allocations and initiatives seem to have been common during startup. Because EMSs and EMS processes have become more accepted and integrated into DOT programs, they currently tend to rely more heavily on regular funding.

Detailed Literature Review Findings

Results of the literature review suggest that EMSs were initially funded by either grant money or special allocation in response to a regulatory violation. The current survey indicates that the initial roll out of an EMS was predominantly funded through existing funds.

Detailed Survey Findings

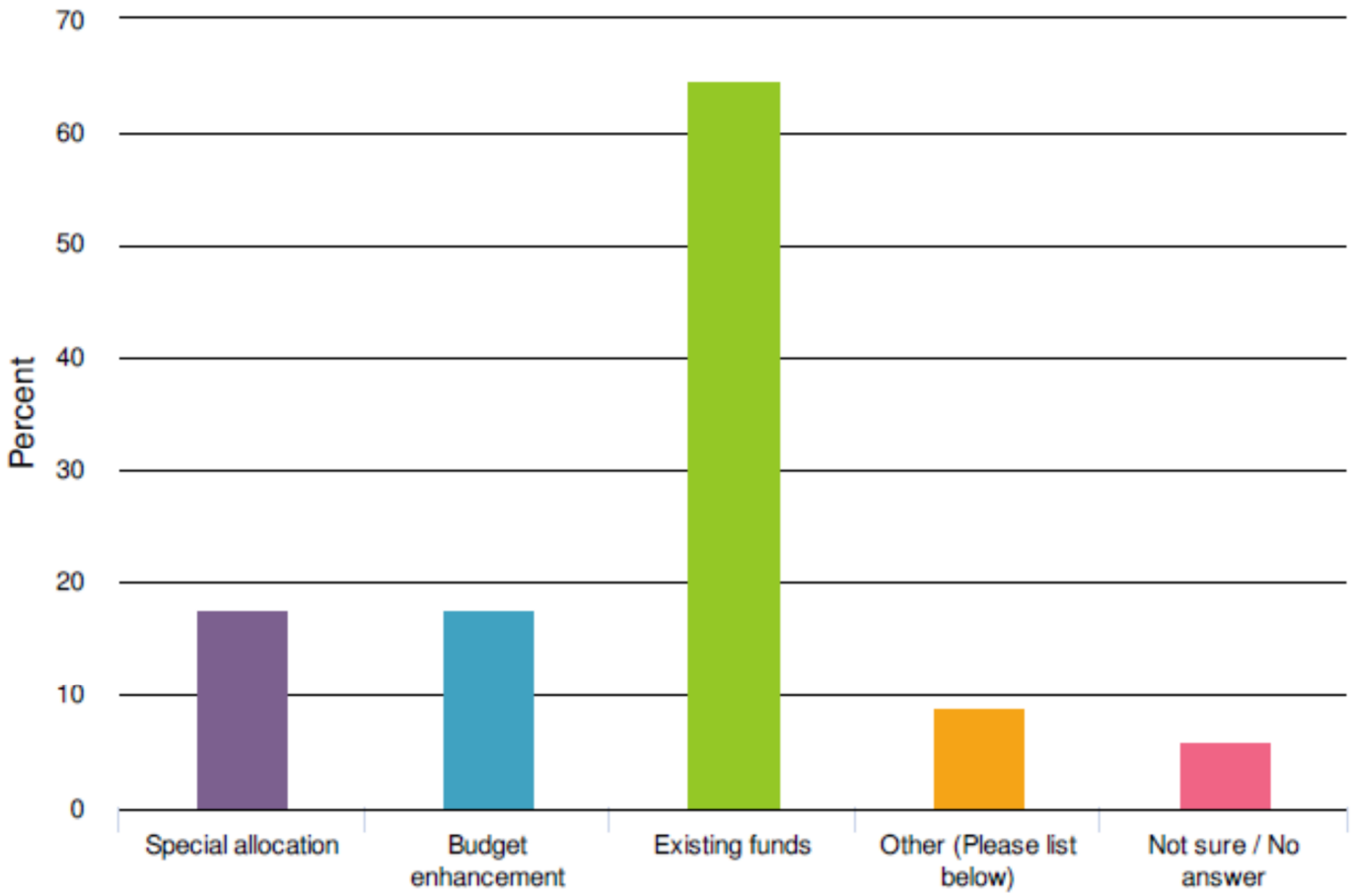
The current survey provided information from 28 state DOTs (23 states were unrepresented). Two states only answered “Not sure/no answer.” Existing funds (64.7%) was the highest ranked answer. Of the 17 states that selected existing funds, 2 also selected special allocation, 2 also selected budget enhancement, and 1 also selected other. Four states only selected special allocation, three states only selected budget

enhancement, and two states only selected other. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 9a: What was the funding source for initial EMS roll out?
(check all that apply)

Number of Individual Respondents		**34**	
Number of States Represented		**28**	
Number of States Not Represented		**23**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Special allocation	17.6%	6	6
Budget enhancement	17.6%	6	5
Existing funds	64.7%	22	17
Other	8.8%	3	3
Answered “Not sure/no answer”	5.9%	2	2
Total		**39**	**33**

Graph of Number of Responses by Count



Question 9a: Please provide further explanation
Response
Various amounts of funds over various years…not easily quantified.
The option not offered is that we do our EMS through staff time, self-audits, Federal Highway Administration (FHWA) interaction, executive management report outs - this has no specific funding but is part of the staff's time.
We have a unit dedicated to compliance, so we don't have a "roll out" cost. We charge mostly directly to project funding for day to day compliance.
Most Maintenance EMS costs come out of crew budgets. A special allocation in 2005-07 was used for primarily for the initial implementation of the SPCC program. Another special allocation in 2010-11 was used to address key issues at maintenance yards. Districts are allocated a small extra fund ($5,000 per biennium) for the ongoing implementation of best management practices (BMPs) at maintenance yards.
Project Funds were used to pay for consultant overview

B-3.6 Question 9b: Initial Costs

Conclusions

Costs vary; costs to establish and maintain an EMS appear to range from several hundred thousand dollars to several million dollars.

Detailed Literature Review Findings

No information was found in the literature review about EMS costs.

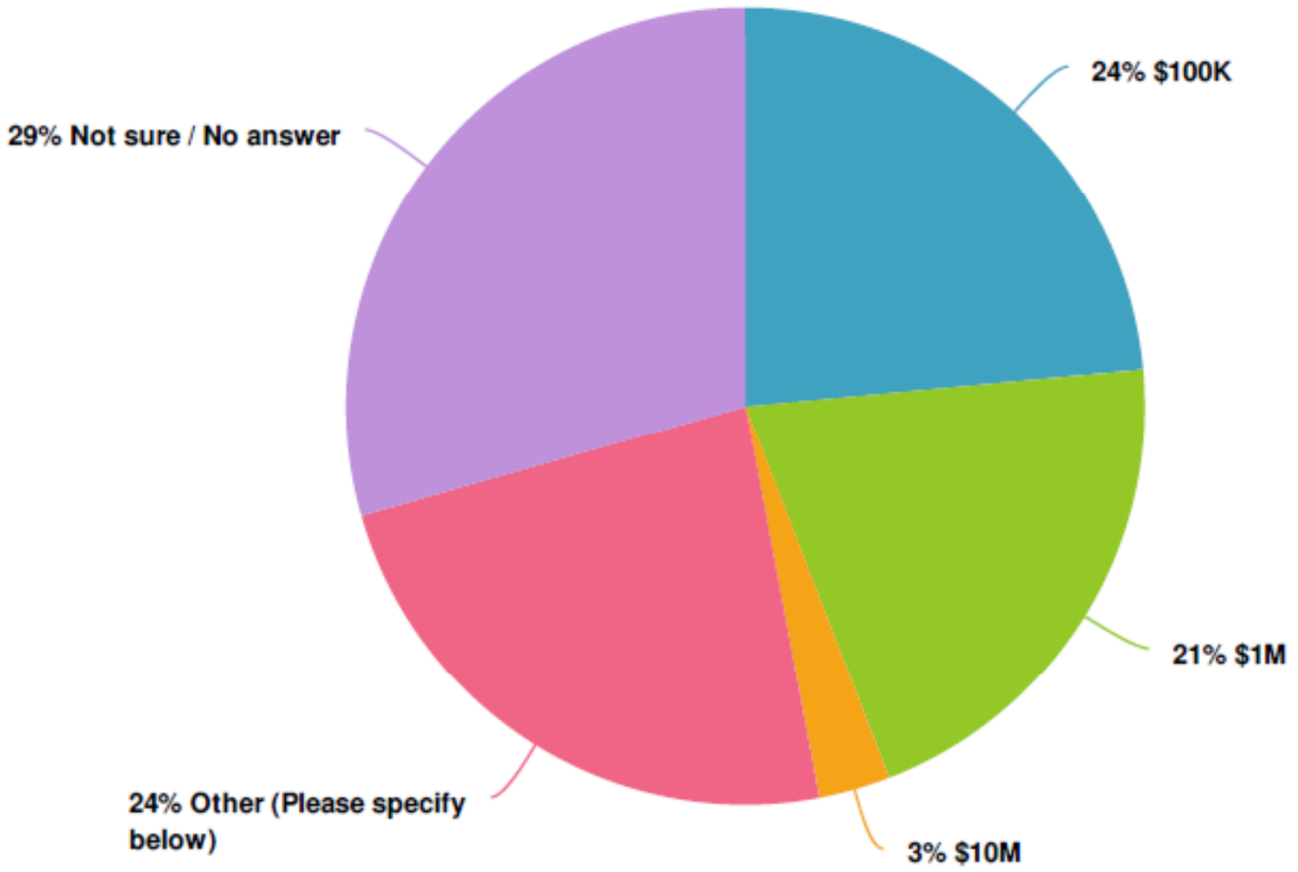
Detailed Survey Findings

The current survey provided information from 28 state DOTs (23 states were unrepresented). Two states only answered "Not sure/no answer." Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 9b: If you had to estimate the initial cost of EMS development, which of the following ranges would be most likely? (If you have actual cost information, please report it as other.) (choose one)

Number of Respondents		**34**	
Number of States Represented		**28**	
Number of States Not Represented		**23**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
$10K	0%	0	0
$100K	23.5%	8	8
$1M	20.7%	7	7
$10M	2.9%	1	1
Other	23.5%	8	8
Answered "Not sure/no answer"	29.4%	10	9
Total	**100%**	**34**	**33**

Graph of Number of Responses by Count



Question 9b: Please provide further explanation
Response
I do not have actual numbers, but this reflects the creation of multiple systems that may be linked, but not integrated.
This is done through staff time for the most part.
The DOT NPDES program ran under a consent decree which required DOT to fully fund the inventory and inspection of the MS4. The approximate cost in 2002 was about $1million for the first year.
Approximately $2 million
$500K
Initial return to compliance over $60 million but now maintaining the EMS about $1 million/year
No specific allocation solely for such a program, as existing funds applied as needed.
We spent approximately $240,000 on development and implementation through an outside contractor.
All funds were associated with current staff labor. No new software was needed.
2005-07: $1.5 million Policy Option Package. About $1m on SPCC containment. About $375,000 on the closure of automotive UICs at maintenance yards. Balance on storm water improvements. 2010-11: $500,000 on storm water improvements including double-walled tanks, water treatment, and containment of liquid deicer. $5,000 per biennium per District on implementation of BMPs at maintenance yards.
$1 million. This would include all the handbooks related to Env subjects and cost of consultant assistance to produce.
Our costs are close to $300,000/year
$200,000
About $5 million

B-3.7 Question 10: Initial Strategies

Conclusions

As with most management programs, training and written procedures, followed by audits, seem to have factored strongly in the development of initial strategies.

Detailed Literature Review Findings

In March 1992, BSI Group headquartered in the United Kingdom published the first EMS standard, BS 7750, based on the PDCA process. In 1994, Maine and Massachusetts DOTs began using EMS. The ISO 14000 EMS series was published in 1996 using BS 7750 as a template. During the late 1990s, EPA began conducting pilot test studies. New York City Transit became the first ISO 14001 certified DOT in 1999, and, in 2002, Pennsylvania became the first state DOT to obtain ISO 14001 certification (in one district). In 2003, the AASHTO Center for Excellence, in partnership with FHWA, formally launched its EMS technical assistance program with a workshop.

The literature review had responses from 24 state DOTs. Of the 24 state DOTs that used some type of EMS program, all 24 appeared to be conducting training, have written procedures (standard operating procedures/manual), perform audits or inspections, and use information technology services.

Detailed Survey Findings

The current survey provided information from 43 state DOTs (8 states were unrepresented). Five states only answered “Not sure/no answer.” Training (69.4%) and procedures (68.1%) were the highest ranked answers by count and procedures (35) and training (32) by state. Of the 35 states that selected procedures,

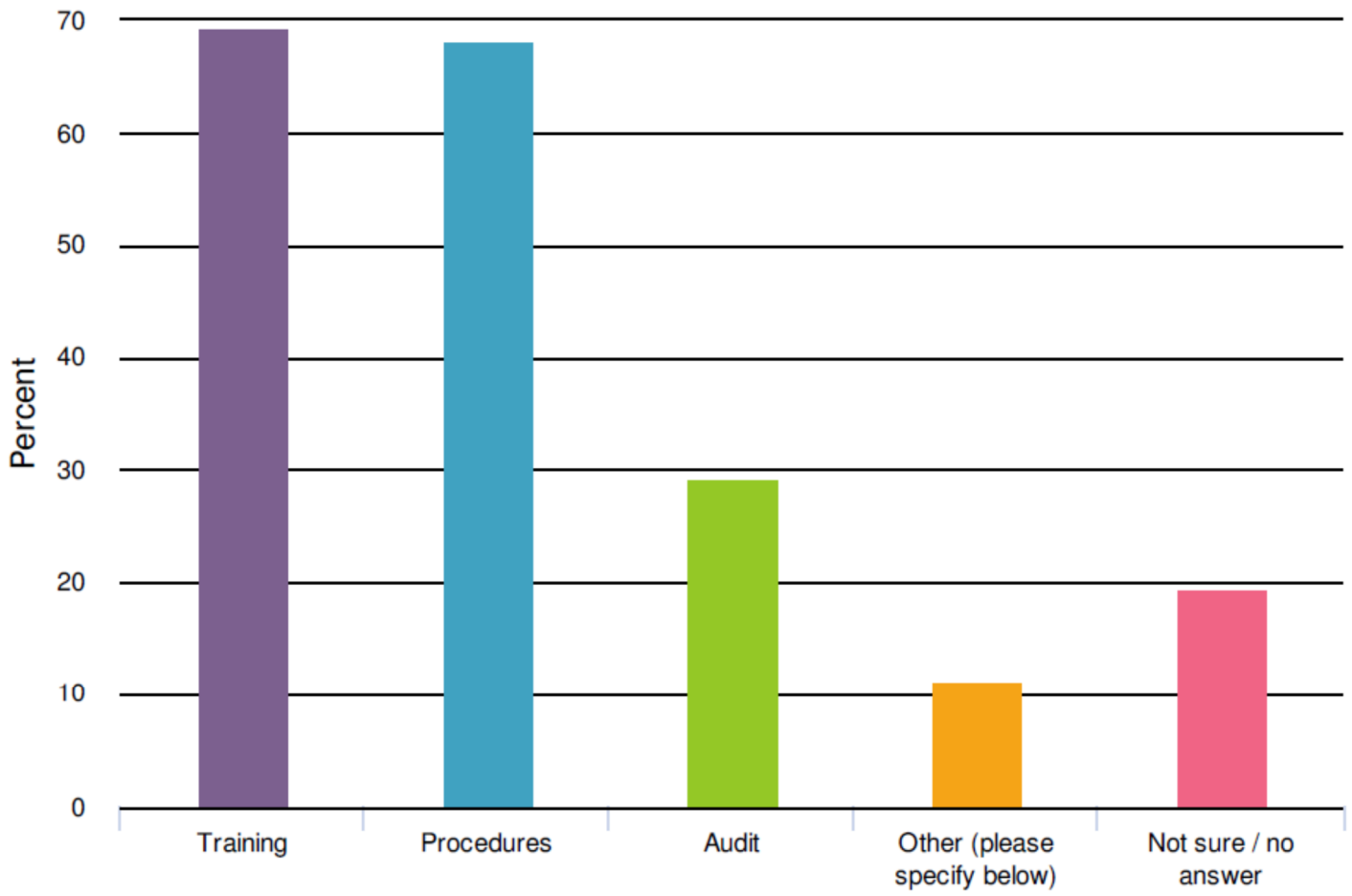
34 also selected training, 16 also selected audit, and 6 also selected other. One state only selected training. Two states only selected other.

Question 10: Initial EMS rollout strategies included

(please check all that apply):

Number of Individual Respondents		**72**	
Number of States Represented		**43**	
Number of States Not Represented		**8**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Training	69.4%	50	32
Procedures	68.1%	49	35
Audit	29.2%	21	16
Other	11.1%	8	8
Answered “Not sure/no answer”	19.4%	14	11
Total		**142**	**102**

Graph of Number of Responses by Count



Question 10: Please provide further explanation
Response
Initial EMS rollout strategies focused on Asbestos compliance. These suffered because of economic downturn in 2009 Later efforts had an executive level champion, but further effort failed because of executive leadership position changes.
Programs such as Winter Storm Management and Stormwater Management Program.
Using the EMS is a deliverable for the majority of tasks that environmental staff perform during project delivery.
This is not a formal packaged EMS system, it is a series of programs that have either oversight, audit checks, monthly reporting, or similar. Topic-specific trainings, guidance manuals, checklists, etc. have been developed as needed. Many of these are on the DOT website - others are trainings that are brought in or developed as the need arises.
The initiation of our compliance unit was quite a while ago. We mostly utilize training to keep our engineers and districts up to date on issues. Projects are inspected by District and our staff at regular intervals depending on project complexity.
Training was critical to educate what we were auditing and why. Buy-in from the region is very important.
Also included construction of compliant structures, disposal of waste and hazardous waste, wetland restoration, demolition of structures
EMS rollout has not taken place yet.
Our system has developed over time, in small or focus areas - primarily in response to some other driver. However, staff do use tools noted above, in addition to staff communication plans at rollout of new processes or programs.
Form templates and toolbox training items.
Audit is checked - however, this was not solely an audit of our EMS - instead, it was rolled into the required self-assessments and audits necessary under NEPA Assignment. During these self-assessments, we look at our entire environmental program to determine if we have any areas needing improvement. Environmental compliance and environmental commitments are a portion of the assessments.
Onsite compliance inspections during construction
Executive Management Policy Support
Our current plan includes completing the EMS Institute, incorporating existing compliance and training program elements consistent with the EMS, completing the additional procedures and elements that are lacking, implementing projects to address our higher risk aspects, and evaluate the overall program prior to potentially expanding to additional facilities and other aspects of the Department.
EMS elements are included in all training and procedures. We also audit specific areas, such as environmental document preparation to ensure EMS elements are included.

B-3.8 Question 11: ISO Certification as an Initial Focus

Conclusions

Although formal use or full implementation of ISO 14001, including certification, is a model for several state DOTs, it is the rare exception. Even those DOTs that achieved certification have backed away from the formal process in favor of a more customized approach more in keeping with their standard unit-oriented quality assurance norms and result oriented audits. Certification costs as reflected in dollar costs and staff time were cited as reasons for discontinuance, while a lack of drivers in terms of increased efficiency, regulatory relief, and public perception have also been cited as contributing factors.

Detailed Literature Review Findings

Results of the literature review indicate that two state DOTs were ISO 14001 certified for some operations; and one state was ISO 14001 certified for one program (a ferry system). The literature review also suggested that 26 state DOTs had created an EMS program but had not sought formal ISO 14001 certification.

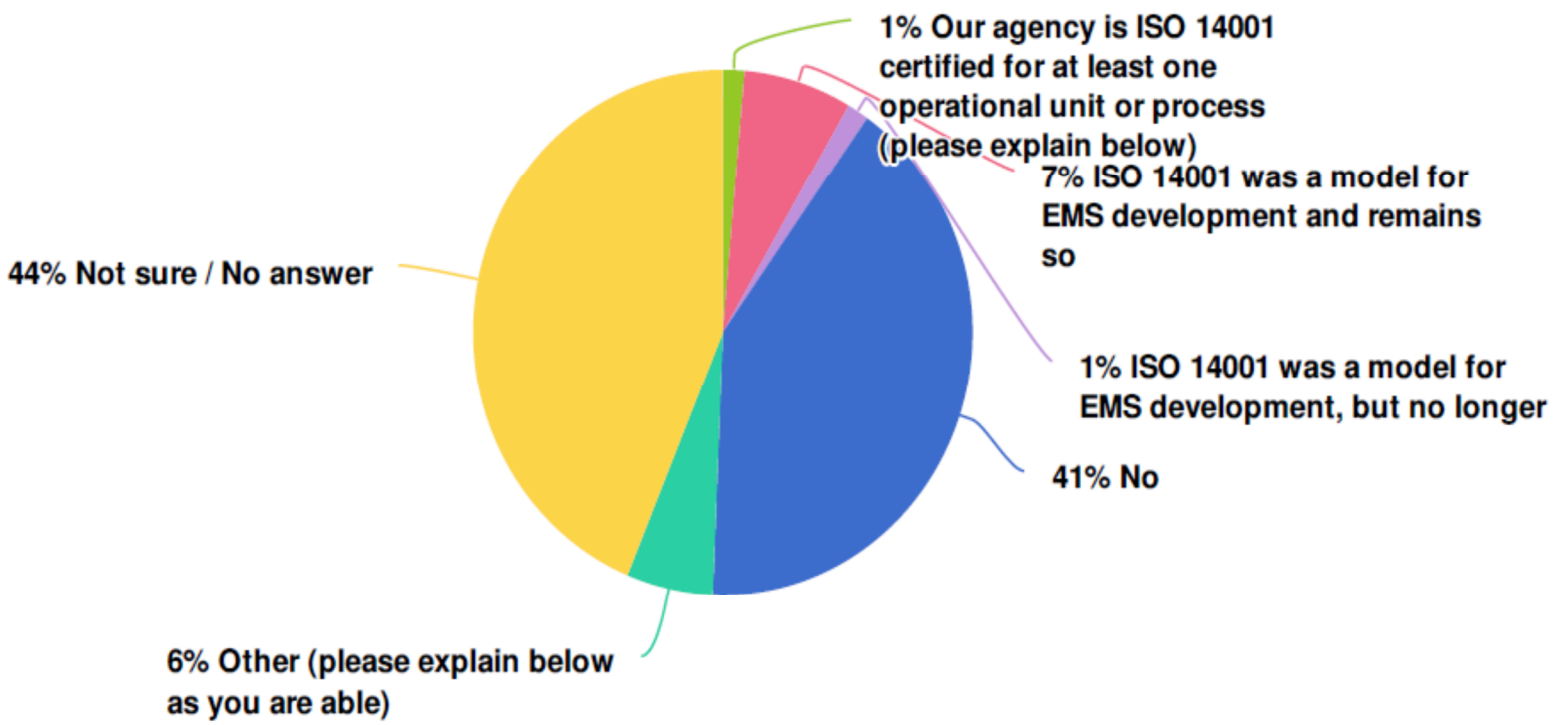
Detailed Survey Findings

The current survey provided information from 43 state DOTs (8 states were unrepresented). Eleven states only answered "Not sure/no answer." No (40.8%) was the highest ranked answer. One state only answered ISO 14001 certified for at least one operational unit or process, two states only responded ISO 14001 was a model for EMS development and remains so, and two states only answered other.

Question 11: Was ISO 14001 Certification a focus for EMS development? ***(choose one)***

Number of Respondents		**71**	
Number of States Represented		**43**	
Number of States Not Represented		**8**	
Response	**Percent Count**	**Number of Responses**	
		Count	**States**
Our agency is ISO 14001 certified for all operations	0%	0	0
Our agency plans to be ISO 14001 certified for all operations	0%	0	0
Our agency plans to be ISO 14001 certified for at least one operational unit or process	1.4%	1	1
ISO 14001 was a model for EMS development and remains so	7.0%	5	5
ISO 14001 was a model for EMS development, but no longer	1.4%	1	1
No	40.8%	29	27
Other	5.6%	4	4
Answered "Not sure/no answer"	43.7%	31	25
Totals	**100%**	**71**	**63**

Graph of Number of Responses by Count



Question 11: Please provide further explanation
Response
Really do not have a formal EMS, but rather training of construction staff for stormwater.
The EMS is based on compliance with applicable state and Federal regulations and best practices.
ISO 14001:2004 was the model for our EMS. Certification was not a consideration. Have not updated to ISO14001:2015.
We have considered developing an EMS in the past. We found that it would be very difficult to implement. The EMS did not differentiate between compliance verses stewardship. We do not intend to implement and EMS, and are not interested in ISO 14001 certification.
We determine the paperwork focus of the ISO certification was not beneficial for our maintenance yard EMS program.
Our waste management unit is ISO 14001 certified.
Part of the ISO 14001 was used to develop the EMS program.
We are currently following the ISO model structure as we develop our EMS through the EMS Institute and will evaluate in the future whether modifications will be warranted. We do not plan to pursue ISO certification.

B-3.9 Question 12a: Regulatory Involvement

Conclusions

Regulatory pressure was a consideration in the past but does not appear currently to be a direct driver of EMSs in most state DOTs.

Detailed Literature Review Findings

Results of the literature review indicate that eight state DOTs started their EMS programs because of EPA consent decrees or enforcement action. One state DOT worked cooperatively with EPA in a pilot program and was also under a consent decree with the state Department of Environmental Services. Three state DOTs were also pilot program states with another regulatory agency. Literature review results indicate that most state DOTs with EMSs appear to have initiated them because of violations or compliance orders from state or federal regulatory agencies.

Detailed Survey Findings

The current survey provided information from 43 state DOTs (8 states were unrepresented). Seven states only answered "Not sure/no answer." No agency involvement (32.4%) was the highest ranked answer. Of the 21 states that answered no agency involvement, three also selected state environmental agency, and one also selected US EPA. Of the 11 states that selected state environmental agency (but not no agency involvement), 6 states also selected US EPA, and 5 states also selected other agency. Of the two states that selected US EPA (but not no agency involvement or state environmental agency), one state also selected other agency. Two states only selected other agency. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 12a: Was there a regulatory agency involved in development your EMS?

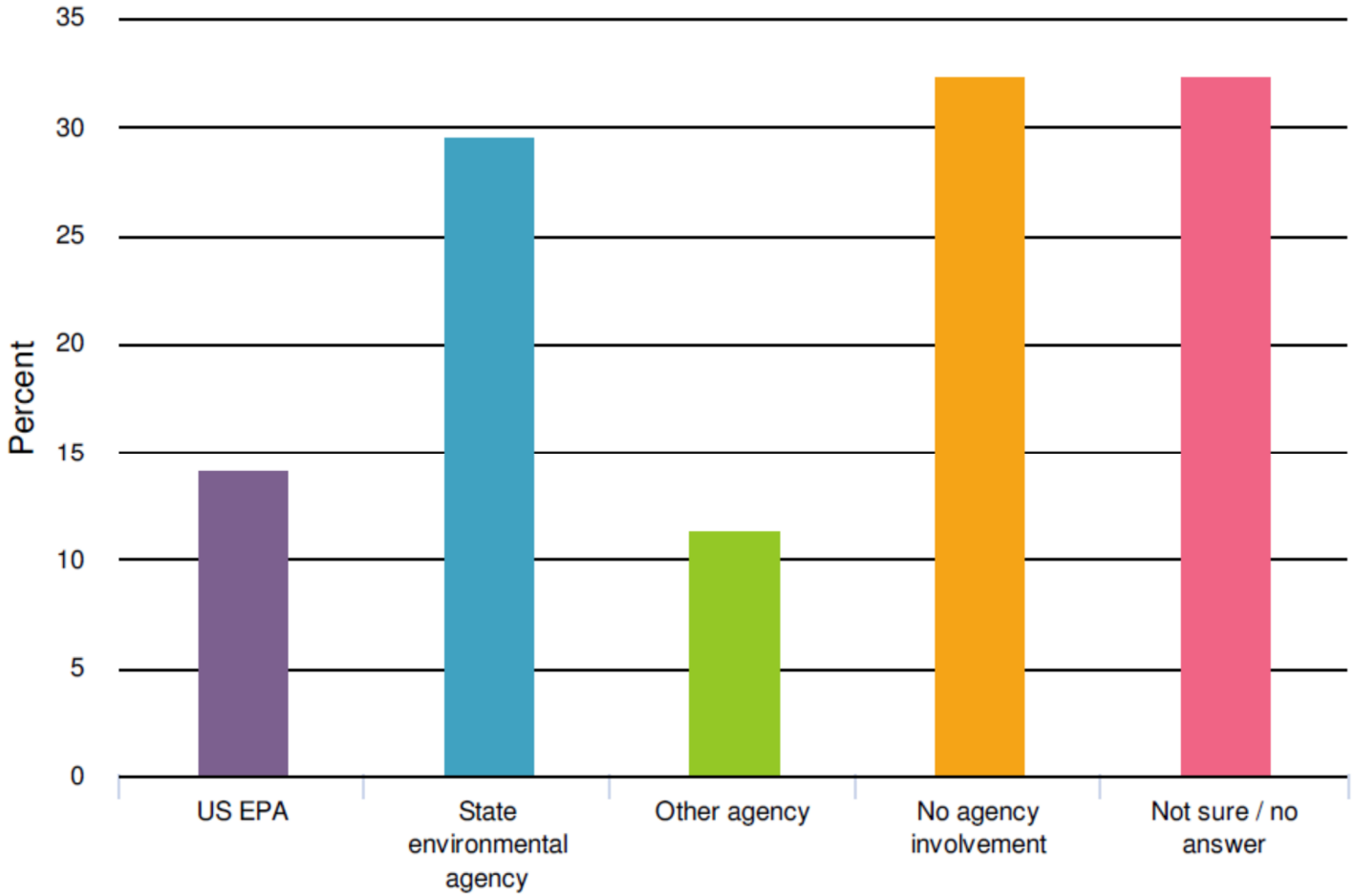
(please check all that apply)

Number of Individual Respondents		**71**	
Number of States Represented		**43**	
Number of States Not Represented		**8**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
US EPA	14.1%	10	9
State environmental agency	29.6%	21	14
Other agency	11.3%	8	8
No agency involvement	32.4%	23	21
Answered "Not sure/no answer"	32.4%	23	17
Total		**85**	**69**

Question 12a: Please provide further explanation

Response
None

Graph of Number of Responses by Count



B-3.10 Question 12b: EPA Involvement

Conclusions

As with the more general question of regulatory agency involvement, regulatory intervention from EPA was a consideration in the past and continues in some exceptions into the present; EPA involvement does not appear to be a current direct driver of EMSs in most states.

Detailed Literature Review Findings

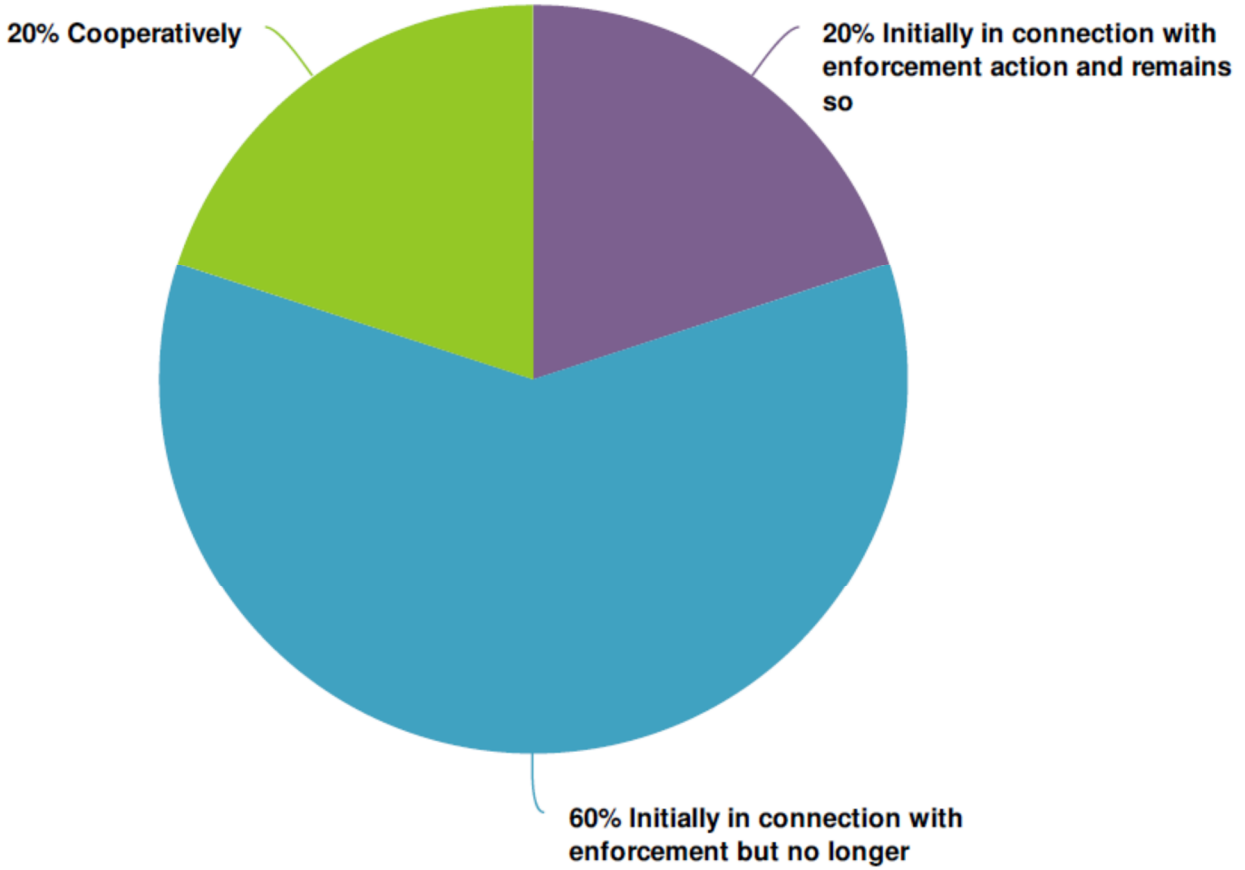
Results of the literature review indicate that several state DOTs started their EMS programs due to EPA consent decrees or enforcement action. At least one other state DOT worked cooperatively with EPA in a pilot program.

Detailed Survey Findings

The current survey provided information from 9 state DOTs (42 states were unrepresented). Zero states only answered "Not sure/no answer." Initially in connection with enforcement but no longer (60%) was the highest ranked answer. Five states only selected initially in connection with enforcement but no longer, two states only selected initially in connection with enforcement action and remains so, and two agencies only selected cooperatively. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 12b: How was EPA involved? ***(choose one)***			
Number of Respondents		**10**	
Number of States Represented		**9**	
Number of States Not Represented		**42**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Initially in connection with enforcement action and remains so	20%	2	2
Initially in connection with enforcement but no longer	60%	6	5
Cooperatively	20%	2	2
Answered "Not sure/no answer"	0%	0	0
Totals	**100%**	**10**	**9**

Graph of Number of Responses by Count



Question 12b: Please provide further explanation
Response
Although our MS4 Permit has been through an audit and currently has an Administrative Order on Consent with no fines, we continue to work closely with EPA on water quality and NEPA.
An agency is the delegated environmental agency to implement EPA's NPDES program. DOT's NPDES program was started as part of a consent decree.
Required to complete $15 million in Environmental Supplement Projects
One EPA-connected effort evolved from stormwater/erosion control consent decree. Majority of all other programs evolved with cooperation of state environmental regulator.
Stormwater related

B-3.11 Question 12c: State Agency Involvement

Conclusions

State DOTs can successful navigate their consent decrees and go on to develop cooperative relationships with state regulatory agencies for EMS continuance. Regulatory pressure is a consideration but does not appear to be the direct driver of EMSs, with most state DOTs reporting cooperative relationships with their sister agencies.

Detailed Literature Review Findings

Results of the literature review indicate that, in June 2007, one state DOT had received a state Administrative Order of Consent and, as part of that order, agreed to develop and apply an EMS for each of the bureaus.

Detailed Survey Findings

The current survey provided information from 14 state DOTs (37 states were unrepresented). Zero states only answered "Not sure/no answer." Cooperatively (52.4%) was the highest ranked answer. Of the 10 states that selected cooperatively, 1 state also selected initially in connection with enforcement action and remains so, and 2 states also selected initially in connection with enforcement but no longer. Two states only selected initially in connection with enforcement action and remains so, and two states only selected initially in connection with enforcement but no longer. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

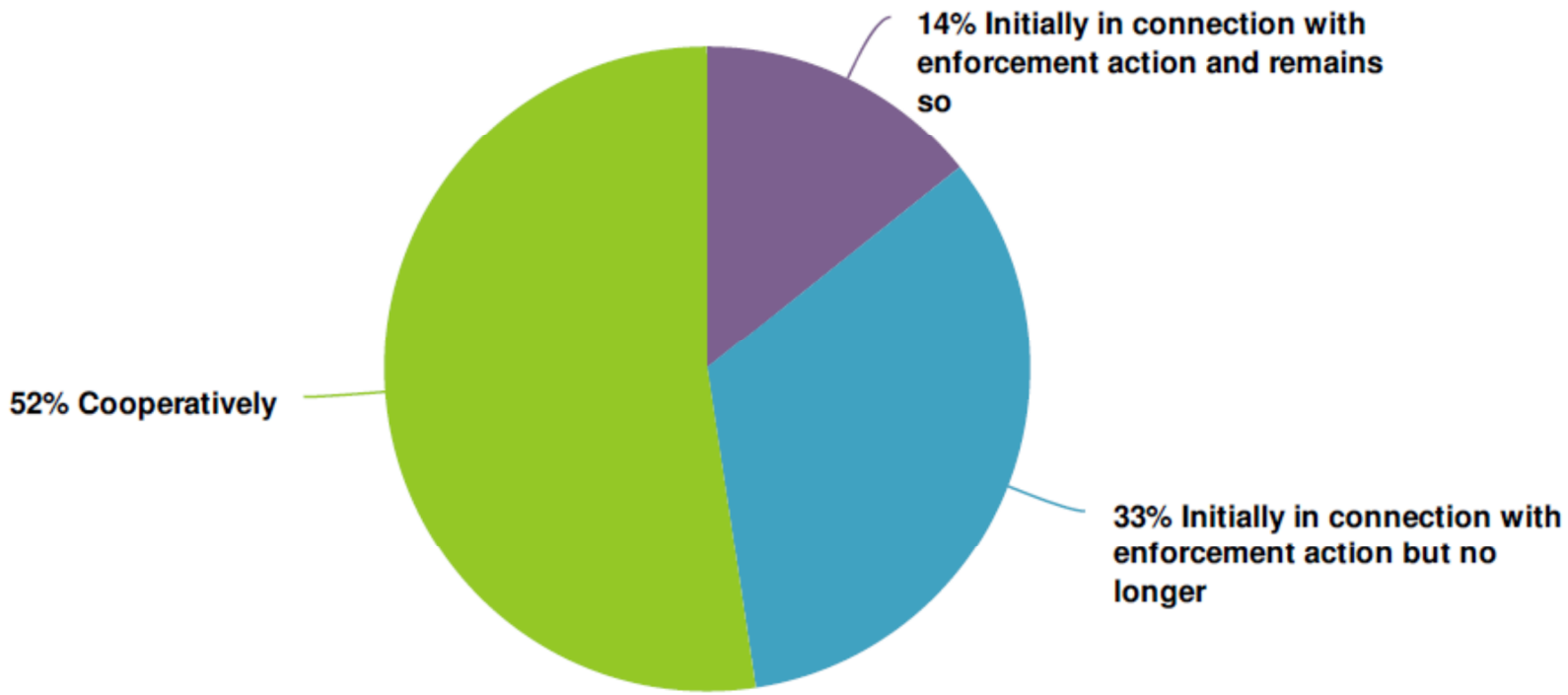
Question 12c: How was your state environmental agency involved? (choose one)

Number of Respondents		**21**	
Number of States Represented		**14**	
Number of States Not Represented		**37**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Initially in connection with enforcement action and remains so	14.3%	3	3
Initially in connection with enforcement but no longer	33.3%	7	4
Cooperatively	52.4%	11	10
Answered "Not sure/no answer"	0%	0	0
Totals	**100%**	**21**	**17**

Question 12c: Please provide further explanation

Response
We have a good working relationship with the Department of Public Health and Environment, and work with them to develop strong programs. This relationship was not always good, and enforcement actions have been in our past.
Through the enforcement of Administrative Consent Orders
Consent Decree
Reviewing and assisting in developing our policies and guidance.

Graph of Number of Responses by Count



B-3.12 Question 12d: Other Agency Involvement

Conclusions

Although perhaps not as common as EPA and state agency consent actions, several DOTs have had positive EMS-related involvement with other outside agencies.

Detailed Literature Review Findings

Results of the literature review indicate 3 state DOTs were 2006 Center for Environmental Excellence EMS Technical Assistance Pilot Projects.

Detailed Survey Findings

The current survey indicates that 8 state DOTs have involvement with other federal or state agencies, primarily FHWA, USACE, and USFWS.

Question 12d: Please identify the other agencies involved in EMS development
Response
FHWA - They participate in checking various parts of our program from NEPA, to safety, to materials and structures, to construction management, etc.
The National Oceanic and Atmospheric Administration/National Marine Fisheries Service, U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service, State Historic Preservation Office (SHPO), State Department of Fish and Wildlife, and State Department of Environmental Quality are involved in the Routine Road Maintenance Guide. State Department of Environmental Quality is involved with the Maintenance Yard EMS Program.
USACE, USFWS, EPA on a limited basis
USACE, FHWA
FHWA plus various other resource agencies
FHWA, USFWS, State Wildlife Resources Agency, USACE, TVA, and SHPO
FHWA, USFWS
Our State Department of Natural Resources are the Department's partner in our Cooperative Agreement. We have other agreements with other state and federal agencies.

B-3.13 Question 12e: Nature of Other Agency Involvement

Conclusions

FHWA promotion of NEPA commitment tracking some 20 years ago continues as a common EMS feature to this day. Other agency involvement in the promotion of maintenance and operations EMS has been insignificant or mostly forgotten.

Detailed Literature Review Findings

Results of the literature review indicate 3 state DOTs were 2006 Center for Environmental Excellence EMS Technical Assistance Pilot Projects.

Detailed Survey Findings

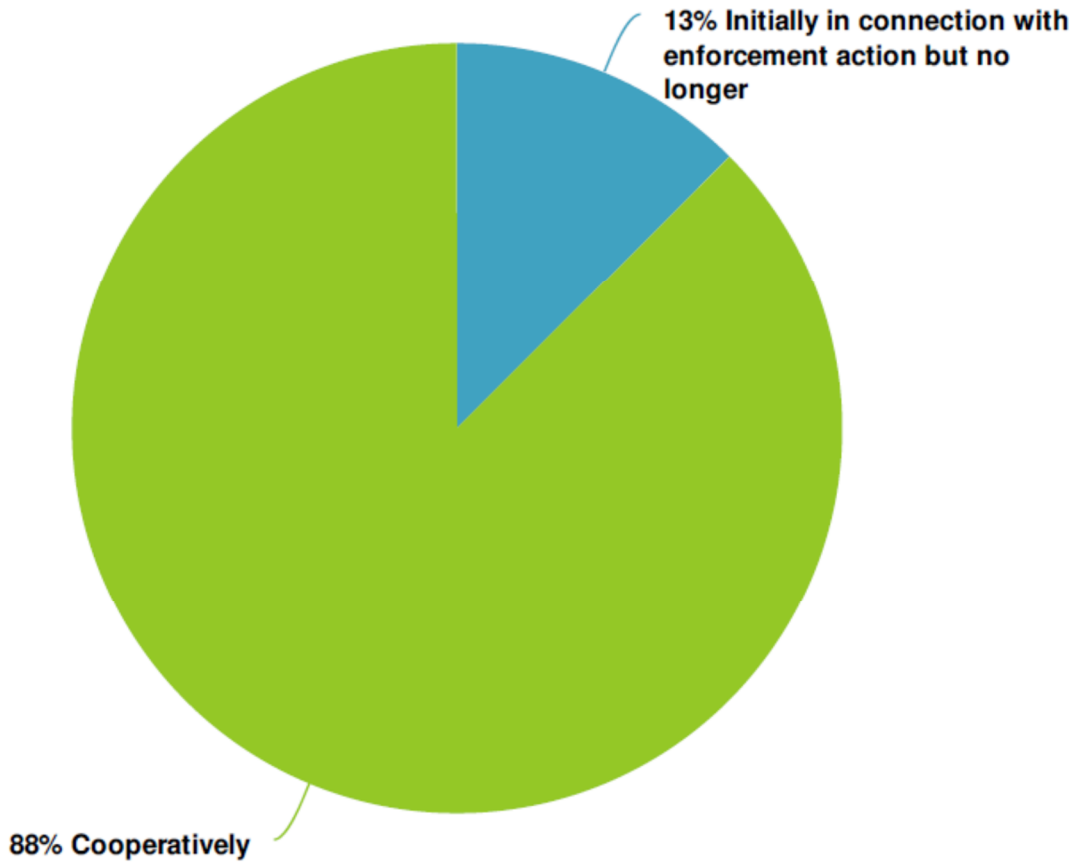
The current survey provided information from 8 state DOTs (43 states were unrepresented). Zero states only answered “Not sure/no answer.” Cooperatively (87.5%) was the highest ranked answer. Seven states only answered cooperatively. One state only answered initially in connection with enforcement but no

longer. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 12e: How were those other agencies involved in EMS development? (choose one)

Number of Respondents		**8**	
Number of States Represented		**8**	
Number of States Not Represented		**43**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Initially in connection with enforcement action and remains so	0%	0	0
Initially in connection with enforcement but no longer	12.5%	1	1
Cooperatively	87.5%	7	7
Answered "Not sure/no answer"	0%	0	0
Totals	**100%**	**8**	**8**

Graph of Number of Responses by Count



Question 12e: Please provide further explanation
Response
We have a monthly Quality Improvement Council where we collaboratively identify risks to our federal program, create Joint Process Reviews, identify recommendations, and follow through those recommendations over time. Part of this involved auditing part of the program to see how they are performing; these audits have resulted in changes in guidance and practices.
To appropriately encapsulate their needs into the system for push/pull data sharing purposes.
All of our agreements are established so enforcement actions do not occur.

B-3.14 Question 13a: EMS Expansion

Conclusions

EMS utility seems proven by the fact that most agencies have expanded their programs.

Detailed Literature Review Findings

The literature review suggested that generally state DOTs were expanding their EMS programs. The literature review did not provide sufficient information to answer whether DOTs had reduced or discontinued their EMS programs.

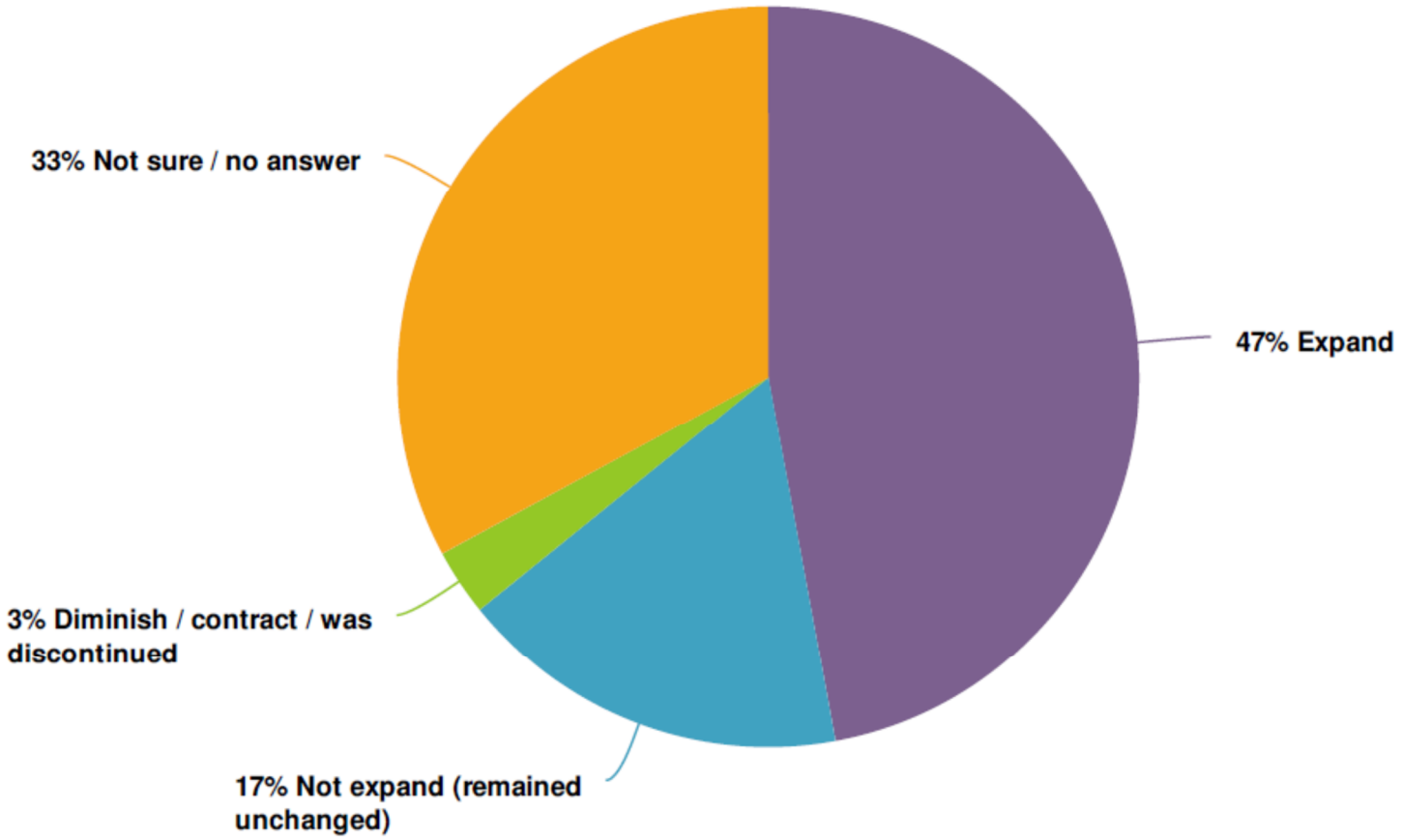
Detailed Survey Findings

The current survey provided information from 42 state DOTs (9 states were unrepresented). Nine states only answered "Not sure/no answer." Expand (47.1%) was the highest ranked answer. Of the 26 states that selected expand, 6 also selected not expand, and 1 state selected diminish. Six states only selected not expand and one state only selected diminish. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 13a: After initial rollout, did your EMS program: (choose one)			
Number of Respondents		**70**	
Number of States Represented		**42**	
Number of States Not Represented		**9**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Expand	47.1%	33	26
Not expand (remained unchanged)	17.1%	12	12
Diminish/contract/was discontinued	2.9%	2	2
Answered "Not sure/no answer"	32.9%	23	18
Totals	**100%**	**70**	**58**

Question 13a: Please provide further explanation
Response
None

Graph of Number of Responses by Count



B-3.15 Question 13b: Reasons for EMS Expansion

Conclusions

EMS utility seems proven by the fact that most agencies expand their programs. Expansion is primarily for reasons of efficiencies. As noted in other question results, violations are a factor in applying EMSs but not a primary driving force in expansion of EMSs.

Detailed Literature Review Findings

The literature review suggests that reasons for expanding EMSs may include increased compliance assurance and cost-effectiveness, adoption and development of BMPs and sustainability practices, enhanced land and resource use planning and management, accelerating and streamlining the project delivery processes, and improved intergovernmental relationships and stakeholder confidence (2010 NCHRP 25-25, Task 63, Report).

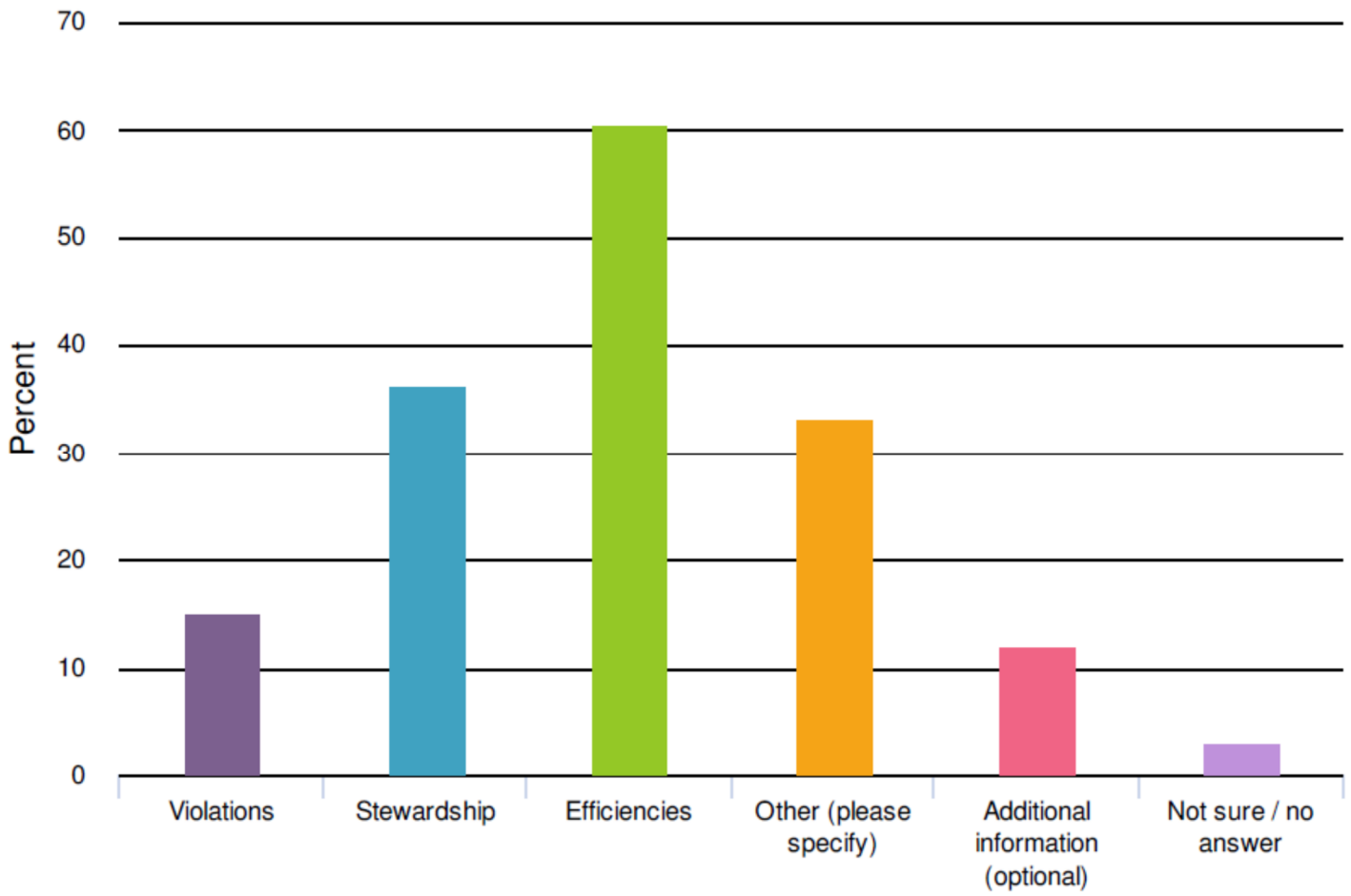
Detailed Survey Findings

The current survey provided information from 25 state DOTs (26 states were unrepresented). Zero states only answered "Not sure/no answer." Efficiencies (60.6%) was the highest ranked answer. Of the 18 states that selected efficiencies, 10 also selected stewardship, 4 also selected violations, and 5 also selected other. One state only selected violations, one state only selected stewardship, and five states only selected other. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 13b: Why was your EMS expanded? ***(choose all that apply)***

Number of Individual Respondents		**33**	
Number of States Represented		**25**	
Number of States Not Represented		**26**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Violations	15.2%	5	5
Stewardship	36.4%	12	11
Efficiencies	60.6%	20	18
Other	33.3%	11	10
Answered "Not sure/no answer"	3.0%	1	1
Total		**53**	**45**

Graph of Number of Responses by Count



Question 13b: Please provide further explanation
Response
DOT's environmental database is always evolving as new tools are developed to improve workflows, collect data, or comply with new requirements.
We could not address everything at once. The program was expanded as time and priorities dictated.
Unit was recently expanded to handle ramp up in project delivery as well as to address MS4 compliance
The EMS has expanded to include electronic construction erosion and sediment control reviews; electronic environmental permit requests; electronic collection of Stormwater facility design documents and data and an electronic environmental review record for NEPA. Most of these are in the final stages of development.
SHPO funded position
We felt the process offered a good opportunity to verify safety and operational items (like stockpile balances, and equipment care)
Changes in regulatory requirements
We tried to expand it to other areas as part of our NEPA Assignment program.
We decided to rollout the program at the start (which would be deciding and developing commitments during NEPA), and then continually add and expand the process to include communication and follow-up/monitoring. This approach allowed us to try out each part of the process, work through the kinks, and expand on areas based on feedback and need.
Training, both public and in-house.
We now have an Environmental Compliance Division. They have hired consultants to assist in both pre-Construction quality assurance/quality control and assist in compliance during construction
Initial rollout included base foundation uses and periodic expansions are included within the schedule for achieving full build.
The initial EMS program was comprehensive. As it has been implemented, changes in process, information management, and reporting have occurred to improve or maintain efficiency.
The program has evolved and updated to meet the current needs of the agency. The program is reviewed annually for continuous improvement.
Although non-compliance did influence change in our EMS, the expansion was mostly a result of the Check and Act components revealing the need to change.
EMS is a continuing process at DOT. As new technologies are developed, new laws are enacted, etc. our functional areas ensure EMS elements are adjust to provide the best program efficiencies possible.

B-3.16 Question 13c: Reasons for not Expanding EMS

Conclusions

Lacking a pressing need for investment of staff time and funds, state DOTs often tend to focus their efforts on more immediate concerns than process-level improvements.

Detailed Literature Review Findings

Results of the literature review yielded little state-specific information; however, these results suggest the reasons for not expanding EMS may include violation satisfied, no interest, not needed, low priority, lack of funds, lack of perceived value, or lack of advocacy.

Detailed Survey Findings

The current survey provided information from 12 state DOTs (39 states were unrepresented). One state only answered “Not sure/no answer.” Other (33.3%) was the highest ranked answer. Four states only selected other. Of the three states that selected low priority (but not other), one also selected lack of funds. Of the three states that selected no interest/perceived need (but not other or low priority), one also

selected violation satisfied. One state only selected violation satisfied. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

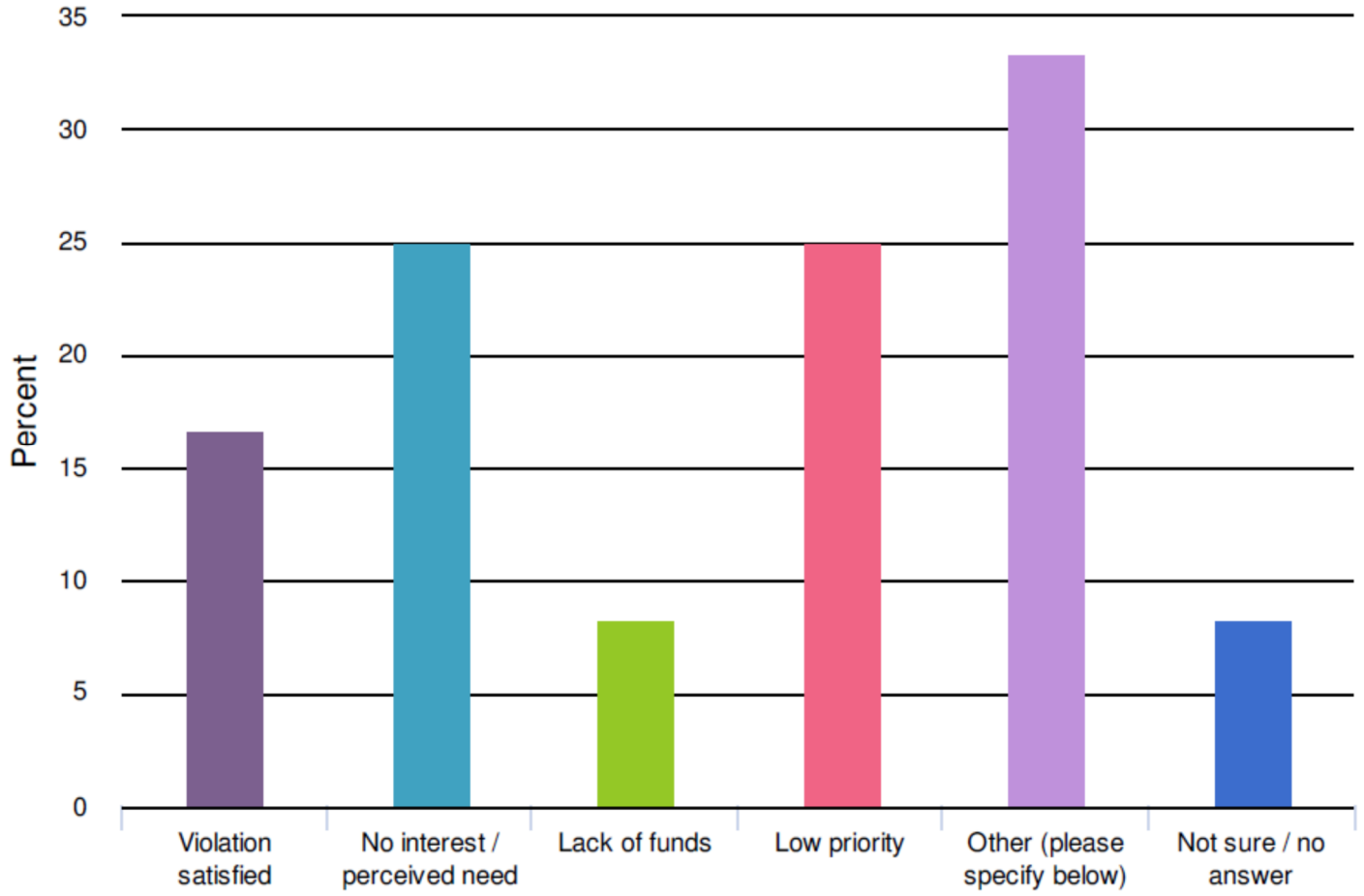
Question 13c: Why was your EMS not expanded (remained unchanged)? (choose all that apply)

Number of Individual Respondents		**12**	
Number of States Represented		**12**	
Number of States Not Represented		**39**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Violation satisfied	16.7%	2	2
No interest/perceived need	25%	3	3
Lack of funds	8.3%	1	1
Lack of national models and tech support	0%	0	0
Low priority	25%	3	3
Other	33.3%	4	4
Answered “Not sure/no answer”	8.3%	1	1
Total		**14**	**14**

Question 13c: Please provide further explanation

Response
After initial rollout of the program, the funding level was maintained without need for expansion. However in future permit cycles, funding will need to expand.
The program was developed in a robust fashion and has met the requirements of the enforcement action.
It works. No need to fix or change.
EMS changed form over time.

Graph of Number of Responses by Count



B-3.17 Question 13d: Reasons for Discontinuing or Reducing EMS

Conclusions

EMS utility seems proven by the fact that most state DOTs expand their programs. Diminishment or discontinuance appears to be a state-specific issue.

Literature Review Findings

The literature review did not provide sufficient information to answer whether state DOTs had reduced or discontinued their EMS programs.

Detailed Survey Findings

The current survey provided information from 2 state DOTs (49 states were unrepresented). Zero states only answered "Not sure/no answer." Low priority (100%) was the highest ranked answer. Of the two states that selected low priority, one also selected both "No interest/perceived need" and "Lack of funds." Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 13d: Why was your EMS discontinued or diminished?

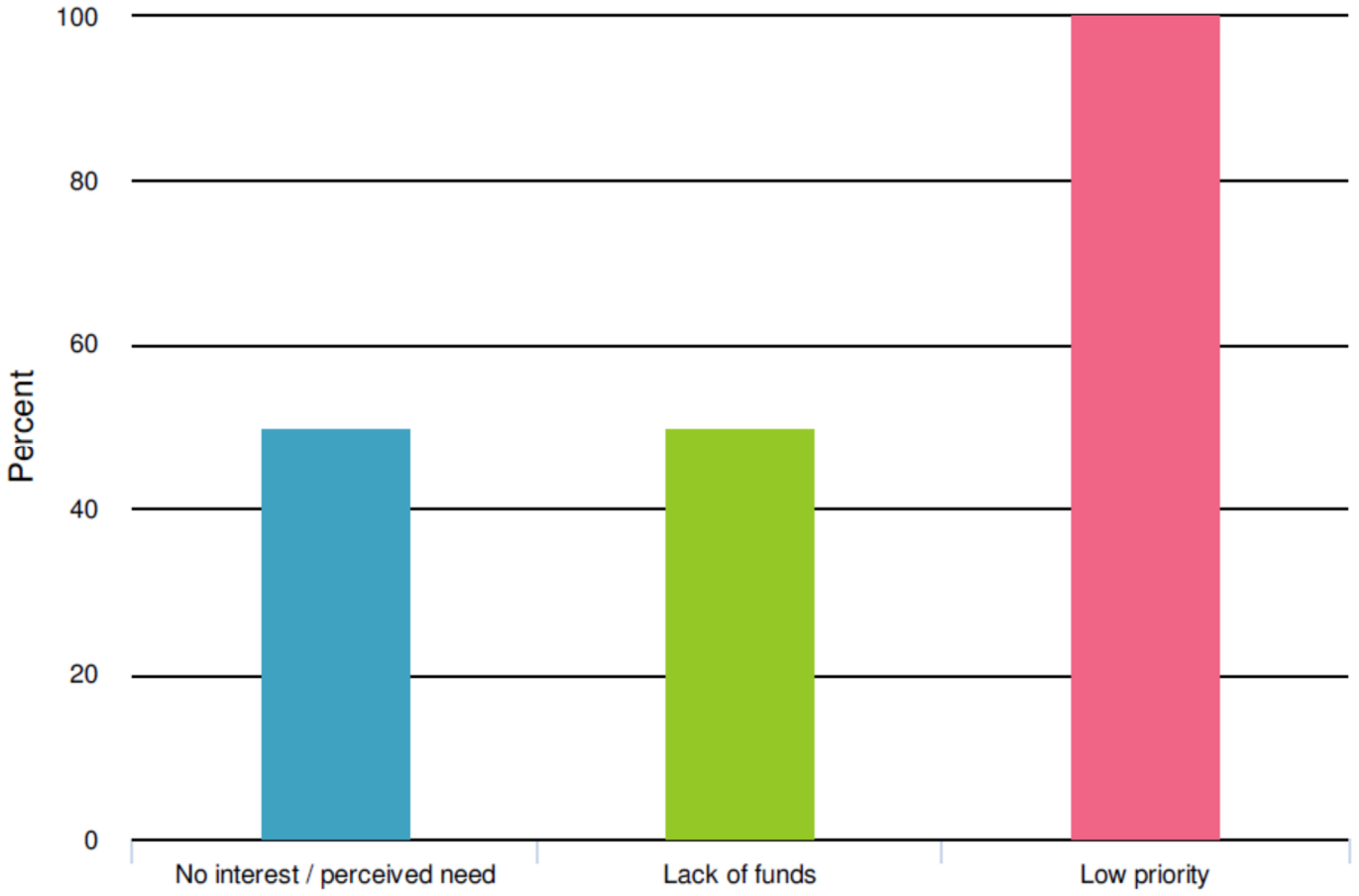
(Check all that apply)

Number of Individual Respondents		**2**	
Number of States Represented		**2**	
Number of States Not Represented		**49**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Violation satisfied	0%	0	0
No interest/perceived need	50%	1	1
Lack of funds	50%	1	1
Lack of national models and tech support	0%	0	0
Low priority	100%	2	2
Other	0%	0	0
Answered "Not sure/no answer"	0%	0	0
Total		**4**	**4**

Question 13d: Please provide further explanation

Response
Went from a Bureau of 30 people down to a section of about 15

Graph of Number of Responses by Count



B-3.18 Question 14a: Agency-Wide Lead

Conclusions

Environmental units seem to commonly, but by no means exclusively, provide EMS leadership. This concurs with the findings in Question 8, in which environmental was selected as the initial champion for EMS development. Perhaps due to organizational placement, environmental units are often out of touch with the details of EMS practice in operations and maintenance, and thus "Have a hard time pulling it all together…" from an agency-wide perspective.

Detailed Literature Review Findings

The literature review did not yield information on lead organizations.

Detailed Survey Findings

Question 14a: The current survey provided information from 42 state DOTs (9 states were unrepresented). Yes and no were equally ranked. Of the 26 states that selected yes, 10 also selected no.

Question 14b: Of the 26 states that stated they have a lead organization,22 states indicated that lead agency was environmental, 1 state indicated that was maintenance, and 3 states indicated that the lead agency was other. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 14a: Does your agency have an EMS lead organization with assigned responsibility for environmental compliance across the entire agency?
(choose one)

Number of Respondents		**68**	
Number of States Represented		**42**	
Number of States Not Represented		**9**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Yes	50%	34	26
No	50%	34	26
Totals	**100%**	**68**	**52**

Question 14b: Where does that leadership reside? (choose one)

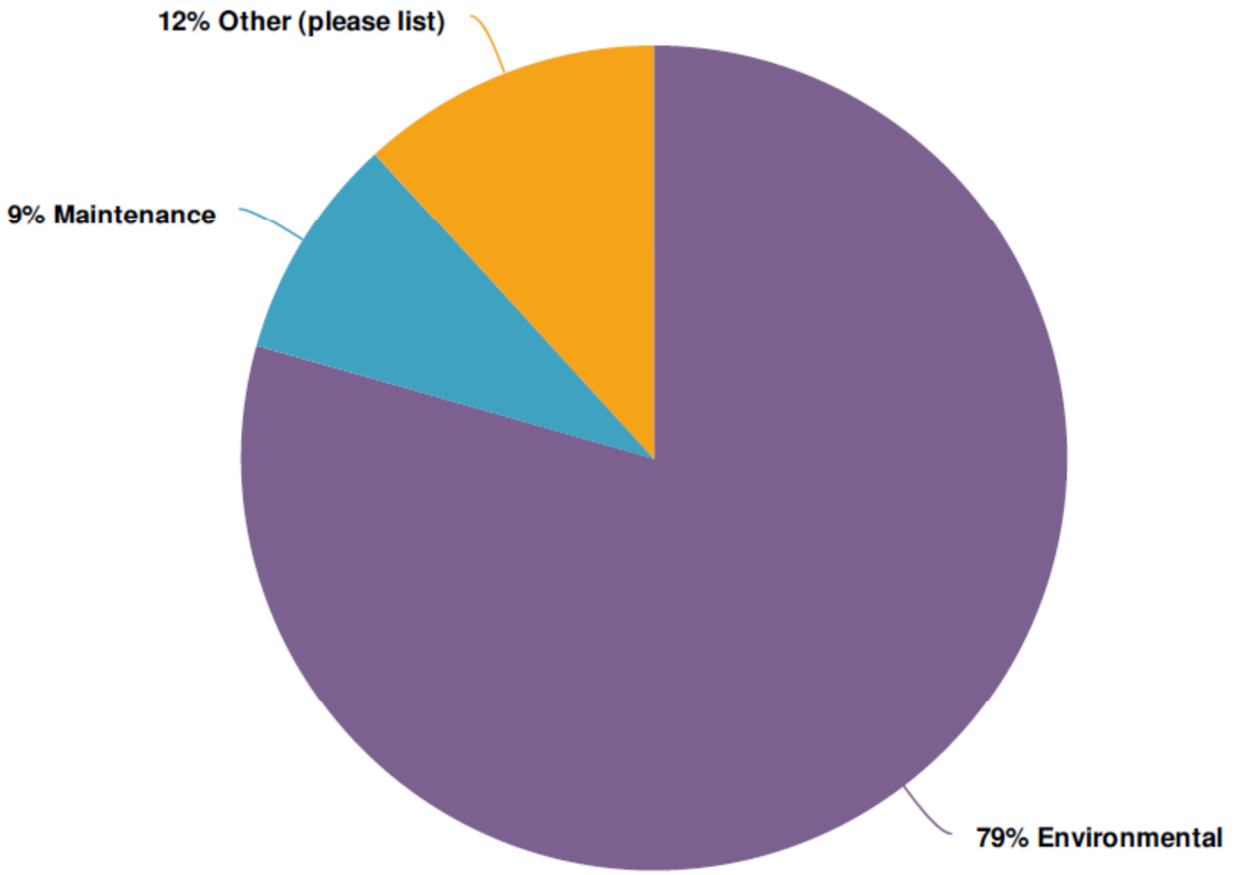
Number of Respondents		**34**	
Number of States Represented		**26**	
Number of States Not Represented		**25**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Environmental	79.4%	27	22
Maintenance	8.8%	3	2
Construction	0%	0	0
Other	11.8%	4	4
Totals	**100%**	**34[1]**	**28**

[1]34 that answered "Yes" in Question 14a
[2]25 consists of the 16 that answered "No" and 9 unrepresented in Question 14a

Question 14b: Please provide further explanation

Response
EMS components are in various areas of Environmental Planning.
The environmental database is managed through DOT Headquarters. All reporting is done by compiling information that is entered into the database statewide.
This is mostly out of environmental, but there are other groups that take responsibilities as well, and have hired specialists to help focus on these goals.
The NPDES group in maintenance oversees a portion and the Environmental stewardship group in Design oversees another portion of the EMS.
There isn't necessarily a lead EMS organization; however, the NPDES program does head up the stormwater permits that require compliance across the agency.
Left up to Districts with little oversight from Headquarters.
This is done within the Bureau of Maintenance and Operations, but the Environmental and Safety offices are partners in the process.
Only the Highway Division and the MBTA have an EMS program.
Executive Office
We have an EMS lead person and teams in the Bureaus with EMS
Environmental is the overall lead of environmental compliance. However, other areas such as engineering and construction are responsible for implementing environmental commitments that will occur during their part of the Project Development Process.
SMEs are responsible for program components. Crews are responsible for implementation.
Office of Stormwater
Environmental Division houses the Compliance Division and ensures NEPA and 404 Permitting compliance
A cross functional management team provides the EMS program direction and support.
Environmental Affairs Division, DOT
Environmental, Location and Design, Construction
The way our EMS has developed is such that any SME in charge of policies/procedures/training/tools/audits/etc. improves DOT's EMS.

Graph of Number of Responses by Count



B-4.0 CURRENT APPLICATIONS

Environmental units are commonly involved in EMS for National Environmental Policy Act (NEPA) compliance, and most other DOT units (including equipment management, highway maintenance facilities, highway maintenance activities, and bridge maintenance) have at least some rudimentary EMS applications of their own, although few, if any have complete, mature, proactive PDCA systems.

The extant EMS processes generally include written procedures, record keeping, reporting, and training as core EMS processes, but application of the complete PDCA approach is rare.

For example, EMS procedures for highway maintenance activities are practically universal, with record keeping, training, and reporting utilized by most, and audit and audit follow-up employed by almost a third of those reporting. However, less than a third seem to have performance targets, and only some 10% claim to use the full PDCA system. That said, much innovation and advancement is taking place in this area with embedded environmental expertise, field availability of GIS resource mapping, just-in-time training, and a developing stewardship ethic.

B-4.1 Question 15a: Breadth of EMS Coverage

Conclusions

The distribution of EMS application areas appears to be generally stable through the past decade, with EMS most frequently applied to NEPA environmental compliance commitments with common application to maintenance activities. Most all DOT units (including capital program, equipment management, highway maintenance facilities, highway maintenance activities, and bridge maintenance) have EMS activities. However, few if any of these tend to have mature, proactive PDCA systems in place or in use.

Detailed Literature Review Findings

The literature review yielded information on 23 state DOTs, and results indicate that 11 state DOTs apply EMS to equipment maintenance facilities; 11 state DOTs applied EMS to highway maintenance facilities; 7 state DOTs applied EMS to highway maintenance activities; 12 state DOTs applied EMS to environmental compliance; 5 state DOTs applied EMS to bridge maintenance; and 7 state DOTs applied EMS to other areas.

Detailed Survey Findings

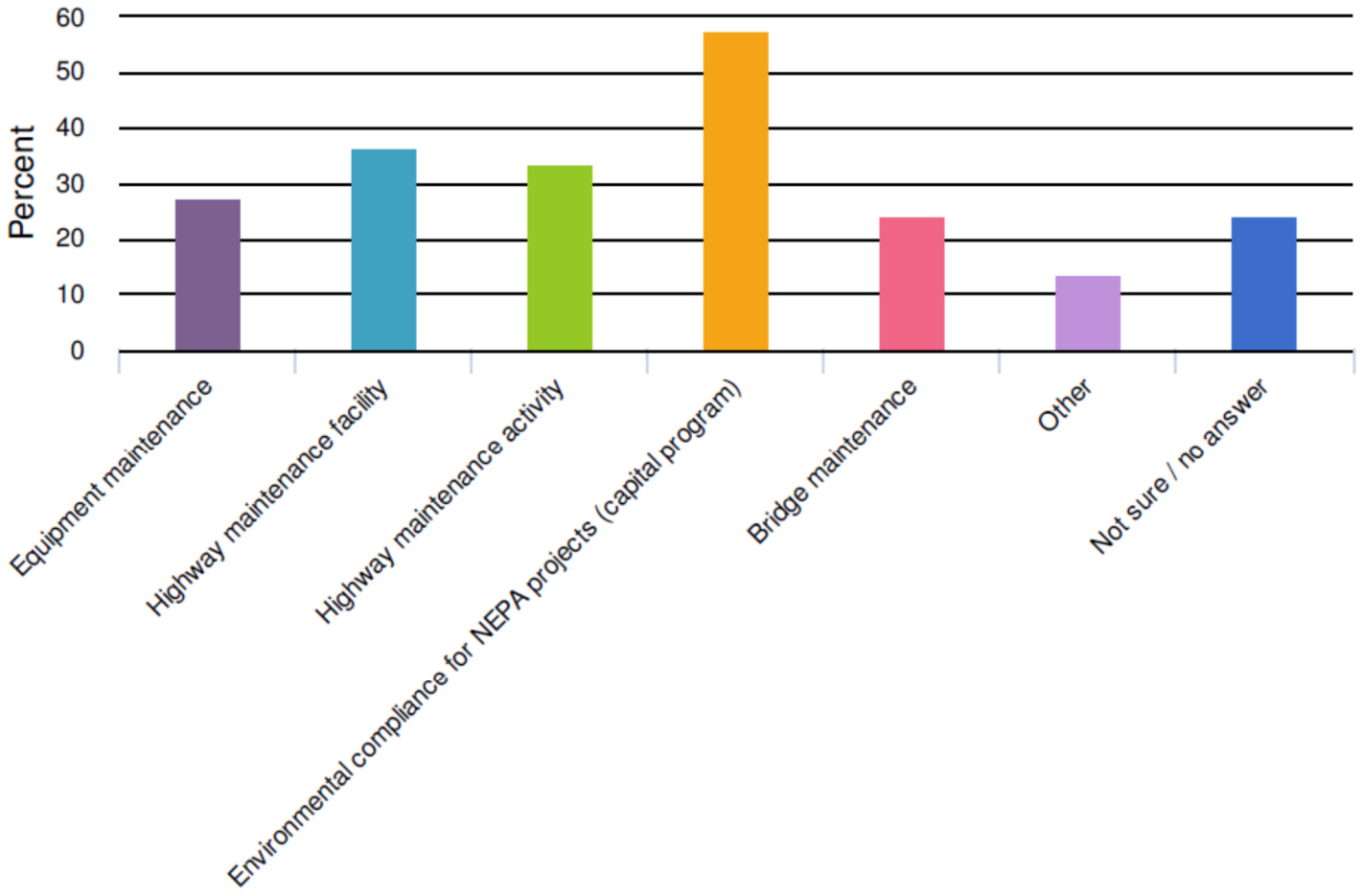
The current survey provided information from 41 state DOTs (10 states were unrepresented). Six states only answered “not sure/no answer.” Environmental compliance for NEPA projects (57.6%) was the highest ranked answer. Of the 31 states that selected environmental compliance, 11 also selected equipment maintenance, 15 also selected highway maintenance facility, 15 also selected highway maintenance activity, 10 also selected bridge maintenance, and 6 also selected other. Of the two states that selected highway maintenance facilities (but not environmental compliance), both also selected equipment maintenance, highway maintenance activity, and bridge maintenance, and one selected other. Two states only selected other. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 15a: Do you have an EMS or quality assurance procedures for any of the following?

(please check all that apply)

Number of Individual Respondents		**66**	
Number of States Represented		**41**	
Number of States Not Represented		**10**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Equipment maintenance	27.3%	18	13
Highway maintenance facility	36.4%	24	17
Highway maintenance activity	33.3%	22	17
Environmental compliance for NEPA projects (capital program)	57.6%	38	31
Bridge maintenance	24.2%	16	12
Other	13.6%	9	9
Answered "Not sure/no answer"	24.2%	16	15
Total		**143**	**114**

Graph of Number of Responses by Count



B-4.2 Question 15b: EMS in Equipment Maintenance

Conclusions

Written procedures, record keeping, and training followed by audits are core EMS processes, and their predominance suggests a serious interest in EMS for equipment maintenance. However less than half of the organizations responding have performance targets, and less than a quarter report PDCA capabilities.

Detailed Literature Review Findings

Results of the literature review indicate that 11 state DOTs apply EMS to equipment maintenance facilities. Two of those state DOTs were ISO 14001 certified at one time.

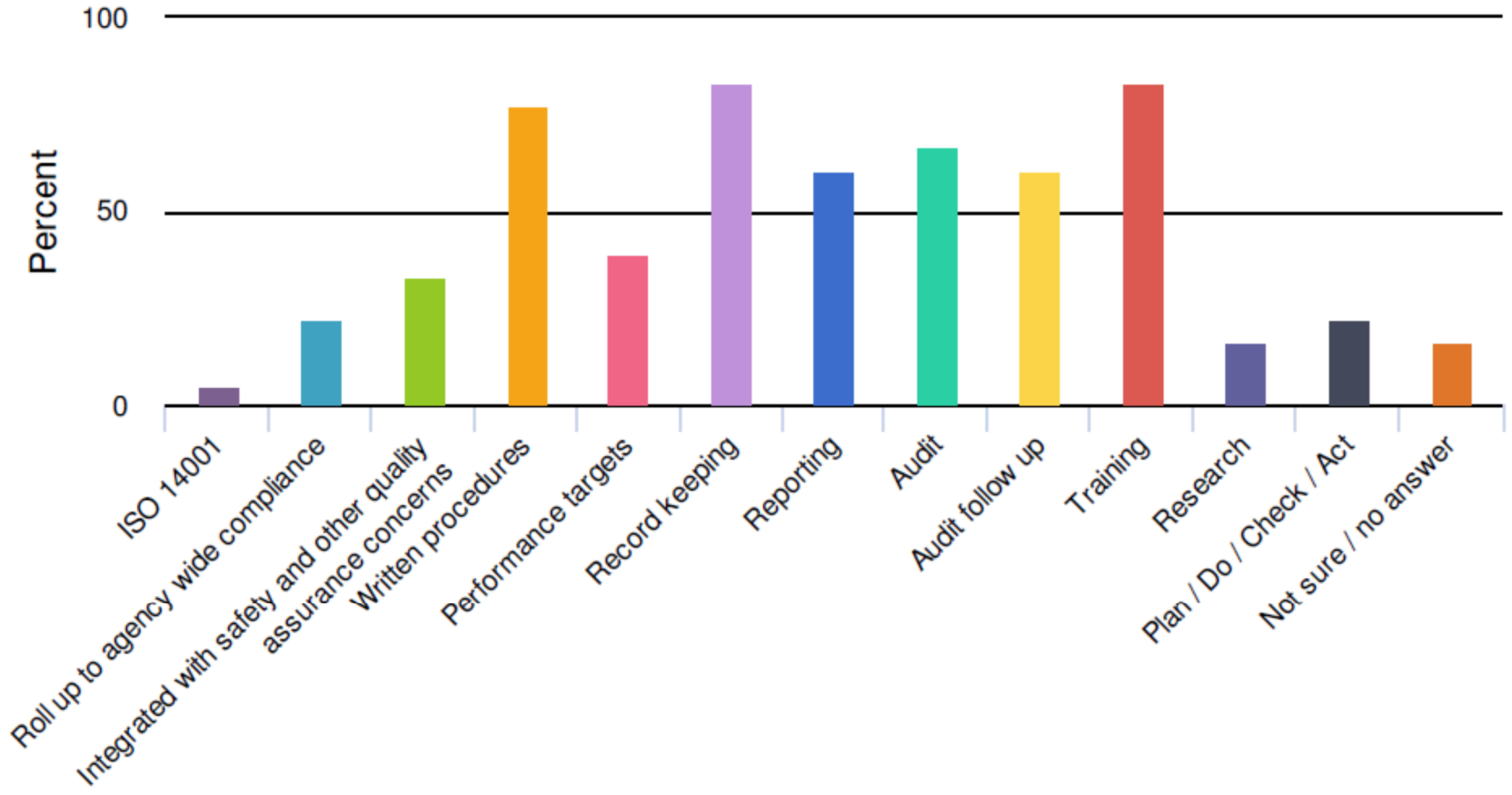
Detailed Survey Findings

The current survey provided information from 13 state DOTs (38 states were unrepresented). Zero states only answered "not sure/no answer." Written procedures (77.8%) was the highest ranked answer. Of the 12 states that selected written procedures, 1 state also selected ISO 14001, 4 states also selected roll up to agency wide compliance, 5 states also selected integrated with safety and other quality assurance concerns, 6 states also selected performance targets, all 12 states also selected record keeping, 9 states also selected reporting, 9 states also selected audit, 9 states also selected audit follow-up, all 12 states also selected training, 3 states also selected research, and 4 states also selected PDCA. One state only selected integrated with safety and other quality assurance concerns. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 15b: Do your equipment maintenance quality assurance procedures include any of the following environmental compliance features?
(please check all that apply)

Number of Individual Respondents		**18**	
Number of States Represented		**13**	
Number of States Not Represented		**38**	
Response	**Percent Count**	**Number of Responses**	**Number of States**
ISO 14001	5.6%	1	1
Roll up to agency wide compliance	22.2%	4	4
Integrated with safety and other quality assurance concerns	33.3%	6	6
Written procedures	77.8%	14	12
Performance targets	38.9%	7	6
Record keeping	83.3%	15	12
Reporting	61.1%	11	9
Audit	66.7%	12	9
Audit follow-up	61.1%	11	9
Training	83.3%	15	12
Research	16.7%	3	3
Plan/Do/Check/Act	22.2%	4	4
Other	0%	0	0
Answered "Not sure/no answer"	16.7%	3	3
	Total	**106**	**90**

Graph of Number of Responses by Count



Question 15b: Please provide further explanation
Response
None

B-4.3 Question 15c: EMS in Highway Maintenance Facilities

Conclusions

EMS procedures for highway maintenance facilities seem more the rule than the exception and predominantly contained written procedures, record keeping, reporting, and training followed closely by audit and audit follow-up. Of those reporting, less than half seem to have performance targets, and less than a third use the full PDCA system.

Detailed Literature Review Findings

Results of the literature review indicate that, in the past, 11 states apply EMS to highway maintenance facilities. For two of those, state DOTs were ISO 14001 certified at one time.

Detailed Survey Findings

The current survey provided information from 17 state DOTs (34 states were unrepresented). Zero states only answered "not sure/no answer." Training (91.7%) and written procedures (87.5%) were the highest ranked answer. Of the 17 states that selected training, 1 state also selected ISO 14001, 9 states also selected roll up to agency wide compliance, 11 states also selected integrated with safety and other quality assurance concerns, 16 states also selected written procedures, 9 states also selected performance targets, 14 states also selected record keeping, 14 states also selected reporting, 14 states also selected audit, 12 states also selected audit follow-up, 7 states also selected research, and 7 states also selected PDCA. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 15c: Do your highway maintenance facility quality assurance procedures include any of the following environmental compliance features?

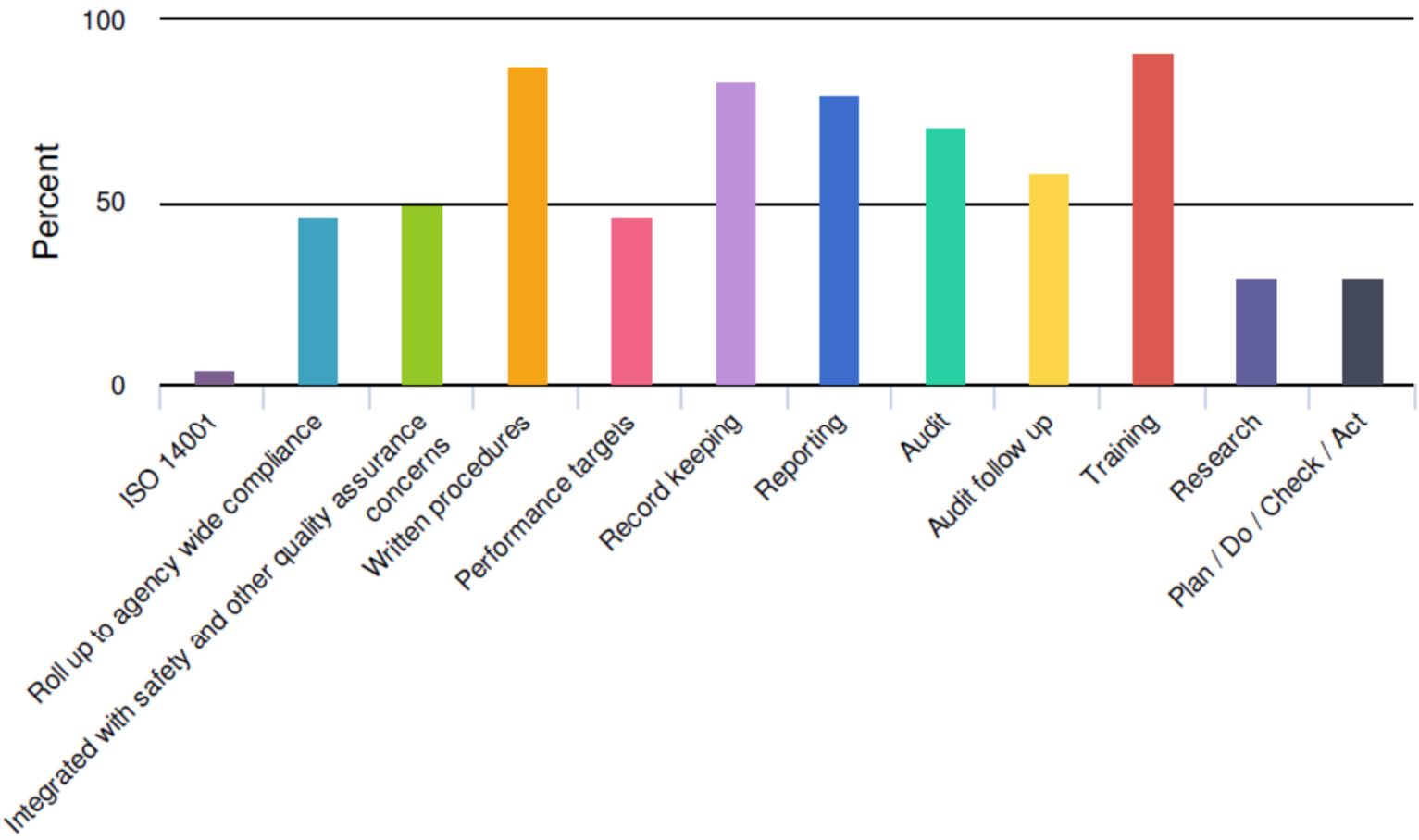
(please check all that apply)

Number of Individual Respondents		**24**	
Number of States Represented		**17**	
Number of States Not Represented		**34**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
ISO 14001	4.2%	1	1
Roll up to agency wide compliance	45.8%	11	9
Integrated with safety and other quality assurance concerns	50%	12	11
Written procedures	87.5%	21	16
Performance targets	45.8%	11	9
Record keeping	83.3%	20	14
Reporting	79.2%	19	14
Audit	70.8%	17	14
Audit follow-up	58.3%	14	12
Training	91.7%	22	17
Research	29.2%	7	7
Plan/Do/Check/Act	29.2%	7	7
Other	0%	0	0
Answered “Not sure/no answer”	0%	0	0
Total		**162**	**131**

Question 15c: Please provide further explanation

Response
We have EMS for Environmental Commitments. In addition, we have performance measures for most of our environmental subjects. We do extensive audits on our facilities. We have guidance/procedures for all areas and training as well.

Graph of Number of Responses by Count



B-4.4 Question 15d: EMS for Highway Maintenance Activities

Conclusions

EMS procedures for highway maintenance activities are practically universal, with record keeping, training, and reporting used by most, and audit and audit follow-up employed by almost a third of those reporting. However, less than a third seem to have performance targets, and only some 10% use the full PDCA system.

Much innovation and advancement is taking place in this area with embedded environmental expertise, field availability of GIS resource mapping, just-in-time training, and a developing stewardship ethic among the most promising developments.

Detailed Literature Review Findings

Results of the literature review indicate that 7 state DOTs apply EMS to highway maintenance activities. Two of those state DOTs were ISO 14001 certified at one time.

Detailed Survey Findings

The current survey provided information from 17 state DOTs (34 states were unrepresented). Two states only answered "not sure/no answer." Training (77.3%) and written procedures (72.7%) were the highest ranked answers. Of the 14 states that selected training, no states also selected ISO 14001, 6 states also selected Roll up to agency wide compliance, 7 states also selected Integrated with safety and other quality assurance concerns, 11 states also selected written procedures, 5 states also selected performance targets, 11 states also selected record keeping,8 states also selected reporting, 6 states also selected audit, 5 states also selected audit follow-up, 3 states also selected research, and 2 states also selected PDCA. One state only selected written procedures. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 15d: Do your highway maintenance activity quality assurance procedures include any of the following environmental compliance features?

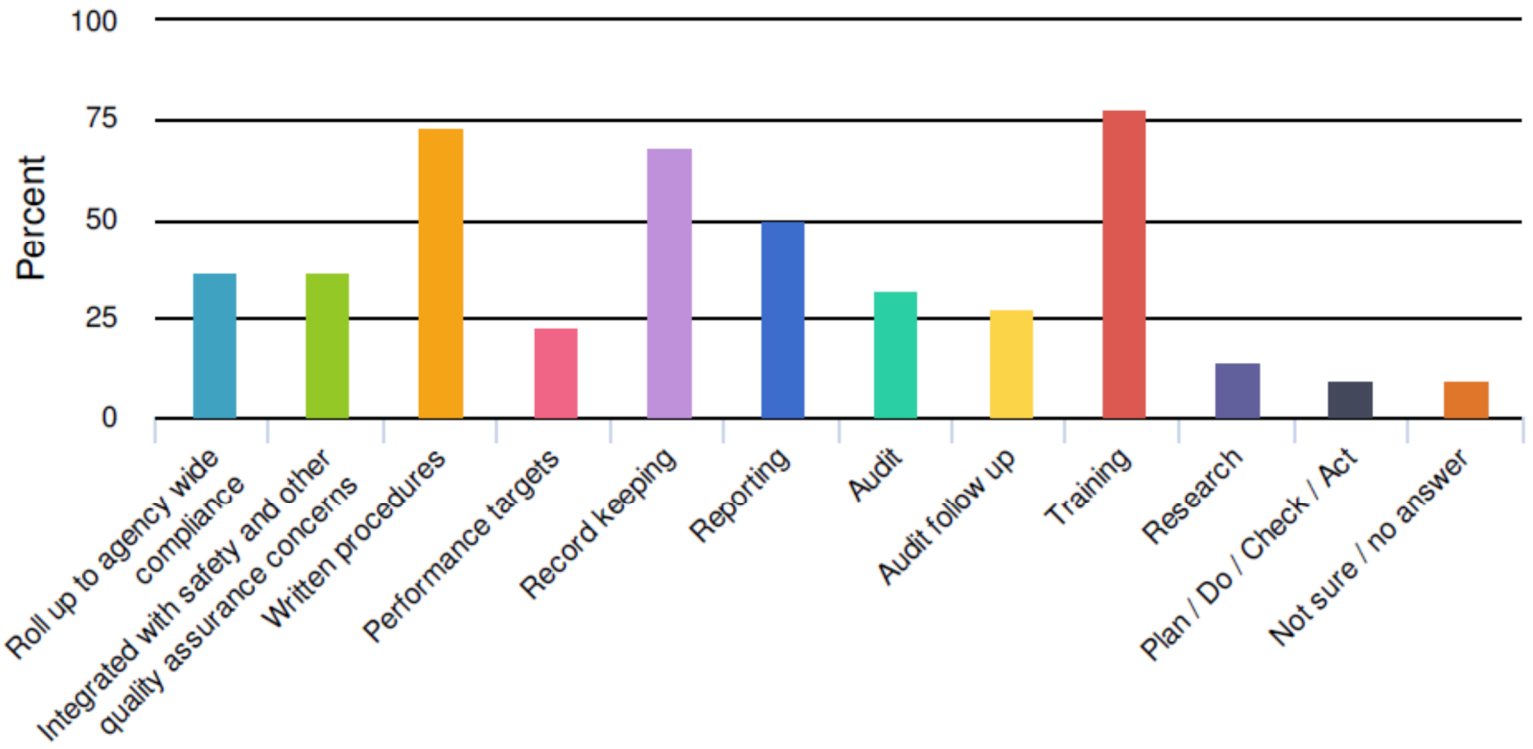
(please check all that apply)

Number of Individual Respondents		**22**	
Number of States Represented		**17**	
Number of States Not Represented		**34**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
ISO 14001	0%	0	0
Roll up to agency wide compliance	36.4%	8	6
Integrated with safety and other quality assurance concerns	36.4%	8	7
Written procedures	72.7%	16	12
Performance targets	22.7%	5	5
Record keeping	68.2%	15	11
Reporting	50%	11	8
Audit	31.8%	7	6
Audit follow-up	27.3%	6	5
Training	77.3%	17	14
Research	13.6%	3	3
Plan/Do/Check/Act	9.1%	2	2
Other	0%	0	0
Answered “Not sure/no answer”	9.1%	2	2
Total		**100**	**81**

Question 15d: Please provide further explanation

Response
DOT's Maintenance Manual and Maintenance Management System are the primary tools.

Graph of Number of Responses by Count



B-4.5 Question 15e: Scope of NEPA EMS Coverage

Conclusions

EMS in NEPA compliance is much more the rule than the exception; however, the sophistication and effectiveness of current applications as measured by adherence to the complete PDCA cycle seem to suggest significant limitations.

The primary focus of EMS application in theNEPA realm is related to environmental compliance quality assurance procedures. Written procedures, record keeping, reporting, and training followed by audits are core EMS processes. However, current applications tend to focus on individual projects and often neglect the program-level analyses needed for continuous improvement. This lack of follow-through on the "check" and "act" parts of the EMS PDCA cycle can limit an agency's ability to proactively implement process improvements, and tends to allow the same project-level issues to arise again and again.

Detailed Literature Review Findings

Results of the literature review indicate that 12 state DOTs apply EMS to NEPA environmental compliance.

Application of environmental compliance quality assurance procedures for NEPA environmental compliance was the number one area selected for EMS application. Written procedures, record keeping, reporting, and training followed by audits are core EMS processes.

Detailed Survey Findings

The current survey provided information from 30 state DOTs (21 states were unrepresented). Four states only answered "not sure/no answer." Record keeping (76.3%) and written procedures (71.1%) were the highest ranked answers. Of the 23 states that selected record keeping, zero states also selected ISO 14001, 10 states also selected roll up to agency wide compliance, 5 states also selected integrated with safety and other quality assurance concerns, 21 states also selected written procedures, 10 states also selected performance targets, 18 states also selected reporting, 15 states also selected audit, 13 states also selected audit follow-up, 18 states also selected training, 6 states also selected research, and 7 states also selected PDCA. One state only selected reporting. One state that selected written procedures (and not record keeping) also selected audit. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 15e: Do your environmental compliance quality assurance procedures include any of the following environmental compliance features?

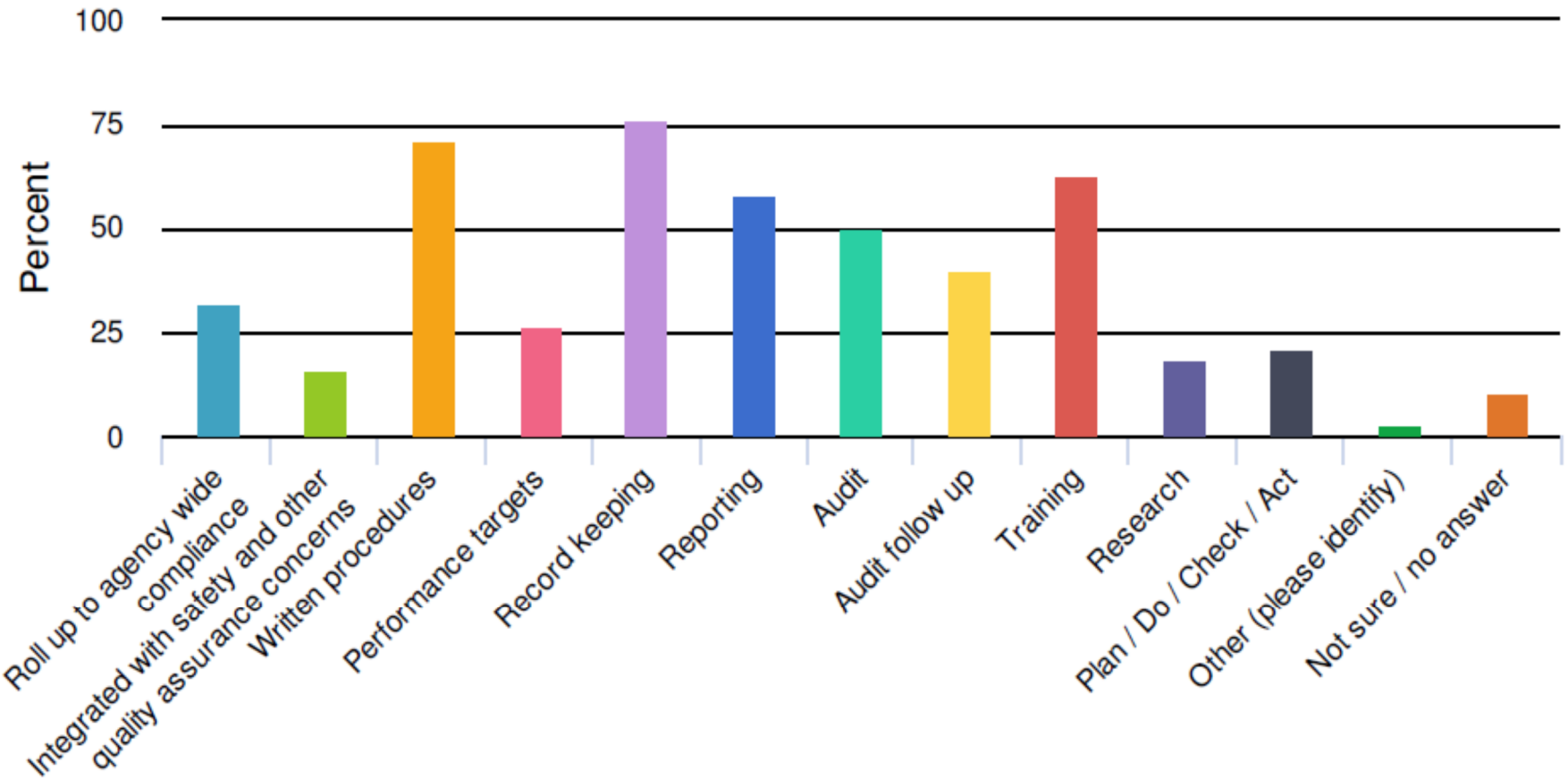
(please check all that apply)

Number of Individual Respondents		**38**	
Number of States Represented		**30**	
Number of States Not Represented		**21**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
ISO 14001	0%	0	0
Roll up to agency wide compliance	31.6%	12	10
Integrated with safety and other quality assurance concerns	15.8%	6	5
Written procedures	71.1%	27	22
Performance targets	26.3%	10	10
Record keeping	76.3%	29	23
Reporting	57.9%	22	19
Audit	50%	19	16
Audit follow-up	39.5%	15	13
Training	63.2%	24	18
Research	18.4%	7	6
Plan/Do/Check/Act	21.1%	8	7
Other	2.6%	1	1
Answered “Not sure/no answer”	10.5%	4	4
	Total	**184**	**154**

Question 15e: Please provide further explanation

Response
Developing capital program EMS right now.
DOT's Environmental Manual is the primary tool/reference for environmental procedures. DOT's Engineering Project Scheduler is the database that records when key environmental activities are due/completed for projects under development. Other design and construction manuals complement the Environmental Manual.

Graph of Number of Responses by Count



B-4.6 Question 15f: Scope of Bridge Maintenance EMS Coverage

Conclusions

Although probably under-reported due to survey mechanics, bridge maintenance activities EMS seem fairly robust as applied with written procedures, training, record keeping, and audit activities as common among those reporting.

Detailed Literature Review Findings

Results of the literature review indicate that 5 state DOTs apply EMS to bridge maintenance.

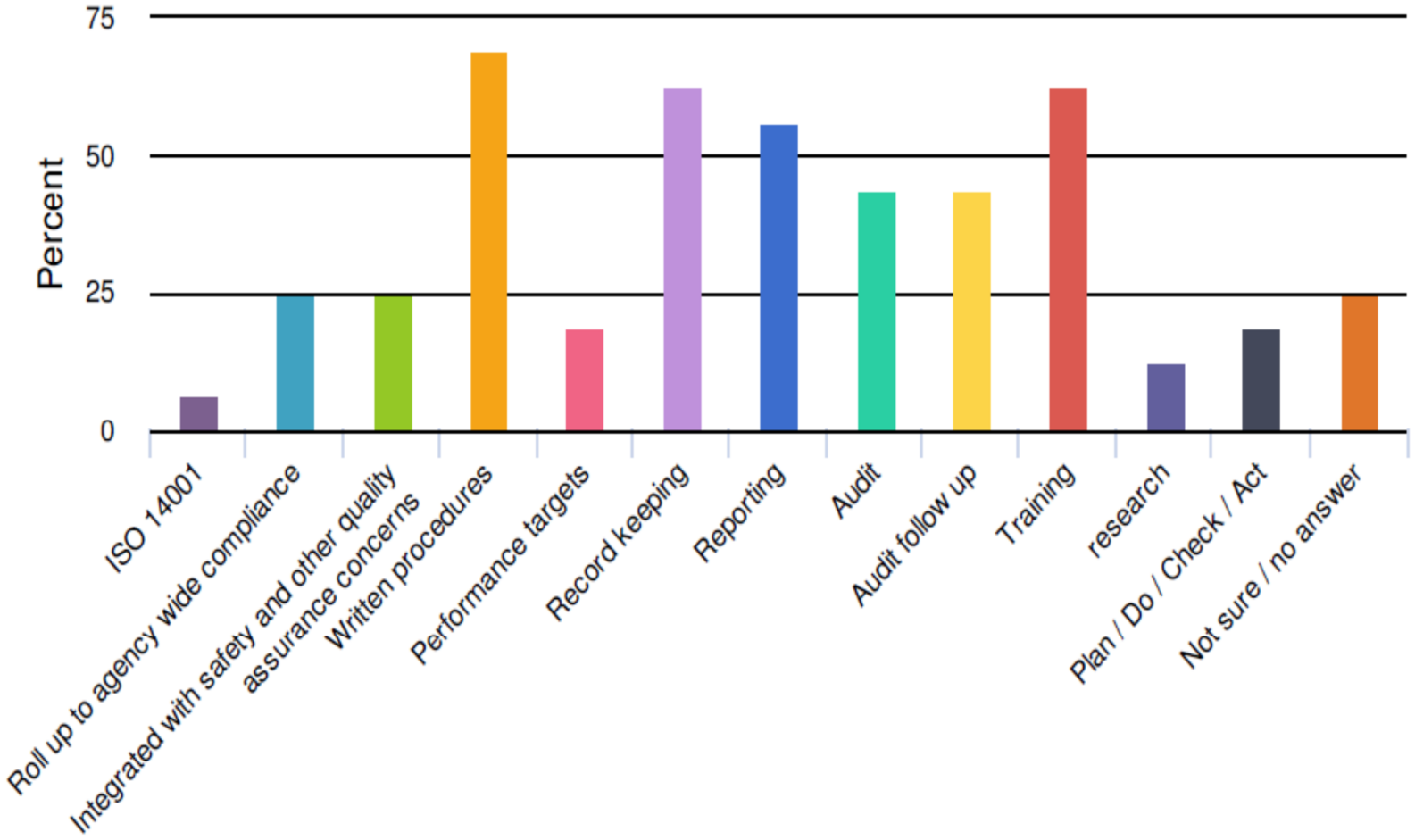
Detailed Survey Findings

The current survey provided information from 12 state DOTs (39 states were unrepresented). Three states only answered "not sure/no answer." Written procedures (68.8%), record keeping (62.5%), and training (62.5%) were the highest ranked answers. Of the nine states that selected written procedures, one state also selected ISO 14001, four states also selected roll up to agency wide compliance, four states also selected integrated with safety and other quality assurance concerns, two states also selected performance targets, seven states also selected record keeping, seven states also selected reporting, five states also selected audit, five states also selected audit follow-up, eight states also selected training, two states also selected research, and three states also selected PDCA. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 15f: Do your bridge maintenance facility quality assurance procedures include any of the following environmental compliance features?
(please check all that apply)

Number of Individual Responses		**16**	
Number of States Represented		**12**	
Number of States Not Represented		**39**	
		Number of Responses	
Response	**Percent Count**	**Count**	**State**
ISO 14001	6.3%	1	1
Roll up to agency wide compliance	25%	4	4
Integrated with safety and other quality assurance concerns	25%	4	4
Written procedures	68.8%	11	9
Performance targets	18.8%	3	2
Record keeping	62.5%	10	7
Reporting	56.3%	9	7
Audit	43.8%	7	5
Audit follow-up	43.8%	7	5
Training	62.5%	10	8
Research	12.5%	2	2
Plan/Do/Check/Act	18.8%	3	3
Other	0%	0	0
Answered "Not sure/no answer"	25%	4	4
	Total	**75**	**61**

Graph of Number of Responses by Count



Question 15f: Please provide further explanation
Response
None

B-4.7 Question 15g: Scope of Other EMS Coverage

Conclusions

EMS application to other areas is not uncommon among state DOTs. However, application of the full PDCA cycle seems to be an exception.

Detailed Literature Review Findings

Results of the literature review indicate that 7 state DOTs applied EMS to other areas. The other areas include application of highway paint, greenhouse gas emissions, ferry systems, endangered species management, laboratory, and vegetation management.

Detailed Survey Findings

The current survey provided information from 9 state DOTs (42 states were unrepresented). One state only answered "not sure/no answer." Training (66.7%) was the highest ranked answer. Of the six states that selected training, one state also selected ISO 14001, one state also selected roll up to agency wide compliance, two states also selected integrated with safety and other quality assurance concerns, four states also selected written procedures, two states also selected performance targets, four states also selected record keeping, three states also selected reporting, audit, and audit follow-up, two states also selected research, and two states also selected PDCA. Two states only selected other.

Other areas for which EMS is applied was not specified by the responding state DOTs. The distribution of procedures was more even, suggesting that when EMS is applied to various areas, the procedures may be specifically tailored to those areas. However, again application of the full PDCA cycle is only seen on an exception basis. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 15g: Do your other quality assurance procedures include any of the following environmental compliance features?

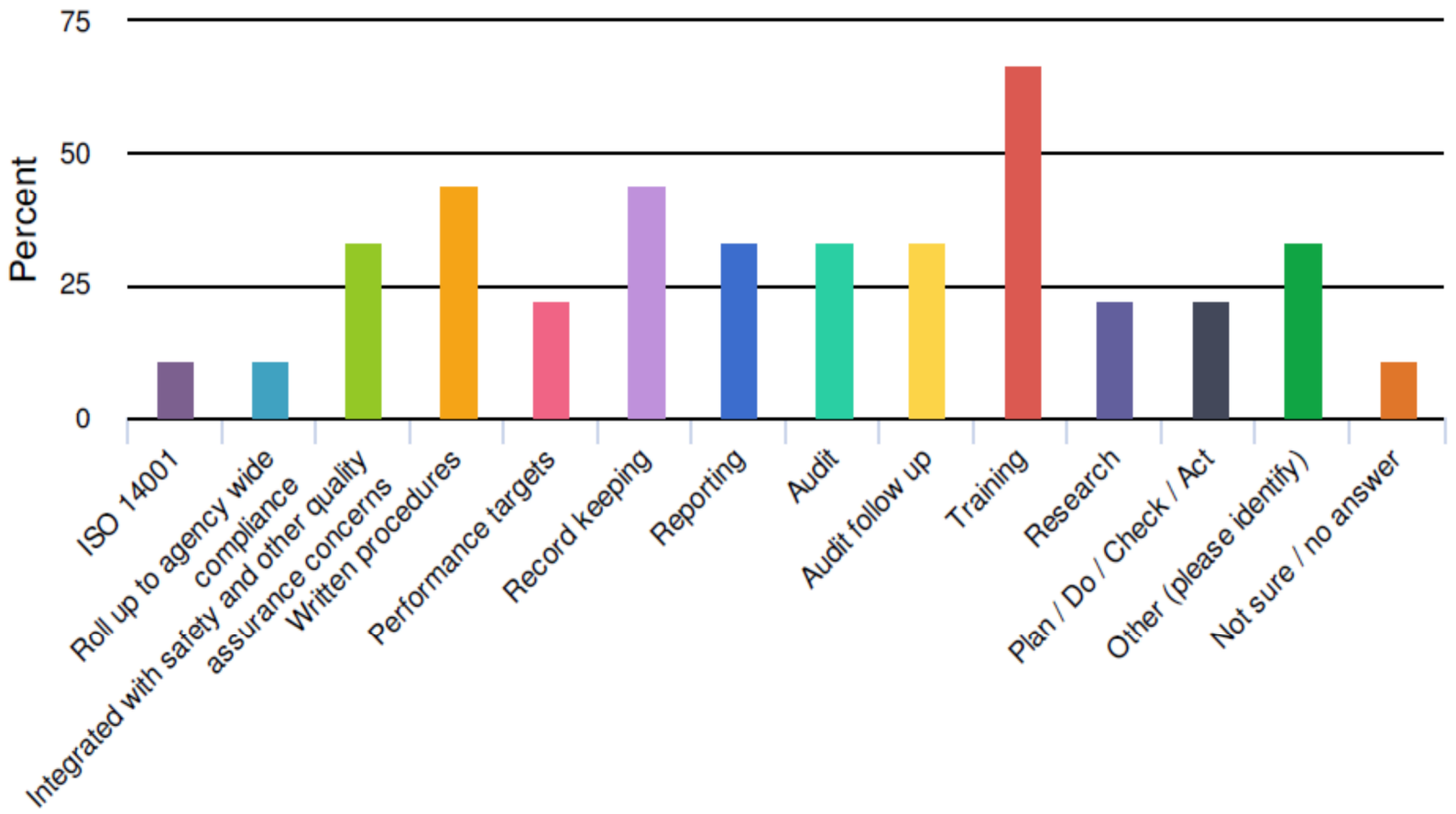
(please check all that apply)

Number of Individual Respondents		**9**	
Number of States Represented		**9**	
Number of States Not Represented		**42**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
ISO 14001	11.1%	1	1
Roll up to agency wide compliance	11.1%	1	1
Integrated with safety and other quality assurance concerns	33.3%	3	2
Written procedures	44.4%	4	4
Performance targets	22.2%	2	2
Record keeping	44.4%	4	4
Reporting	33.3%	3	3
Audit	33.3%	3	3
Audit follow-up	33.3%	3	3
Training	66.7%	6	6
Research	22.2%	2	2
Plan/Do/Check/Act	22.2%	2	2
Other	33.3%	3	3
Answered "Not sure/no answer"	11.1%	1	1
Total		**38**	**38**

Question 15g: Please provide further explanation

Response
It is unclear if you are asking for quality assurance procedures regarding roadway maintenance or operation goals or if this is for environmental effects. Of course, the roadway maintenance and operations have quality assurance, as well as bridge maintenance, and environmental performance. For large NEPA projects, we have an independent quality assurance review by Headquarters beyond the project team prior to being delivered to FHWA. Other programs have reporting requirements, as well as internal checks for compliance.
We have environmental specifications and written BMPs for almost all aspects of contracted work and maintenance.
We have comprehensive quality assurance procedures that will continue not to be associated with an EMS.
We have some quality assurance in some discipline areas, but not very many. For instance, we have recently beefed up our quality control and quality assurance for programmatic CE agreements.
There is an EMS manual that applies across the agency.

Graph of Number of Responses by Count



B-5.0 ANALYSIS METHODS/DRIVERS

EMS data analysis systems are used mainly to drive compliance-based follow-up on an exception basis. Most state DOTs rely on manual and/or incident-driven review of their limited EMS data.

B-5.1 Question 16: EMS Data Analysis

Conclusions

The vast majority of state DOTs rely on manual or incident-driven EMS data analysis, and only a few reported routine systematic review of EMS data. Moreover, as suggested by interviews and data from other survey questions on the scope and depth of EMS across the full complement of DOT functions, it seems that systematic assessment of performance (the "check" part of PDCA) is often limited and, with it, the ability to proactively act on needed improvements.

Literature Review Findings

Results of the literature review show that 29 DOTs had some type of data analysis process.

Detailed Survey Findings

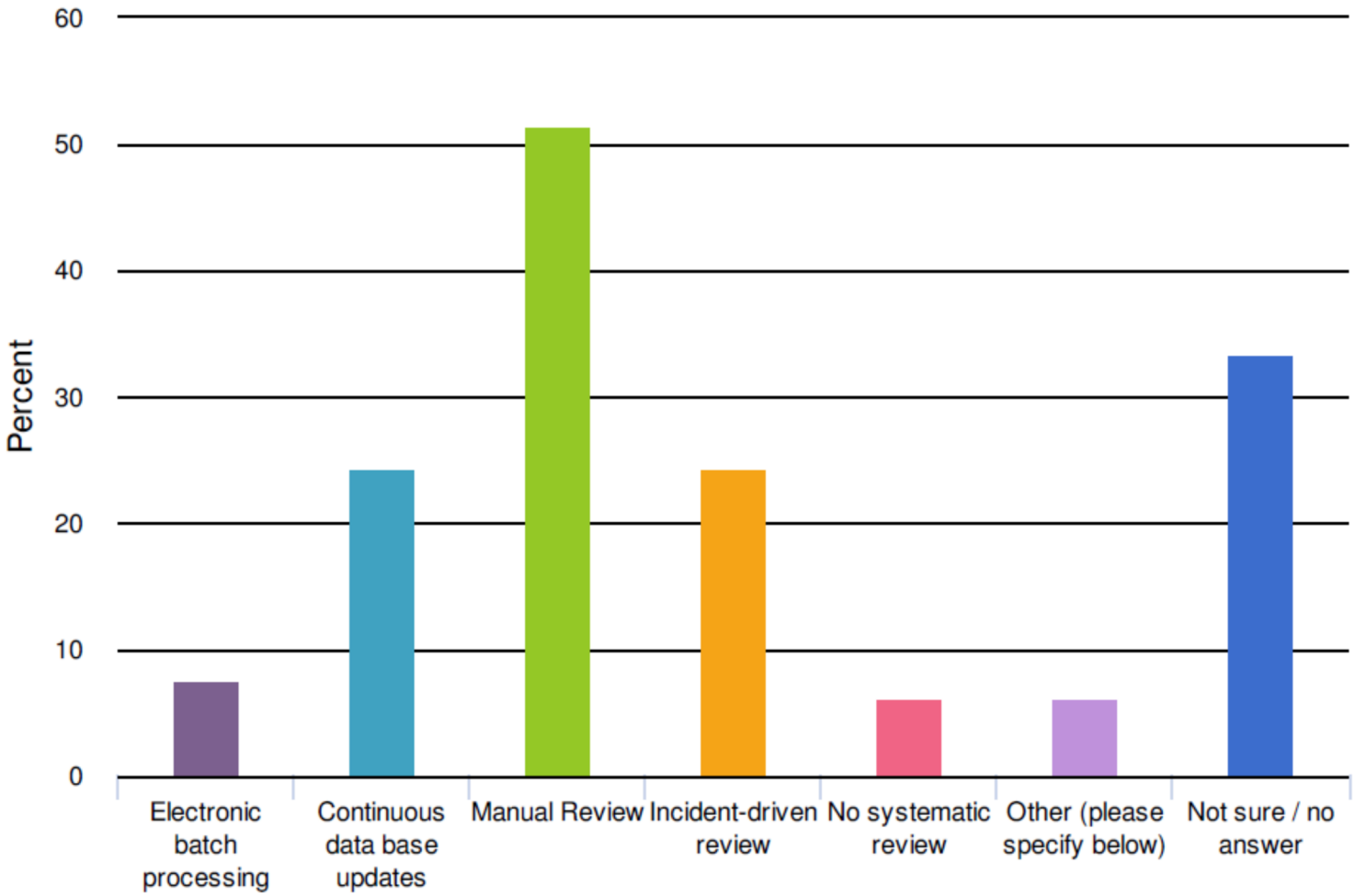
The current survey provided information from 41 state DOTs (10 states were unrepresented). Eight states only answered "Not sure/no answer." Manual review (51.5%) was the highest ranked answer. Of the 26 states that selected manual review, four states also selected electronic batch processing, 11 states also selected continuous database updates, 12 states also selected incident-driven review, 1 state also selected no systematic review, and 2 states also selected other. Of the three states that selected continuous database updates (but not manual review), one also selected electronic batch processing and incident-driven review. Two states only selected no systematic review, and 2 states only selected other. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 16: Does your EMS data analysis process include the following?

(please check all that apply)

Number of Individual Respondents		**66**	
Number of States Represented		**41**	
Number of States Not Represented		**10**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Electronic batch processing	7.6%	5	5
Continuous database updates	24.2%	16	14
Manual review	51.5%	34	26
Incident-driven review	24.2%	16	13
No systematic review	6.1%	4	3
Other	6.1%	4	4
Answered "Not sure/no answer"	33.3%	22	19
Total		**101**	**84**

Graph of Number of Responses by Count



Question 16: Please provide further explanation
Response
Most of our EMS is by hand through process reviews, although our water quality construction program and permanent water quality program compliance expenditures are tracked electronically through a database as well.
Periodic site inspections utilized
We have been using a spreadsheet driven process with paper forms in the field. Last year we used iPads running an app called Fulcrum, which worked great in the field, but was challenging to adapt our analysis process. This year we hope that will go more smoothly.
Now that I think more about this, we have an ESA system that helps to track our projects that fall under our Programmatic Section 7 Biological Opinion. It's an IT tool where the program lead can view performance and extrapolate it into a report.
EMS program using both internal and external data.
We are working towards an environmental commitments tracking process.

B-6.0 BEST PRACTICES/LESSONS LEARNED

Integration with other processes is clearly an important theme. State DOTs appear to have learned through experience that program-area local ownership of EMS, which allows for the synergistic integration with companion procedures, is often critical to success. Engagement and training of employees along with outreach to regulatory agencies can also enhance success.

B-6.1 Question 17: EMS-driven Processes

Conclusions

EMS data analysis systems drive compliance-based follow-up in the vast majority of applications.

Literature Review Findings

Results of the literature review indicate that 19 state DOTs had some type of data analysis process.

Detailed Survey Findings

The current survey provided information from 41 state DOTs (10 states were unrepresented). Seven states only answered “not sure/no answer.” Compliance-based follow-up (60%) was the highest ranked answer. Of the 27 states that selected compliance-based follow-up, 11 states also selected risk-based analysis and follow-up, 13 states also selected voluntary follow-up, 15 states also selected incident-driven review, and 1 state also selected other. Of three states that selected voluntary follow-up (but not compliance-based follow-up), one also selected incident-driven review and no systematic follow-up. Three states only selected no systematic follow-up, and one state only selected other. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

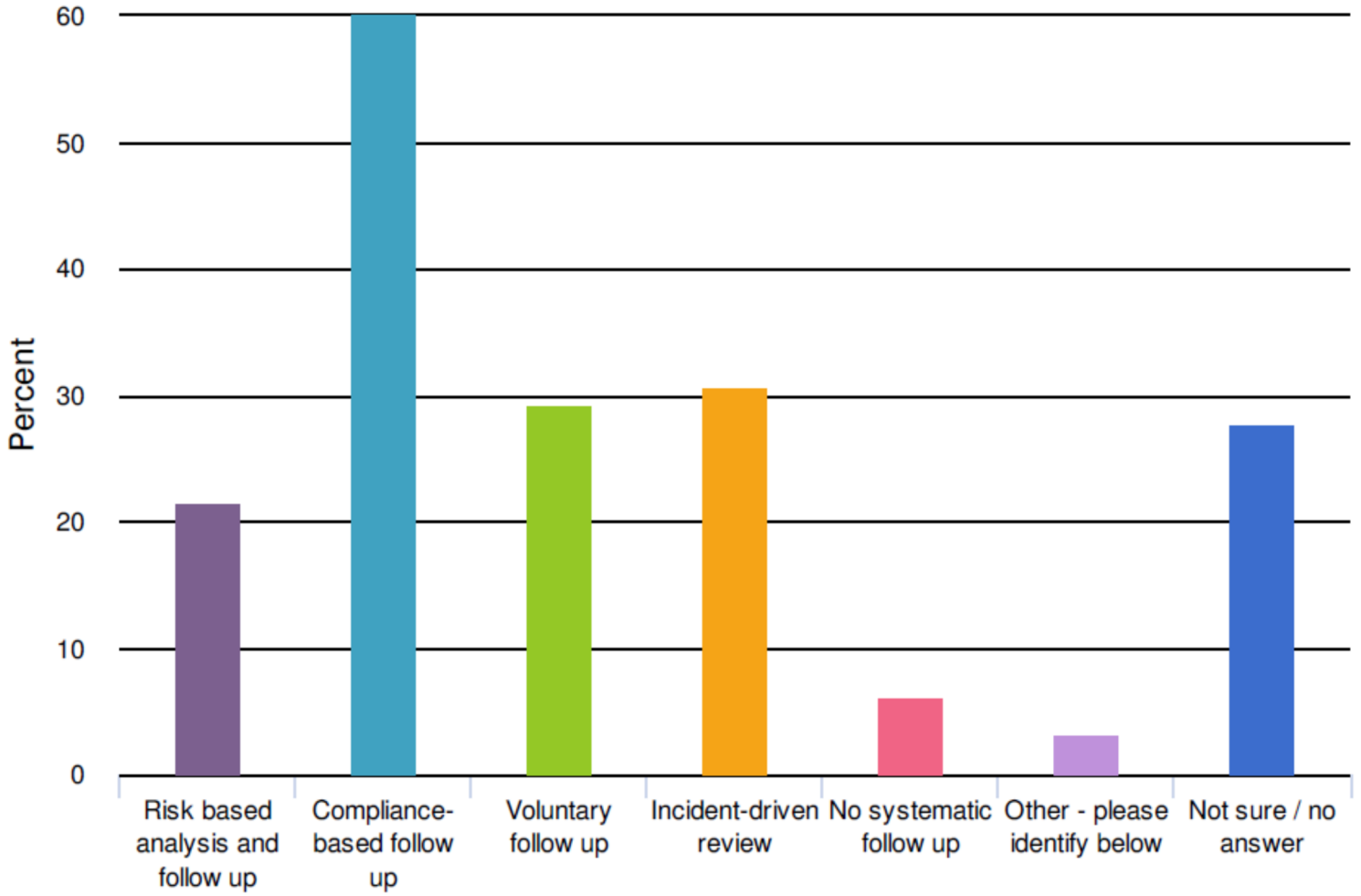
Question 17: Do your EMS data analysis processes drive any of the following?
(please check all that apply)

Number of Individual Respondents		**65**	
Number of States Represented		**41**	
Number of States Not Represented		**10**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Risk based analysis and follow-up	21.5%	14	11
Compliance-based follow-up	60%	39	27
Voluntary follow-up	29.2%	19	16
Incident-driven review	30.8%	20	16
No systematic follow-up	6.2%	4	4
Other	3.1%	2	2
Answered "Not sure/no answer"	27.7%	18	16
Total		**116**	**92**

Question 17: Please provide further explanation

Response
We often do process reviews that result in improved guidance, a change in procedure, or the development of streamlining tools. We have a good relationship with the regulators because we keep track and address compliance issues as soon as they are discovered - this builds trust.
I checked the compliance based follow-up since the Programmatic Section 7 BO requires form submittals, and if the Regions aren't submitting forms, the program lead gives them a call or reminds them periodically.
Inspections occur on ALL NEPA and USACE permitted projects

Graph of Number of Responses by Count



B-6.2 Question 18: EMS Lessons Learned

Conclusions

Integration with other processes is clearly an important theme. State DOTs appear to have learned through experience that local ownership of EMS allowing for better integration with companion procedures is critical to success. Engagement and training of employees along with outreach to regulatory agencies also seem to underpin EMS success.

Literature Review Findings

None of note.

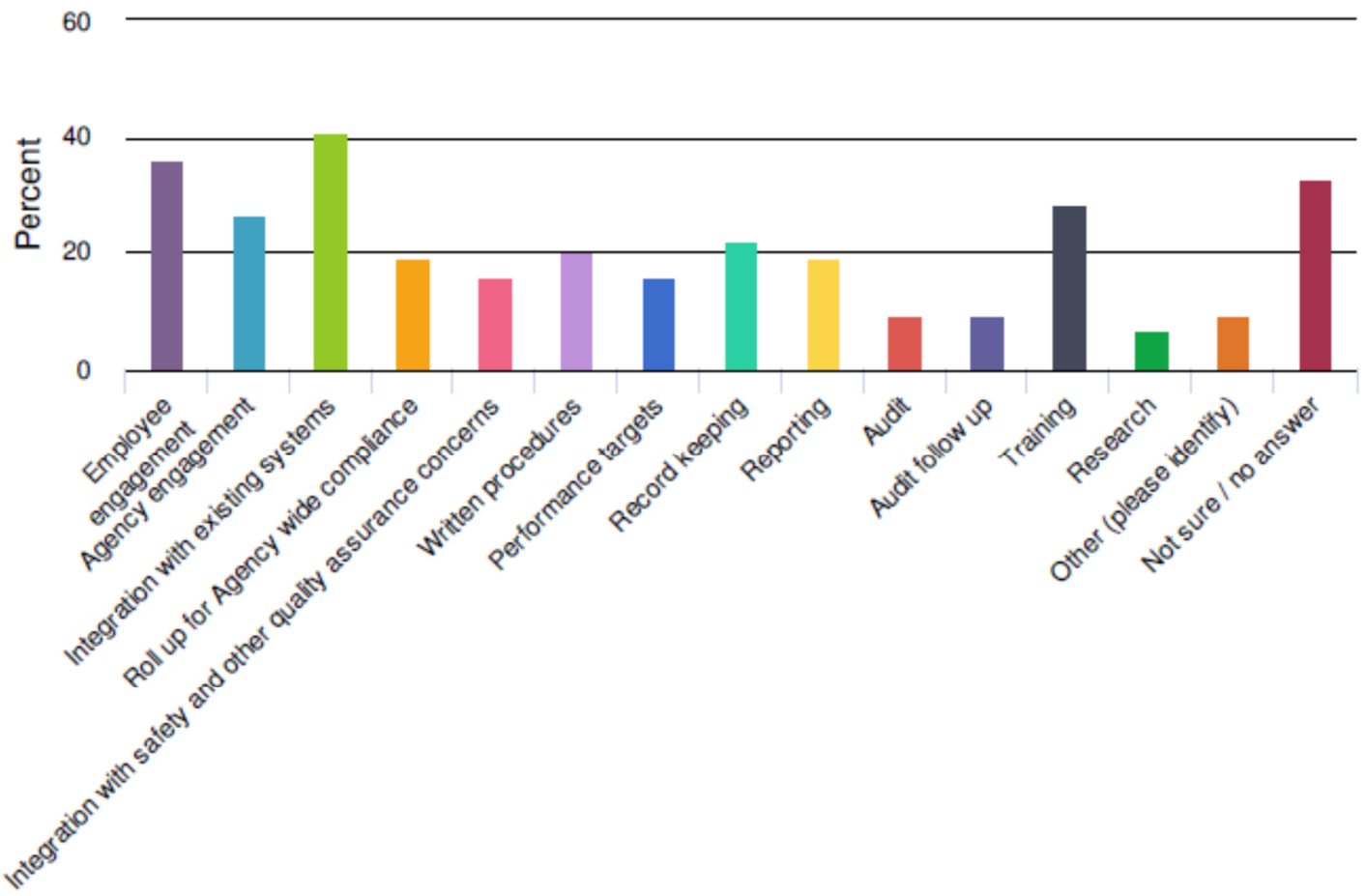
Detailed Survey Findings

The current survey provided information from 41 state DOTs (10 states were unrepresented). Eight states only answered "not sure/no answer." Integration with existing systems (40.6%) was the highest ranked answer. Of the 24 states that selected integration with existing systems, 19 states also selected employee engagement, 12 states also selected agency engagement, 10 states also selected roll up for agency wide compliance, 8 states also selected integration with safety and other quality assurance concerns, 11 states also selected written procedures, 9 states also selected performance targets, 11 states also selected record keeping, 12 states also selected reporting, 6 states also selected audit, 5 states also selected audit follow-up, 13 states also selected training, and 3 states also selected other. Of the 3 states that selected training (but not integration with existing systems), one state also selected written procedures and record keeping, one state also agency engagement, and one state also selected research. Of the one state that selected employee engagement (but not integration with existing systems or training), that state also selected agency engagement, roll up for agency wide compliance, performance targets, and audit follow-up. The one state that selected agency engagement (but not integration with existing systems, training, or employee engagement), also selected other. One state only selected roll up for agency wide compliance, one state only selected record keeping, and two states only selected other. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 18: If your EMS development processes were to be developed again, would you do more? *(please check all that apply)*

Number of Individual Responses		**64**	
Number of States Represented		**41**	
Number of States Not Represented		**10**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Employee engagement	35.9%	23	20
Agency engagement	26.6%	17	15
Integration with existing systems	40.6%	26	24
Roll up for Agency wide compliance	18.8%	12	12
Integration with safety and other quality assurance concerns	15.6%	10	8
Written procedures	20.3%	13	13
Performance targets	15.6%	10	10
Record keeping	21.9%	14	13
Reporting	18.8%	12	12
Audit	9.4%	6	6
Audit follow-up	9.4%	6	6
Training	28.1%	18	16
Research	6.3%	4	4
Other	9.4%	6	6
Answered “Not sure/no answer”	32.8%	21	15
	Total	**198**	**180**

Graph of Number of Responses by Count



Question 18: Please provide further explanation
Response
I would like to see if someone is doing this in a better way. It does work well for us but maybe there is one better that doesn't need so much monitoring. The monitoring keeps us involved and on top of the program though. I know in water quality, we will be looking at some EMSs just for that program to see if there is a better way to keep on top of all the moving parts.
If we were to develop a plan for our compliance unit and the work they perform, the above would be my focus areas.
As noted above, procedures and education are not labeled specifically as EMS related internally.
We do not plan to redevelop an EMS.
We have a long ways to go with quality assurance in this agency, not just in environmental. The agency is moving more in the quality assurance direction where looking more into EMS may be beneficial. We are also in the early stages of developing an IT tool that would track project status, allow us to enter data once from which to create various documents - it would be used as a QA tool as well.
We do most of the stuff on the list to some capacity. A lot of the compliance it driven by independent oversite program by FHWA as they have delegated activities to the DOT.
DOT would likely include more features to facilitate regulatory compliance in addition to stormwater compliance (e.g., underground storage tanks/40 CFR).
Recommendations were made by cross functional teams to the executive management team who made the decisions. There was engagement, procedures, measurement targets, etc. I do not think there would be much to change. Moving forward changes are for continuous improvement of the program.
DOT is currently in the process of developing a formal EMS for a Residency Complex Facility.
We should have started with a tracking process and database capabilities.

B-7.0 COST/BENEFIT

State DOTs feel that EMS processes are highly cost effective for the monetary, stewardship, and compliance benefits generated. Given the difficulties in quantifying "impacts avoided"; formal Cost / Benefit analysis has not been a focus for in-depth investigation either within the DOT's or by outside researchers. Most EMS efforts were initiated with, and virtually all continue to operate under, regular funding sources as opposed to one-time allocations or special budgetary items. Costs to establish and maintain EMS appear to range from several hundred thousand to several million dollars.

B-7.1 Question 19: EMS Benefit/Cost

Conclusions

State DOTs feel the benefits of EMS are well worth the costs, even if the monetary, stewardship, and compliance benefits are not been formally quantified.

Literature Review Findings

None of note.

Detailed Survey Findings

The current survey provided information from 41 state DOTs (10 states were unrepresented). Twenty-nine states only answered "not sure/no answer." +5 (14.1%) was the highest ranking office. Of the nine states that answered +5, one state also selected 1 and one state also selected both 1 and +10. Two states

only selected 1, and one state only selected +10. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Note that three quarters of those responding did not offer even a guess as to the benefit/cost ratio of EMS. This may speak to their view of the importance of this issue along with the difficulties inherent in estimating the likelihood and cost of violations and the value of preventing environmental compliance violations.

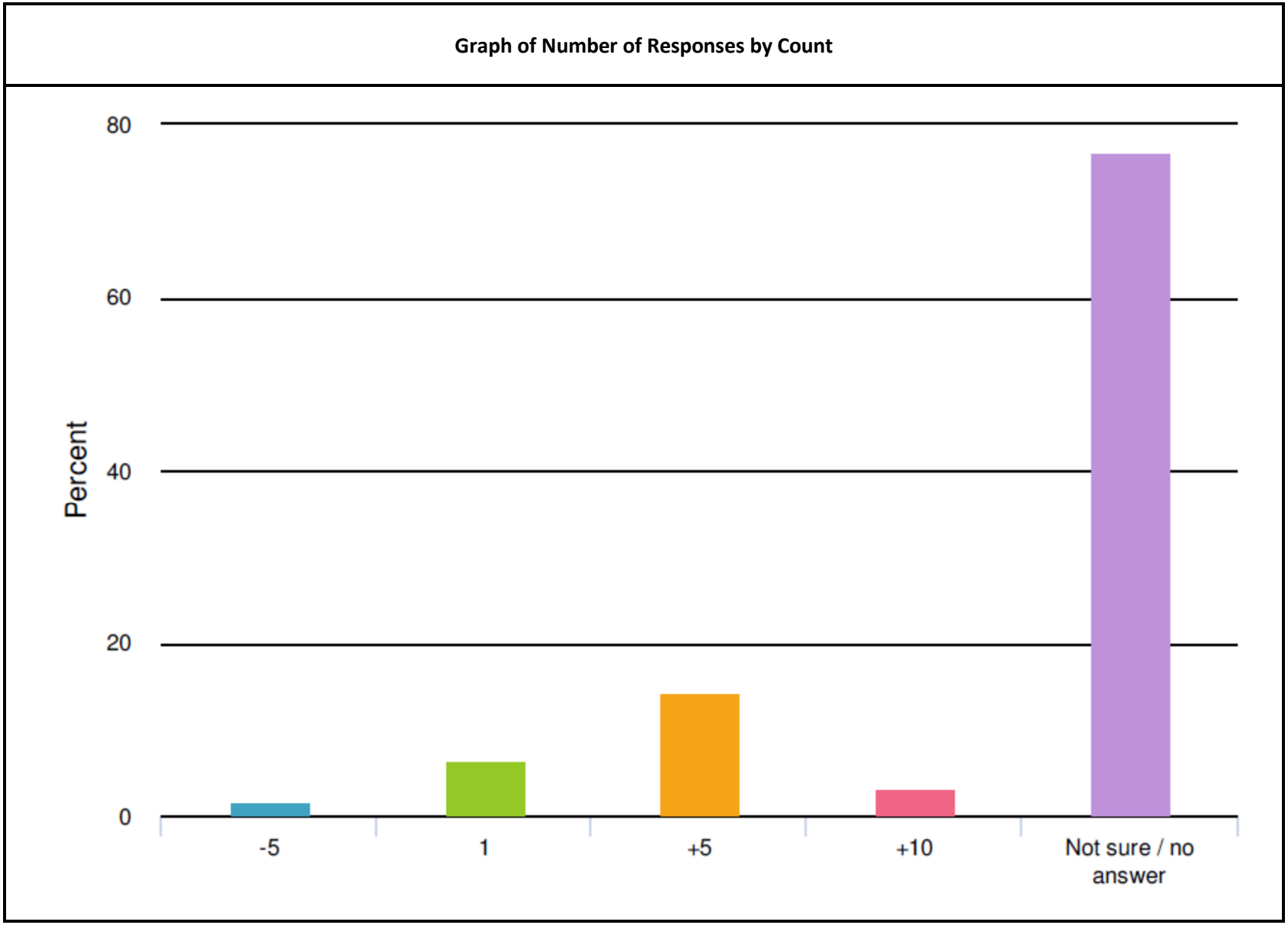
Question 19: If a Benefit/Cost ratio for our EMS could be developed, I would expect it to be on the order of:

(please check all that apply, and if you have an actual estimated value – please list it below)

Number of Individual Responses		**64**	
Number of States Represented		**41**	
Number of States Not Represented		**10**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
-10	0%	0	0
-5	1.6%	1	1
1	6.3%	4	4
+5	14.1%	9	9
+10	3.1%	2	2
Answered "Not sure/no answer"	76.6%	49	36
Total		**65**	**52**

Question 19: Please provide further explanation

Response
It is working. We are staying in compliance. We don't have a huge number of staff so maybe the cost isn't so bad. But this is not something that we have purchased. We are willing to share our guidance manuals and tools we have developed, but it is our process and procedures that add value as part of the EMS.
The Highway Division has had relative few enforcement actions from the state DEP and non-related to Fed EPA. So regulatory compliance is strong.
Our EMS had more cost than benefit. Therefore it was discontinued.
While the EMS developed by SCDOT facilitates efficient and cost effective regulatory compliance, it can be enhanced to be even more cost effective.


Graph of Number of Responses by Count
Percent
80
60
40
20
0
-5
1
+5
+10
Not sure / no answer

B-8.0 SPINOFF APPLICATIONS & OTHER OBSERVATIONS

Environmental streamlining is a common EMS spinoff application. Regulatory agencies seem willing to reduce their level of intervention and oversight in direct proportion to their confidence in DOT EMS implementation. Use of the PDCA approach in EMS may encourage its use in other areas – just as use of PDCA in areas such as asset management tends to encourage its application to environmental concerns.

B-8.1 Question 20: EMS Spinoff Benefits

Conclusions

Regulatory agencies seem willing to reduce their level of intervention and oversight due to their confidence in DOT EMS.

Literature Review Findings

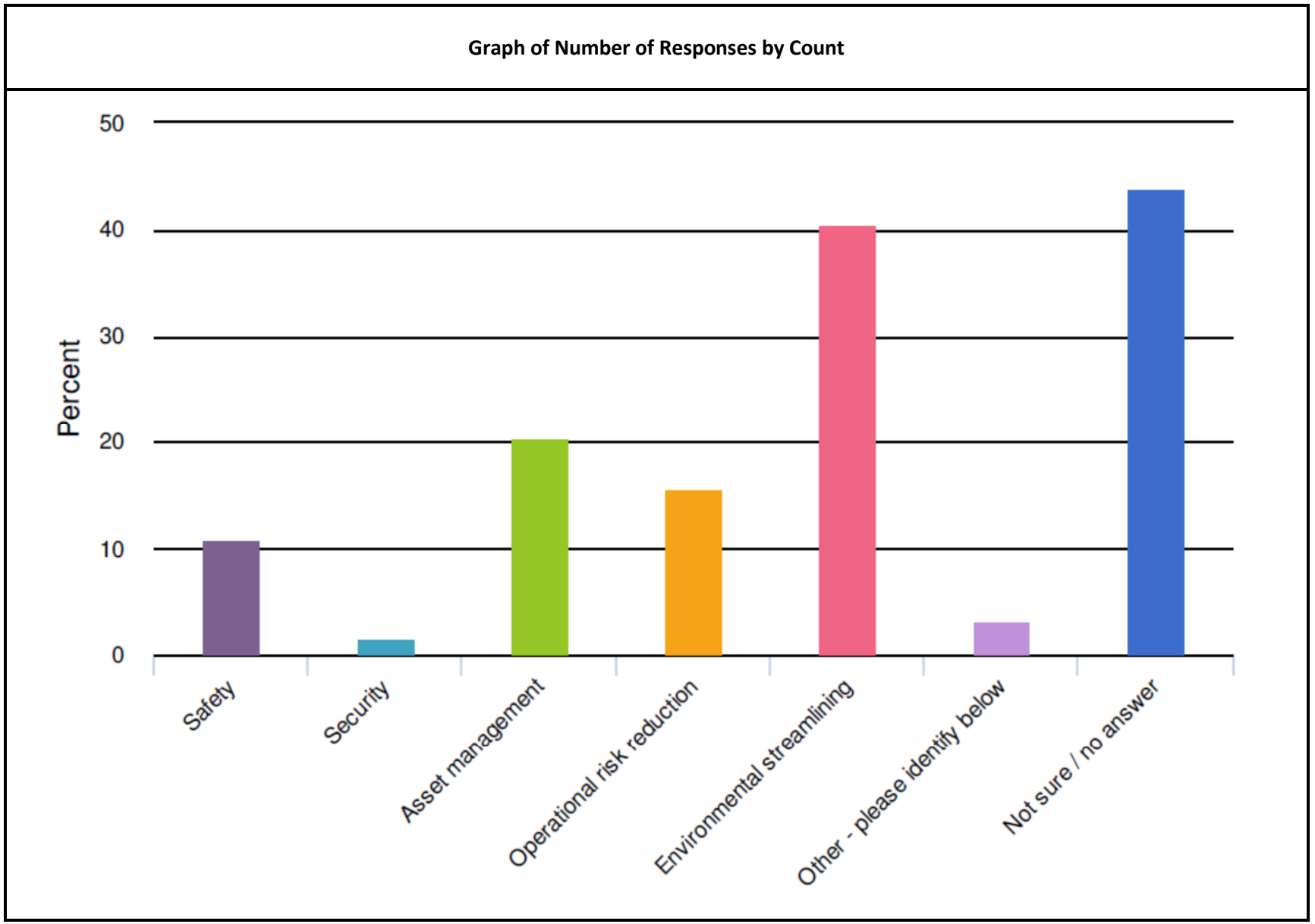
The literature review yielded information on seven state DOTs with spinoff applications for highway paint, greenhouse gas emissions, a ferry system, endangered species management, materials testing laboratory operations, and vegetation management.

Detailed Survey Findings

The current survey provided information from 41 state DOTs (10 states were unrepresented). Fifteen states only answered "not sure/no answer." Environmental streamlining (40.6%) was the highest ranked answer. Of the 19 states that selected environmental streamlining, 4 states also selected safety, 8 states also selected asset management, and 9 states also selected operational risk management. Of the four states that selected asset management (but not operational risk reduction), one state also selected safety, security, and operational risk reduction. One state only selected safety, and two states only selected other. Note that these rankings are consistent whether by count or state, indicating that the multiple respondents did not affect results.

Question 20: If your EMS development process contributed to "spin-off" improvements in other subject areas, which of the following areas were improved? *(please check all that apply)*

Number of Individual Respondents		**64**	
Number of States Represented		**41**	
Number of States Not Represented		**10**	
Response	**Percent Count**	**Number of Responses**	
		Count	**State**
Safety	10.9%	7	6
Security	1.6%	1	1
Asset management	20.3%	13	12
Operational risk reduction	15.6%	10	10
Environmental streamlining	40.6%	26	19
Other (please identify below)	3.1%	2	2
Answered "Not sure/no answer"	43.8%	28	24
Total		**87**	**74**


Graph of Number of Responses by Count
Percent
50
40
30
20
10
0
Safety
Security
Asset management
Operational risk reduction
Environmental streamlining
Other - please identify below
Not sure / no answer

Question 20: Please provide further explanation
Response
Environmental information is shared with other databases so managers can make enterprise level decisions.
Asset management was improved due to the discovery of issues that needed to be addressed through our attention and oversight - assets such as permanent water quality and maintenance facility water quality management, and our wildlife fencing maintenance. Environmental streamlining is always on our minds in ways to do the job better with less - and this improves our compliance as well.
No spin-off improvements were realized.
Developing IOCs/note-to-file documents to help environmental staff take common comments from resource agencies and provide standard environmental commitments that are written in contract language in order to help increase compliance by making commitments actionable and enforceable.
Based on initial feedback from District Executive Level during the development of our EMS, there may be interest in synergies with our Safety Program.

Appendix C: Survey with Cover Letter

June 11 2018

RE: NCHRP 25-25, Task 111 - Environmental Management System (EMS) Perspectives for State DOTs

Dear Member of the AASHTO Committee on Construction,

The Louis Berger Group, Inc., under the Transportation Research Board's National Cooperative Highway Research Program (NCHRP), Project 25-25, Research for the AASHTO Committee on Environment and Sustainability, is conducting an online survey for Task 111, Environmental Management System (EMS) Perspectives for State DOTs. The primary audience for this information will be DOT staff and executives concerned with environmental compliance and stewardship.

Information gained through this survey will be attributed to specific organizations - but not to specific individuals, pending further contact.

More information on the project may be found at:

http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4335

The survey is designed for completion in less than 20 minutes but could take longer if you are willing to upload supplementary information. Questions on survey mechanics may be forwarded to Douglas Parker, doparker@louisberger.com, and our Principal Investigator (PI), Gary McVoy GmcvoyLLC@gmail.com can address more general questions.

An EMS may be defined as some systematic means of planning, executing, checking, revising, and improving environmental compliance and/or stewardship. In this light, even basic quality assurance procedures for avoidance of environmental violations across various program areas and geographical bounds are of interest.

You are among the key experts to be surveyed for this project. DOT and Transit Agency Environmental Directors are considered primary recipients, able to respond on an agency wide basis; but independent (optional) input from other recipients is also highly valued. We realize that you receive many inquiries like this, but your input is important to our industry and to your peers.

Please enter your responses via
Survey Gizmo **https://www.surveygizmo.com/s3/4265034/Task111EMS** no later than Friday, June 29, 2018.

Thank you.

The Louis Berger Team

Gary R. McVoy, Ph.D. PI, McVoy Associates
Robin L. Maycock, Project Manager, Louis Berger, Raleigh, NC
Wayne W. Kober, Senior Advisor
Douglas S. Parker, Technical Research Support, Louis Berger, Raleigh, NC

NCHRP Project 25-25 Task 111
Environmental Management System
Perspectives for State DOTs

Respondent Profile

1. Survey Respondent's Name: *

First Name

Last Name

2. Survey Respondent's Email: *

3. Which of the following best describes your agency? *

- State DOT
- Transit Agency
- Regulatory Agency
- Resource Agency
- Highway Authority
- Federal Transportation Agency
- City Transportation Agency
- County
- Local Transportation Agency
- Other - (Please Specify)

4. Agency Name: *

5. Which of the following best describes your role? *

- DOT Environmental Director / Staff (including Technical Expert, SME, Program Lead, etc.)
- Executive / Executive Staff
- Design Director / Staff
- Construction Director / Staff
- Highway Maintenance Director / Staff
- Equipment Maintenance Staff / Staff
- Transit Agency Director / Staff
- Field Staff
- Other - (Please Specify)

General Framework

6. Using the definition above, please indicate how your agency applies environmental management, using the following means, to your operational units, e.g. Sub-units within Operations, Design, Construction, Maintenance, Equipment Management, Regions, etc. (Please check all that apply).

	At least one unit	***Most units***	***All units***
Comprehensive written procedures	☐	☐	☐
Integration with safety and other quality assurance concerns	☐	☐	☐
Performance targets	☐	☐	☐
Record keeping	☐	☐	☐
Reporting	☐	☐	☐
Periodic audits	☐	☐	☐
Audit follow up	☐	☐	☐
Training	☐	☐	☐
Research	☐	☐	☐

- ○ I'm not sure or I don't know how our agency applies environmental management
- ○ None of the above applies to our agency

(Optional) Please provide further explanation, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Page 3 None of the above

Answering "None of the options apply" implies your operational units do not use any form of EMS or environmental quality assurance.

If this **is not** true, please hit the back button and select the closest option for what your organization does.
If this **is** true, please answer why not? (Please check all that apply.)
*

- [ ] Not considered
- [ ] Considered, not pursued
- [ ] Considered, no available funds/budget
- [ ] No knowledge/ability
- [ ] No perceived need/benefit/value
- [ ] Other - (Please Specify)

(Optional) Please provide further explanation, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Page 3 Not Sure

Can you direct us to someone who does know? *

- Yes
- No

Please provide the contact information of the person who does know. Thank you for your assistance.

First Name

Last Name

Title

Agency Name

Primary Job Description / Responsibilities

City

State

Email Address *

Phone Number

Initial Focus

7. What was the initial focus for EMS development? *

- [ ] Highway maintenance
- [ ] Equipment management
- [ ] NEPA design commitments
- [ ] Storm water
- [ ] Other (please list below)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on your initial focus for EMS, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Champion

8. What part of your agency was the initial champion for EMS development? *

- Environmental
- Executive
- Maintenance
- Construction
- Other (Please list below)
- Not sure / No answer

(Optional) Please provide further explanation on the EMS project champion, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Funding

9. Are you familiar with your agency's EMS funding? *

- ○ Yes
- ○ No

What was the funding source for initial EMS roll out? *

- ☐ Special allocation
- ☐ Budget enhancement
- ☐ Existing funds
- ☐ Other (Please list below)
- ☐ Not sure / No answer

(Optional) Please provide further explanation on the initial funding source for EMS, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

If you had to estimate the initial cost of EMS development, which of the following ranges would be most likely? (If you have actual cost information, please report it as other.) *

- $10K
- $100K
- $1M
- $10M
- Other (Please specify below)
- Not sure / No answer

Cost Information / Link to cost information:
Email of agency contact for further details:

Can you direct us to someone who is familiar with your EMS funding? *

- Yes
- No

Thank you. Please provide their contact information below:

First Name

Last Name

Title

Agency Name

Email Address *

Phone Number

Roll Out

10. Initial EMS rollout strategies included: *

- [ ] Training
- [ ] Procedures
- [ ] Audit
- [ ] Other (please specify below)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on initial EMS rollout strategies, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

ISO 14001

11. Was ISO 14001 Certification a focus for EMS development? *

- Our agency is ISO 14001 certified for all operations
- Our agency plans to be ISO 14001 certified for all operations
- Our agency is ISO 14001 certified for at least one operational unit or process (please explain below)
- Our agency plans to be ISO 14001 certified for at least one operational unit or process (please explain below)
- ISO 14001 was a model for EMS development and remains so
- ISO 14001 was a model for EMS development, but no longer
- No
- Other (please explain below as you are able)
- Not sure / No answer

(Optional) Please provide further explanation on ISO 14001 certification, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Agency Involvement

12. Was there a regulatory agency involved in developing your EMS? (please check all that apply) *

- [ ] US EPA
- [ ] State environmental agency
- [ ] Other agency
- [ ] No agency involvement
- [ ] Not sure / no answer

How was the US EPA involved? *

- ○ Initially in connection with enforcement action and remains so
- ○ Initially in connection with enforcement but no longer
- ○ Cooperatively
- ○ Not sure / no answer

(Optional) Please provide further explanation on US EPA involvement, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

How was your state environmental agency involved? *

- Initially in connection with enforcement action and remains so
- Initially in connection with enforcement action but no longer
- Cooperatively
- Not involved

(Optional) Please provide further explanation on state environmental agency involvement, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Please identify the other agencies involved in EMS development *

How were those other agencies involved in EMS development? *

- Initially in connection with enforcement action and remains so
- Initially in connection with enforcement action but no longer
- Cooperatively
- Not sure / no answer

(Optional) Please provide further explanation on other agency EMS involvement, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Expansion / Contraction

13. After initial rollout, did your EMS program: *

- Expand
- Not expand (remained unchanged)
- Diminish / contract / was discontinued
- Not sure / no answer

Why was your EMS expanded? *

- [ ] Violations
- [ ] Stewardship
- [ ] Efficiencies
- [ ] Other (please specify)
- [ ] Additional information (optional)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on why your EMS program expanded, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Why was your EMS not expanded (remained unchanged)? *

- [ ] Violation satisfied
- [ ] No interest / perceived need
- [ ] Lack of funds
- [ ] Lack of national models and tech support
- [ ] Low priority
- [ ] Other (please specify below)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on why your EMS program did not expand, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Why was your EMS discontinued or diminished? *

- [ ] Violation satisfied
- [ ] No interest / perceived need
- [ ] Lack of funds
- [ ] Lack of national models and tech support
- [ ] Low priority
- [ ] Other (please specify below)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on why your EMS was diminished or discontinued, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

EMS Lead

14. Does your agency have an EMS lead organization with assigned responsibility for environmental compliance across the entire agency? *

- Yes
- No

Where does that leadership reside? *

- Environmental
- Maintenance
- Construction
- Other (please list)

(Optional) Please provide further explanation on EMS lead organization, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Facilities

15. Do you have an EMS or quality assurance procedures for any of the following? (please check all that apply) *

- [ ] Equipment maintenance
- [ ] Highway maintenance facility
- [ ] Highway maintenance activity
- [ ] Environmental compliance for NEPA projects (capital program)
- [ ] Bridge maintenance
- [ ] Other
- [ ] Not sure / no answer

Do your equipment maintenance quality assurance procedures include any of the following environmental compliance features? (please check all that apply) *

- [ ] ISO 14001
- [ ] Roll up to agency wide compliance
- [ ] Integrated with safety and other quality assurance concerns
- [ ] Written procedures
- [ ] Performance targets
- [ ] Record keeping
- [ ] Reporting
- [ ] Audit
- [ ] Audit follow up
- [ ] Training
- [ ] Research
- [ ] Plan / Do / Check / Act
- [ ] Other (please identify)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on equipment maintenance quality assurance procedures, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Do your highway maintenance facility quality assurance procedures include any of the following environmental compliance features? (please check all that apply) *

- [ ] ISO 14001
- [ ] Roll up to agency wide compliance
- [ ] Integrated with safety and other quality assurance concerns
- [ ] Written procedures
- [ ] Performance targets
- [ ] Record keeping
- [ ] Reporting
- [ ] Audit
- [ ] Audit follow up
- [ ] Training
- [ ] Research
- [ ] Plan / Do / Check / Act
- [ ] Other (please identify)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on highway maintenance facility quality assurance procedures, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Do your highway maintenance activity quality assurance procedures include any of the following environmental compliance features? (please check all that apply) *

- [ ] ISO 14001
- [ ] Roll up to agency wide compliance
- [ ] Integrated with safety and other quality assurance concerns
- [ ] Written procedures
- [ ] Performance targets
- [ ] Record keeping
- [ ] Reporting
- [ ] Audit
- [ ] Audit follow up
- [ ] Training
- [ ] Research
- [ ] Plan / Do / Check / Act
- [ ] Other (please identify)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on highway maintenance activity quality assurance procedures, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Do your environmental compliance quality assurance procedures include any of the following environmental compliance features? (please check all that apply) *

- [ ] ISO 14001
- [ ] Roll up to agency wide compliance
- [ ] Integrated with safety and other quality assurance concerns
- [ ] Written procedures
- [ ] Performance targets
- [ ] Record keeping
- [ ] Reporting
- [ ] Audit
- [ ] Audit follow up
- [ ] Training
- [ ] Research
- [ ] Plan / Do / Check / Act
- [ ] Other (please identify)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on environmental compliance quality assurance procedures, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Do your bridge maintenance quality assurance procedures include any of the following environmental compliance features? (please check all that apply) *

- [ ] ISO 14001
- [ ] Roll up to agency wide compliance
- [ ] Integrated with safety and other quality assurance concerns
- [ ] Written procedures
- [ ] Performance targets
- [ ] Record keeping
- [ ] Reporting
- [ ] Audit
- [ ] Audit follow up
- [ ] Training
- [ ] research
- [ ] Plan / Do / Check / Act
- [ ] Other (please identify)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on bridge maintenance quality assurance procedures, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Do your other quality assurance procedures include any of the following environmental compliance features? (please check all that apply) *

- [ ] ISO 14001
- [ ] Roll up to agency wide compliance
- [ ] Integrated with safety and other quality assurance concerns
- [ ] Written procedures
- [ ] Performance targets
- [ ] Record keeping
- [ ] Reporting
- [ ] Audit
- [ ] Audit follow up
- [ ] Training
- [ ] Research
- [ ] Plan / Do / Check / Act
- [ ] Other (please identify)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on other quality assurance procedures, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Data Analysis

16. Does your EMS data analysis process include the following? (please check all that apply) *

- [ ] Electronic batch processing
- [ ] Continuous data base updates
- [ ] Manual Review
- [ ] Incident-driven review
- [ ] No systematic review
- [ ] Other (please specify below)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on EMS data analysis processes, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

17. Do your EMS data analysis processes drive any of the following? (please check all that apply) *

- [ ] Risk based analysis and follow up
- [ ] Compliance-based follow up
- [ ] Voluntary follow up
- [ ] Incident-driven review
- [ ] No systematic follow up
- [ ] Other - please identify below
- [ ] Not sure / no answer

(Optional) Please provide further explanation on EMS data analysis processes, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Best Practices / Lessons Learned / Continuing Value

18. If your EMS development process were to be developed again, would you do more? (please check all that apply) *

- [ ] Employee engagement
- [ ] Agency engagement
- [ ] Integration with existing systems
- [ ] Roll up for Agency wide compliance
- [ ] Integration with safety and other quality assurance concerns
- [ ] Written procedures
- [ ] Performance targets
- [ ] Record keeping
- [ ] Reporting
- [ ] Audit
- [ ] Audit follow up
- [ ] Training
- [ ] Research
- [ ] Other (please identify)
- [ ] Not sure / no answer

(Optional) Please provide further explanation on EMS development process, URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

19. If a Benefit / Cost ratio for our EMS could be developed, I would expect it to be on the order of : (please check all that apply, and if you have an actual estimated value - please list it below)
*

- [ ] -10
- [ ] -5
- [ ] 1
- [ ] +5
- [ ] +10
- [ ] Not sure / no answer

Actual estimated value:

20. If your EMS development process contributed to "spin-off" improvements in other subject areas, which of the following areas were improved? (please check all that apply) *

- [ ] Safety
- [ ] Security
- [ ] Asset management
- [ ] Operational risk reduction
- [ ] Environmental streamlining
- [ ] Other - please identify below
- [ ] Not sure / no answer

(Optional) Please provide further explanation on EMS spin-off improvements. URL links, document upload, and/or email of agency contact for further details:

Document Upload
Allowed file types: png, gif, jpg, jpeg, doc, xls, docx, xlsx, pdf, txt, mov, mp3, mp4
Maximum file size 500k
See the end of the survey for additional uploads

Browse...

Additional Information

Thank you for helping to support technical transfer with your peers.

(Optional) If you have any additional comments, please include them below. You can include URLs for any websites for reference.

File #1

Browse...

File #2

Browse...

File #3

Browse...

File #4

Browse...

File #5

Browse...

Interview Request

Based on your answers, we may wish to interview you for further information. Would you be willing to participate in a follow-up interview? *

- Yes
- No

Thank you for your willingness to participate. Please provide your contact information. Interviews will be conducted during summer 2018, and we will contact you if you are selected for an interview.

First Name

Last Name

Title

Agency Name

City

State

Email Address

Phone Number