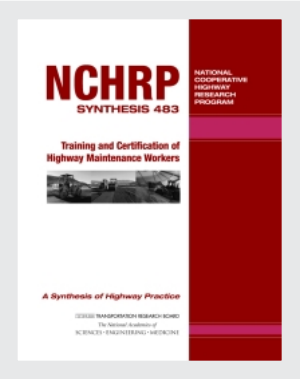

Training and Certification of Highway Maintenance Workers

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Training and Certification of Highway Maintenance Workers

A Synthesis of Highway Practice

TRB TRANSPORTATION RESEARCH BOARD
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Training and Certification of Highway Maintenance Workers

A Synthesis of Highway Practice

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

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The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communication and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to the National Research Council is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the National Research Council and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the National Research Council and the Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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Cover figure: Photos 1 and 2: Roller equipment; Photo 3: Collecting sand from a stockpile. *Credit:* Nevada Department of Transportation.

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The synthesis was performed under NCHRP Project 20-05 by Ms. Nancy Laffey and Ms. Kathryn A. Zimmerman of Applied Pavement Technology, Inc. The work was conducted under the leadership and guidance of Ms. Jo Allen Gause, Senior Program Officer, Transportation Research Board. Throughout this project, Ms. Gause has provided tremendous support and encouragement.

The authors are indebted to the state departments of transportation (DOTs) and provincial ministries of transportation (MOTs) listed in Appendix A that participated in the survey. Their thoughtful responses to the survey are appreciated and their contributions to making this information available are noted. In addition, the time and efforts of the representatives from the Alaska, California, Idaho, Iowa, Missouri, North Carolina, South Carolina, and Utah DOTs; the Clear Roads research program; the Transportation Coordination Curriculum Council (TC3); and the Upper Great Plains Transportation Institute (UGPTI) at North Dakota State University, who participated in the interviews, are recognized with gratitude.

Finally, the authors recognize with sincere gratitude and appreciation the contributions of the Topic Panel. Their careful review and insights greatly enhanced the final product.

FOREWORD

Highway administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to highway administrators and engineers. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire highway community, the American Association of State Highway and Transportation Officials—through the mechanism of the National Cooperative Highway Research Program—authorized the Transportation Research Board to undertake a continuing study. This study, NCHRP Project 20-5, "Synthesis of Information Related to Highway Problems," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an NCHRP report series, *Synthesis of Highway Practice.*

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

By Jo Allen Gause
Senior Program Officer
Transportation
Research Board

This synthesis documents front-line maintenance worker training and certification practices for highway transportation agencies in the United States and Canada. The information presented includes the types of topics being addressed by training and certification programs, the delivery methods used to provide the training, the sources of instruction, and whether material-sharing relationships are being utilized to access training. In addition, the synthesis captures how training is related to performance and the incentives being used by state and provincial agencies to encourage front-line maintenance workers to complete training.

Information used in this study was gathered through a literature review and a survey of state departments of transportation and Canadian provincial transportation agencies. Follow-up interviews with selected agencies provided additional information.

Nancy Laffey and Kathryn A. Zimmerman, Applied Pavement Technology, Inc., Urbana, Illinois, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable with the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

CONTENTS

Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the web at www.trb.org) retains the color versions.

TRAINING AND CERTIFICATION OF HIGHWAY MAINTENANCE WORKERS

SUMMARY

Highway maintenance workers perform a broad range of activities related to the maintenance and operation of the highway network under a variety of weather and traffic conditions. In the performance of their duties they are exposed to a variety of challenges and hazards. These workers need appropriate knowledge, skills, and abilities to perform their activities effectively, thereby promoting the mobility, safety, and preservation of the nation's highway system. Accordingly, suitable training and certification of maintenance workers is vital to their efficiency and safety.

In recent years, highway transportation agencies have dealt with a "perfect storm" of circumstances that have forced them to reevaluate how they develop, deliver, and document training for front-line maintenance workers. These circumstances include reductions in operating budgets; reductions in maintenance staff resulting from hiring freezes, layoffs, and retirement; loss of institutional knowledge and experience; additional skill requirements for software and equipment operation; and increased federal training and certification requirements for certain technical areas.

In addition, maintenance plays a vital role in supporting highway transportation agencies' plans to meet asset management requirements, as documented in the 2012 highway legislation commonly known as *Moving Ahead for Progress in the 21st Century* (or MAP-21). Collecting roadway inventory and condition data, reporting resource usage, and meeting performance targets in various technical areas are some of the additional tasks that maintenance must support.

The response to changes in maintenance operations varies considerably from state to state and province to province, resulting in great diversity in training and certification programs across the United States and Canada. The objective of this synthesis is to document what the states, provinces, and territories are doing to meet these challenges and identify innovative programs, procedures, and products that are successfully meeting training needs for front-line maintenance workers in the current climate. This includes a discussion of the types of content being delivered; the methods used for delivery; the technology being used to support training; the procedures that are in place to support workforce development, including incentives and requirements; and the opportunities being leveraged to capitalize on training budgets through pooled-fund initiatives and materials-sharing partnerships.

In addition, this synthesis documents the efforts highway transportation agencies are undertaking to align training with workforce development goals and performance objectives, as well as to track the impact of training on individual job performance.

The information contained in this synthesis was obtained using three different sources. First, a literature review was conducted to provide background information about the state of maintenance training and certification practice. Second, a survey asking for information about training and certification practices was distributed to each of the voting members

of the AASHTO Subcommittee on Maintenance (SCOM) and 13 Canadian ministries of transportation (MOTs). A total of 41 state departments of transportation (DOTs) (82% of the 50 states) and six MOTs (46% of the 10 provinces and three territories) responded to the survey. Finally, follow-up interviews with representatives from eight DOTs, the Clear Roads research program, the Transportation Curriculum Coordination Council (TC3), and the Upper Great Plains Transportation Institute (UGPTI) at North Dakota State University were conducted to expand on the following three aspects of their programs:

- Delivery methods: what methods of delivery are being utilized and why?
- Training and resource sharing opportunities: what partnerships and resources have been established to extend limited maintenance training resources and how do they operate?
- Training and performance: how well are training efforts aligned with performance expectations for maintenance workers?

These three topic areas were identified for further investigation for several reasons. First, on reviewing the survey results, the highway transportation agencies appeared to be showing the most divergence and innovation in these features of their programs. Therefore, the case examples highlight innovative practices and programs that can serve as models for other agencies. Second, given the cost associated with the development and delivery of training, it is insightful to know which delivery methods agencies consider to be the best value and how they make decisions about alloting precious training dollars. Finally, performance management is a common focus of government policy and initiatives. Therefore, it is of interest to see how training is being used to convey information about performance expectations and how to meet those expectations.

The survey results show that most state and provincial highway transportation agencies provide technical training to front-line highway maintenance workers, regardless of the size of their maintenance workforce or whether they utilize contract maintenance staff to perform maintenance functions. In addition, the training offerings are varied across the following five technical training areas:

- Bridges,
- Highway safety and reliability,
- Pavements,
- Roadway/roadside, and
- General maintenance skills.

Within each of the five categories, highway transportation agencies identified subtopics for which they provide training. All but one of these subtopics (General Maintenance Skills) align with the AASHTO SCOM Technical Working Groups. (The Equipment Group was represented as a subtopic under each of the first four categories to better identify the type of equipment training provided.) Survey respondents documented the training delivery methods they use and the topics for which training is required or certification offered. By and large, instructor-led training and on-the-job training are still the most widely used methods for delivering training across all content areas and are largely considered the most effective. However, several agencies did document growing use of alternative delivery methods, such as web-based training. There is a less consistent use of requirements and certifications for training because agencies require and certify content in each of the five technical categories for different reasons. Certification is usually done to meet safety and liability concerns.

Agencies also identified their sources for facilitating training, largely citing experienced agency employees as their most utilized instructor base. Contractors and consultants were also used, in addition to equipment manufacturers, other agency personnel (if a training partnership existed), community colleges, and unions.

Most agencies indicated that they are developing training in-house and that more than 50% of their training development efforts are conducted internally.

The survey of practice included questions that focused on the incentives to take training offered by the highway transportation agency. These questions offered insight on how agencies motivate front-line maintenance workers to complete training. The agencies that offer incentives identified the types of incentives offered. Incentives include the opportunity to acquire new skills, keep pace with technology, and be promoted. Several agencies also noted that the completion of training can qualify an employee for a new job or wage increase.

It appears that only about half of the agencies align training courses with employee performance requirements and significantly less consider technical training completion as a component in evaluating performance. Of that group, almost all formally document training completion on the performance evaluation.

Most agencies indicated that supervisors support training enrollment by making recommendations on training to the employee. About two-thirds of the agencies stated that supervisors consider training completion when making promotion recommendations.

The survey results indicate that most maintenance employees attend mandatory and nonmandatory training at least once a year and in several instances, more than once a year. The most cited reasons for retaking training are requirements and supervisor recommendations.

Only nine of 47 highway transportation agencies indicated that they measure the effectiveness of training on employee performance. Among these, the data are usually collected in the form of a survey administered to participants that measures their impressions of the effects of training on their performance. No states identified using more objective measures to determine the impact of training on an employee's performance.

Eight of the 47 agencies collect data to determine the impact of training on the organization. Among these, the method of measuring impact is a survey sent to maintenance personnel asking for their impressions of the impact of training on the maintenance program. In a couple of instances, more objective methods are used, such as compiling pre- and posttraining employee evaluation data and analyzing the results.

On the subject of additional training needs, each of the five content categories was selected by survey respondents as an area for which additional training was needed. General maintenance skills was the most widely selected technical content area for which additional training was needed, with pavement training not far behind. Some of the most identified topics for additional training under general maintenance skills were planning and scheduling, customer service, and maintenance quality assurance program inspections. It may be possible for an agency such as TC3 to utilize this needs list and communicate directly with the states requesting this training to identify existing training products or development of new training products.

In addition to existing training needs, the results from this synthesis identified several gaps in current knowledge that could be addressed by research and outreach activities. One area in which further study is needed is the use of technology-based delivery methods, such as web- or computer-based training, web or video conference training, or mobile training, by the state highway agencies. Many of the technology-based methods can mitigate training challenges such as scheduling conflicts and limited travel budgets. Research is needed on the barriers to adopting these methods, cases of successful use at state highway agencies, and guidance on appropriate content for and implementation of technology-based methods.

Additional research is also needed on how agencies measure the impact of training on an individual's performance and the most effective methods for collecting these data. Without this information it is very difficult to justify the importance of training to employees and management and to determine if training products are supporting workforce development goals.

Finally, further outreach is needed to document the alignment between training and performance expectations for front-line maintenance workers and to disseminate this information to state highway agencies. This might be achieved through a peer exchange or facilitated web or video conference with agencies that have established programs. Information gathered might include how the link between training and performance objectives is established, tracked, and recorded and how that information is used to determine employee advancement.

CHAPTER ONE

INTRODUCTION

BACKGROUND

The response to changes in maintenance operations varies considerably from state to state and province to province, resulting in great diversity in training and certification programs across the United States and Canada. The objective of this synthesis is to document training activities conducted by states, provinces, and territories to meet challenges to maintenance operations, and to identify innovative programs, procedures, and products that successfully meet training needs for front-line maintenance workers. This includes a discussion of the types of content delivered, the methods used for delivery, the technology used to support training, the procedures in place to support workforce development (including incentives and requirements), and the opportunities leveraged to capitalize on training budgets through pooled-fund initiatives and materials-sharing partnerships.

In addition, this synthesis documents highway transportation agencies' efforts to align training with workforce development goals and performance objectives, as well as to track the impact of training on individual job performance.

REPORT ORGANIZATION

This synthesis of practice is organized into the five chapters described here:

- Chapter One—Introduction. This chapter introduces the synthesis, providing background information and summarizing the scope and organization of the document.
- Chapter Two—Literature Review. The findings from the literature are summarized and presented in this chapter. Relevant topics covered in the literature review include training development efforts in specific technical content areas, training programs that support employee advancement and pay increases, and training development and delivery partnerships.
- Chapter Three—State of the Practice. The results of the survey of state practice are presented in this chapter by topic area. The topic areas include the following:
  - Survey content,
  - General training program overview,
  - Training content and delivery,
  - Incentives to take training,
  - Frequency of training events and tracking participation,
  - Evaluating the effects of training on worker performance and the organization, and
  - Training development.
- Chapter Four—Case Examples. This chapter summarizes the information provided by the eight state DOTs, the Clear Roads research program, TC3, and UGPTI at North Dakota State University about delivery methods, training and resource sharing opportunities, and training metrics. Information on the development of their maintenance training programs and the rationale behind important decisions such as certification areas is provided in order to document how the maintenance training program evolved and how it aligns with performance requirements for maintenance workers.
- Chapter Five—Conclusions. The synthesis concludes with a summary of key observations and suggested areas for further research and outreach for the training and certification of front-line maintenance workers.
- Appendices—Two appendices are included with the synthesis. Appendix A, which is available in both the print and electronic versions, presents the responses to the survey questions. Appendix B provides a copy of the questionnaire that was distributed electronically to the state and provincial participants. It is not included in the printed version of the report, but is in the web version.

SYNTHESIS OBJECTIVES

The objective of this synthesis is to document and summarize current practices for training and certification of front-line highway maintenance workers in areas such as pavements, bridges, roadsides, equipment, highway safety and reliability, and general maintenance skills. The synthesis focuses on training directly related to the performance of job duties. For the purposes of this synthesis, training is defined as a structured, repeatable learning experience that follows a formalized plan.

To the extent possible, the synthesis documents the rationale behind decisions concerning training and certification. This information is intended to help agencies evaluate and improve their maintenance training and certification programs.

SYNTHESIS SCOPE AND APPROACH

The synthesis addresses all aspects of training and certification programs for front-line maintenance workers and presents current practices in the following areas:

- Subject areas of training;
- Training delivery mode (e.g., instructor-led training and web-based training);
- Source of training [e.g., in-house, consultant, and local technical assistance programs (LTAPs)];
- Methods of determining training effectiveness;
- Value of training to organization and employee;
- Inducements to participate in training (e.g., mandatory and nonmandatory);
- Regularity of training (e.g., single event and recurring); and
- Training that leads to certification.

The information contained in this synthesis was obtained using three different sources. First, a literature review was conducted to provide background information about the state of maintenance training and certification practice. Second, a survey was distributed to each of the voting members of the AASHTO SCOM and the 13 Canadian MOTs asking for information about their training and certification practices. Forty-one state DOTs (82%) and six MOTs (46% of the 10 provinces and three territories) responded to the survey. Finally, follow-up phone interviews with representatives from eight DOTs, the Clear Roads research program, TC3, and UGPTI were conducted to expand on the following three aspects of their programs:

- Delivery methods: what methods of delivery are being utilized and why?
- Training and resource sharing opportunities: what partnerships and resources have been established to extend limited maintenance training resources and how do they operate?
- Training and performance: how well are training efforts aligned with performance expectations for maintenance workers?

The eight highway transportation agencies were selected to participate in the interviews because they expressed willingness to provide additional information and demonstrated noteworthy maintenance training and certification practices. A range of approaches were represented in the case examples, including the following:

- The utilization of multiple delivery methods (e.g., online, mobile, and video) to provide training;
- The utilization of partnerships to develop and deliver training; and
- The existence of a well-structured or well-documented training program that aligns clearly with workforce development objectives and includes a learning management system for tracking training accomplishments for each employee.

In addition, interviews were conducted with representatives from the Clear Roads research program, TC3, and UGPTI. (These organizations were listed by state respondents as training partners.) Each of these organizations works with highway transportation agencies to develop and deliver training, although their methods for identifying needs, developing content, and delivering training to the target audience varies. The differences in their approaches are explained in detail in the case examples, each offering a unique approach that could serve as a model to other agencies.

TERMINOLOGY

The following terms were defined in the survey:

- Blended training—training that is delivered using two or more delivery methods (e.g., instructor-led training combined with on-the-job training).
- Cross-training—to train an employee to be proficient at different, usually related, skills, tasks, jobs, and so forth.
- Instructor-led training—training that is delivered in the classroom; an instructor is present to facilitate instruction.
- Mobile training—training that is delivered through a mobile application by means of a cell phone or tablet; training is completed according to the participant's pace and schedule.
- On-the-job training—training that is delivered by an experienced employee; often includes demonstration lessons and opportunities for inexperienced employees to practice new skills and receive feedback on performance.
- Self-study, paper-based training—training material is provided either in hardcopy or electronically; training is completed independently according to the participant's pace and schedule.
- Video conference training—training that is delivered through a video conferencing system; an instructor is present to facilitate instruction.
- Web-based training—training that is delivered online through the Internet or intranet; training is completed independently according to the participant's pace and schedule.
- Web conference training—training that is delivered through an online web conferencing system; an instructor is present to facilitate instruction.

CHAPTER TWO

LITERATURE REVIEW

OVERVIEW

Training, and in some cases certifying, front-line maintenance workers is necessary. Training and certification prepare maintenance workers to complete a multitude of operational activities safely, accurately, and efficiently. However, given the range of maintenance activities typically performed, the improvements in maintenance technology and practice, and the increasing number of requirements that need to be met by maintenance workers today, it is a challenge for highway transportation agencies to keep their training programs current and highly effective.

This literature review highlights research documenting the need for maintenance training and certification programs, and efforts being made to keep such programs current and effective. Much of the literature presented in this review focuses on the methods used to deliver training effectively to maintenance audiences, partnering relationships to develop and deliver training, and efforts to link training and performance.

When gathering resources for this literature review, it became clear that there is very little research available on practices for training and certifying front-line highway maintenance workers. Much of the information available and applicable to this synthesis focuses on transportation workforce development efforts in general or for a specific technical area, such as safety. There is some documentation of state agency maintenance training programs, partnerships, and training initiatives, which is included. Information from related industries, such as transit, is utilized to present innovative approaches to maintenance training and certification that could be replicated by highway transportation agencies. In addition, information from international organizations on the topic of highway maintenance training and certification is included as a means of highlighting effective practices and approaches that could be adapted by domestic highway agencies.

WHY MAINTENANCE TRAINING AND CERTIFICATION IS NECESSARY

Thirty years ago, at a highway maintenance conference hosted by the World Bank, there was a presentation on the state of road maintenance training in the developing world (Morra 1985). During the presentation, it was observed that highway transportation agencies in the developing world had made a heavy investment in infrastructure and equipment. The biggest threat to this investment, according to the presenter, was the lack of qualified, motivated personnel to plan, construct, and maintain the existing roadway network (Morra 1985). Conference participants identified the lack of "training manpower" as a significant hindrance to economic growth (Morra 1985). Five reasons were identified for why training programs across the developing world were failing to meet the needs of developing countries (Morra 1985). These are (Morra 1985)

- Lack of support for the program on the part of the highest levels of management,
- Lack of sound policy on training,
- Lack of an effective permanent training program within the agency,
- Limited incentives or motivation for maintenance personnel to attend training, and
- Shortage of funds to meet annual expenditures required to implement the training program.

The situation described in 1985 likely resonates with American highway transportation agencies today. Training continues to be vital to maintaining a productive maintenance workforce, but its impact is often compromised by lack of funding, planning, and upper-management support (Committee on Future Surface Transportation Agency Human Resource Needs: Strategies for Recruiting, Training, and Retaining Personnel 2003).

Moreover, highway agencies today face additional challenges that were not nearly as prominent 30 years ago. Rapid advances in technology are driving the need for a skilled and versatile maintenance workforce (Cristofaro 2006). Maintenance workers, particularly those maintaining and repairing equipment, need an identified list of requisite technical skills (Cristofaro 2006). However, the external labor market cannot supply a sufficient number of workers with these skills, and the competition for skilled employees is fierce (Committee on Future Surface Transportation Agency Human Resource Needs: Strategies for Recruiting, Training, and Retaining Personnel 2003; Cristofaro 2006).

Agencies typically look to develop requisite maintenance skills through training. This necessary skill-development

training can eventually lead to more cost-effective repairs, better availability of needed equipment, and less equipment and staff downtime (Wemhoff 2012). This aspect of training becomes vital for agencies that are encountering increasing demands on maintenance personnel as staffing is decreased. According to the literature, decreases in maintenance staffing typically correspond to growth in the transportation program overall, which means there is no corresponding reduction in the amount of maintenance work that needs to be completed (Committee on Future Surface Transportation Agency Human Resource Needs: Strategies for Recruiting, Training, and Retaining Personnel 2003). Therefore, it is imperative that existing workers receive training so the maintenance program can operate effectively and efficiently.

CHANGING THE WAY TECHNICAL TRAINING IS DELIVERED

As was mentioned in the Morra presentation (1985), one of the reasons that training programs were failing to meet the needs of developing countries was a lack of adequate funding. This problem is also often encountered by state highway agencies. By federal and private industry standards, transportation agency workforce training expenditures are insufficient (Committee on Future Surface Transportation Agency Human Resource Needs: Strategies for Recruiting, Training, and Retaining Personnel 2003). Studies of training investment in the private sector and federal agencies have shown that successful organizations spend, on average, 2% of salaries on training, which is at least four times more than transportation agencies spend on training (Committee on Future Surface Transportation Agency Human Resource Needs: Strategies for Recruiting, Training, and Retaining Personnel 2003).

In today's economic climate, many transportation agencies struggle to justify their training investment, and leverage the modest training budgets they have for optimal impact (Rall et al. 2011). One way that agencies are seeking to do this is through the use of nontraditional methods for delivering training.

Nontraditional methods of delivering training include technology-based methods such as web-based training, web conference training, and mobile training. A 2015 review of state highway agency websites indicates that nontraditional delivery methods are being used to deliver technical training. TC3 stated in its 2012 Strategic Plan that although its initial training offerings were provided as instructor-led courses, economic challenges prevented that model from being used on a large scale (TC3 2012). Other transportation training initiatives, such as AASHTO's Snow and Ice Pooled Fund Cooperative Program, elected to develop computer-based winter maintenance training because of the cost-effectiveness and convenience of the medium (Clear Roads, http://clearroads.org/computer-based-training/, accessed June 3, 2015).

The TC3 Strategic Plan further supports the use of online learning as its primary training platform because of the availability of the Internet across the country (TC3 2012). Although there is no evidence that highway transportation agencies are preparing to make online training their primary delivery method, transportation agencies are using alternative delivery methods to meet a portion of their training needs. This information is supported by TC3 membership data.

As of June 2015, TC3 reported that 30 state highway transportation agencies were contributing to the technical services committee through a pooled fund (A. Jaffee, personal communication, June 17, 2015). The pooled fund's primary purpose is to develop and distribute web-based training content, largely targeted to maintenance personnel. With an investment of $20,000 annually, participating state agencies have access to more than 80 web-based training modules. If an agency compares this investment against the average cost to develop a single training course, an agency gains approximately $450,000 in leveraged course development. This represents a return on the investment of 2,150% (A. Jaffee, personal communication, June 17, 2015).

Economics are not the only reason to pursue alternative delivery methods such as web-based training. These methods can preserve the presence of the instructor but negate the costs of travel or a training facility. They can also serve special training needs. For instance, Leiphart and Ngo (2002) indicate that it would be financially difficult for most transportation agencies to develop and maintain a course with a limited number of attendees. They show that web or video conferencing may be a more effective technique for delivering these types of specialized training courses because the material can be delivered to a small audience on an as-needed basis.

Alternative delivery methods can provide greater flexibility for the maintenance trainee, allowing him or her to access learning as needed and from varying locales (Lowrie et al. 2011). In addition, training can be completed at the maintenance worker's pace and in accordance with his or her schedule. Such access to training allows agencies to make different decisions about training requirements and certifications, given the availability of training to maintenance workers.

According to a study conducted by Rutgers University on surface transportation security training needs, "[I]nternet-based webinars and teleconferences are becoming an increasingly popular training mechanism" (Lowrie et al. 2011, pp. 122). According to the Rutgers study, these mediums are preferred because employees can participate directly from work sites while retaining interaction with peers. The study also found that trainees prefer to be able

to balance the online training with face-to-face instruction (Lowrie et al. 2011).

As documented in the literature, alternative delivery methods provide greater flexibility in scheduling and allow the trainee to set his or her own pace. This is a value to transportation workers who believe that their training time is limited. In an FHWA study on workforce development, 26 state respondents indicated that they had 2 hours or less per week to devote to professional development (Leiphart and Ngo 2002). In addition, the majority of respondents, including managers, indicated that training was most effectively delivered in intervals of 1 hour or less and that they preferred to take training in an office within driving distance of their workplace (Leiphart and Ngo 2002). This information indicates that transportation employees have limited time to attend classroom training and are reluctant to participate in training that requires travel.

Alternative delivery methods allow maintenance personnel to receive the training they need despite constrained budgets, travel policies, or schedules. However, there are some concerns about the effectiveness of self-paced training. Research indicates that the application of this method and its effectiveness for maintenance personnel is sparse (Nakanishi et al. 2015). One study found that online and computer-based training received mixed support from survey respondents on the subject of its effectiveness, particularly for front-line maintenance personnel (Lowrie et al. 2011). Although there are considerable benefits for both the trainee and the organization using alternative methods, the study listed the following concerns (Lowrie et al. 2011):

- The inability to verify maintenance workers' performance,
- The lack of instructor or peer interaction, and
- The lack of transferability of the content throughout the agency.

These concerns may explain why most state highway agencies continue to favor traditional methods of training. The inclination for traditional delivery methods is supported by a report prepared for the Montana DOT that indicates that the greatest improvement in performance is obtained from on-the-job training (Lees 2002). The study indicates that those agencies interviewed for the report relied heavily on the on-the-job training owing to time constraints and remote work locations for construction (Lees 2002). Other research found that the most effective method for front-line maintenance personnel was providing hands-on training and problem solving (Lowrie et al. 2011).

The TC3 numbers indicate that highway transportation agencies are using alternative delivery methods to provide training, most likely as a supplement to traditional methods for certain types of content. It may be that highway transportation agencies are creating blended training: different content taught different ways in order to achieve a combined success. *NCHRP Report 468* indicates that blended learning is preferred by some agencies because it takes advantage of the most effective elements of each training medium within agency constraints (Nakanishi et al. 2015). As highway transportation agencies continue to balance budget constraints against the need to develop a skilled workforce, it appears likely that they will continue to use both traditional and alternative delivery methods to meet their training needs.

TRAINING DEVELOPMENT AND DELIVERY PARTNERING EFFORTS

The pursuit of alternative delivery methods is one way agencies make training available with modest training budgets. Other strategies involve sharing materials or partnering with other agencies on course developments. As previously noted, more efforts are being made in the transportation industry to partner in order to gain access to necessary training and certification programs (TC3 2012; Clear Roads 2015). Most of these partnering efforts evolved as an answer to the challenge of developing comprehensive training material. By combining funds with peer agencies, common training needs can be developed cost-effectively. In addition, similar partnerships with LTAP offices or community colleges can also help reduce training costs for an agency, as documented in the literature.

One example of training partnering efforts comes from Montana DOT. Before developing their own partnerships, Montana DOT hired a consultant to investigate existing partnerships in the highway transportation community to develop and deliver core courses of common interest in the areas of design, construction, and inspection of highway projects. The study found that partnering led to reduced fees for training, the ability to share training responsibilities, and an improved product resulting from collaboration on the design of the course (Lees 2002).

The Montana study also reports several key elements that must be in place for a strong partnership to develop (Lees 2002). First, the partnership should have dedicated funding available from course fees, which allows for budget planning and the prioritization of training needs. Second, the partnership should allow for collaborative design to take place, which introduces the possibility of bringing new experiences and perspectives into the training content, which may have an important impact on the quality of the final training product. Third, the partnership should provide for the joint delivery of training, thus easing the burden on any one agency and further exposing trainees to new ideas and experiences provided by different instructors. Finally, the partnership should strive for continuous improvement in all aspects of training development and delivery through the creation of a

training plan that examines the relevance of existing training products and suggests necessary improvements.

In addition to partnerships among state agencies, the research suggests that partnerships with community colleges are occurring more regularly and more formally, and provide significant opportunity for growth (Glitmana 2010).

In 2002, the University of Vermont Transportation Research Center conducted an analysis of community colleges that provide training in support of transportation workforce development. The analysis discovered the following about this partnership (Glitmana 2010):

- The majority of schools reported having programs that develop skills relevant to the transportation sector, especially general skills (e.g., finance, technologies, operations, and maintenance) that are transferrable to nontransportation industries.
- When schools plan to expand or initiate transportation curriculum, it is primarily in technical areas such as engineering, in which the skills may extend to sectors other than transportation.
- Similarly, when schools indicated having specialized equipment, most of the investment was for tools that could be leveraged beyond transportation studies. Few schools reported owning or having access to transportation-specific equipment such as training ships, rail cars, or airplane fuselages.
- The majority of schools reported having strategic partnerships with other schools.

Of 145 community colleges, 38% indicated they had an operations and maintenance curriculum in place (Glitmana 2010). In addition, a significant number of respondents indicated they have, or plan to acquire, specialized equipment to support transportation-related training (Glitmana 2010). Although few indicated they had plow, mowing, or other maintenance-related types of equipment, equipment to provide commercial driver training was common (Glitmana 2010).

Community colleges in partnerships with state and local transportation agencies and transportation-related industry groups provided guidance for establishing those relationships if not already in place (Glitmana 2010):

- Establish a formalized advisory board with representation from both private- and public-sector partners.
- Enhance the transportation aspect of existing complementary degree and certificate programs by broadening the content to include relevant transportation concepts and skills.
- Investigate existing state and federal programs as potential sources of funding, expertise, and assistance for establishing or enhancing the transportation curriculum.
- Tap into private- and public-sector demand for customized, noncredit training that can become the foundation for building a broader transportation program.

Of the four practices listed here, the third and fourth bullets have the biggest implications for highway transportation agencies. They indicate that there are existing resources an agency can use to establish partnerships and funding opportunities to support training development efforts.

LINKING TRAINING TO PERFORMANCE

Another important aspect of the training and certification of maintenance workers that is discussed in the literature is the ability to link training to performance. As stated earlier, limited incentives or motivation for maintenance personnel to attend training can lead to a failure of the employee and the agency to meet maintenance needs (Morra 1985). Establishing the link between training and performance helps ensure that the maintenance workforce has the skills and the flexibility necessary to address technical job requirements. Linking training to performance also helps ensure that employees clearly understand the expectations of the job, how those expectations are to be met, and the incentives available to meet those expectations (Aschbrenner et al. 2000; Cristofaro 2006).

North Carolina DOT (NCDOT) has made significant progress in this area (Aschbrenner et al. 2000). In recognition of high employee turnover rates, loss of qualified workers to better paying industries, and reductions in the number of experienced employees as a result of layoffs and retirement, NCDOT developed a program to outline the specific requirements, knowledge, skills, and abilities that maintenance workers needed at various levels across content areas (Aschbrenner et al. 2000). At each level, training was identified to develop the requisite knowledge, skills, and abilities; test mastery; and certify. As employees completed the process at each level, they received advancement and pay raises. As a result, there were benefits at all levels of the organization, including the development of quality training materials, the acquisition of valuable skills by the trainee, and an improvement of service for the traveling public.

NCDOT's example indicates that substantial planning was required in order to establish a training program that aligned with performance objectives for maintenance workers in each employment category. The literature identifies the following actions as important considerations for developing training that aligns with performance (Wemhoff 2012):

- Determine the expected skill and knowledge required for all levels of employment (i.e., beginner, intermediate, and advanced).

- Determine the standards for recognizing successful completion of the training task.
- Identify follow-on training (and possibly more testing) needed to advance employees along the career path.
- Decide if national certifications will be considered as standard for satisfactory completion or determine if more stringent requirements are needed.

It is important that this information be considered carefully by highway transportation agencies seeking to establish a similar link to training and performance for front-line maintenance workers.

CHAPTER THREE

STATE OF THE PRACTICE

OVERVIEW

To better understand the current front-line maintenance training and certification practices used by state and provincial transportation agencies, a survey of practice was conducted through NCHRP in cooperation with AASHTO. The survey instrument was distributed to the voting members of SCOM and transportation agency contacts in each of the Canadian provinces and territories. These efforts resulted in a total of 47 completed responses, including 41 state DOT responses (out of 50) and six responses from Canadian MOTs (out of 13), as shown in Figure 1. The responses from state DOTs represents an 82% response rate among state DOTs.

FIGURE 1 NCHRP Topic 46-17 response record.

This chapter summarizes the findings from the survey of practices. The information is presented in a number of formats, including both tables and graphs, as appropriate. A copy of the survey questions that were distributed electronically is provided as Appendix B (online version only), and the responses received are presented in Appendix A.

SURVEY CONTENT

The survey questions were organized into the following six categories:

- General information—The questions in this section ask respondents to provide the number of front-line maintenance workers employed by the agency and the amount of maintenance work performed by contract. If the agency indicated that maintenance work is performed by contract, additional questions asked respondents for information concerning training and certification requirements for contract maintenance employees. In addition, respondents were asked about practices related to the sharing of training materials.
- Training content and delivery—This section of the survey asks about the technical content areas being addressed through training across roadway assets. If an agency indicated that training was provided to front-line maintenance workers, respondents were asked to identify (1) general technical training content areas for which they offered training, (2) subtopic content areas for each category, (3) the methodology used to provide training, and (4) the source of instructors for each content area. Training areas covered in the survey include the following:
  - Bridges,
  - Highway safety and reliability,
  - Pavements,
  - Roadway/roadside, and
  - General maintenance skills.
- Inducements to take training—The questions in this section of the survey investigate how highway transportation agencies are motivating front-line maintenance workers to enroll and complete training. Questions in this section not only focus on motivational factors such as pay, but also seek to establish how training is related to performance.
- Frequency of training events and tracking participation—This section seeks to establish the frequency with which front-line maintenance workers take mandatory and nonmandatory training and are encouraged to refresh their skills.
- Evaluating the effects of training on worker performance and the organization—Questions in this sec-

tion pertain to the agency's practice of measuring the impact of training, on both front-line maintenance workers and the organization. One question asks the respondent to provide an opinion on which delivery methods are the most effective for this audience.
- Training development—The final section of questions explores how highway transportation agencies developing training (whether in-house or outsourcing) and what they would identify as the biggest training needs by technical content area.

The results of the survey are presented in the remainder of this chapter. In addition to the survey results, interviews were conducted with representatives from eight state DOTs and several national transportation training groups to explore additional program features. The results from the interviews are presented in chapter four.

GENERAL TRAINING PROGRAM OVERVIEW

Forty-one state DOTs and six provinces and territories responded to the survey. Of that number, 23 (49%) reported that they have a maintenance workforce of between 500 and 1,500 employees (see Table 1).

TABLE 1
NUMBER OF FRONT-LINE MAINTENANCE WORKERS EMPLOYED BY THE AGENCY

Number of Front-Line Maintenance Workers	Count	Percentage
0–500	8	17.0
501–1,500	23	48.9
1,500–3,000	11	23.4
Greater than 3,000	5	10.6

As shown in Figure 2, 34 of the agencies are currently contracting out 50% or less of their maintenance work.

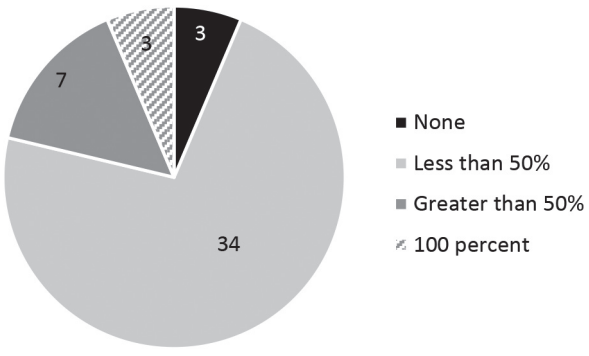


FIGURE 2 Amount of maintenance work being contracted by agencies (47 responses).

Of those agencies contracting out maintenance work, only seven require contract workers to be trained and certified beyond federal requirements and all seven require documentation verifying training and certification requirements have been met. Of those seven:

- Three agencies have training and certification requirements that are *the same* for state, provincial, and contract maintenance workers.
- One agency identifies training and certification requirements are *less stringent* for state and provincial maintenance workers than for contract maintenance workers.
- Two agencies identify training and certification requirements that are *more stringent* for state and provincial maintenance workers than for contract maintenance workers.
- One agency respondent does not know whether the requirements for contract workers are the same or different than what is required for state or provincial maintenance workers.

For the agencies with more stringent requirements, one agency identified more stringent requirements in all five technical areas and the other agency identified more stringent requirements only for roadway/roadside and general maintenance skills.

Among the agencies responding to this survey, 34 share materials with other organizations, as shown in Table 2.

TABLE 2
DO YOU SHARE TRAINING MATERIALS WITH OTHER ORGANIZATIONS?

Answer Options	Count	Percentage
Yes	34	72.3
No	13	27.7

The highest preponderance of sharing occurs with other state and provincial highway agencies and LTAPs (82% and 65%, respectively). Six respondents identified sharing materials with TC3, and four listed "other" partners (see Figure 3). Some of these other partners were identified as the American Public Works Association (APWA) and county transportation agencies within the state.

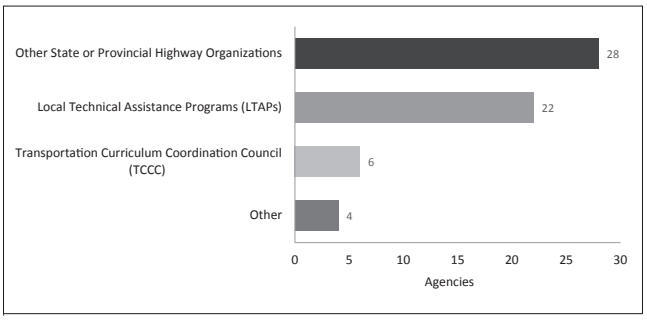


FIGURE 3 Agencies with which states and provincial highway agencies share training materials (34 responses).

TRAINING CONTENT AND DELIVERY

The information pertaining to content and delivery is organized under the following headings: technical content, delivery methods, required training, certification, and instructional sources. Within each topic, information is presented to identify the knowledge and skills currently considered necessary for maintenance workers to be trained. This information can serve as a resource to other agencies looking to develop similar content or those seeking to evaluate their current offerings and identify gaps.

Forty-one DOTs and six MOTs responded affirmatively about providing technical training for front-line maintenance workers when asked to complete the questions in this section of the survey. Participants from these agencies were asked to select the content areas for which they provide training. Based on the content areas selected, participants were then asked additional questions about the subtopic for which training was provided, skill requirements, and certification requirements. Participants were also asked to identify the method(s) used to deliver training for each main content area and instructor sources for the training.

Technical Content

Bridges

Thirty agencies indicated that they are providing bridge training in the areas of equipment operations, carpentry, concrete cutting or placement, erosion control, pile driving, welding, torch cutting, bolted connections, bridge inspections (not National Bridge Inspection Section), bridge preservation activities, and "other" (see Figure 4). Two agencies identified other types of training, one specifying bridge painting training.

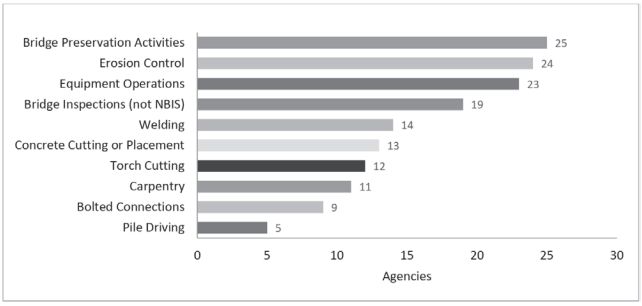


FIGURE 4 Bridge training topics (30 responses).

Highway Safety and Reliability

Thirty-four agencies indicated that they provide highway safety and reliability training on topics related to both traffic service and safety/reliability, as shown in Figure 5. (Note that some of this training may be mandated under federal or state law.) Those agencies were asked to select the subtopics within the highway safety and reliability category for which they provide training. Those subtopics were broken into two categories: traffic services, and safety and reliability. Traffic services subtopics include as equipment operations, curb markings, incident management, emergency traffic control, guardrail/end treatments/median barriers, snow and ice control for operators, debris removal, and "other." In addition, training on safety and reliability includes equipment operations, work zone safety, personal protective equipment, flagger, securing and hauling cargo, and "other." One agency identified other types of training as tractor and mower safety, hydraulics, and electrical.

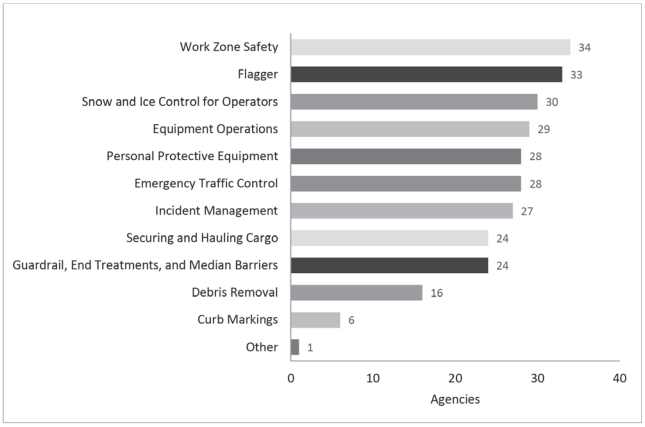


FIGURE 5 Highway safety and reliability training topics (34 responses).

Pavements

Thirty-three agencies indicated that they provide pavement training on both roadway/shoulders and drainage topics, as shown in Figure 6. In the area of roadway and shoulders, training topics include equipment operations, asphalt emulsion (storage and handling), base and subbase repair, asphalt pavement patching, shoulder and ditch maintenance, preservation treatment application, soil stabilization, inspections, and "other." Drainage topics include equipment operations, roadway drainage systems, pipe installation, basic surveying, inspections, confined space, subsurface drainage, and "other." One agency identified pavement design and pavement rehabilitations (rigid, asphalt) as additional training topics.

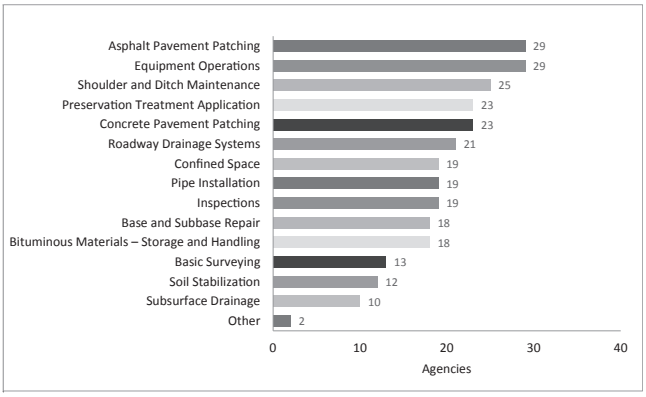


FIGURE 6 Pavement training topics (33 responses).

Roadway and Roadside

Thirty-six agencies indicated that they provide training on roadway and roadside topics such as vegetation management, herbicide/pest management, fence installation, pesticide handling and disposal regulations, retaining wall construction and maintenance, sign and pavement marking retro-reflectivity, rest area management activities, storm water management activities, and "other" (see Figure 7). One agency listed contamination soil management and road project environmental monitoring as additional training topics.

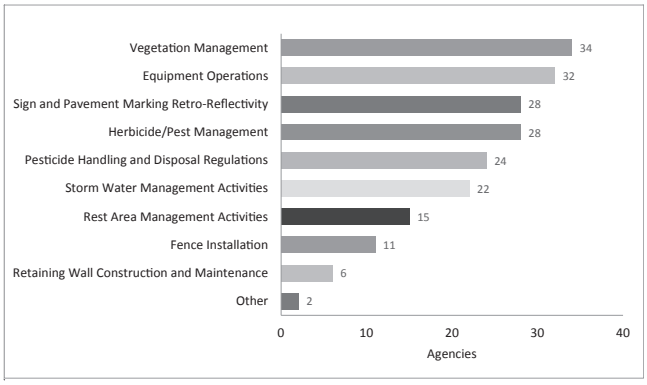


FIGURE 7 Roadway/roadside training topics (36 responses).

General Maintenance Skills

Thirty-nine agencies indicated that they provide training on general maintenance skills in the areas of rental equipment supervision, customer service, scheduling and planning, street and driveway access, math, subdivision roads, utility encroachments, purchase order contract, fleet management, maintenance management system data entry, maintenance quality assurance program inspections, plan reading, driving skills, and "other" (see Figure 8). One agency listed safety checks on equipment, how to properly complete forms used to track maintenance activities, survey basics, explosive use, rock scaling, and patrolling as additional training topics.

Delivery

There are many delivery methods highway transportation agencies can use to deliver training. The purpose of this section is to determine what methods are used to deliver training and who is supporting these delivery methods. The survey results illustrate the diversity found in state maintenance training programs to meet the professional demands and learning styles of maintenance workers, and the broadened use of technology to address training needs. The results were also used to identify the methods considered to be most effective for front-line maintenance workers.

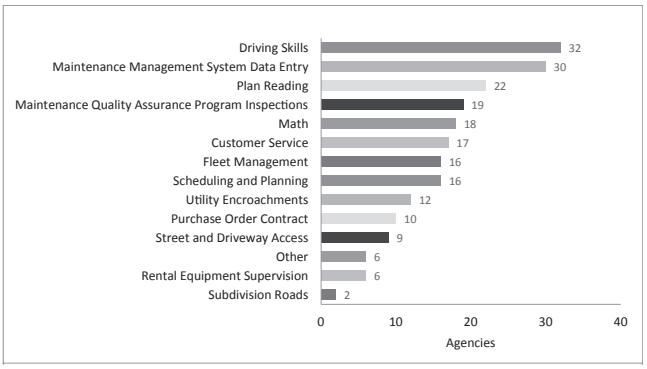


FIGURE 8 General maintenance skills training topics (39 responses).

As shown in Table 3, transportation agencies use a variety of methods to deliver technical training (respondents were allowed to select all methods that applied for each content area). However, it is clear that on-the-job and instructor-led training are dominant. According to the information provided, on-the-job and instructor-led training are the most common delivery methods used for bridge training. For highway safety and reliability, pavements, and roadway/roadside, instructor-led training is the most predominant delivery method, although on-the-job training is a close second for pavements (18 agencies selected instructor-led training and 17 agencies selected on-the-job training). For general maintenance skills, both on-the-job and instructor-led training were the predominant methods.

For bridge, pavement, roadway/roadside, and general maintenance skills, state agencies indicated that they also use other delivery methods. One respondent stated that policy manuals were used for pavement training, and one respondent listed the use of self-paced correspondence courses for roadway/roadside and general maintenance skills training (see

TABLE 3
NUMBER OF AGENCIES USING VARIOUS DELIVERY METHODS

	Instructor-Led Training	Web or Video Conference Training	Web-Based, Mobile, Video, Paper-Based Training	On-the-Job Training	Other	Number of Responses
Bridge	18	4	4	19	1	30
Highway Safety and Reliability	27	7	5	14	0	34
Pavements	18	6	6	17	2	33
Roadway/Roadside	24	6	6	16	1	36
General Maintenance Skills	24	3	7	24	2	39

chapter four, Case Examples, for more information on this method). In addition, another respondent recorded use of an academy that addresses general maintenance skills content.

Twenty-four agencies identified on-the-job training as the most effective delivery method for training maintenance workers, and 15 selected instructor-led training (see Figure 9). Three agencies selected web or video conference training, two selected self-paced learning, and three agencies selected "other." Three respondents listed instructor-led training in combination with on-the-job training as the most effective delivery method.

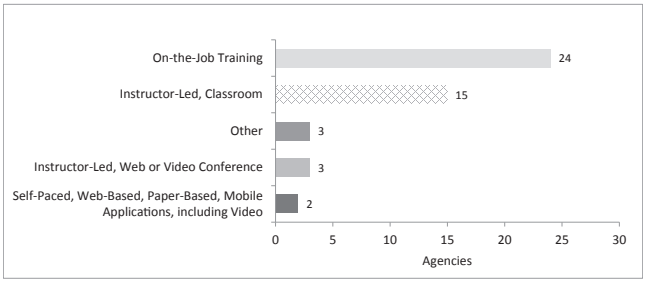


FIGURE 9 Preferences on the most effective method of delivering training to maintenance workers (47 responses).

As shown in Table 4, most transportation agencies rely on DOT employees to deliver training across all technical content areas. Contracted instructors are the second most highly utilized source in each topic area (respondents were allowed to select all sources that applied for each content area). Four state agencies listed the following options for instructors: materials suppliers, industry associations, state university transportation technology transfer and research centers, and FHWA.

Requirements and Certification

The survey of practice identified content areas that required training or certification. For each technical content area, respondents were asked whether training was required or certification provided. If respondents answered "yes" to either question, they were asked to select the topic(s) for which training was required or certification provided. The results are presented in Table 5.

These results are further broken out in Figures 10–14 for each technical content area. The results show that requiring training is far more common than providing certification. Certification appears to be most common when workers are exposed to traffic (e.g., flagger training) or working with hazardous materials (e.g., pesticide training).

Agencies were also asked to provide information on why certification might be offered in a particular content area. They were prompted to select all reasons that applied. Fifteen agencies said they do not offer certification. Of those that do, as shown in Figure 15, 21 indicated that certification is offered on topics related to safety, liability, and insurance issues. Agency history (17 respondents) and federal, state, or provincial mandates (16 respondents) were the two other main reasons for offering certification. Respondents that selected other reasons for offering certification did not provide any additional explanation.

TABLE 4
SOURCES OF INSTRUCTORS AND FACILITATORS FOR MAINTENANCE TRAINING

	DOT Employees	Contracted Instructors	Equipment Manufacturers	LTAPs	Unions	Community Colleges	Other	Number of Responses
Bridges	26	15	7	5	1	4	4	30
Highway Safety and Reliability	31	15	7	7	1	2	6	34
Pavements	31	9	4	5	1	2	5	33
Roadway/Roadside	33	10	6	5	1	2	4	36
General Maintenance Skills	37	9	7	5	1	4	4	39

TABLE 5
TRAINING AND CERTIFICATION REQUIREMENTS PER TECHNICAL CONTENT AREA

Technical Content Area	Training Required?				Certification Provided?			
	Yes	No	Don't know	Number of responses	Yes	No	Don't know	Number of responses
Bridges	17	10	3	30	6	15	9	30
Highway Safety and Reliability	26	7	1	34	16	15	3	34
Pavements	13	19	1	33	8	23	2	33
Roadway/Roadside	23	11	2	36	17	17	2	36
General Maintenance Skills	29	9	1	39	13	25	1	39

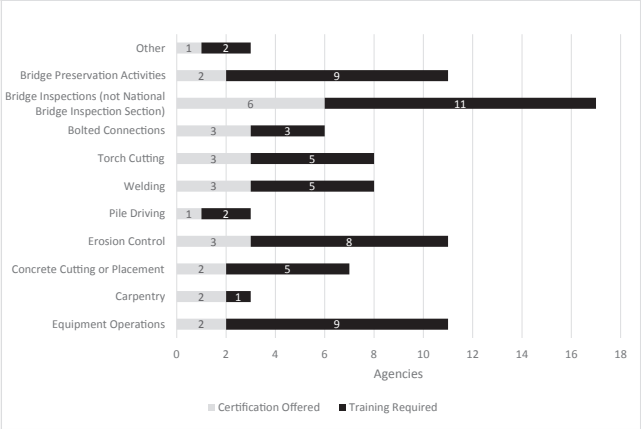


FIGURE 10 Bridge topics for which training is required or certification offered (17 and six responses, respectively).

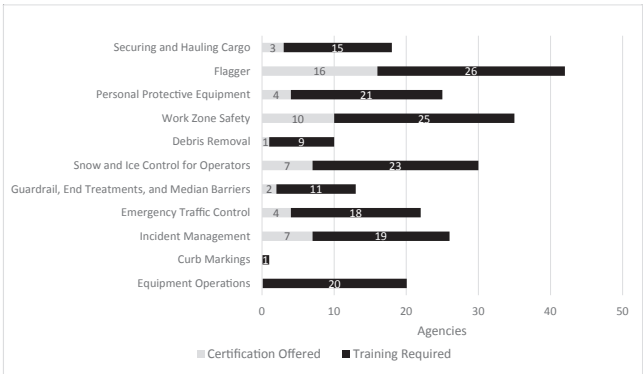


FIGURE 11 Highway safety and reliability topics for which training is required or certification offered (27 and 17 responses, respectively).

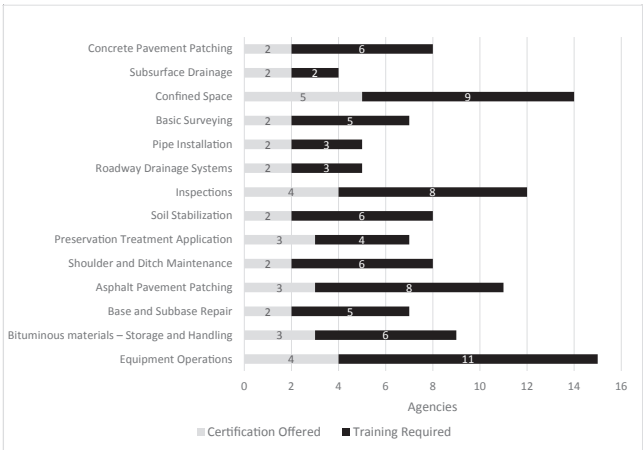


FIGURE 12 Pavement topics for which training is required or certification offered (13 and eight responses, respectively).

INCENTIVES TO TAKE TRAINING

The survey of practice included questions that focused on the incentives to take training that are offered by the highway transportation agency to better understand how agencies motivate front-line maintenance workers to complete training. Incentives include skill acquisition, advancement, and pay increases. These may be used alone or in conjunction with one another. They may also be used in conjunction with requirements and certification.

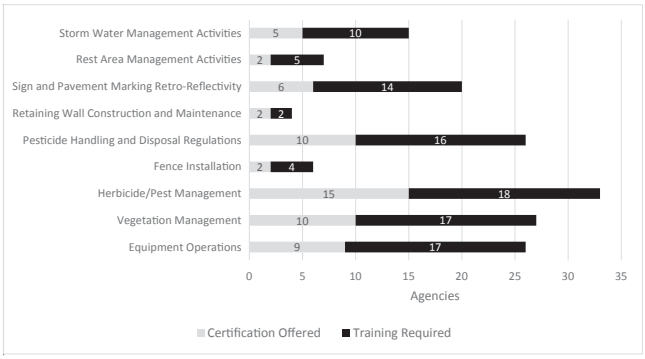


FIGURE 13 Roadway and roadside topics for which training is required or certification offered (23 and 17 responses, respectively).

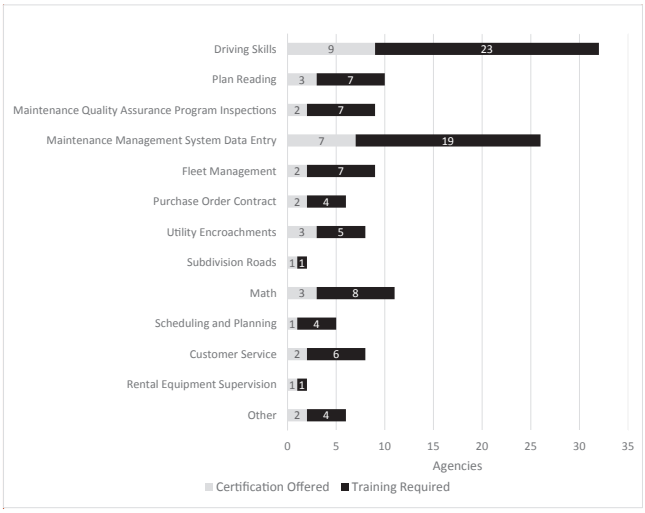


FIGURE 14 General maintenance skill topics for which training is required or certification offered (29 and 13 responses, respectively).

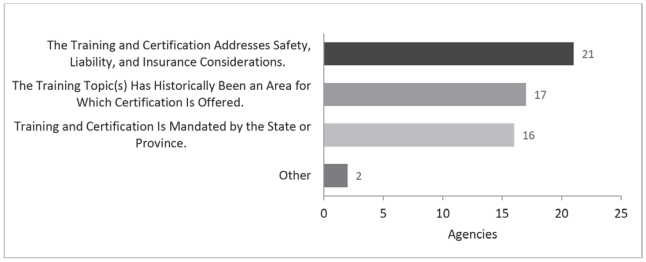


FIGURE 15 Reasons for offering worker certification (47 responses).

In addition, the survey included questions intended to identify whether training is formally aligned with employee performance evaluations and whether training contributes to employee advancement. These questions were designed to determine whether the workforce development path aligns

with training offerings, thus making the purpose of attending training and its benefits clear to maintenance workers.

Finally, the survey included questions on the subject of the extent to which supervisors support training enrollment and completion. As per the survey, supervisors also may play a crucial role in disseminating information about employee training requirements and their connection to professional development.

Twenty-two highway agencies indicated that they provide incentives to maintenance workers to take training. Agencies that responded affirmatively to this question were asked to identify the types of training incentives they used. As shown in Table 6, there were a variety of answers. The agency that selected "other" stated that workers are automatically promoted, resulting in a wage increase.

TABLE 6
INCENTIVES PROVIDED TO ENCOURAGE PARTICIPATION IN TRAINING

Training Incentives	Count
Completion of training allows workers to acquire new skills or keep pace with technology	17
Completion of training qualifies workers for promotion	16
Completion of training qualifies workers for specific jobs (such as inspector)	12
Completion of training is linked to a wage increase	12
Completion of training is necessary to retain employment	11
Other	1
Number of Agencies Responding to the Question	22

According to the survey results, 24 of 44 agencies consider their training programs to be aligned with maintenance worker performance requirements (those responding affirmatively to this question responded to the next question). Sixteen of the 24 agencies use participation in technical training as a factor in evaluating performance (those responding affirmatively to this question responded to the next question). Fourteen of the 16 agencies that consider training in evaluating performance indicated that they formally document training on the performance evaluation. These responses are all included in Table 7.

TABLE 7
ALIGNING TRAINING PROGRAM OFFERINGS WITH MAINTENANCE WORKER PERFORMANCE REQUIREMENTS

Question	Yes	No	Number of Responses
Does your organization align its training program offerings with maintenance worker performance requirements?	24	20	44
Is worker participation in technical training a factor in evaluating performance?	16	8	24
Is worker participation in technical training formally documented on the performance evaluation?	14	2	16

To learn more about the involvement of supervisors in recommending training, participating agencies were asked two questions. First, the agencies were asked to identify whether supervisors regularly recommend training for maintenance workers in order to improve performance and possibly advance. Second, they were asked if the promotion of a front-line maintenance worker is dependent on the completion of certain training requirements. Responses to both questions are found in Table 8.

TABLE 8
SUPERVISOR RECOMMENDATIONS FOR TRAINING, AND TRAINING REQUIREMENTS FOR PROMOTION

Question	Yes	No	Don't Know	Number of Responses
Do supervisors regularly recommend training for maintenance workers to attend in order to improve performance and possibly advance?	35	6	6	47
Is the promotion of a front-line maintenance worker dependent on the completion of certain training requirements?	28	19	0	47

FREQUENCY OF TRAINING EVENTS AND TRACKING PARTICIPATION

A series of questions were included in the survey of practice to determine how frequently maintenance workers access training and whether they have opportunities to refresh knowledge and skills training as needed during their length of employment. Together with information about training length and delivery method, the responses help form a complete picture of an agency's training program for front-line maintenance workers.

First, the participants were asked a question about the frequency with which the average maintenance worker participates in mandatory training. As shown in Figure 16, 21 of the 47 responding agencies indicated that maintenance employees participate in mandatory training more than once a year, and 18 agencies reported that maintenance employees participate in training at least once a year.

Participants were also asked to identify the frequency with which the average maintenance worker participates in nonmandatory training. The response breakdown, as shown in Figure 17, was similar to that for mandatory training. A total of 19 agencies indicated maintenance employees participate in nonmandatory training more than once a year, and 15 agencies reported that the average maintenance worker participates in nonmandatory training at least once a year. However, five respondents indicated they did not know the answer to this question because no formal process for reporting participation in nonmandatory training existed.

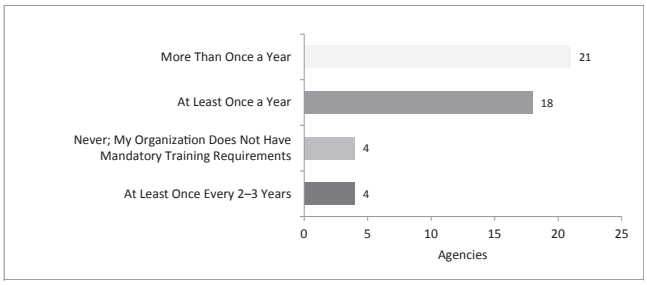


FIGURE 16 Frequency of participation in mandatory training for the average maintenance worker (47 responses).

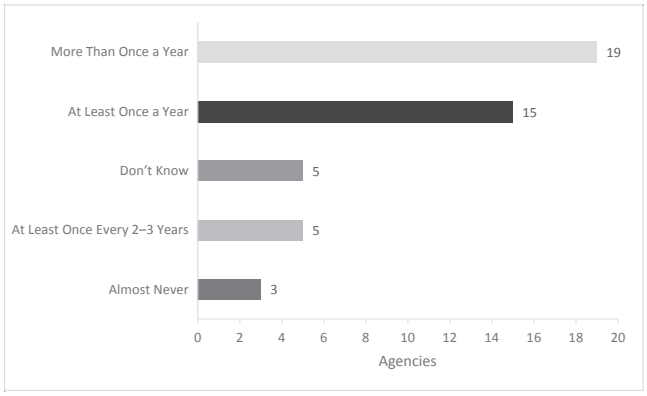


FIGURE 17 Frequency of participation in nonmandatory training (47 responses).

The survey also asked participants to provide information on the frequency with which training is repeated. Agencies were able to select multiple responses (see Figure 18). Twenty-three agencies indicated that certain training must be retaken after a certain amount of time, and 20 agencies indicated it could be done at the suggestion of a supervisor. Thirteen agencies stated training could be retaken any time, and an equivalent number indicated training could be retaken at the next scheduled session.

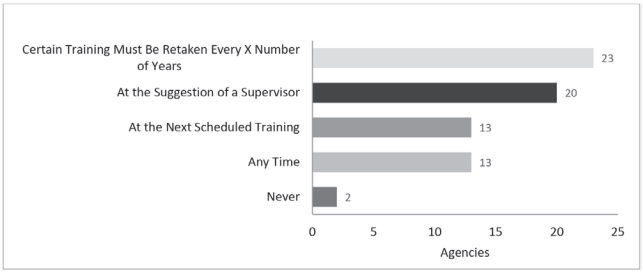


FIGURE 18 Frequency with which training is retaken to refresh knowledge and skills (47 responses).

EVALUATING THE EFFECTS OF TRAINING ON WORKER PERFORMANCE AND THE ORGANIZATION

Because training represents a significant investment for most agencies, the survey of practice included questions to determine if agencies measure the impact of training on either the individual maintenance worker or the agency. If agencies identified that they are collecting such data for either, additional questions followed about how that information is being collected. The data collection options represented both subjective and objective methods, with the option to provide additional information by selecting the "other" category.

As shown in Figure 19, few of the agencies that responded to the survey measure the effectiveness of training on worker performance.

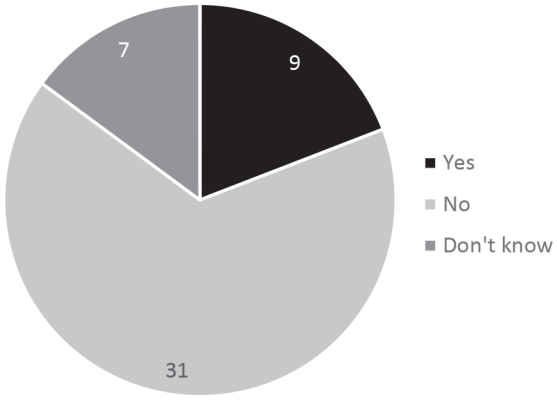


FIGURE 19 Number of agencies measuring the effectiveness of training on worker performance (47 responses).

The nine states that measure training effectiveness on worker performance were asked to document the method used, and the results are presented in Table 9. Three of the agencies responding to this question provided multiple answers, indicating that a variety of methods are used. None of the agencies require supervisors to complete pre- and postevaluations of workers' performance following training. The agency that selected "other" as a response indicated that the agency uses "ongoing assessment" to measure the effectiveness of training on worker performance.

TABLE 9
METHODS USED TO MEASURE TRAINING EFFECTIVENESS

In Order to Determine the Impact of Training on Worker Performance, My Agency….	Number of Responses
Collects feedback from participants within 1 year of training being completed via a survey, performance evaluation, or follow-up call with a representative from the human resources or training departments	2
Administers an evaluation to each participant at the end of training that includes questions about whether the training will help them complete their work	9
Requires supervisors to complete pre- and posttraining evaluation forms of worker performance. Posttraining evaluations are completed within 1 year of participant attending training.	0
Other	1
Number of Agencies Responding	9

A similar question was asked to determine whether agencies measure the impact of training on the organization. As Figure 20 shows, only eight of 47 respondents replied in the affirmative. The other answers were either "no" (over half of the responses) or "don't know."

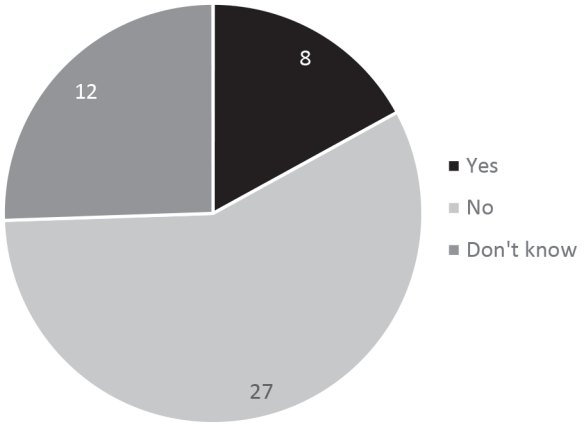


FIGURE 20 Number of agencies measuring the impact of training on the organization (47 responses).

The eight agencies that monitor the impact of training on the organization were asked to provide information on how that is done (see Table 10). A total of five agencies conduct an annual survey to measure the training impact on the organization, and three agencies rely on pre- and posttraining evaluations to measure training effectiveness. The agency that selected "other" reported that "in-house safety incident frequency" is used to measure the effectiveness of training on the organization.

TABLE 10
IN ORDER TO DETERMINE WHETHER TRAINING HAS IMPACTED THE ORGANIZATION, MY ORGANIZATION . . .

Methods of Collecting Measurement Data	Number of Responses
Administers an annual survey to gather feedback on the impact of training on the maintenance program	5
Compiles all pre- and post-training evaluation results and runs an analysis to determine the impact of training on worker performance	3
Hires a consultant to evaluate the training program and report recommendations and issues	1
Other	1
Number of Agencies Responding to the Question	8

TRAINING DEVELOPMENT

In this final section of the survey, highway transportation agencies were asked to document their in-house training efforts to help determine the degree to which in-house and outsourced training efforts are used. Questions in this part of the survey also asked agencies to identify their biggest training need to help guide future course development or sharing of training materials across agencies.

As shown in Figure 21, 43 of the 47 agencies that provide training indicated that they develop training materials in-house. Of the 43 agencies that develop training in-house, 33 indicated that more than 50% of their training is developed in-house.

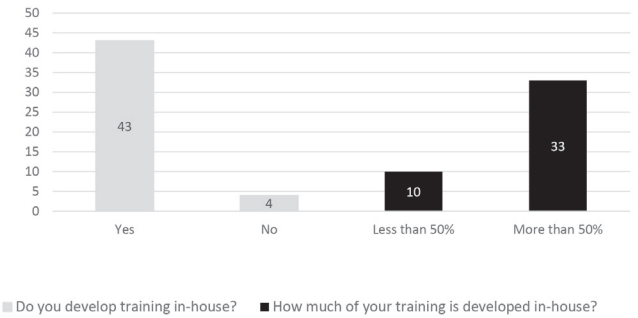


FIGURE 21 Number of agencies developing training in-house and percentage of training being developed in-house (47 and 43 responses, respectively).

Agencies were asked to identify the content areas for which there were training gaps. In other words, for which areas is there insufficient training content to support training needs? Responses are presented in Figure 22. As the figure shows, the greatest training needs are in the general maintenance skills area.

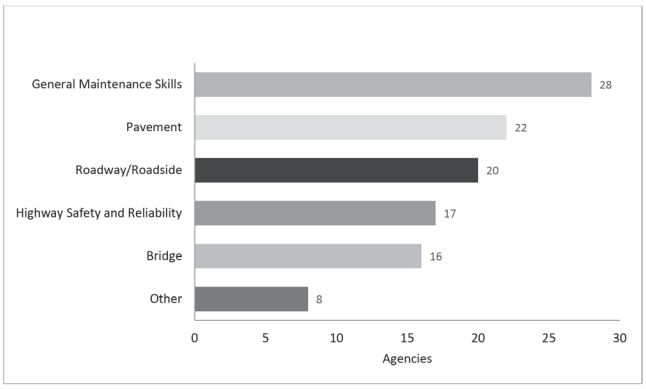


FIGURE 22 Training gaps (47 responses).

Respondents were able to choose subtopics for each general technical content area selected for additional training. Specific topics that would address the training needs in each content area are presented in Figures 23–27.

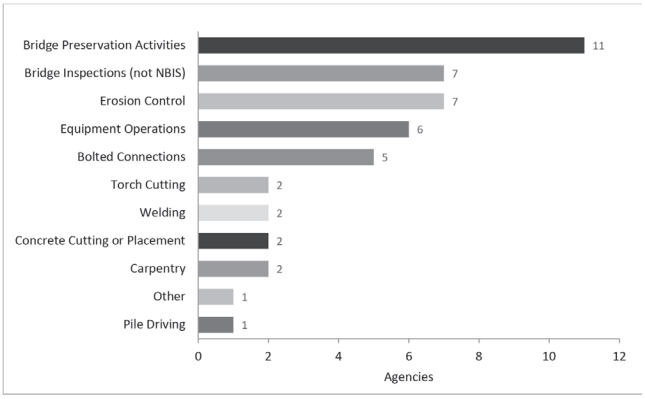


FIGURE 23 Bridge training gaps (16 responses).

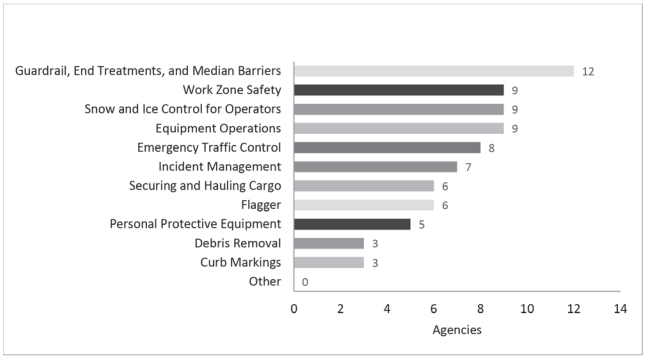


FIGURE 24 Highway safety and reliability training gaps (16 responses).

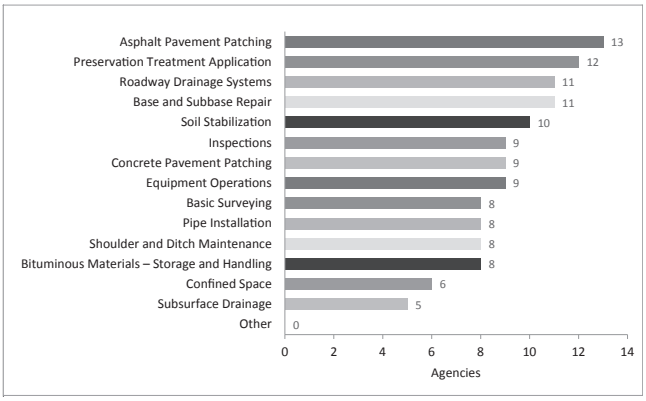


FIGURE 25 Pavement training gaps (22 responses).

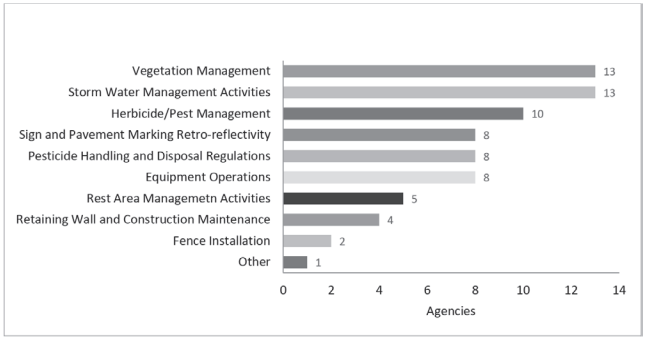


FIGURE 26 Roadway and roadside training gaps (19 responses).

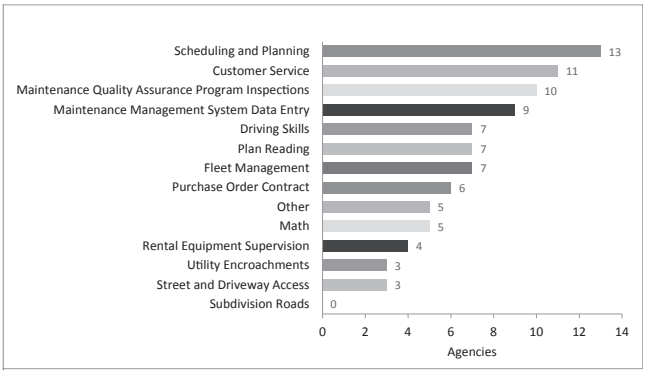


FIGURE 27 General maintenance skills training gaps (28 responses).

CHAPTER FOUR

CASE EXAMPLES

APPROACH

Three topics were identified through analysis of the survey responses as being appropriate for in-depth review. For each topic, at least two highway transportation agencies were interviewed in order to give a broader perspective of how agencies were addressing the following topics:

- Delivery methods: what methods of delivery impact are being utilized and why?
- Training and resource sharing opportunities: what partnerships and resources have been established to extend limited maintenance training resources and how do they operate?
- Training and performance: how well are training efforts aligned with performance expectations for maintenance workers?

The eight state transportation agencies selected to participate in the interviews (Alaska, California, Idaho, Iowa, Missouri, North Carolina, South Carolina, and Utah) were chosen based on several factors, including their expressed willingness to provide additional information, their continued involvement in training maintenance workers, and their availability to participate in the interviews. Other factors, such as the following, were considered so that a range of program characteristics and approaches were represented in the case examples:

- The utilization of multiple delivery methods (e.g., online, mobile, or video to provide training);
- The utilization of partnerships to develop and deliver training; and
- The existence of a well-structured or well-documented training program (e.g., training aligns clearly with workforce development objectives and there is a learning management system for tracking training).

A summary of some of the characteristics provided during the survey of state practice for each agency that participated in the interviews is provided in Table 11.

In addition, interviews were conducted with representatives from the Clear Roads research program, TC3, and UGPTI. Each of these organizations works with highway transportation agencies to develop and deliver training.

TABLE 11
CHARACTERISTICS OF THE STATE DOTs INTERVIEWED

State	Number of Front-Line Maintenance Workers	Use of Contract Maintenance	Methods Used to Deliver Training	Do You Share Training Materials with Other Organizations?	Does Your Organization Measure the Effectiveness of Training on Worker Performance?
Alaska	501–1,500	Less than 50%	Instructor-led, self-paced video	Yes	No
California	>3,000	Less than 50%	Instructor-led, on-the-job, self-paced correspondence	Yes	No
Idaho	501–1,500	Less than 50%	Instructor-led, on-the-job, self-paced web-based, web conference	Yes	Yes
Iowa	501–1,500	Less than 50%	Instructor-led, on-the-job, self-paced	No	No
Missouri	1,500–3,000	None	Instructor-led, on-the-job, self-paced web-based	Yes	No
North Carolina	1,500–3,000	Less than 50%	Instructor-led, self-paced web-based	Yes	No
South Carolina	1,500–3,000	Less than 50%	Instructor-led, on-the-job, self-paced web-based	Yes	No
Utah	501–1,500	Less than 50%	Instructor-led, on-the-job, self-paced web-based, web conference	Yes	Yes

The information presented in this chapter is not intended to provide a comprehensive summary of the practices in any of the eight states that participated in the interviews. Rather, only the highlights of the discussions in each of the three areas are provided to focus on the findings and overall lessons learned.

DELIVERY METHODS

The previous chapter discussed the preponderance of on-the-job and instructor-led training delivery methods at highway transportation agencies. These two methods are still the most widely used methods for delivering front-line maintenance training and are considered to be the most effective, whether used alone or in conjunction with one another. Yet several highway transportation agencies documented the use of alternative delivery methods. The motivation to use and implement these methods is the focus of this section. Five state transportation agencies (California, Iowa, Idaho, South Carolina, and Utah) and UGPTI were interviewed about the delivery methods they use to provide maintenance training.

Self-Paced Correspondence Courses

The California DOT was selected for closer scrutiny in this area owing to its use of correspondence courses for providing roadside and general maintenance skills training. The correspondence courses were developed and implemented with assistance from consultants in the late 1980s. Several different topics are covered under each category, as shown in Table 12.

TABLE 12
HIGHWAY MAINTENANCE CORRESPONDENCE COURSES OFFERED BY THE CALIFORNIA DEPARTMENT OF TRANSPORTATION (2015)

Volume	Title
I	Pre-Operations
	Chapter 1: Safety
	Chapter 2: Telecommunications
	Chapter 3: Equipment Management and Preventative Maintenance
II	Roadbed Maintenance
	Chapter 1: Bases and Subbases
	Chapter 2: Flexible Roadbed
	Chapter 3: Rigid Roadbed
	Chapter 4: Shoulders and Bicycle Facilities
III	Roadside Maintenance
	Chapter 1: Drainage
	Chapter 2: Guardrail, Median Barriers, and Crash Cushions
	Chapter 3: Fences
	Chapter 4: Litter, Debris, and Spills
	Chapter 5: Slides, Slipouts, and Storm Patrol
IV	Traffic Control Device Maintenance
	Chapter 1: Pavement Delineation
	Chapter 2: Signs
	Chapter 3: Guide Markers
	Chapter 4: Electrical Devices
V	Specialized Maintenance
	Chapter 1: Maintenance of Structures
	Chapter 2: Maintenance of Public Service Facilities
	Chapter 3: Operations of Moveable Bridges, Tunnels, Tubes, Ferry Boats, and Toll Plazas
	Chapter 4: Snow Removal, Ice Control, and Avalanche Control
	Chapter 5: Maintenance and the Environment
VI	Plan Reading
VII	Practical Mathematics

Source: Bishop and Wagner-Tyack (1986).

The process for completing a correspondence course involves several steps. First, an interested employee requests the course(s) to complete. Second, the content is made available through the agency's intranet training website. An employee's supervisor can print the content or have it printed by his or her staff. Next, the employee completes the training on his or her own and sets the schedule for completion. Once the training is complete, the employee is expected to submit the final exam answer sheet to his or her supervision chain of command. At that point, the employee receives a certificate of completion and the course is recorded on the employee's training history. Completion of this process can vary from district to district, which is a challenge. Other challenges to using this delivery method are maintaining the course content and increasing the amount of participation among field maintenance staff statewide.

Currently the agency has a plan to update the content, adding courses on topics that have expanded since the 1980s, such as storm water and environmental issues. Once the content is updated, the courses will be redesigned as interactive, web-based courses so that employees can access the material on the Internet from their own personal computers or smartphones. The DOT is also considering methods to encourage supervisors to use small portions of the courses at tailgate safety meetings to train all their employees over time.

California DOT has been using this type of self-paced training for over three decades. The agency has a high level of satisfaction with this method. The DOT is satisfied with this type of training because it does the following:

- Allows new employees to acquire the knowledge they need about the proper way maintenance work is to be accomplished rather than relying on coworkers to teach this information;
- Provides the proper terminology on topics, establishing a baseline vocabulary for the entire staff; this vocabulary is acquired in a safe learning environment (i.e., free of judgment);

- Allows the employees to complete the courses at their own speed and does not remove them from field operations for long periods; most supervisors allow work hours to be used to complete the courses when available; and
- Ties promotional exams and training together; questions on the promotional exams have been formulated based on the course content.

On-the-Job Training

Iowa DOT relies heavily on the use of on-the-job training to deliver front-line maintenance training. The use of this delivery method is not unusual, as the survey results indicated. However, on-the-job training can require a tremendous number of agency resources to work successfully. The Iowa DOT has overcome these resource issues to deliver an effective maintenance training program using in-house staff, as discussed here.

The Iowa DOT supports a comprehensive on-the-job training program for front-line maintenance workers. When Iowa DOT started its on-the-job training program, it was to focus on several key components related to certification areas and to train all construction and maintenance employees to support all of Iowa DOT's project needs. Then additional skills training needs were identified. It was determined that the necessary skills were most effectively taught by means of on-the-job training because this delivery method allowed an experienced employee to verify that the skills were mastered by the trainee. Because both the trainer and trainee were already on the project, training could be facilitated more quickly and efficiently than with classroom training. In Iowa, classroom training risked being overset by weather events and other demands on maintenance staff's time. With the on-the-job training method, that issue was mitigated. On-the-job training also appealed to Iowa DOT because the training could be customized for each project based on the skill level of the available staff, and could be provided "just in time."

To develop the program, Iowa DOT identified content that would be appropriate for on-the-job training and a plan for keeping the content current. At the district level, Iowa DOT developed checklists of requisite skills for various maintenance (and construction) positions. The checklists are used in the field by trainers to guide on-the-job training and to track mastery for each employee. Annually, the district engineer and district construction and maintenance manager review upcoming projects, staffing availability, skills, and certification status to affirm the training content and to schedule training for assigned staff.

Iowa DOT uses experienced maintenance employees to deliver on-the-job training, unless the training is required for certification. Certification courses may utilize contractors or other technical experts. The trainers are committed to the training program and have their supervisor's support to participate. Once someone is selected and approved to be a trainer, that person participates in in-house facilitator training. Additional, formal train-the-trainer sessions may be offered if the trainer is also providing certification training. Potential trainers are tested to confirm their mastery of the on-the-job training content.

Iowa DOT developed a process for training and tracking completion, which follows the progression described here:

- The trainer works with the maintenance trainee one-on-one until the trainer is confident in the trainee's ability to work independently.
- The trainer completes a checklist for the employee to indicate mastery of skills and readiness to perform job tasks independently.
- The trainer makes that recommendation to the supervisor.
- The supervisor maintains records of employee completion. (The human resources department is in the process of acquiring a new software system that will capture and store employee on-the-job training completion records. That system will integrate tracking, recording, notification, and training. Human resources anticipates the software will be up and running by Fall 2015.)

Iowa DOT identified several issues with on-the-job training that they are working to address or plan to address in the future. One issue is the time it takes to bring one person up to speed on all construction and maintenance skills. Iowa DOT is addressing this issue during the hiring process, identifying candidates for hire that already have the requisite construction and maintenance skills, thus requiring less training.

Another issue is the risk of inconsistency inherent in on-the-job training, given the number of trainers across the state. Variance in trainers' ability and approach can result in a lack of uniformity across training topics (there are 1,000 maintenance employees across six districts with 109 maintenance garages). Although this risk is offset by the ability to provide localized, customized training, a plan is under consideration to revive Iowa's Maintenance Academy for the entire workforce, rather than only new employees. This would allow for more uniform delivery of certain topics. New employees would continue to get field training in order to acquire the necessary skills immediately required to perform their work.

There is also an issue with maintaining skills if there are not enough opportunities (projects) available to practice applying newly acquired skills. No specific plan has been identified to address this issue.

Cross-Training

As a result of interviews with Iowa DOT about its on-the-job training program, it came to light that the agency is also using

cross-training for construction and maintenance workers in an effort to make the most effective use of the existing staff. Cross-training is being used in conjunction with on-the-job training. (The prevalence and structure of cross-training programs across the United States are currently being researched and documented under NCHRP 20-68a: U.S. Domestic Program Scan 13-01: Advances in Developing a Cross-Trained Workforce. Iowa is participating in that effort.)

In Iowa, the goal is to have everyone in maintenance and construction trained to perform certain work, such as sample hot-mix asphalt pavements. The expectation is that at each technician level, employees will master and maintain certain basic skills. In order to advance, maintenance technicians must acquire additional skills, which can also result in incentive pay if the employee works outside of his or her class to complete training or certification.

An example of how cross-training works within the on-the-job training program is as follows. Maintenance workers need to be trained to perform construction inspections. A maintenance employee who needs to develop this skill is paired with a seasoned construction employee for a certain amount of time. The seasoned employee provides guidance and oversight to the trainee (not necessarily using a formal checklist) until a recommendation is made to the supervisor regarding the trainee's ability to complete the job independently. Tracking of completion may or may not be formally recorded by the supervisor.

Web-Based Training

Web-based training is delivered online through the Internet or intranet. The training is completed independently according to the participant's pace and schedule, making it an appropriate delivery option for front-line maintenance workers whose schedules are often affected by unplanned events. As the survey indicated, web-based training has become a common delivery option for specific types of content in certain states. Two state transportation agencies were interviewed to illustrate why highway transportation agencies are choosing web-based training and how they are supporting web-based training at their agencies. The selected agencies include the South Carolina DOT and the Idaho Transportation Department (ITD).

South Carolina DOT transitioned to web-based training as the predominant method of delivering maintenance training in 2008–2009. Several circumstances led to this decision. First, South Carolina DOT was an active member of TC3, which had decided to pursue web-based training course developments. The agency's experience with web-based training up until that point had been satisfactory, particularly concerning the flexibility web-based training offered (e.g., self-paced is easily reviewed). Since South Carolina DOT's training department largely focused on soft skills training and state-specific procedures and policy training, using TC3's web-based training products gave the South Carolina DOT access to much of the basic maintenance knowledge and skills training it needed. In addition, South Carolina DOT had an employee developing web-based trainings for safety, so maintenance decided to utilize this employee's skills for the development of web-based maintenance trainings as well.

When South Carolina DOT identifies a maintenance training need, its first step is to identify the availability of existing content through TC3 or another resource. If no training exists, South Carolina DOT identifies all of the existing resources that can be utilized for web-based training purposes (e.g., presentations and videos) and uses them to develop the product in-house.

South Carolina DOT invested in a learning management system to make the web-based training content available to employees. The learning management system allows employees to register, take, and track completion of training. South Carolina DOT currently has an effort in progress to develop a mandatory curriculum for maintenance employees. Existing web-based training courses will be a part of that curriculum. Using the learning management system, an employee's progress completing mandatory training can be easily tracked. This information can eventually be used to conduct performance evaluations, including providing data to support recommendations for advancement and wage increases.

ITD had reasons similar to South Carolina DOT's for embracing web-based training. ITD wanted greater flexibility in providing training for its approximately 560 employees, who are spread over a large geographic area. It was a considerable challenge to coordinate schedules and transport employees to a single training site for a single training event. In addition, ITD wanted to minimize the risk of an emergency situation derailing training. In a state with so many winter weather events, this can pose a considerable challenge. ITD also wanted to be able to respond to changes in the workforce, which was increasingly younger and more comfortable with online training.

ITD was initially introduced to the idea of self-paced training through participation in a pooled-fund study to develop computer-based winter maintenance training. Then ITD became a member of TC3 and began utilizing the web-based training products offered by that organization, such as modules on basic math, plan reading, and materials. Now ITD uses web-based training to support its workforce development program, for which training is an integral part. A maintenance employee must complete 70 hours of training in the first two career steps of the program. Many of those training hours are satisfied using web-based training. The

use of web-based training allows ITD to get instant feedback on an employee's mastery of specific knowledge and skills through the use of online exams and evaluations.

Web and Video Conference Training

Web and video conference training is delivered through an online web or video conferencing system; an instructor is present to facilitate instruction. Given the favor shown by highway transportation agencies for delivery methods that allow for trainer-trainee interaction, it is not a surprise that some states are seeking ways to preserve this interaction while also reducing delivery costs by using web or video conference training. To highlight the use of these delivery methods, Utah DOT (UDOT) and UGPTI at North Dakota State University were interviewed to explore how they utilize these methods in support of maintenance training.

UDOT has been using web conference training for 10 years. UDOT's transition to web conference training came out of an initial effort to certify all construction personnel as part of a cross-training effort. The certification program was delivered on a web conference platform to minimize travel and facility costs and to minimize scheduling conflicts. Web conference training also allowed UDOT to record live sessions and share them with those unable to participate. Eventually UDOT realized the value of training all maintenance personnel in this way.

As the web conference training certification effort was proceeding, UDOT was developing the Transportation Education Program (TEP) in conjunction with a community college. TEP's purpose is also to support UDOT's cross-training effort for construction and maintenance. Its objective is to improve the knowledge, skills, and abilities of construction and maintenance workers so they can move between the two activities. TEP was initially developed as classroom-based training but was switched to mainly web conference and web-based training to reduce delivery costs. As a result of making the switch from classroom to web conference and web-based training, UDOT's operating costs to deliver TEP were almost halved.

To get the web conference training programs up and running, UDOT had to identify a web conferencing platform and sites in each region where employees could go to participate in web conference sessions. (Employees now have the ability to participate in web conference training from a computer at a maintenance shed or from home.) UDOT is also in the process of implementing a learning management system to centralize registration, tracking, and reporting, tasks previously completed by the regional training managers.

Most UDOT web conference training developments are done in-house, unless videos produced by other agencies, such as TC3, are utilized. The ability to develop state-specific content is one reason in-house development is used. Recently, UDOT hired an instructional systems designer to enhance its in-house development capabilities and a training program manager to oversee all of its training products. Delivery of web conference training courses is often done using UDOT staff, who also provide much of UDOT's non-TEP maintenance and construction training. The community college also provides instructors as needed.

UGPTI is actively using video conferencing to support the Transportation Learning Network (TLN) (www.Translearning.org), which is a partnership between four DOTs (North Dakota, South Dakota, Wyoming, and Montana) and the Mountain Plains Consortium (eight universities and colleges). TLN members work together to develop and deliver new and innovative technology transfer content applicable to the membership.

Each state is solicited to identify potential technology and skill transfer topics on an annual basis. A list of topics are compiled and the states prioritize these topics (see Table 13

TABLE 13
EXAMPLE LIST OF PRIORITIES FOR TLN TRAINING

Course Name	Program Area	Description and Learning Objectives	Course Length	Suggestion Source	Target Audience
Hearing Conservation and Protection	Maintenance	Education on effects of hearing loss due to work environment and steps to prevent hearing loss	2 h	NDDOT	Maintenance and construction
Truck Mounted Attenuator—TMA	Maintenance	Proper techniques when operating a TMA	2 h	NDDOT	Maintenance
Pavement Marking for Maintenance Employees	Maintenance	Introduction to various pavement marking materials available and procedures for installation and best service life	2 h	SDDOT	Maintenance, local
Asphalt Paving Operations for Maintenance Staff	Maintenance		TBD	NDDOT	Maintenance field staff and supervisors
NHI—Guardrail Maintenance Techniques	Maintenance	Regular items to inspect or issues to look for Coordinating repairs and materials consideration Liability issues	7 h	SDDOT	Maintenance and guardrail design staff

for an example). TLN member states typically develop the content for each approved topic/course. UGPTI's role is to develop and host top priority training to support technology transfer efforts. Typically this equates to 30 to 50 training events hosted per year from November to May. Video conference topics have included pavement preservation, safety, hydraulics, geotech, project management, erosion and sediment control, and soft skills.

To support the video conference training deliveries, UGPTI established approximately 40 sites across the four states and provided them with high-definition equipment (e.g., cameras and screens). Then three sites were selected from which to broadcast the training.

All training participants register and access the training through UGPTI's learning management system. Participants use sign-in sheets at the training sites to document their attendance. At the conclusion of the training, site coordinators administer paper-based evaluations. These are collected and mailed or scanned back to UGPTI. UGPTI compiles the evaluations and makes the attendance and evaluation data available to the member states. This information is also tracked in the learning management system.

UGPTI reports certain issues with video conference training that they actively manage. One issue is with bandwidth limitations, which occasionally interfere with delivering video conference training. Another area that requires careful consideration for video conference delivery is the presence of a well-trained support staff. Finally, UGPTI recommends conducting a needs assessment and thoroughly vetting all video conference systems before selecting a system for use. UGPTI indicates that it is essential that the system purchased supports all of the agency's needs.

MATERIALS SHARING

As documented in the previous chapter, 34 of 47 agencies that were surveyed share training materials. Training partners vary by agency and can include other highway transportation agencies, LTAPs, community colleges, and transportation training organizations. Agencies share all types of materials, including instructor-led training and web-based training. The sharing relationships can be formal, such as participation in TC3, or informal, such as sending an e-mail requesting materials to a distribution list. Whatever form it takes, sharing materials plays an essential role in the training and certification of front-line maintenance workers.

The benefits of sharing materials are evident. For instance, sharing allows highway transportation agencies to access a greater pool of training resources than they could likely develop on their own. This section documents sharing experiences between Alaska DOT and the APWA and other transportation groups, as well as pooled-fund activities sponsored by the Clear Roads research program and TC3.

The Alaska Department of Transportation and Public Facilities (ADOTPF) Division of Maintenance and Operations maintains a sharing relationship that may appear familiar to many highway transportation agencies. ADOTPF is a member of local, regional, and national chapters of transportation industry groups, specifically AASHTO, Western Association of State Highway and Transportation Officials, and APWA. ADOTPF uses its participation in these groups to share ADOTPF's maintenance training materials and to request materials when a need arises. Most of this sharing is done informally, with an e-mail sent out to members. More formal needs identification can occur at the three annual meetings of AASHTO, Western Association of State Highway and Transportation Officials, and APWA Winter Maintenance Subcommittee, of which ADOTPF is a member.

Much of the training ADOTPF makes available is video training (an example of a shared video training can be viewed at http://dot.alaska.gov/stwdmno/psa_video.shtml). ADOTPF accesses training material of all varieties, including APWA's Winter Maintenance Supervisor program (http://www.apwa.net/learn/certificates/winter-maintenance-supervisor-certificate). ADOTPF may use APWA to deliver the courses, such as with the Winter Maintenance Supervisor program, or use internal staff.

ADOTPF has realized a tremendous benefit from these sharing relationships. First, the agency acknowledges a savings of time and resources by not reinventing the wheel on training materials. If ADOTPF has a need, the agency can usually find someone within the network who has addressed that need and is willing to provide materials or even deliver training. Sharing also provides ADOTPF with new training ideas that can be evaluated, developed, and implemented to best suit the agency. Finally, these sharing relationships also allow ADOTPF to grow its resource network and identify the most useful sources for certain content and types of materials.

CLEAR ROADS

The Clear Roads research program (http://clearroads.org/) supports the development of training materials that can be shared by member agencies. One of their primary activities is supporting "technology transfer by developing practical field guides and training curriculum to promote the results of research projects" (Clear Roads, http://clearroads.org/, accessed June 9, 2015). The Clear Roads program's approach is as follows: "By evaluating materials, equipment, and methods in real-world conditions, the program identifies the most effective techniques and technologies to save agencies money, improve safety, and increase efficiency" (Clear Roads, http://clearroads.org/, accessed June 9, 2015).

Previously, Clear Roads supported a pooled-fund effort to develop computer-based training for snowplow drivers, maintenance crews, and others. As part of a current research project, Clear Roads is creating 25 instructor-led training modules of varying lengths for state workforce crews on snowplow operations. The instructor-led training modules are designed for different experience levels. The resulting instructor-led training products will be available to all 29 Clear Road member agencies.

TC3 (http://tc3.transportation.org) is a national collaboration that identifies gaps in highway transportation training content and provides subject-matter expertise to get courses developed and maintained. TC3 is an all-volunteer organization; all committee members have full-time jobs at DOTs across the country.

Several respondents to the survey identified TC3 as a sharing partner. Indeed, TC3 lists 30 state agencies as members and, as of 2015, has had 100,000 participants complete TC3 courses. Currently, states can access TC3 training for free through the National Highway Institute's website. Member states, who contribute $20,000 annually to participate, can load TC3 products directly to their state's learning management system, in addition to receiving technical support to accomplish the transfer. Eventually, TC3 expects to have its own learning management system in place. After that point, courses will be free only to member states.

The current free status of web-based training content makes it an affordable resource for highway transportation agencies. For its $20,000 investment, the agency gains direct access to approximately $300,000 worth of training material. In addition, TC3 members can direct new development efforts: TC3 usually develops 20 instructional hours per year.

TC3 provides additional benefits to members and nonmembers. TC3 maintains competency matrices for maintenance workers. Those competency matrices are mapped to the available training. TC3 also prioritizes training needs. Finally, with the implementation of its own learning management system, TC3 can offer a way for states without a learning management system to track training completion.

LINKING TRAINING TO PERFORMANCE

The ability to connect training to performance requirements is essential for a successful workforce development program. As previously stated, it is important to link training and performance so employees clearly understand the expectations of the job, how those expectations are to be met, and the incentives available to meet those expectations. The purpose of this section is to delve into the practices of three agencies that are successfully establishing the link between training and performance at their agencies.

NCDOT's Skill-Based Pay Program was the focus of an article published in 2000 and was part of the literature review conducted for this synthesis (Aschbrenner et al. 2000). North Carolina consented to participate in an interview about this program at an interesting time in the program's history. The state legislature had recently instructed the DOT that it did not have the authority to conduct the program in its current form, so the DOT restructured some aspects of the program while maintaining the program's core functions.

The DOT's Skill-Based Pay Program is designed to promote flexibility and equity among transportation workers, and to help the department remain competitive in the marketplace. It addresses the training needs of employees for career development and supports the department's Performance Management Program. NCDOT's Skill-Based Pay Program initially identified six levels of competency within four functional area groups. For each competency within each level, various skills, tasks, and abilities are identified. Employees are required to master these in order to be certified at that competency level and advance. Currently, advancing through a competency level does not automatically result in an increase in pay, but there is an effort in progress to return to a merit-based pay system.

These competencies are directly related to performance. Each employee has a performance development plan that documents the following:

- The existing skills at their competency,
- The skills that they plan to attain, and
- A plan for how they will master the skills to advance.

The program has three phases. The first phase is testing. Following the completion of self-paced training, an employee can identify his or her readiness to complete an exam. By passing this written exam, the maintenance employee demonstrates mastery of basic knowledge and procedures required to advance to the next phase: on-the-job training. During on-the-job training, a trainee is paired with a certified instructor or experienced maintenance employee. The trainee must pass performance-based tests in order to move on to the final phase: certification.

The cornerstone of NCDOT's program is its learning management system, which tracks all training. The learning management system allows NCDOT to track class completion, scores, and certifications for every employee. The system can administer and score exams. It sends updates to supervisors notifying them about an employee's readiness to advance a competency level.

Missouri DOT (MODOT) implemented a program in 2012 called the Gear Up Program. The program's goal is to train and retain new front-line maintenance employees. The training employees receive in Gear Up is directly aligned with employee performance expectations. Gear Up consists of one week-long training program that employees attend immediately upon hire. This training outlines performance expectations and provides basic training in various categories related to the performance expectations, including safety and equipment operations. At the conclusion of a 90-day probation period, employees participate in a 1-day training that focuses on expectations aligned with equal employment opportunities and other soft skill requirements. In the 18 months following the employee's start date, on-the-job training for equipment operations occurs. During this time, employees also have the support of a peer mentor. At the conclusion of the program, employees attend a wrap-up session that serves as a refresher of all the information they have gained in their first year. In this session employees are required to fill out a final satisfaction survey for the program.

MODOT's employee development team collects evaluation data measuring the employee's experience in the Gear Up program in addition to collecting anecdotal data from the mentor and supervisor on the employee's performance and readiness to perform required tasks (see Figure 28). MODOT

On-the-Job Training Checklist

Dump Truck & Cargo Securement

Employee :_____ Mentor:_____ Date OJT Started:_____

*Check **YES** when the new employee has demonstrated the knowledge and ability to perform the competency*
*Check **N/A (non-applicable)** if the competency does not apply to the employee*

SAFETY BEGINS WITH ME — I'm Safe | What I Use Is Safe | Where I Am Is Safe | My Customers Are Safe | So We Go Home Safe

			General	
Y	N	N/A	Wears appropriate clothing/PPE for work assigned	
Y	N	N/A	Seeks assistance when uncertain/offers help when needed	
Y	N	N/A	Is aware of surroundings/employees at all times	
			Inspection	
Y	N	N/A	Demonstrates pre-trip inspection and documentation	
Y	N	N/A	Demonstrates post-trip inspection and documentation	
			General Operations	
Y	N	N/A	Uses 3-Points of contact when entering/exiting	
Y	N	N/A	Demonstrates proper start-up procedure	
Y	N	N/A	Uses spotter and performs circle check every time	
Y	N	N/A	Properly backs truck during various maintenance operations	
Y	N	N/A	Demonstrates proper shut-down procedure	
Y	N	N/A	Demonstrates proper use of state radio	
			Is capable of properly/safely:	
Y	N	N/A	Operating loaded truck	
Y	N	N/A	Operating a truck in adverse conditions (Wet, Snow, Icy, etc...)	
Y	N	N/A	Operating a truck in traffic	
Y	N	N/A	Fueling truck at end of shift	
Y	N	N/A	Dumping materials at stockpiles	
Y	N	N/A	Operating ALL controls efficiently	
			Preventative Maintenance	
Y	N	N/A	Uses Lock Out Tag Out (LOTO) when servicing truck	
Y	N	N/A	Is capable of properly performing PM 1 service	
Y	N	N/A	Uses proper fluid types	
Y	N	N/A	Disposes of materials	
Y	N	N/A	Records usage, documents service and records inspections	
Y	N	N/A	Performs general cleaning and care as needed	

			Attachments
Y	N	N/A	Able to hook up attachments to hydraulic system
Y	N	N/A	Able to attach and operate a front mount/rear broom
			Cargo Securement - Driver Responsibilities
Y	N	N/A	Understands drivers responsibility when securing cargo
Y	N	N/A	Knows vehicles MAX height regulation: 13'6"
Y	N	N/A	Knows vehicles MAX width regulation: 8"6"
Y	N	N/A	Regularly identifies clearance signs while operating vehicle
Y	N	N/A	Knows the truck and/or trailer GVW & GCVW
Y	N	N/A	Ensures tailgate is secured and latched properly
Y	N	N/A	Ensures material is confined in the bed and there is no unconfined loose material
Y	N	N/A	Demonstrates understanding and proper use of Center of Gravity and how it relates to loading equipment
Y	N	N/A	Understands not to overload equipment
Y	N	N/A	Understands when and how to use and secure the tarp
Y	N	N/A	Discuss and demonstrate the appropriate ways to secure different types of cargo (i.e. tools, cinder beds, securing load on the trailer etc.).
Y	N	N/A	Understands how to determine the number of Tie-Downs needed to properly secure the cargo
Y	N	N/A	Identifies and selects proper tie-down devices based cargo
Y	N	N/A	Identifies and selects proper anchor points on cargo and vehicle/ trailer
Y	N	N/A	Understands the difference of Direct and Indirect Securement methods
Y	N	N/A	Demonstrates Direct securement methods
Y	N	N/A	Understands when Indirect securement methods are allowed
Y	N	N/A	Regularly inspects tie-downs, chains, binders and straps for dam age.
Y	N	N/A	Is able to determine the number of Tie-Downs needed to properly secure heavy equipment *Grade 70 chain for securing heavy equipment

Comments:_____

_____

_____

OJT Completion Date:_____ **Trainer Signature:**_____

Employee Signature:_____ **Supervisor Signature:**_____

Successful Employees Sooner *LMS # 24487-OJT*

FIGURE 28 Example of a Missouri Department of Transporation on-the-job training checklist.

flags comments submitted by trainees and mentors indicating issues with the training and performance. This information is sent either to the mentor and supervisor, or to human resources, as applicable. The compiled data are also sent to the entire employee development team and human resources management to help identify any issues with the training products and future needs. In addition, analysis results have been used by leadership to support business decisions.

Soon MODOT will have sufficient data from each district to indicate the program's impact on employee turnover and retention. It will use this information to improve the program and better align training and performance.

ITD puts significant emphasis on winter performance standards. So much so that within the last year, ITD developed a career step program that ties a maintenance employee's career advancement to his or her maintenance team's ability to meet minimum winter maintenance performance requirements. Each maintenance team has to meet the minimum winter maintenance performance standard. If the team meets the standard, which is reviewed annually, team members can advance up the career ladder. If the team fails to meet the minimum standard, there is no advancement that year. To see the performance metrics as shown by the ITD Dashboard, see Figures 29 and 30.

Maintenance staff must complete at least 70 hours of training within each career step in order to acquire the skills necessary to meet the performance target. Each step of the career path includes online training, on-the-job training, simulator training, classroom training, and equipment performance exams. Performance exams are administered in a one-on-one setting, similar to a commercial driver's license exam. The exams are administered by a supervisor who has received training as an examiner, has had his or her performance evaluated with the specific equipment, and is not a direct supervisor of the employee. All training completion and exam scores are tracked in the learning management system. IDT can monitor an employee's mastery of a specific knowledge base and training experience through the use of online exams and evaluations.

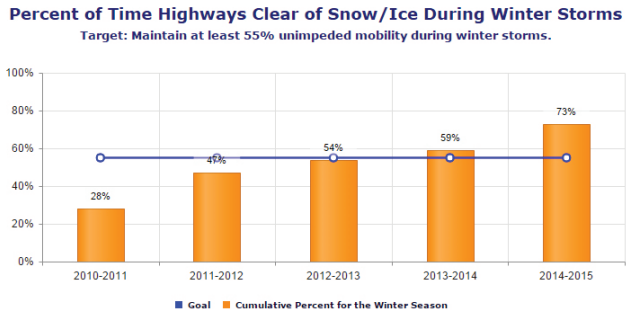


FIGURE 30 Idaho's winter maintenance performance data.

FIGURE 29 Idaho's Dashboard reflects winter maintenance performance measures.

CHAPTER FIVE

CONCLUSIONS

OVERALL FINDINGS

Training and certification programs for front-line maintenance workers vary considerably across transportation agencies in the United States and Canada. Although there is some relative consistency in the training content provided across the general content categories, delivery methods, requirements, incentives, frequency, and tracking all differ.

The survey of practice shows more than half of the 47 respondents provide training in bridges, highway safety and reliability, pavements, roadway/roadside, and general maintenance skills. The preferred method of delivering training is instructor-led training, on-the-job training, or a combination of the two.

The most common content areas for which training and certification are required is general maintenance skills, highway safety and reliability, and roadway/roadside. Agencies provide certification because of concerns about safety, liability, and insurance considerations.

More than half of the respondents do not use incentives to encourage training participation. For those agencies that do use incentives, the most frequently selected incentives dealt with skill development (allowing trainees to keep pace with technology) and promotional opportunities. More than half of the respondents indicated that maintenance training is aligned with performance requirements, with 16 agencies indicating they use training to evaluate performance and 14 stating they document training completion on performance evaluations. In addition, almost three-quarters of the respondents said that supervisors regularly recommend training for maintenance workers to attend in order to improve performance and possibly advance. More than half stated that the promotion of a front-line maintenance worker is dependent on the completion of certain training requirements.

The majority of the agencies indicated that maintenance employees attend mandatory and nonmandatory training at least once a year. Most training is retaken as refresher training after a certain time interval, although a little less than half of the agencies indicated training can be retaken at the suggestion of a supervisor.

Only nine agencies measure the impact of training on the employee, and only eight measure the impact of training on the organization. For those that collect data on the impact of training on the maintenance employee's performance, the most typical method used was an evaluation administered at the end of training to determine whether participants thought the training would help them complete their work. No states identified using more objective measures to determine the impact of training on an employee's performance. For those agencies measuring the impact of training on the organization, the most typical method used was an annual survey to gather feedback on the impact of training on the maintenance program.

Almost all of the agencies responded that they develop training in-house, and more than three-quarters of the respondents stated that more than 50% of their training products are developed this way.

Finally, agencies identified training needs for every general content area, although the area of need selected the most was general maintenance skills training. Some of the most-identified topics for training under general maintenance skills were planning and scheduling, customer service, and maintenance quality assurance program inspections.

Selecting Delivery Methods

The state and provincial agencies surveyed in this study indicated their preference for more traditional delivery methods for maintenance training and certification. Instructor-led training and on-the-job training are not only used the most frequently to deliver training for all content areas, they are the preferred method for delivering training. However, this synthesis also documents agencies' increasing reliance on alternative methods of training delivery, such as web-based, video conference, and web conference training. Agencies use these methods to save money (i.e., to reduce costs associated with travel, facilities, and instructor time), reduce scheduling issues, and provide greater flexibility to maintenance personnel by allowing them to set the pace and date for completion. Agencies also use alternative methods to deliver certain types of content, such as basic terminology and policy information, in conjunction with instructor-led training or on-the-job training.

Maximizing Training and Resource Sharing Opportunities

A significant number of highway transportation agencies report that they share training materials. The nature of these relationships is varied. Some have formal partnerships with other states, LTAPs, community colleges, or industry groups. Others utilize informal networks to obtain and share training materials. Regardless of the nature of the sharing relationships, it is evident that the existing relationships provide significant training support to the agencies utilizing them. TC3's data alone show that states that participate in this training partnership stand to realize a substantial return on their investment, and in turn, a substantial improvement in the quantity of materials maintenance employees can utilize.

Aligning Training and Performance

Several agencies are putting the mechanisms in place to align training and performance, if they have not done so already. These agencies are doing the following:

- Aligning performance requirements with training products;
- Acquiring a learning management system that can administer, compile, and disseminate evaluation data quickly and clearly or have an alternative, reliable method in place for completing and tracking training and performance evaluation; and
- Developing procedures for collecting evaluation data to determine training's impact on performance and retention.

FURTHER RESEARCH

The results from this synthesis identified several gaps in current knowledge that could be addressed by the research and outreach activities described here.

The results of this survey indicate that traditional methods of delivering training, such as instructor-led classroom training and on-the-job training, are still the most utilized delivery methods. Although some states are adopting technology-based delivery methods (e.g., web-based or web conference training), the reasons for the limited implementation of such options needs to be explored and examples of successful utilization of technology-based delivery methods with this audience documented. Additional research in this area would provide agencies with information about the barriers to successfully implementing this type of training, as well as the following:

- The types of content that could be taught successfully by means of technology-based delivery methods;
- The steps required to develop, deliver, and track training for technology-based delivery methods; and
- The costs associated with developing, delivering, and maintaining technology-based training products.

As the survey indicated, a need for more training was recorded in every technical content area and for almost every subtopic area. This list of needs could be utilized by training organizations such as TC3 and Clear Roads as they identify training needs and plan training developments. Greater effort is also needed to identify, compile, and communicate the availability of training materials regionally or nationally, as it is clear that several of the topics indicated as a training need did correspond to existing training products.

Finally, the survey indicates that further research is needed to document the alignment between training and performance expectations for front-line maintenance workers. The results of this survey indicate that although some states have made a concerted effort to define performance expectations and offer training that aligns with expectations, this is not being consistently done. Further information is needed on how agencies are doing the following:

- Aligning performance expectations with training products,
- Integrating training requirements into professional development and performance reviews,
- Communicating performance expectations and training requirements, and
- Tracking and documenting performance achievements and training completion.

ACRONYMS

ADOTPF	Alaska Department of Transportation and Public Facilities
APWA	American Public Works Association
DOT	Department of transportation
ITD	Idaho Transportation Department
LTAP	Local technical assistance program
MODOT	Missouri Department of Transportation
MOT	Ministry of transportation
NCDOT	North Carolina Department of Transportation
SCOM	Subcommittee on Maintenance
TC3	Transportation Curriculum Coordination Council
TEP	Transportation Education Program
TLN	Transportation Learning Network
UDOT	Utah Department of Transportation
UGPTI	Upper Great Plains Transportation Institute

REFERENCES

Aschbrenner, D.R., D. Domico, and A.M. Fountain II, "North Carolina DOT's Skill-Based Pay Program. A Working Model for Training and Compensating Highway Workers," *Transportation Research Record: Journal of the Transportation Research Board*, *No. 1729*, Transportation Research Board of the National Academies, Washington, D.C., 2000, pp. 3–11.

Bishop, M. and J. Wagner-Tyack, Maintenance Correspondence Course: Roadbed Maintenance, Division of Highway Maintenance, California Department of Transportation, Sacramento, Calif., 1986, 23 pp.

Committee on Future Surface Transportation Agency Human Resource Needs: Strategies for Recruiting, Training, and Retaining Personnel, *Special Report 275: The Workforce Challenge: Recruiting, Training, and Retaining Qualified Workers for Transportation and Transit Agencies*, Transportation Research Board of the National Academies, Washington, D.C., 2003, 206 pp.

Cristofaro, D., "Maintenance Testing: The ASE Certification Credential: What Does It Mean to Our Industry," *Mass Transit*, Dec. 2006 [Online]. Available: http://www.masstransitmag.com/article/10221279/maintenance-testing [accessed April 7, 2015].

Glitmana, K., *Transportation Workforce Development at Community Colleges*, Report #10-002, University of Vermont Transportation Research Center, Burlington, 2010, 35 pp.

Lees, P.L., *Cooperative Training Program*, FHWA/MT-02-014/8168, Montana Department of Transportation and Federal Highway Administration, Washington, D.C., 2002, 48 pp.

Leiphart, K.L. and C.N. Ngo, *Results from a Safety Survey: Workforce Development for Transportation Professionals*, Federal Highway Administration, Washington, D.C., 2002, 36 pp.

Lowrie, K.W., J.A. Shaw, and M.R. Greenberg, "Assessment of Surface Transportation Security Training Needs and Delivery Preferences," *Journal of Public Transportation*, Vol. 14, No. 4, University of South Florida, Tampa, 2011, pp. 109–130.

Morra, G.A., "World Bank Experience in Training of Road Maintenance Personnel," presented at the Pan American Highway Maintenance Conference, Los Angeles, Calif., Sept. 8–13, 1985.

Nakanishi, Y.J. and P.M. Auza, *NCHRP Synthesis 468: Interactive Training for All-Hazards Emergency Planning, Preparation, and Response for Maintenance and Operations Field Personnel*, Transportation Research Board, Washington, D.C., 2015, 184 pp.

Rahn, P.K., et al., *European Practices in Transportation Workforce Development*, Federal Highway Administration, Washington, D.C., 2003, 50 pp.

Rall, J., A. Wheet, N.J. Farber, and J.B. Reed, *Transportation Governance and Finance: A 50-State Review of State Legislatures and Departments of Transportation*, National Conference of State Legislatures and AASHTO Center for Excellence in Project Finance, Washington, D.C., 2011, 212 pp.

Transportation Curriculum Coordination Council (TC3), *Strategic Plan*, TC3, 2012 [Online]. Available: http://tccc.gov/files/strategicplan.pdf [accessed June 11, 2015].

Upper Great Plains Transportation Institute, *Copy of 2015–2016 Priorities for TLN Training*, UGPTI, Fargo, N.D., 2015.

Warne, T., *NCHRP Synthesis 323: Recruiting and Retaining Individuals in State Transportation Agencies*, Transportation Research Board, Washington, D.C., 2003, 70 pp.

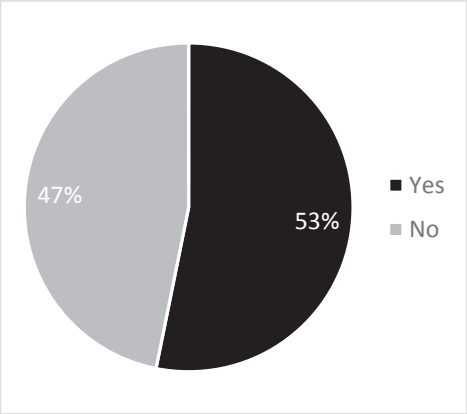
Wemhoff, D.W., "Equipment Mechanic Training and Certification,' In *TR Circular E-C163: Maintenance Management 2012*, presented at the 2012 AASHTO–TRB Maintenance Management Conference, July 15–19, 2012, Seattle, Wash. Transportation Research Board of the National Academies, Washington, D.C., 2012, pp. 41–45.

APPENDIX A

Survey Results

1. The synthesis will include three to five case examples to illustrate different training program practices being used. Would your organization be interested in participating in a case study?

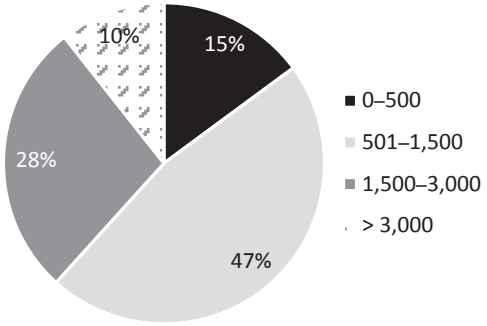
State	Yes/No
Alaska	Yes
Arizona	Yes
Arkansas	Yes
California	Yes
Colorado	Yes
Connecticut	Yes
Florida	No
Georgia	Yes
Idaho	Yes
Indiana	No
Iowa	Yes
Kansas	No
Kentucky	Yes
Maine	Yes
Maryland	Yes
Massachusetts	No
Michigan	Yes
Minnesota	No
Mississippi	No
Missouri	Yes
Montana	No
Nevada	Yes
New Hampshire	No
New Mexico	No
New York	Yes
North Carolina	Yes
North Dakota	Yes
Ohio	Yes
Oklahoma	No
Pennsylvania	No
Rhode Island	No
South Carolina	Yes
South Dakota	No
Tennessee	No
Texas	Yes
Utah	Yes
Virginia	No
Washington	Yes
West Virginia	No
Wisconsin	No
Wyoming	No
Alberta	Yes
New Brunswick	Yes
Northwest Territories	No
Ontario	No
Quebec	No
Saskatchewan	No



Yes	**25**
No	**22**

2. Select the state or province you represent, and [question] 3. Approximately how many front-line maintenance workers are employed by your state or provincial organization?

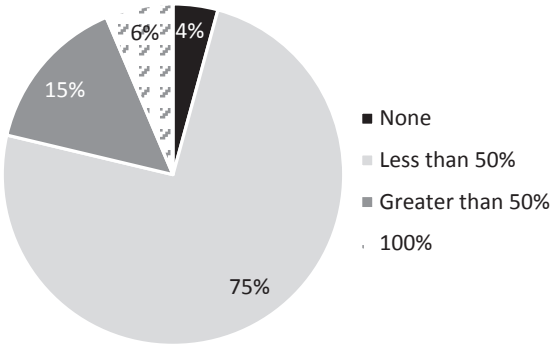
State	Front-Line Maintenance Workers Employed
Alaska	501–1,500
Arizona	501–1,500
Arkansas	1,500–3,000
California	Greater than 3,000
Colorado	501–1,500
Connecticut	501–1,500
Florida	501–1,500
Georgia	1,500–3,000
Idaho	501–1,500
Indiana	501–1,500
Iowa	501–1,500
Kansas	1,500–3,000
Kentucky	1,500–3,000
Maine	501–1,500
Maryland	501–1,500
Massachusetts	0–500
Michigan	0–500
Minnesota	501–1,500
Mississippi	501–1,500
Missouri	1,500–3,000
Montana	501–1,500
Nevada	501–1,500
New Hampshire	501–1,500
New Mexico	501–1,500
New York	1,500–3,000
North Carolina	1,500–3,000
North Dakota	0–500
Ohio	1,500–3,000
Oklahoma	501–1,500
Pennsylvania	Greater than 3,000
Rhode Island	0–500
South Carolina	1,500–3,000
South Dakota	501–1,500
Tennessee	1,500–3,000
Texas	Greater than 3,000
Utah	501–1,500
Virginia	501–1,500
Washington	1,500–3,000
West Virginia	Greater than 3,000
Wisconsin	501–1,500
Wyoming	0–500
Alberta	0–500
New Brunswick	501–1,500
Northwest Territories	0–500
Ontario	0–500
Quebec	Greater than 3,000
Saskatchewan	501–1,500



Answer Options	Agencies
0–500	8
501–1,500	23
1,500–3,000	11
> 3,000	5

4. What percentage of maintenance work is performed by contract?

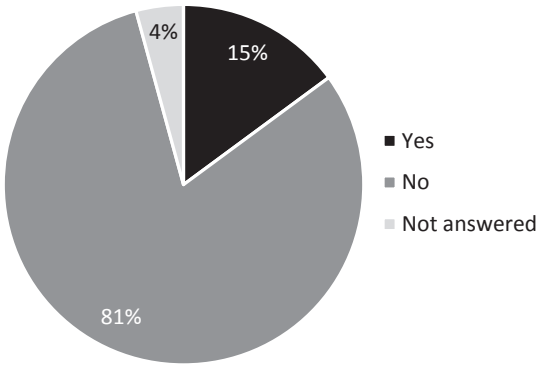
State	Percentage
Alaska	Less than 50%
Arizona	Less than 50%
Arkansas	Less than 50%
California	Less than 50%
Colorado	Less than 50%
Connecticut	Less than 50%
Florida	Greater than 50%
Georgia	Less than 50%
Idaho	Less than 50%
Indiana	Less than 50%
Iowa	Less than 50%
Kansas	Less than 50%
Kentucky	Less than 50%
Maine	Less than 50%
Maryland	Less than 50%
Massachusetts	Less than 50%
Michigan	Greater than 50%
Minnesota	Less than 50%
Mississippi	Less than 50%
Missouri	None
Montana	Less than 50%
Nevada	Less than 50%
New Hampshire	Less than 50%
New Mexico	Less than 50%
New York	Less than 50%
North Carolina	Less than 50%
North Dakota	Less than 50%
Ohio	Less than 50%
Oklahoma	Less than 50%
Pennsylvania	Less than 50%
Rhode Island	Greater than 50%
South Carolina	Less than 50%
South Dakota	Less than 50%
Tennessee	Less than 50%
Texas	Greater than 50%
Utah	Less than 50%
Virginia	Greater than 50%
Washington	Less than 50%
West Virginia	Less than 50%
Wisconsin	100%
Wyoming	Less than 50%
Alberta	100%
New Brunswick	Less than 50%
Northwest Territories	Greater than 50%
Ontario	100%
Quebec	Greater than 50%
Saskatchewan	None



Answer Options	Agencies
None	2
Less than 50%	35
Greater than 50%	7
100%	3

5. Does your state or province require contract workers to be trained and certified beyond federal requirements?

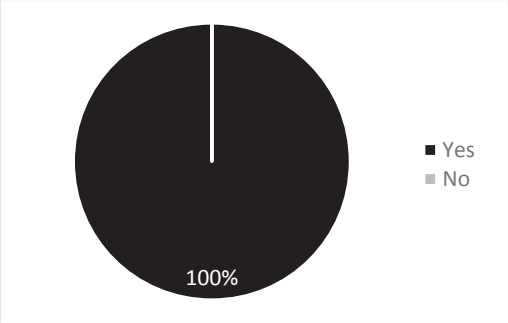
State	Yes/No
Alaska	No
Arizona	No
Arkansas	No
California	Yes
Colorado	No
Connecticut	No
Florida	Yes
Georgia	No
Idaho	No
Indiana	No
Iowa	No
Kansas	No
Kentucky	No
Maine	No
Maryland	No
Massachusetts	Yes
Michigan	No
Minnesota	No
Mississippi	No
Missouri	NA
Montana	No
Nevada	No
New Hampshire	No
New Mexico	No
New York	No
North Carolina	No
North Dakota	No
Ohio	No
Oklahoma	No
Pennsylvania	Yes
Rhode Island	No
South Carolina	No
South Dakota	No
Tennessee	No
Texas	No
Utah	Yes
Virginia	No
Washington	No
West Virginia	No
Wisconsin	No
Wyoming	No
Alberta	No
New Brunswick	Yes
Northwest Territories	No
Ontario	No
Quebec	Yes
Saskatchewan	NA



Answer Options	Agencies
Yes	7
No	38
Not answered	2

6. Do you require documentation verifying that training and certification requirements have been met?

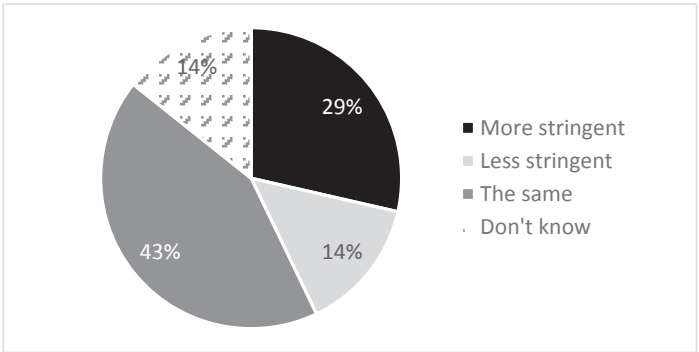
State	Verify?
California	Yes
Florida	Yes
Massachusetts	Yes
Pennsylvania	Yes
Utah	Yes
New Brunswick	Yes
Quebec	Yes



Answer Options	Agencies
Yes	7
No	0

7. In general, training and certification requirements are…

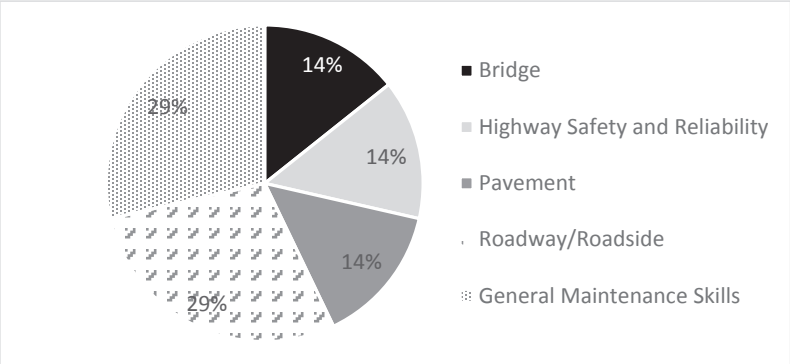
State	Response
California	More stringent for state and provincial maintenance workers than contract maintenance workers.
Florida	The same for state, provincial, and contract maintenance workers.
Massachusetts	The same for state, provincial, and contract maintenance workers.
Pennsylvania	Don't know.
Utah	More stringent for state and provincial maintenance workers than contract maintenance workers.
New Brunswick	The same for state, provincial, and contract maintenance workers.
Quebec	Less stringent for state and provincial maintenance workers than contract maintenance workers.



Answer Options	Agencies
More stringent	2
Less stringent	1
The same	3
Don't know	1

8. For which training categories do you have more stringent requirements for state and provincial maintenance workers?

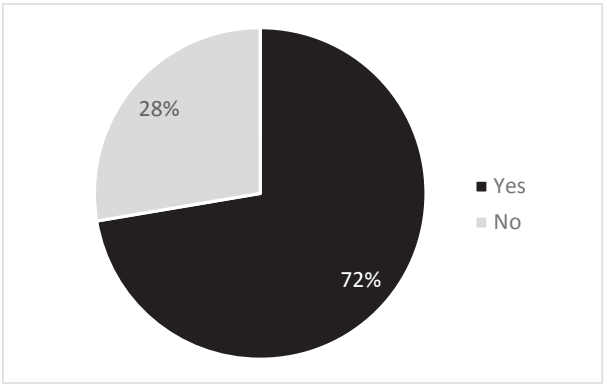
State	Training Categories
California	Bridges, Highway Safety and Reliability, Pavement, Roadway/Roadside, and General Maintenance Skills
Florida	
Massachusetts	
Pennsylvania	
Utah	Roadway/Roadside, and General Maintenance Skills
New Brunswick	
Quebec	



Answer Options	Agencies
Bridge	1
Highway Safety and Reliability	1
Pavement	1
Roadway/Roadside	2
General Maintenance Skills	2

9. Do you share training materials with other organizations?

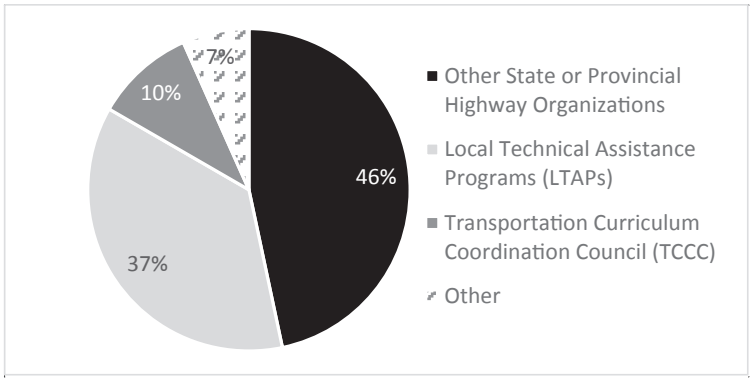
State	Yes/No
Alaska	Yes
Arizona	Yes
Arkansas	No
California	Yes
Colorado	Yes
Connecticut	Yes
Florida	Yes
Georgia	Yes
Idaho	Yes
Indiana	No
Iowa	No
Kansas	Yes
Kentucky	Yes
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Michigan	Yes
Minnesota	Yes
Mississippi	No
Missouri	Yes
Montana	Yes
Nevada	Yes
New Hampshire	Yes
New Mexico	Yes
New York	Yes
North Carolina	Yes
North Dakota	Yes
Ohio	No
Oklahoma	No
Pennsylvania	No
Rhode Island	Yes
South Carolina	Yes
South Dakota	Yes
Tennessee	No
Texas	Yes
Utah	Yes
Virginia	Yes
Washington	Yes
West Virginia	No
Wisconsin	No
Wyoming	Yes
Alberta	No
New Brunswick	Yes
Northwest Territories	Yes
Ontario	No
Quebec	Yes
Saskatchewan	No



Yes	34
No	13

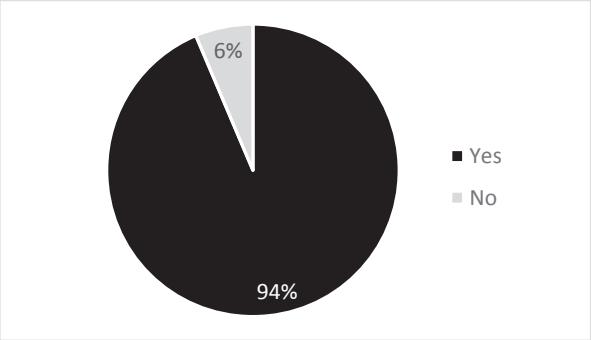
10. Select the organizations with whom you share materials. Select all that apply.

State	Other State or Provincial Highway Organizations	Local Technical Assistance Programs (LTAPs)	Transportation Curriculum Coordination Council (TCCC)	Other
Alaska	X			Local public agency members
Arizona	X	X		
Arkansas				
California	X			
Colorado	X	X		Local and county agencies
Connecticut	X			
Florida	X			
Georgia	X	X		
Idaho		X	X	
Indiana				
Iowa				
Kansas	X	X		
Kentucky	X	X	X	
Maine	X	X		
Maryland	X			
Massachusetts	X	X		
Michigan	X	X		
Minnesota	X	X		
Mississippi				
Missouri	X			
Montana	X	X		
Nevada				Public information by request
New Hampshire	X	X		
New Mexico				Local public agency
New York	X	X	X	
North Carolina	X			
North Dakota	X	X	X	
Ohio				
Oklahoma				
Pennsylvania				
Rhode Island	X	X		
South Carolina	X		X	
South Dakota	X	X		
Tennessee				
Texas	X			
Utah	X	X	X	
Virginia	X	X		
Washington		X		
West Virginia				
Wisconsin				
Wyoming	X	X		
Alberta				
New Brunswick	X			
Northwest Territories		X		
Ontario				
Quebec		X		
Saskatchewan				
Total Agencies	28	22	6	4



11. Do you offer technical training to front-line maintenance workers?

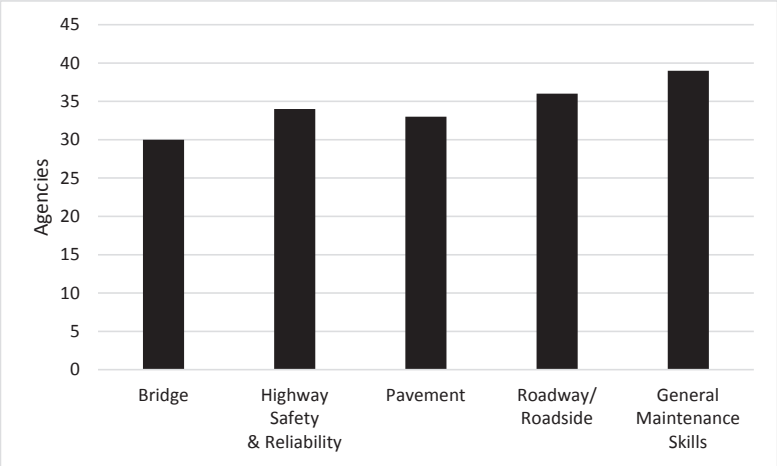
State	Yes/No
Alaska	Yes
Arizona	Yes
Arkansas	No
California	Yes
Colorado	Yes
Connecticut	Yes
Florida	Yes
Georgia	Yes
Idaho	Yes
Indiana	Yes
Iowa	Yes
Kansas	Yes
Kentucky	Yes
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Michigan	Yes
Minnesota	Yes
Mississippi	Yes
Missouri	Yes
Montana	Yes
Nevada	Yes
New Hampshire	Yes
New Mexico	Yes
New York	Yes
North Carolina	Yes
North Dakota	Yes
Ohio	Yes
Oklahoma	Yes
Pennsylvania	Yes
Rhode Island	Yes
South Carolina	Yes
South Dakota	Yes
Tennessee	Yes
Texas	Yes
Utah	Yes
Virginia	Yes
Washington	Yes
West Virginia	No
Wisconsin	No
Wyoming	Yes
Alberta	Yes
New Brunswick	Yes
Northwest Territories	Yes
Ontario	Yes
Quebec	Yes
Saskatchewan	Yes



Yes	44
No	3

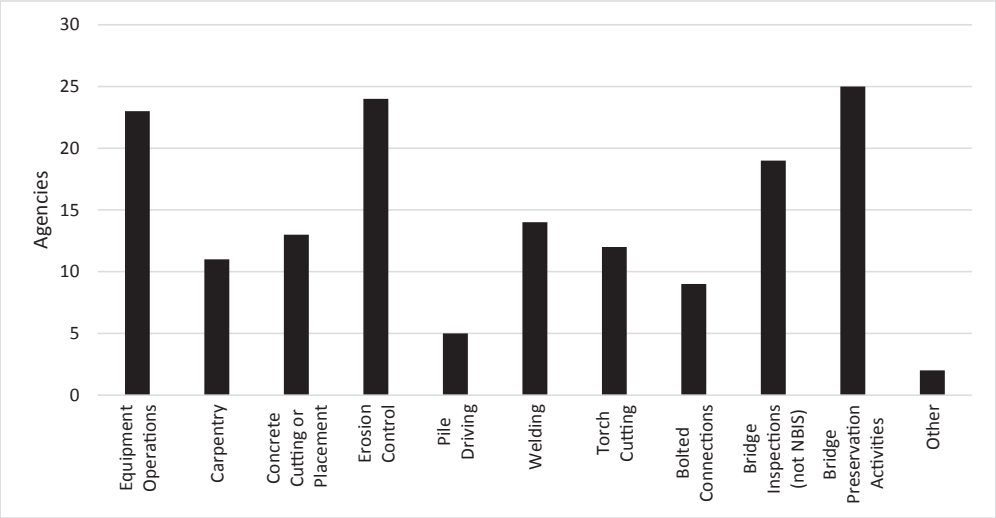
12. For which of the following areas do you offer technical training to front-line maintenance workers?

State	Bridges	Highway Safety & Reliability	Pavements	Roadway/ Roadside	General Maintenance Skills
Alaska			X	X	X
Arizona		X	X	X	X
California	X	X	X	X	X
Colorado	X	X	X	X	X
Connecticut	X	X	X	X	X
Florida		X	X	X	X
Georgia	X	X	X	X	X
Idaho	X	X	X	X	X
Indiana	X		X	X	
Iowa	X	X		X	X
Kansas	X	X	X		X
Kentucky		X	X	X	X
Maine	X	X	X	X	X
Maryland					X
Massachusetts	X	X	X	X	X
Michigan	X	X	X	X	X
Minnesota	X	X	X	X	X
Mississippi		X			
Missouri	X	X	X	X	X
Montana	X	X	X	X	X
Nevada	X	X	X	X	X
New Hampshire	X	X	X	X	X
New Mexico	X	X	X	X	X
New York	X	X	X	X	X
North Carolina			X		
North Dakota	X	X	X	X	X
Ohio	X	X	X	X	X
Oklahoma				X	
Pennsylvania	X	X	X	X	X
Rhode Island	X				X
South Carolina	X	X	X	X	X
South Dakota			X	X	
Tennessee		X			X
Texas	X	X	X	X	X
Utah		X		X	X
Virginia	X	X		X	X
Washington	X	X	X	X	X
Wyoming	X	X	X	X	X
Alberta	X	X	X	X	X
New Brunswick	X			X	X
Northwest Territories	X	X		X	X
Ontario					X
Quebec		X	X	X	X
Saskatchewan			X		X
Total Agencies	30	34	33	36	39



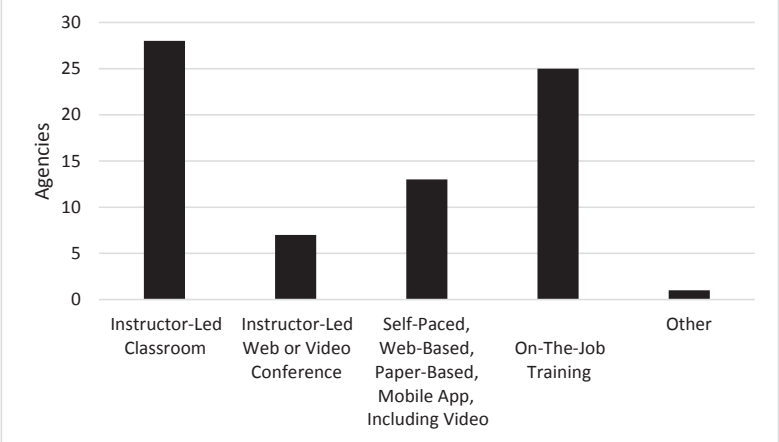
13. Select the bridge topics for which your organization offers training.

State	Equipment Operations	Carpentry	Concrete Cutting or Placement	Erosion Control	Pile Driving	Welding	Torch Cutting	Bolted Connections	Bridge Inspections (not NBIS)	Bridge Preservation Activities	Other
California	X	X	X	X		X	X	X	X	X	
Colorado	X		X	X		X	X		X	X	
Connecticut	X	X	X	X					X	X	
Georgia	X			X	X				X		
Idaho	X			X						X	
Indiana	X									X	
Iowa			X	X		X	X		X	X	
Kansas	X			X					X		
Maine	X	X	X	X		X	X		X	X	
Massachusetts	X	X	X	X	X	X	X	X	X	X	
Michigan				X						X	
Minnesota	X	X	X			X		X	X	X	
Missouri	X	X	X	X	X	X	X	X	X	X	
Montana				X					X		
Nevada	X	X	X	X		X	X			X	
New Hampshire	X					X	X	X		X	
New Mexico	X										
New York	X	X	X	X		X	X	X	X	X	
North Dakota				X					X	X	
Ohio	X				X				X	X	Bridge painting
Pennsylvania				X						X	
Rhode Island										X	
South Carolina	X	X	X	X	X	X		X		X	
Texas	X			X		X	X	X	X	X	On-the-job training
Virginia	X			X						X	
Washington	X	X	X	X		X	X	X	X	X	
Wyoming			X	X						X	
Alberta	X			X			X		X	X	
New Brunswick	X	X		X		X			X		
Northwest Territories	X			X					X	X	
Total Agencies	23	11	13	24	5	14	12	9	19	25	2



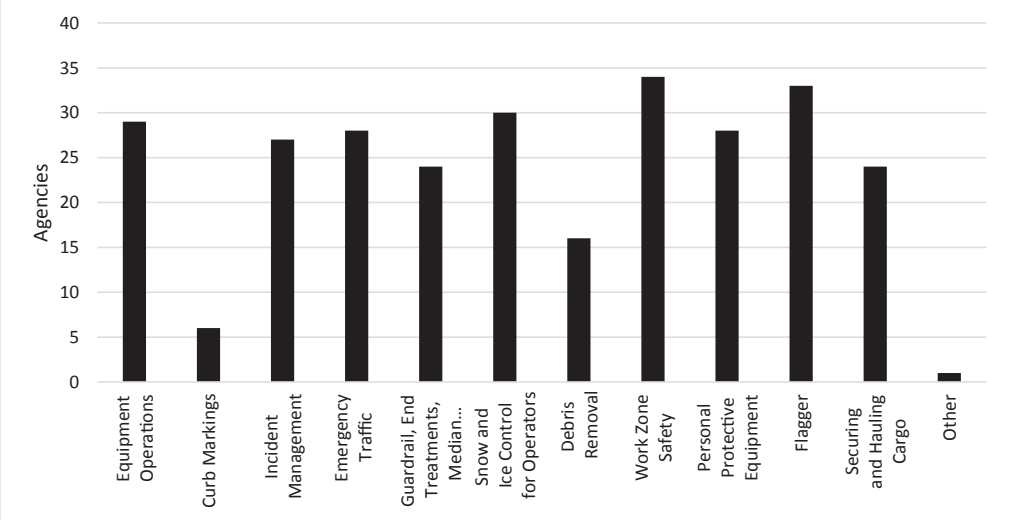
14. Which of the following methods do you use to deliver bridge training? Select all that apply.

State	Instructor-Led Classroom	Instructor-Led Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training	Other
California	X		X	X	
Colorado	X			X	
Connecticut	X	X		X	
Georgia	X			X	
Idaho	X		X		
Indiana	X			X	
Iowa	X		X	X	
Kansas	X			X	
Maine	X			X	
Massachusetts	X	X	X	X	
Michigan	X				
Minnesota	X		X	X	
Missouri	X		X	X	
Montana		X		X	
Nevada	X			X	
New Hampshire	X		X	X	
New Mexico					Don't know
New York	X	X	X	X	
North Dakota	X	X	X	X	
Ohio	X			X	
Pennsylvania	X	X		X	
Rhode Island	X				
South Carolina	X		X	X	
Texas	X			X	
Virginia	X			X	
Washington	X		X	X	
Wyoming	X	X			
Alberta	X		X	X	
New Brunswick	X			X	
Northwest Territories	X		X	X	
Total Agencies	28	7	13	25	1



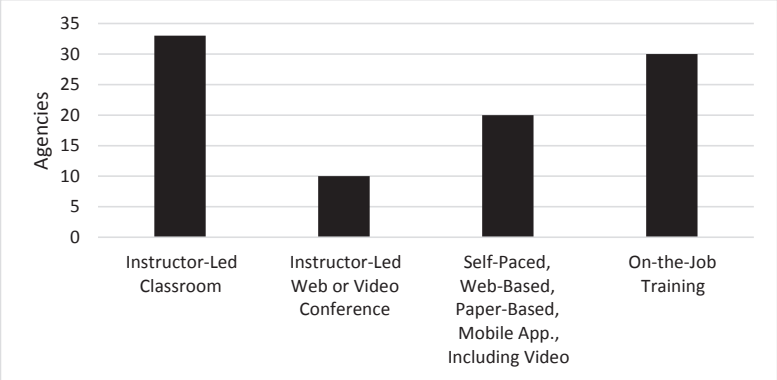
15. Select the highway safety and reliability topics for which your organization offers training.

State	Equipment Operations	Curb Markings	Incident Management	Emergency Traffic Control	Guardrail, End Treatments, and Median Barriers	Snow and Ice Control for Operators	Debris Removal	Work Zone Safety	Personal Protective Equipment	Flagger	Securing and Hauling Cargo	Other
Arizona	X		X	X	X	X		X	X	X	X	
California	X		X	X	X	X	X	X	X	X	X	
Colorado	X	X	X	X	X	X	X	X	X	X	X	
Connecticut	X		X	X	X	X		X	X	X	X	
Florida	X	X		X	X			X	X	X	X	
Georgia	X				X			X		X		
Idaho	X		X	X	X	X		X	X	X		
Iowa	X		X	X	X	X		X	X	X	X	
Kansas	X		X	X		X		X		X	X	
Kentucky	X		X	X	X	X	X	X	X	X	X	
Maine	X					X		X	X	X	X	
Massachusetts	X		X	X	X	X	X	X	X	X	X	
Michigan	X		X	X	X	X		X	X		X	
Minnesota	X			X	X	X		X	X	X	X	
Mississippi				X				X		X		
Missouri	X	X	X	X	X	X	X	X	X	X	X	
Montana	X		X	X	X	X	X	X	X	X	X	
Nevada	X	X	X	X	X	X	X	X	X	X	X	
New Hampshire	X		X	X	X	X		X	X	X		
New Mexico	X	X	X	X	X	X	X	X	X	X	X	
New York	X		X			X	X	X	X	X	X	
North Dakota	X		X	X	X	X		X	X	X	X	Tractor and mower safety, hydraulics, diesel exhaust fluid, electrical
Ohio	X		X	X	X	X	X	X	X	X	X	
Pennsylvania			X			X		X	X	X	X	
South Carolina	X		X	X		X		X	X	X	X	
Tennessee						X		X		X		
Texas	X		X	X		X	X	X	X	X	X	
Utah	X	X		X	X	X	X	X	X	X		
Virginia	X		X			X	X	X	X	X		
Washington	X		X	X	X	X	X	X	X	X	X	
Wyoming			X	X	X	X		X		X		
Alberta	X		X	X	X	X	X	X	X	X	X	
Northwest Territories	X		X	X	X	X	X	X	X	X		
Quebec			X	X				X		X		
Total Agencies	29	6	27	28	24	30	16	34	28	33	24	1



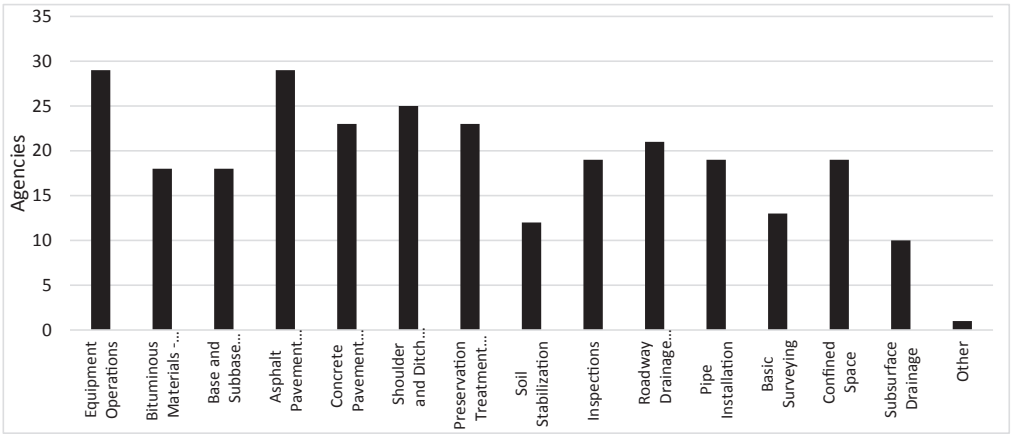
16. Which of the following methods do you use to deliver highway safety and reliability training? Select all that apply.

State	Instructor-Led Classroom	Instructor-Led Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training
Arizona	X		X	X
California	X		X	X
Colorado	X	X		X
Connecticut	X	X	X	X
Florida	X	X	X	X
Georgia	X	X		X
Idaho	X		X	X
Iowa	X		X	X
Kansas	X		X	X
Kentucky	X			X
Maine	X			X
Massachusetts	X		X	X
Michigan	X			X
Minnesota	X		X	X
Mississippi	X			
Missouri	X		X	X
Montana	X			X
Nevada	X			X
New Hampshire	X		X	X
New Mexico	X			
New York	X	X		X
North Dakota		X	X	
Ohio	X			X
Pennsylvania	X	X		X
South Carolina	X		X	X
Tennessee	X			X
Texas	X		X	X
Utah	X	X	X	X
Virginia	X		X	X
Washington	X		X	X
Wyoming	X	X		X
Alberta	X	X	X	X
Northwest Territories	X		X	X
Quebec	X		X	
Total Agencies	33	10	20	30



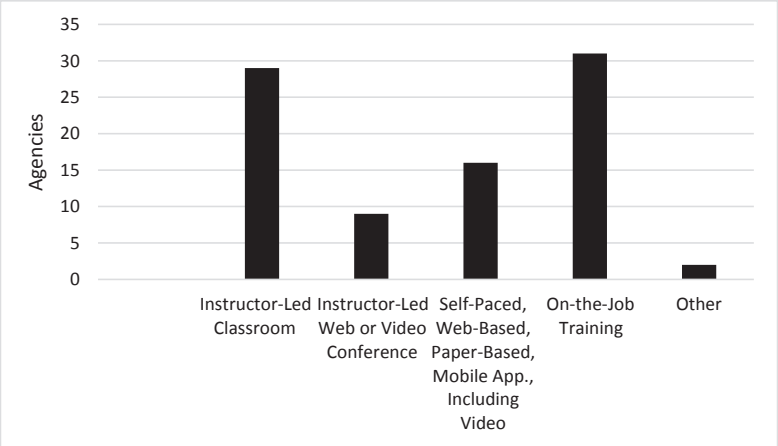
17. Select the pavement topics for which your organization offers training. (This category includes the following types of assets: paved shoulder, unpaved shoulder, paved roadway, culvert, flume, curb and gutter, sidewalk, ditch or slope, drop inlet, underdrain, and edgedrain.)

State	Equipment Operations	Bituminous Materials – Storage and Handling	Base and Subbase Repair	Asphalt Pavement Patching	Concrete Pavement Patching	Shoulder and Ditch Maintenance	Preservation Treatment Application	Soil Stabilization	Inspections	Roadway Drainage Systems	Pipe Installation	Basic Surveying	Confined Space	Subsurface Drainage	Other
Alaska	X			X											
Arizona	X	X		X	X	X	X	X	X			X			
California	X	X	X	X	X	X	X	X	X	X	X		X	X	
Colorado	X	X	X	X	X	X	X		X	X	X		X	X	
Connecticut	X	X		X		X	X	X	X	X	X	X	X	X	
Florida				X	X	X			X				X		
Georgia	X	X	X	X	X	X	X		X	X	X				
Idaho	X		X	X		X	X			X		X			
Indiana	X		X	X	X	X	X			X	X		X	X	
Kansas	X	X		X	X	X	X				X		X	X	
Kentucky	X	X	X	X	X	X			X	X	X				
Maine	X					X					X	X	X		
Massachusetts	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Michigan	X					X									
Minnesota	X	X	X	X		X	X	X	X	X	X	X	X	X	
Missouri	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Montana	X	X		X	X	X									
Nevada	X	X	X	X	X	X	X	X	X	X	X		X	X	
New Hampshire	X			X						X	X		X		
New Mexico	X	X	X	X	X	X	X	X	X	X	X				
New York	X			X	X	X	X			X	X		X	X	
North Carolina										X					
North Dakota			X	X	X	X	X	X		X	X	X			
Ohio	X	X	X	X	X	X		X	X	X		X			
Pennsylvania	X	X	X	X		X	X			X	X		X		
South Carolina	X		X	X	X	X	X		X	X	X	X			
South Dakota	X	X		X	X		X								
Texas	X	X	X	X	X		X	X	X			X	X		
Washington	X	X	X	X	X	X	X	X	X	X			X		
Wyoming	X		X	X	X		X				X	X	X		
Alberta	X			X	X				X	X			X		
Quebec				X	X	X	X		X			X	X		Pavement design and Pavement rehabilitations (rigid, asphalt)
Saskatchewan	X						X		X						
Total Agencies	29	18	18	29	23	25	23	12	19	21	19	13	19	10	1



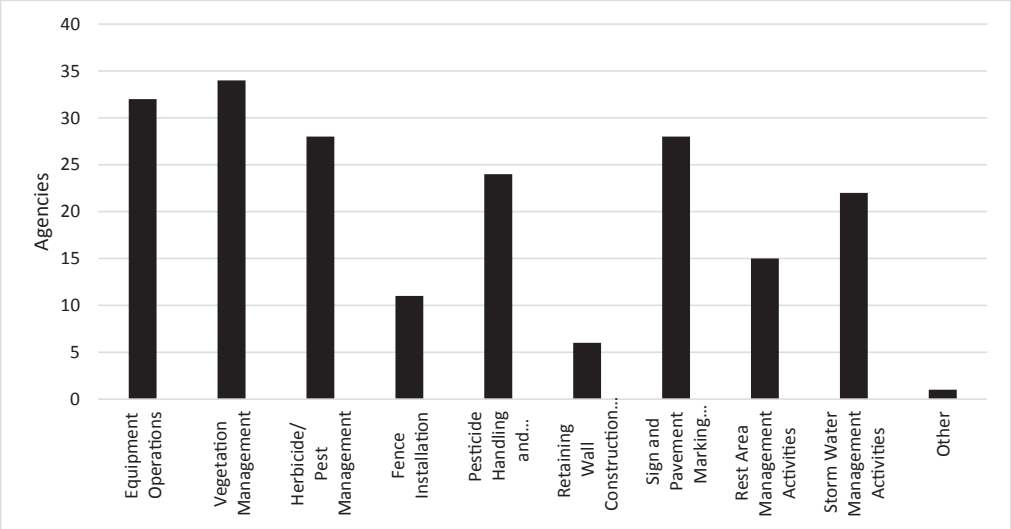
18. Which of the following methods do you use to deliver pavement training?

State	Instructor-Led Classroom	Instructor-Led Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training	Other
Alaska	X				
Arizona	X			X	
California	X		X	X	Instructor-led training in development
Colorado	X			X	
Connecticut	X	X	X	X	
Florida			X	X	
Georgia	X	X		X	
Idaho	X		X	X	
Indiana	X		X	X	
Kansas	X			X	
Kentucky	X			X	
Maine	X			X	
Massachusetts	X	X	X	X	
Michigan	X			X	
Minnesota	X		X	X	
Missouri	X		X	X	
Montana	X			X	
Nevada	X			X	
New Hampshire	X		X	X	
New Mexico			X	X	
New York	X	X		X	
North Carolina	X				
North Dakota		X	X	X	Policy manual
Ohio	X			X	
Pennsylvania	X			X	
South Carolina	X		X	X	
South Dakota	X	X	X	X	
Texas	X		X	X	
Washington	X	X	X	X	
Wyoming	X	X		X	
Alberta			X	X	
Quebec	X	X		X	
Saskatchewan	X			X	
Total Agencies	29	9	16	31	2



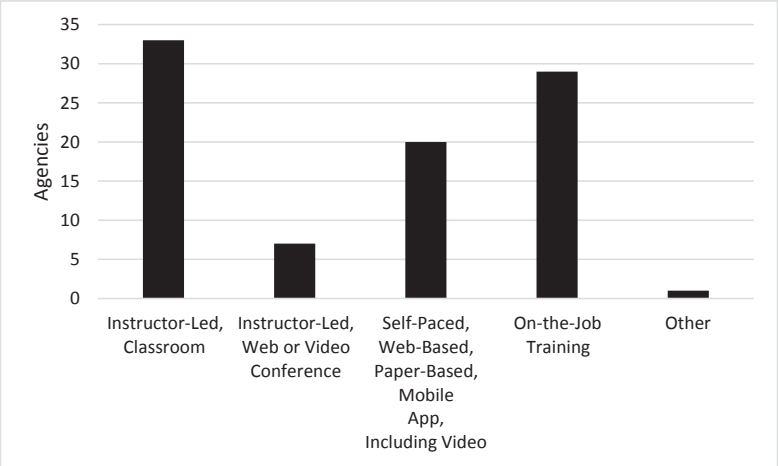
19. Select the roadway/roadside topics for which your organization offers training.

State	Equipment Operations	Vegetation Management	Herbicide/ Pest Management	Fence Installation	Pesticide Handling and Disposal Regulations	Retaining Wall Construction and Maintenance	Sign and Pavement Marking Retro-Reflectivity	Rest Area Management Activities	Storm Water Management Activities	Other
Alaska	X	X	X				X		X	
Arizona	X	X	X	X	X		X	X	X	
California	X	X	X	X	X	X	X		X	
Colorado	X	X	X	X	X		X	X	X	
Connecticut	X	X	X	X	X		X	X	X	
Florida	X	X	X		X		X	X	X	
Georgia	X	X	X		X		X	X	X	
Idaho	X	X	X				X		X	
Indiana	X	X	X				X			
Iowa	X	X	X		X		X	X		
Kentucky	X	X	X		X			X		
Maine	X	X	X		X					
Massachusetts	X	X	X	X	X	X	X	X	X	
Michigan	X	X			X					
Minnesota	X	X	X		X		X			
Missouri	X	X	X		X	X	X	X		
Montana	X	X	X	X	X		X	X	X	
Nevada	X	X	X	X	X	X	X	X	X	
New Hampshire	X								X	
New Mexico	X	X	X	X	X	X	X	X	X	
New York	X	X	X		X		X			
North Dakota		X	X		X		X		X	
Ohio	X	X	X	X	X		X		X	
Oklahoma	X	X	X		X					
Pennsylvania	X	X	X				X		X	
South Carolina		X	X		X		X		X	
South Dakota	X									
Texas	X	X	X		X		X			
Utah	X	X	X						X	
Virginia	X	X	X		X				X	
Washington	X	X	X	X	X		X	X	X	
Wyoming		X		X			X		X	
Alberta	X	X					X			
New Brunswick	X	X					X			
Northwest Territories	X	X				X	X	X		
Quebec		X					X	X	X	Contamination soil management and road project environmental monitoring
Total Agencies	32	34	28	11	24	6	28	15	22	1



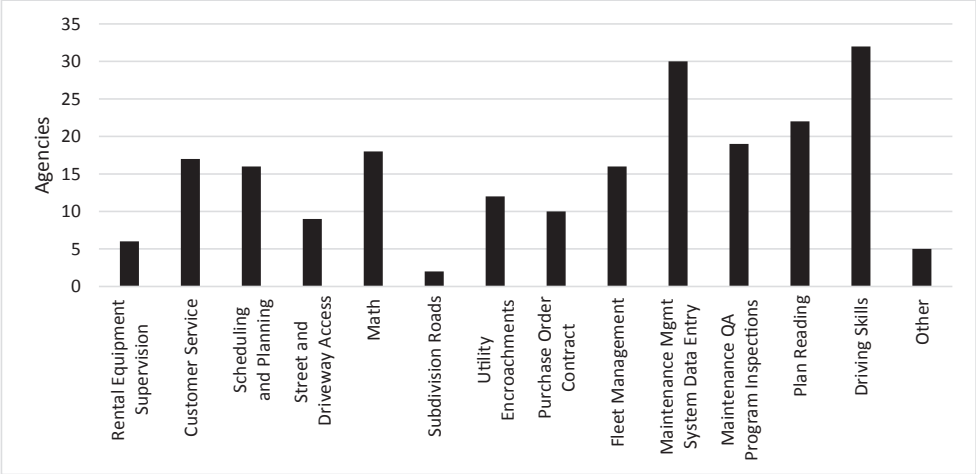
20. Which of the following methods do you use to deliver roadway/roadside training? Select all that apply.

State	Instructor-Led, Classroom	Instructor-Led, Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training	Other
Alaska	X		X		
Arizona	X			X	
California	X		X	X	Most of these topics are covered in a self-paced correspondence course
Colorado	X			X	
Connecticut	X	X	X	X	
Florida	X		X	X	
Georgia	X	X		X	
Idaho	X		X		
Indiana	X		X	X	
Iowa	X		X	X	
Kentucky	X			X	
Maine	X			X	
Massachusetts	X	X	X	X	
Michigan	X			X	
Minnesota	X		X	X	
Missouri	X		X	X	
Montana	X			X	
Nevada	X			X	
New Hampshire	X		X	X	
New Mexico			X		
New York	X	X		X	
North Dakota	X	X	X		
Ohio	X			X	
Oklahoma	X			X	
Pennsylvania	X				
South Carolina	X		X	X	
South Dakota			X	X	
Texas	X		X	X	
Utah	X	X	X		
Virginia	X		X	X	
Washington	X		X	X	
Wyoming	X	X		X	
Alberta			X	X	
New Brunswick	X			X	
Northwest Territories	X			X	
Quebec	X				
Total Agencies	33	7	20	29	1



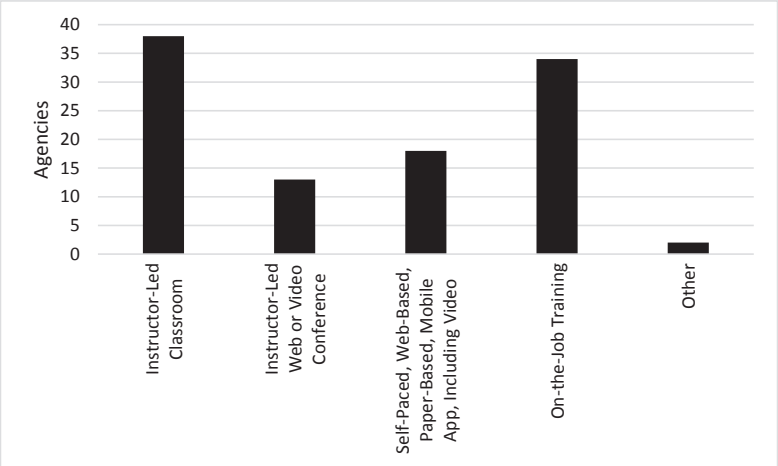
21. Select the general maintenance skills for which your organization offers training.

State	Rental Equipment Supervision	Customer Service	Scheduling and Planning	Street and Driveway Access	Math	Subdivision Roads	Utility Encroachments	Purchase Order Contract	Fleet Management	Maintenance Management System Data Entry	Maintenance QA Program Inspections	Plan Reading	Driving Skills	Other
Alaska		X							X	X	X	X		
Arizona	X		X		X			X	X	X	X	X	X	
California		X			X							X	X	Explosive use, rock scaling, tow truck and avalanche control training
Colorado		X	X	X	X		X	X	X	X	X	X	X	
Connecticut		X	X				X		X				X	
Florida		X	X	X	X		X	X	X	X	X	X	X	
Georgia		X	X						X	X			X	
Idaho		X			X					X		X	X	
Iowa		X			X				X	X	X	X	X	
Kansas										X			X	
Kentucky	X	X	X					X	X	X			X	
Maine					X					X		X	X	
Maryland	X	X			X					X	X	X	X	Proper plowing/salting techniques, proper use of heavy equipment, safety checks on equipment, how to properly complete forms used to track maintenance activities
Massachusetts	X	X	X	X	X	X	X	X	X	X	X	X	X	
Michigan										X				
Minnesota					X							X	X	
Missouri		X		X			X					X	X	
Montana		X					X		X	X			X	
Nevada	X		X		X	X	X	X	X	X	X	X	X	
New Hampshire				X			X	X		X	X		X	
New Mexico										X			X	
New York									X				X	
North Dakota					X				X	X		X	X	Survey basics, flagger, work zone safety, National Incident Management System, incident command system
Ohio					X						X	X	X	
Pennsylvania		X	X		X						X	X	X	
Rhode Island														Traffic control, chainsaw operation
South Carolina		X	X	X	X		X	X		X	X	X	X	
Tennessee					X					X	X	X		
Texas										X			X	
Utah					X			X		X	X	X	X	
Virginia				X						X	X		X	
Washington		X	X	X	X		X	X	X	X	X	X	X	
Wyoming		X	X							X	X	X		
Alberta			X				X		X	X	X	X	X	
New Brunswick			X	X					X	X			X	
Northwest Territories	X		X				X			X			X	
Ontario										X	X			Patrolling
Quebec														
Saskatchewan			X							X			X	
Total Agencies	6	17	16	9	18	2	12	10	16	30	19	22	32	5



22. Which of the following methods do you use to deliver general maintenance skills training? Select all that apply.

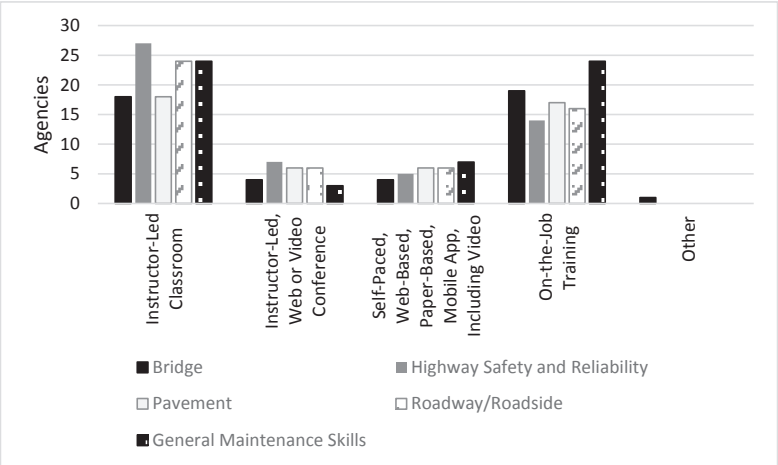
State	Instructor-Led, Classroom	Instructor-Led, Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training	Other
Alaska	X				
Arizona	X		X	X	
California	X		X	X	Some of the unchecked are covered for Supervisor level and above. Many of the topics are covered in a self-paced correspondence course.
Colorado	X		X	X	
Connecticut	X	X	X	X	
Florida	X		X	X	
Georgia	X	X		X	
Idaho	X		X	X	
Iowa	X		X	X	
Kansas	X	X		X	
Kentucky	X			X	
Maine	X			X	
Maryland	X		X	X	
Massachusetts	X	X	X	X	
Michigan	X				
Minnesota	X		X	X	
Missouri	X	X		X	
Montana	X			X	
Nevada	X			X	
New Hampshire	X		X	X	
New Mexico			X		
New York	X	X		X	
North Dakota	X	X	X	X	Academy
Ohio	X			X	
Pennsylvania	X			X	
Rhode Island	X			X	
South Carolina	X		X	X	
Tennessee	X			X	
Texas	X	X		X	
Utah	X	X	X	X	
Virginia	X		X	X	
Washington	X		X	X	
Wyoming	X	X		X	
Alberta	X	X	X	X	
New Brunswick	X			X	
Northwest Territories	X			X	
Ontario	X	X			
Quebec	X	X			
Saskatchewan	X			X	
Total Agencies	38	13	18	34	2



23. Which delivery method is predominant for the technical content areas?

SUMMARY TOTALS

	Instructor-Led Classroom	Instructor-Led, Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training	Other
Bridges	18	4	4	19	1
Highway Safety and Reliability	27	7	5	14	0
Pavements	18	6	6	17	0
Roadway/ Roadside	24	6	6	16	0
General Maintenance Skills	24	3	7	24	0



Which delivery method is predominant for the technical content areas? (Continued)

INDIVIDUAL STATE ANSWERS

Bridges

State	Instructor-Led Classroom	Instructor-Led, Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training	Other
California	X		X	X	
Colorado				X	
Connecticut				X	
Georgia	X	X		X	
Idaho	X				
Indiana				X	
Iowa				X	
Kansas	X			X	
Maine				X	
Massachusetts	X				
Michigan	X				
Minnesota	X		X	X	
Missouri	X			X	
Montana	X			X	
Nevada	X			X	
New Hampshire	X				
New Mexico					X
New York	X			X	
North Dakota		X			
Ohio	X				
Pennsylvania	X				
Rhode Island				X	
South Carolina			X	X	
Texas	X			X	
Virginia	X				
Washington	X				
Wyoming		X			
Alberta			X	X	
New Brunswick	X			X	
Northwest Territories		X		X	
Total Agencies	18	4	4	19	1

Which delivery method is predominant for the technical content areas? (Continued)

INDIVIDUAL STATE ANSWERS

Highway Safety and Reliability

State	Instructor-Led Classroom	Instructor-Led, Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training
Arizona	X			
California	X			X
Colorado				X
Connecticut	X			
Florida	X			
Georgia	X	X		X
Idaho	X			
Iowa				X
Kansas	X		X	X
Kentucky	X			X
Maine	X			
Massachusetts	X			
Michigan	X			
Minnesota	X		X	X
Mississippi	X			
Missouri	X			X
Montana	X			X
Nevada	X			X
New Hampshire	X			
New Mexico		X	X	
New York	X			X
North Dakota		X		
Ohio	X			
Pennsylvania	X			
South Carolina			X	X
Tennessee	X			
Texas	X	X		X
Utah	X			
Virginia	X			
Washington	X			
Wyoming		X		
Alberta	X	X	X	X
Northwest Territories		X		
Quebec	X			
Total Agencies	27	7	5	14

Which delivery method is predominant for the technical content areas? (Continued)

INDIVIDUAL STATE ANSWERS

Pavements

State	Instructor-Led Classroom	Instructor-Led, Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training
Alaska	X			
Arizona	X			
California			X	X
Colorado				X
Connecticut				X
Florida				X
Georgia	X	X		X
Idaho			X	
Indiana				X
Kansas	X			X
Kentucky	X			X
Maine	X			
Massachusetts	X			
Michigan	X			
Minnesota	X		X	X
Missouri	X			X
Montana		X		X
Nevada	X			X
New Hampshire				X
New Mexico			X	
New York	X			X
North Carolina		X		
North Dakota		X		
Ohio	X			
Pennsylvania	X			
South Carolina			X	X
South Dakota		X		
Texas	X			X
Washington	X			
Wyoming		X		
Alberta			X	X
Quebec	X			
Saskatchewan	X			
Total Agencies	18	6	6	17

Which delivery method is predominant for the technical content areas? (Continued)

INDIVIDUAL STATE ANSWERS

Roadway/Roadside

State	Instructor-Led Classroom	Instructor-Led, Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training
Alaska	X			
Arizona	X			
California	X		X	X
Colorado				X
Connecticut				X
Florida	X			
Georgia	X	X		X
Idaho	X			
Indiana				X
Iowa				X
Kentucky	X			X
Maine	X			
Massachusetts		X		
Michigan	X			
Minnesota	X		X	X
Missouri	X			X
Montana	X			X
Nevada	X			X
New Hampshire	X			
New Mexico			X	
New York	X			X
North Dakota				X
Ohio	X			
Oklahoma	X			
Pennsylvania	X			
South Carolina	X		X	
South Dakota		X		
Texas	X		X	X
Utah		X		
Virginia	X			
Washington	X			
Wyoming		X		
Alberta			X	X
New Brunswick	X			X
Northwest Territories		X		
Quebec	X			
Total Agencies	24	6	6	16

Which delivery method is predominant for the technical content areas? (Continued)

INDIVIDUAL STATE ANSWERS

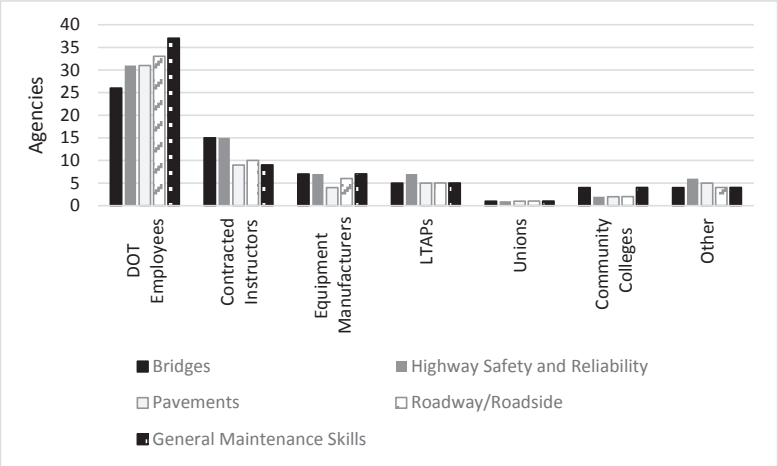
General Maintenance Skills

State	Instructor-Led Classroom	Instructor-Led, Web or Video Conference	Self-Paced, Web-Based, Paper-Based, Mobile App, Including Video	On-the-Job Training
Alaska	X			
Arizona	X			
California	X		X	X
Colorado				X
Connecticut				X
Florida			X	
Georgia	X	X		X
Idaho				X
Iowa				X
Kansas				X
Kentucky	X			X
Maine	X			
Maryland	X			X
Massachusetts	X			
Michigan	X			
Minnesota	X		X	X
Missouri	X			X
Montana	X			X
Nevada	X			X
New Hampshire	X			
New Mexico			X	
New York	X			X
North Dakota				X
Ohio	X			X
Pennsylvania	X			
Rhode Island				X
South Carolina			X	X
Tennessee	X			
Texas	X			X
Utah			X	
Virginia				X
Washington	X			
Wyoming		X		
Alberta	X		X	X
New Brunswick	X			X
Northwest Territories		X		X
Ontario	X			
Quebec	X			
Saskatchewan				X
Total Agencies	24	3	7	24

24. Who facilitates training for each technical content area?

SUMMARY TOTALS

	DOT Employees	Contracted Instructors	Equipment Manufacturers	LTAPs	Unions	Community Colleges	Other
Bridges	26	15	7	5	1	4	4
Highway Safety and Reliability	31	15	7	7	1	2	6
Pavements	31	9	4	5	1	2	5
Roadway/Roadside	33	10	6	5	1	2	4
General Maintenance Skills	37	9	7	5	1	4	4



Who facilitates training for each technical content area? (Continued)

INDIVIDUAL STATE ANSWERS

Bridges

State	DOT Employees	Contracted Instructors	Equipment Manufacturers	LTAPs	Unions	Community Colleges	Other
California	X						
Colorado	X						
Connecticut	X	X					X
Georgia	X			X			
Idaho	X						
Indiana	X						
Iowa	X	X				X	
Kansas	X	X	X				
Maine	X	X					
Massachusetts	X	X	X				
Michigan	X						
Minnesota	X						
Missouri	X		X				
Montana	X						
Nevada	X	X	X	X		X	X
New Hampshire	X						
New Mexico	X						
New York	X		X		X	X	
North Dakota		X		X			X
Ohio	X						
Pennsylvania		X					
Rhode Island		X		X			
South Carolina	X	X					
Texas	X	X					
Virginia	X	X					
Washington	X						
Wyoming	X	X		X			
Alberta			X			X	X
New Brunswick	X	X					
Northwest Territories	X	X	X				
Total Agencies	26	15	7	5	1	4	4

Who facilitates training for each technical content area? (Continued)

INDIVIDUAL STATE ANSWERS

Highway Safety and Reliability

State	DOT Employees	Contracted Instructors	Equipment Manufacturers	LTAPs	Unions	Community Colleges	Other
Arizona	X						
California	X						X
Colorado	X						
Connecticut	X	X					X
Florida	X						
Georgia	X			X			
Idaho	X						
Iowa	X	X					
Kansas	X		X				X
Kentucky	X	X		X			
Maine	X	X					
Massachusetts	X	X	X				
Michigan	X						
Minnesota	X						
Missouri	X						
Mississippi		X					
Montana	X			X			
Nevada	X	X	X	X		X	X
New Hampshire	X						
New Mexico	X						
New York	X		X		X	X	
North Dakota		X		X			X
Ohio	X						
Pennsylvania	X						
South Carolina	X						
Tennessee	X	X					
Texas	X	X					
Utah	X	X	X	X			
Virginia	X	X					
Washington	X						
Wyoming	X	X		X			
Alberta		X	X				X
Northwest Territories	X	X	X				
Quebec	X						
Total Agencies	31	15	7	7	1	2	6

Who facilitates training for each technical content area? (Continued)

INDIVIDUAL STATE ANSWERS

Pavements

State	DOT Employees	Contracted Instructors	Equipment Manufacturers	LTAPs	Unions	Community Colleges	Other
Alaska		X					
Arizona	X						
California	X						X
Colorado	X						
Connecticut	X	X					X
Florida	X						
Georgia	X			X			
Idaho	X						
Indiana	X						
Kansas	X		X				
Kentucky	X			X			
Maine	X	X					
Massachusetts	X	X	X				
Michigan	X						
Minnesota	X						
Missouri	X						
Montana	X						
Nevada	X	X	X	X		X	X
New Hampshire	X						
New Mexico	X						
New York	X		X		X	X	
North Carolina	X						
North Dakota	X	X		X			X
Ohio	X	X					
Pennsylvania	X						
South Carolina	X						
South Dakota	X						
Texas	X	X					
Washington	X						
Wyoming	X	X		X			
Alberta							X
Quebec	X						
Saskatchewan	X						
Total Agencies	31	9	4	5	1	2	5

Who facilitates training for each technical content area? (Continued)

INDIVIDUAL STATE ANSWERS

Roadway/Roadside

State	DOT Employees	Contracted Instructors	Equipment Manufacturers	LTAPs	Unions	Community Colleges	Other
Alaska		X	X	X			
Arizona	X						
California	X						X
Colorado	X						
Connecticut	X	X					X
Florida	X						
Georgia	X			X			
Idaho	X						
Indiana	X						
Iowa	X	X	X				
Kentucky	X			X			
Maine	X	X					
Massachusetts	X	X	X				
Michigan	X						
Minnesota	X						
Missouri	X						
Montana	X						
Nevada	X	X	X	X		X	X
New Hampshire	X						
New York	X		X		X	X	
New Mexico	X						
North Dakota	X						
Ohio	X						
Oklahoma		X					
Pennsylvania	X						
South Carolina	X						
South Dakota	X						
Texas	X	X					
Utah	X		X				
Virginia	X	X					
Washington	X						
Wyoming	X	X		X			
Alberta							X
New Brunswick	X						
Northwest Territories	X						
Quebec	X						
Total Agencies	33	10	6	5	1	2	4

Who facilitates training for each technical content area? (Continued)

INDIVIDUAL STATE ANSWERS

General Maintenance Skills

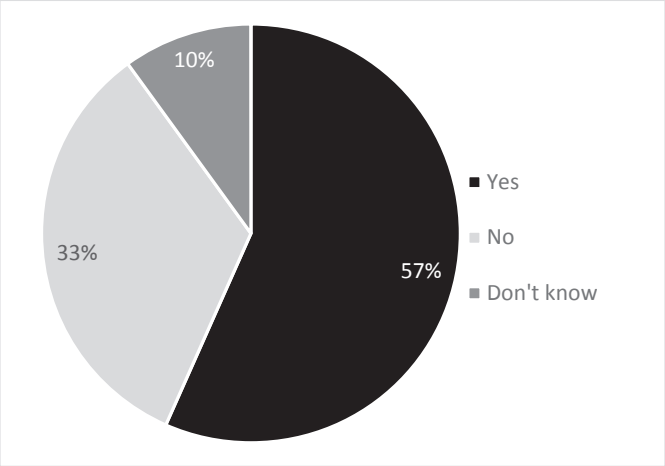
State	DOT Employees	Contracted Instructors	Equipment Manufacturers	LTAPs	Unions	Community Colleges	Other
Alaska	X						
Arizona	X						
California	X						X
Colorado	X						
Connecticut	X	X					X
Florida	X						
Georgia	X			X			
Idaho	X						
Iowa	X		X				
Kansas	X						
Kentucky	X			X			
Maine	X	X					
Maryland	X	X	X			X	
Massachusetts	X	X	X				
Michigan	X						
Minnesota	X						
Missouri	X		X				
Montana	X						
Nevada	X	X		X		X	
New Hampshire	X						
New York	X		X		X	X	
New Mexico	X						
North Dakota	X		X			X	X
Ohio	X						
Pennsylvania	X						
Rhode Island		X		X			
South Carolina	X						
Tennessee	X						
Texas	X	X					
Utah	X						
Virginia	X	X	X				
Washington	X						
Wyoming	X	X		X			
Alberta							X
New Brunswick	X						
Northwest Territories	X						
Ontario	X						
Quebec	X						
Saskatchewan	X						
Total Agencies	37	9	7	5	1	4	4

25. If you selected “other” as a facilitator option, please fill in the type of facilitator used.

State	Bridges	Highway Safety and Reliability	Pavements	Roadway/ Roadside	General Maintenance Skills
Connecticut	Tech. Transfer Center at University of Connecticut (UCONN)	Tech. Transfer Center at UCONN	Tech. Transfer Center at UCONN	Tech. Transfer Center at UCONN	Tech. Transfer Center at UCONN
Kansas		FHWA materials			
North Dakota	NDSU - UGPTI	NDSU - UGPTI	NDSU - UGPTI	NDSU - UGPTI	NDSU - UGPTI
Nevada	Material Suppliers, Industry Assoc.	Material Suppliers, Industry Assoc.	Material Suppliers, Industry Assoc.	Material Suppliers, Industry Assoc.	
Alberta	In-house	In-house	In-house	In-house	In-house

26. Is bridge training required?

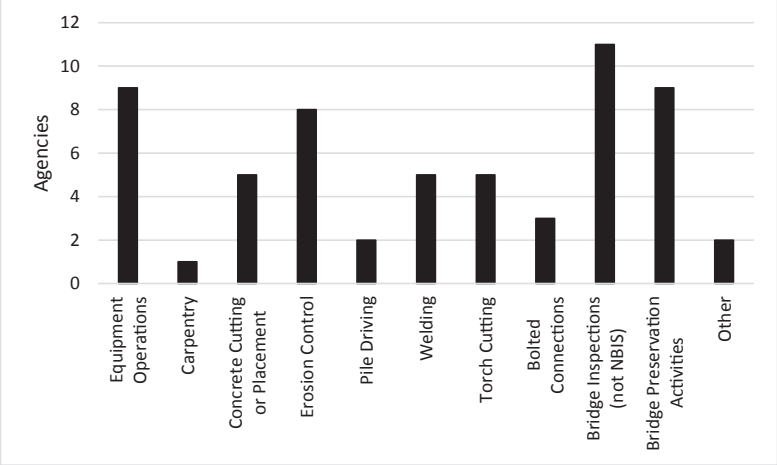
State	Yes/No
California	No
Colorado	Yes
Connecticut	Yes
Georgia	Yes
Idaho	Yes
Indiana	No
Iowa	Yes
Kansas	Don't know
Maine	No
Massachusetts	Yes
Michigan	Don't know
Minnesota	Yes
Missouri	Yes
Montana	No
Nevada	Yes
New Hampshire	Yes
New Mexico	Don't know
New York	No
North Dakota	No
Ohio	Yes
Pennsylvania	No
Rhode Island	No
South Carolina	No
Texas	Yes
Virginia	Yes
Washington	Yes
Wyoming	No
Alberta	Yes
New Brunswick	Yes
Northwest Territories	Yes



Yes	17
No	10
Don't know	3

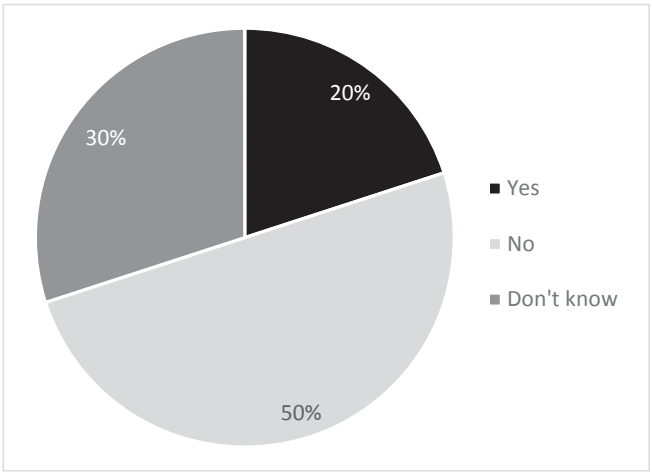
27. Select the bridge topics for which training is required

State	Equipment Operations	Carpentry	Concrete Cutting or Placement	Erosion Control	Pile Driving	Welding	Torch Cutting	Bolted Connections	Bridge Inspections (not NBIS)	Bridge Preservation Activities	Other
Colorado									X		
Connecticut	X		X	X							
Georgia									X		
Idaho										X	
Iowa			X			X	X		X	X	
Massachusetts	X	X	X	X	X	X	X	X	X	X	
Minnesota									X		
Missouri	X		X	X	X			X		X	
Nevada	X			X		X					
New Hampshire	X										
Ohio	X								X	X	X
Texas				X		X	X	X	X	X	X
Virginia	X			X							
Washington	X		X	X		X	X		X	X	
Alberta	X						X		X	X	
New Brunswick									X		
Northwest Territories				X					X	X	
Total Agencies	9	1	5	8	2	5	5	3	11	9	2



28. Is certification in bridges offered?

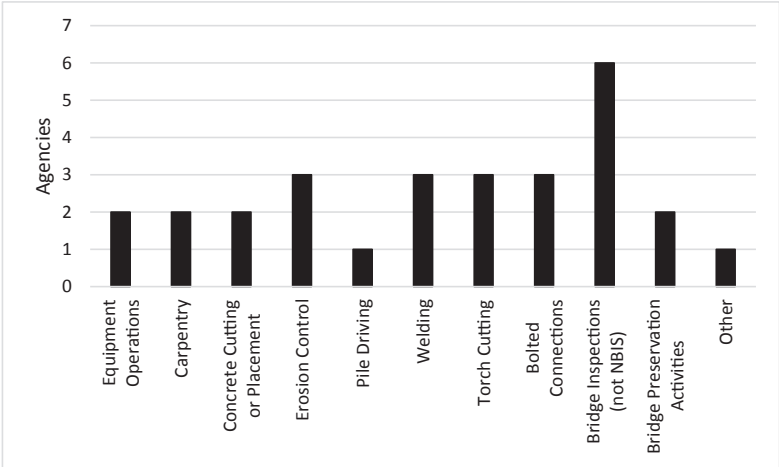
State	Yes/No
California	Yes
Colorado	Yes
Connecticut	Don't know
Georgia	Don't know
Idaho	No
Indiana	No
Iowa	No
Kansas	Don't know
Maine	No
Massachusetts	Yes
Michigan	Don't know
Minnesota	Yes
Missouri	Don't know
Montana	No
Nevada	No
New Hampshire	No
New Mexico	Don't know
New York	No
North Dakota	No
Ohio	No
Pennsylvania	No
Rhode Island	No
South Carolina	No
Texas	Yes
Virginia	No
Washington	Don't know
Wyoming	Don"t know
Alberta	No
New Brunswick	Don't know
Northwest Territories	Yes



Yes	6
No	15
Don't know	9

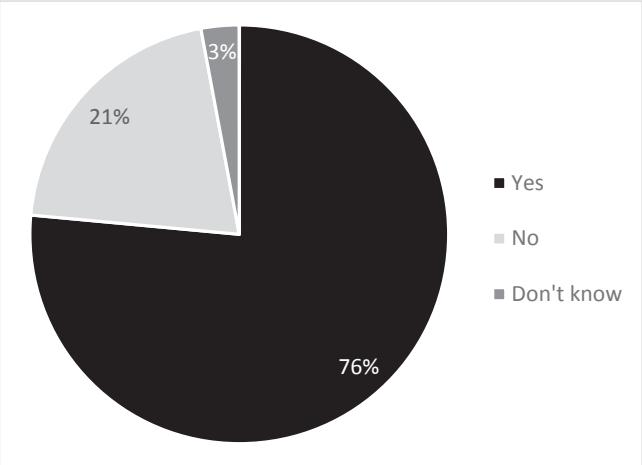
29. Select the bridge topics for which certification is offered.

State	Equipment Operations	Carpentry	Concrete Cutting or Placement	Erosion Control	Pile Driving	Welding	Torch Cutting	Bolted Connections	Bridge Inspections (not NBIS)	Bridge Preservation Activities	Other
California	X	X	X	X		X	X	X	X	X	
Colorado									X		
Massachusetts	X	X	X	X	X	X	X	X	X	X	
Minnesota									X		
Texas						X	X	X	X		X
Northwest Territories				X					X		
Total Agencies	2	2	2	3	1	3	3	3	6	2	1



30. Is highway safety and reliability training required?

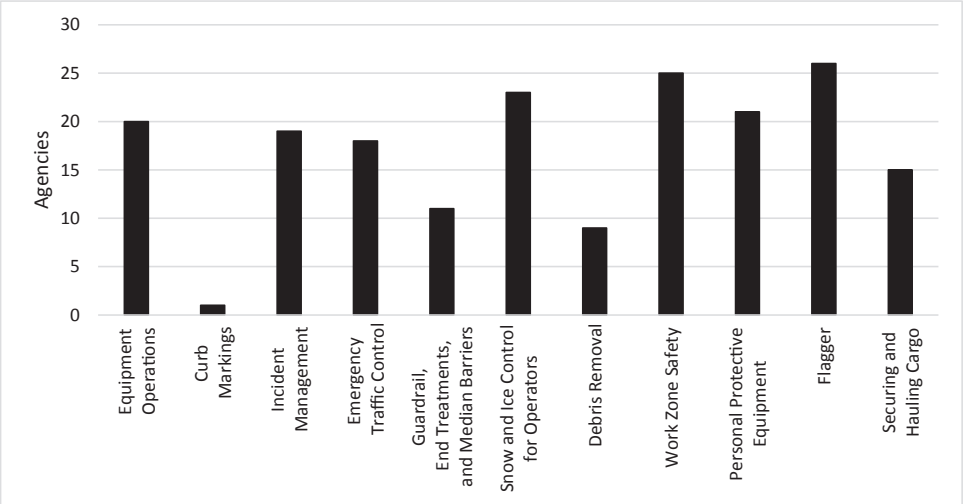
State	Yes/No
Arizona	Yes
California	Yes
Colorado	No
Connecticut	Yes
Florida	Yes
Georgia	No
Idaho	Yes
Iowa	Yes
Kansas	Yes
Kentucky	Yes
Maine	Yes
Massachusetts	Yes
Michigan	No
Minnesota	Yes
Mississippi	Yes
Missouri	Yes
Montana	Yes
Nevada	Yes
New Hampshire	Yes
New Mexico	Don't know
New York	No
North Dakota	No
Ohio	Yes
Pennsylvania	Yes
South Carolina	No
Tennessee	Yes
Texas	Yes
Utah	Yes
Virginia	Yes
Washington	Yes
Wyoming	No
Alberta	Yes
Northwest Territories	Yes
Quebec	Yes



Yes	26
No	7
Don't know	1

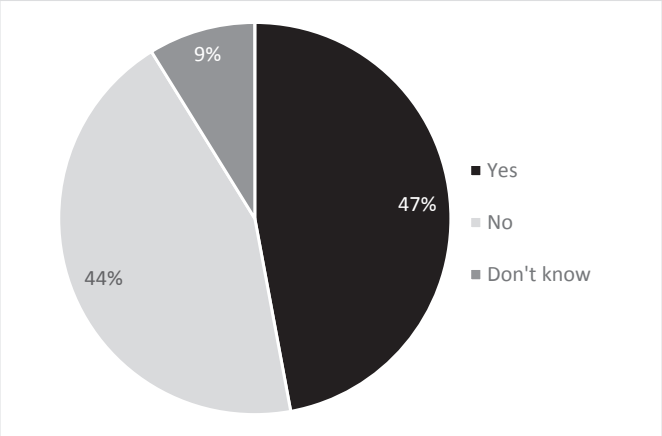
31. Select the highway safety and reliability topics for which training is required.

State	Equipment Operations	Curb Markings	Incident Management	Emergency Traffic Control	Guardrail, End Treatments, and Median Barriers	Snow and Ice Control for Operators	Debris Removal	Work Zone Safety	Personal Protective Equipment	Flagger	Securing and Hauling Cargo	Securing and Hauling Cargo
Arkansas			X	X		X		X	X	X	X	
Arizona	X		X	X	X	X		X	X	X	X	
California	X		X	X		X	X	X	X	X	X	
Connecticut	X		X	X	X	X		X	X	X	X	
Florida								X		X		
Idaho	X		X	X		X		X	X			
Iowa	X		X	X	X	X		X	X	X	X	
Kansas	X		X			X				X		
Kentucky	X		X	X	X	X	X	X	X	X	X	
Maine	X					X		X	X	X	X	
Massachusetts	X		X	X	X	X	X	X	X	X	X	
Minnesota	X			X		X		X	X	X	X	
Mississippi				X				X		X		
Missouri	X	X	X	X	X	X	X	X	X	X	X	
Montana	X		X	X	X	X	X	X	X	X	X	
Nevada	X							X	X	X		
New Hampshire			X			X		X	X	X		
Ohio	X		X	X	X	X	X	X	X	X	X	
Pennsylvania			X			X		X		X		
Tennessee						X		X		X		
Texas	X		X	X		X	X	X	X	X	X	
Utah	X			X	X	X			X	X		
Virginia	X		X			X		X	X	X		
Washington	X		X	X		X		X	X	X	X	
Alberta	X		X	X	X	X	X	X	X	X	X	
Northwest Territories	X		X	X	X	X	X	X	X	X		
Quebec								X		X		
Total Agencies	20	1	19	18	11	23	9	25	21	26	15	



32. Is certification in highway safety and reliability offered?

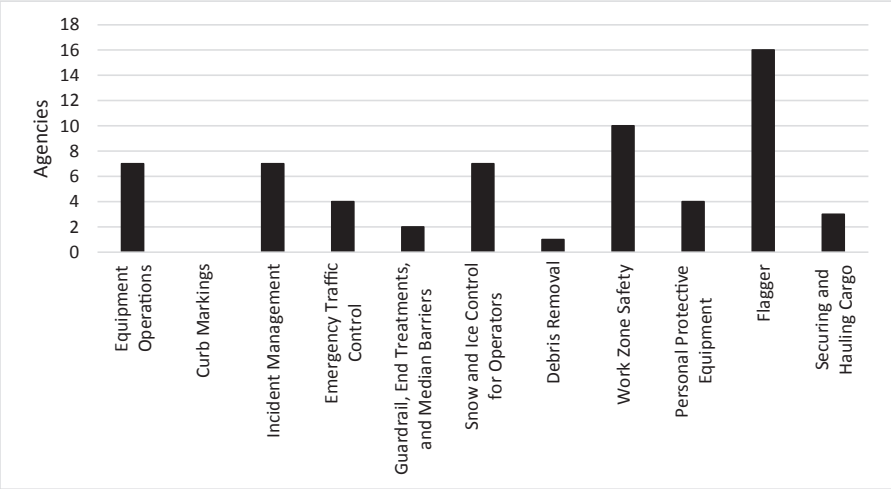
State	Yes/No
Arizona	No
California	Yes
Colorado	No
Connecticut	Yes
Florida	Yes
Georgia	No
Idaho	Yes
Iowa	No
Kansas	Yes
Kentucky	Yes
Maine	Yes
Massachusetts	Yes
Michigan	No
Minnesota	No
Mississippi	Yes
Missouri	Don't know
Montana	No
Nevada	Yes
New Hampshire	Yes
New Mexico	Don't know
New York	No
North Dakota	No
Ohio	No
Pennsylvania	Yes
South Carolina	No
Tennessee	Yes
Texas	Don't know
Utah	Yes
Virginia	Yes
Washington	Yes
Wyoming	No
Alberta	No
Northwest Territories	No
Quebec	No



Yes	16
No	15
Don't know	3

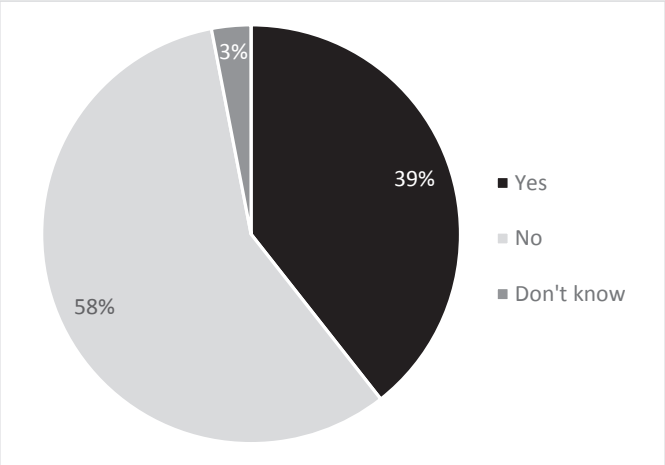
33. Select the highway safety and reliability topics for which certification is offered.

State	Equipment Operations	Curb Markings	Incident Management	Emergency Traffic Control	Guardrail, End Treatments, and Median Barriers	Snow and Ice Control for Operators	Debris Removal	Work Zone Safety	Personal Protective Equipment	Flagger	Securing and Hauling Cargo
Arkansas								X		X	
California	X		X	X		X		X	X	X	X
Connecticut			X	X						X	
Florida								X		X	
Idaho	X							X		X	
Kansas	X					X					
Kentucky			X					X		X	
Maine	X					X				X	
Massachusetts	X		X	X	X	X	X	X	X	X	X
Mississippi								X		X	
Nevada										X	
New Hampshire			X			X				X	
Pennsylvania			X							X	
Tennessee								X		X	
Utah	X				X					X	
Virginia						X		X	X	X	
Washington	X		X	X		X		X	X	X	X
Total Agencies	7	0	7	4	2	7	1	10	4	16	3



34. Is pavement training required?

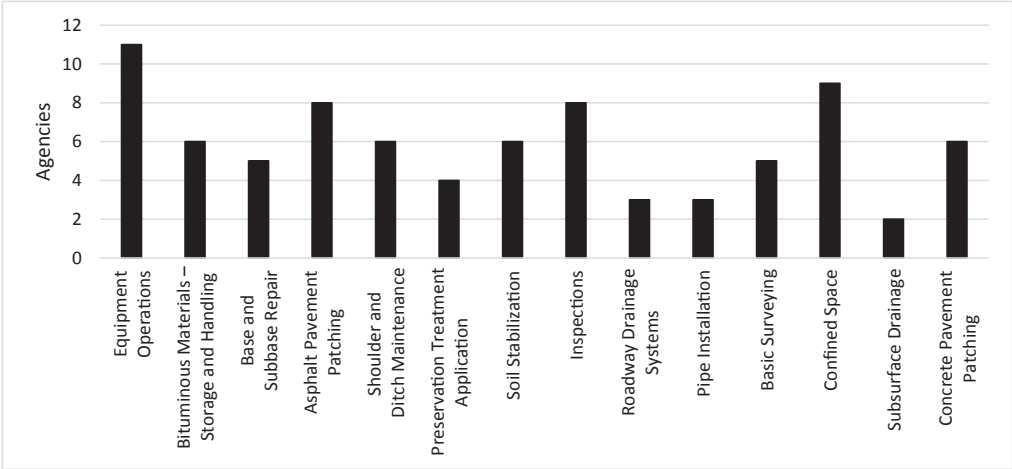
State	Yes/No
Alaska	No
Arizona	Yes
California	No
Colorado	Yes
Connecticut	No
Florida	Yes
Georgia	No
Idaho	Yes
Indiana	No
Kansas	No
Kentucky	No
Maine	Yes
Massachusetts	Yes
Michigan	No
Minnesota	Yes
Missouri	Yes
Montana	No
Nevada	Yes
New Hampshire	Yes
New Mexico	No
New York	No
North Carolina	No
North Dakota	No
Ohio	Yes
Pennsylvania	No
South Carolina	No
South Dakota	Don't know
Texas	Yes
Washington	Yes
Wyoming	No
Alberta	No
Quebec	No
Saskatchewan	No
Quebec	No



Yes	13
No	19
Don't know	1

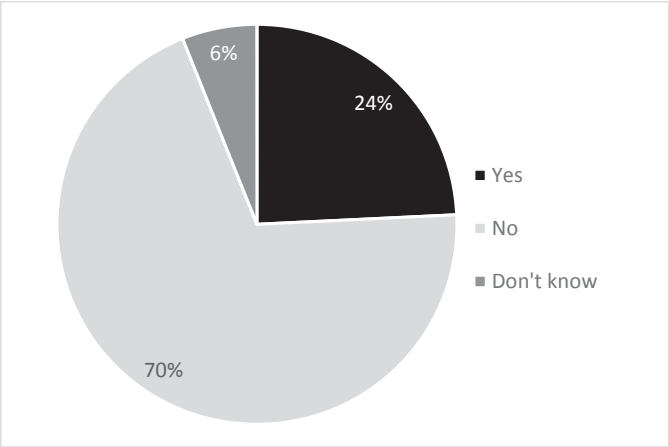
35. Select the pavement topics for which training is required.

State	Equipment Operations	Bituminous Materials – Storage and Handling	Base and Subbase Repair	Asphalt Pavement Patching	Shoulder and Ditch Maintenance	Preservation Treatment Application	Soil Stabilization	Inspections	Roadway Drainage Systems	Pipe Installation	Basic Surveying	Confined Space	Subsurface Drainage	Concrete Pavement Patching
Arizona	X	X		X	X		X	X			X			X
Colorado	X	X		X										
Florida				X	X			X				X		X
Idaho	X		X											
Maine	X									X		X		
Massachusetts	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Minnesota	X	X	X	X	X	X	X	X	X	X	X	X	X	
Missouri	X			X	X		X					X		X
Nevada	X	X						X				X		
New Hampshire												X		
Ohio	X		X	X	X		X	X	X		X			X
Texas	X	X	X	X		X	X	X			X	X		X
Washington	X					X		X				X		
Total Agencies	11	6	5	8	6	4	6	8	3	3	5	9	2	6



36. Is certification in pavements offered?

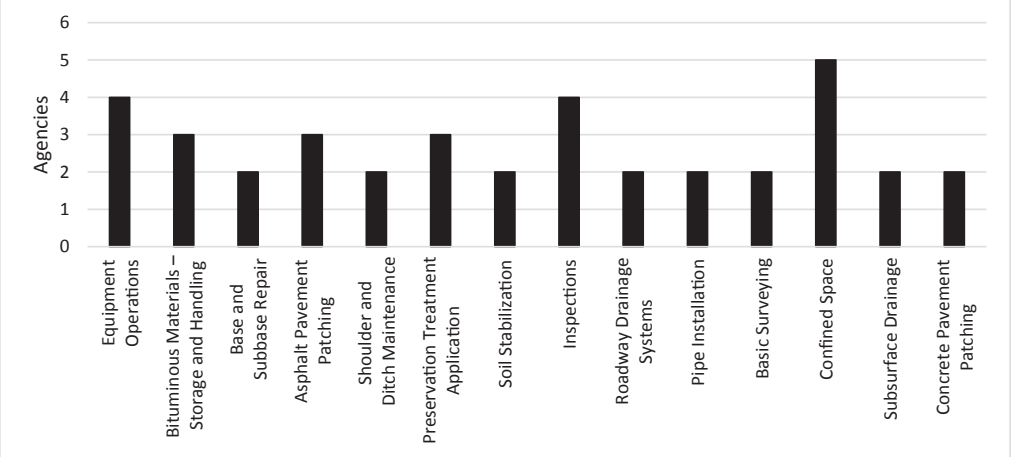
State	Yes/No
Alaska	No
Arizona	No
California	Yes
Colorado	No
Connecticut	No
Florida	No
Georgia	No
Idaho	No
Indiana	No
Kansas	No
Kentucky	No
Maine	Yes
Massachusetts	Yes
Michigan	Don't know
Minnesota	No
Missouri	Don't know
Montana	No
Nevada	Yes
New Hampshire	Yes
New Mexico	No
New York	No
North Carolina	No
North Dakota	No
Ohio	Yes
Pennsylvania	No
South Carolina	No
South Dakota	No
Texas	Yes
Washington	Yes
Wyoming	No
Alberta	No
Quebec	No
Saskatchewan	No
Quebec	No



Yes	8
No	23
Don't know	2

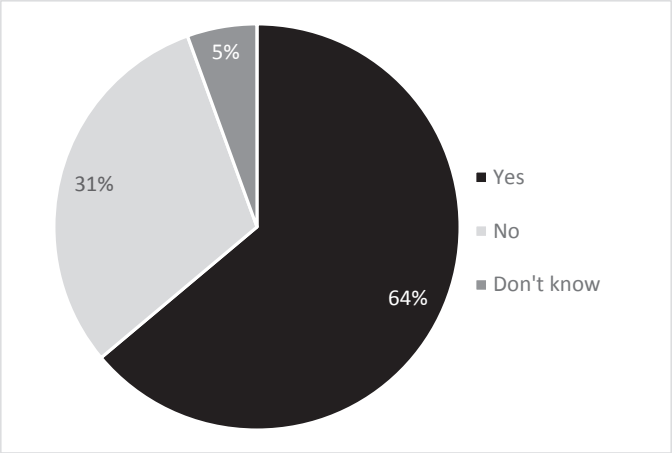
37. Select the pavement topics for which certification is offered.

State	Equipment Operations	Bituminous Materials – Storage and Handling	Base and Subbase Repair	Asphalt Pavement Patching	Shoulder and Ditch Maintenance	Preservation Treatment Application	Soil Stabilization	Inspections	Roadway Drainage Systems	Pipe Installation	Basic Surveying	Confined Space	Subsurface Drainage	Concrete Pavement Patching
California	X	X	X	X	X	X	X	X	X	X		X	X	X
Maine	X													
Massachusetts	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nevada												X		
New Hampshire												X		
Ohio		X		X							X			
Texas								X						
Washington	X					X		X				X		
Total Agencies	4	3	2	3	2	3	2	4	2	2	2	5	2	2



38. Is roadway/roadside training required?

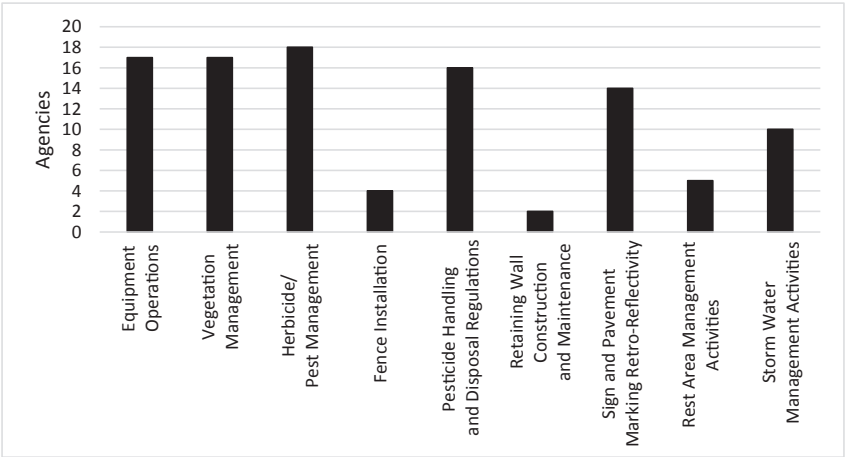
State	Yes/No
Alaska	No
Arizona	Yes
California	Yes
Colorado	No
Connecticut	Yes
Florida	Yes
Georgia	No
Idaho	Yes
Indiana	No
Iowa	Yes
Kentucky	Yes
Maine	Yes
Massachusetts	Yes
Michigan	Don't know
Minnesota	Yes
Missouri	Yes
Montana	Yes
Nevada	Yes
New Hampshire	No
New Mexico	No
New York	No
North Dakota	Yes
Ohio	Yes
Oklahoma	No
Pennsylvania	No
South Carolina	No
South Dakota	Don't know
Texas	Yes
Utah	Yes
Virginia	Yes
Washington	Yes
Wyoming	No
Alberta	Yes
New Brunswick	Yes
Northwest Territories	Yes
Quebec	Yes



Yes	23
No	11
Don't know	2

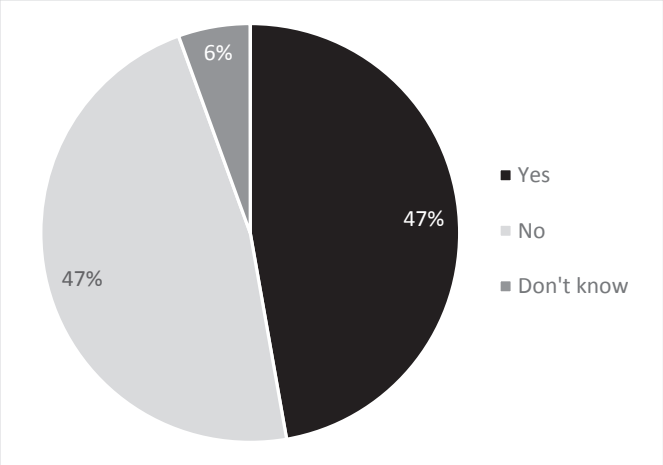
39. Select the roadway/roadside topics for which training is required.

State	Equipment Operations	Vegetation Management	Herbicide/Pest Management	Fence Installation	Pesticide Handling and Disposal Regulations	Retaining Wall Construction and Maintenance	Sign and Pavement Marking Retro-Reflectivity	Rest Area Management Activities	Storm Water Management Activities
Arizona	X		X	X	X		X		X
California	X				X				X
Connecticut		X	X		X				
Florida			X		X		X	X	X
Idaho		X	X						
Iowa		X	X		X				
Kentucky	X	X	X		X				
Maine	X	X	X		X				
Massachusetts	X	X	X	X	X	X	X	X	X
Minnesota	X	X	X		X		X		
Missouri	X	X	X		X	X	X	X	X
Montana	X	X	X	X	X		X	X	
Nevada	X		X		X				X
North Dakota		X	X				X		X
Ohio	X	X	X	X	X		X		X
Texas	X	X	X		X		X		
Utah	X	X	X						
Virginia	X		X		X				X
Washington	X	X	X		X		X		X
Alberta	X	X					X		
New Brunswick	X	X					X		
Northwest Territories	X	X					X	X	
Quebec							X		
Total Agencies	17	17	18	4	16	2	14	5	10



40. Is certification in roadway/roadside offered?

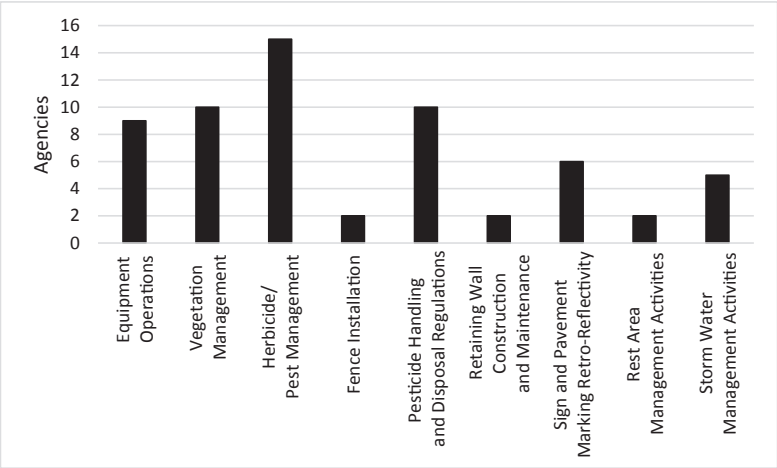
State	Yes/No
Alaska	No
Arizona	No
California	Yes
Colorado	No
Connecticut	Yes
Florida	Yes
Georgia	No
Idaho	Yes
Indiana	No
Iowa	Yes
Kentucky	Yes
Maine	Yes
Massachusetts	Yes
Michigan	Don't know
Minnesota	No
Missouri	Don't know
Montana	No
Nevada	Yes
New Hampshire	No
New Mexico	No
New York	No
North Dakota	Yes
Ohio	No
Oklahoma	Yes
Pennsylvania	No
South Carolina	No
South Dakota	No
Texas	Yes
Utah	Yes
Virginia	Yes
Washington	Yes
Wyoming	No
Alberta	No
New Brunswick	Yes
Northwest Territories	Yes
Quebec	No



Yes	17
No	17
Don't know	2

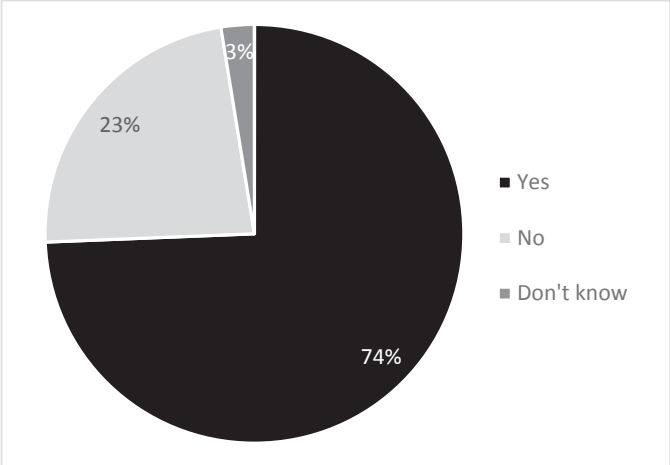
41. Select the roadway/roadside topics for which certification is offered.

State	Equipment Operations	Vegetation Management	Herbicide/Pest Management	Fence Installation	Pesticide Handling and Disposal Regulations	Retaining Wall Construction and Maintenance	Sign and Pavement Marking Retro-Reflectivity	Rest Area Management Activities	Storm Water Management Activities
California	X	X	X	X	X	X	X		X
Connecticut			X						
Florida			X		X				
Idaho		X	X						
Iowa		X	X		X				
Kentucky	X	X	X		X				
Maine	X		X		X				
Massachusetts	X	X	X	X	X	X	X	X	X
Nevada			X		X				
North Dakota			X						X
Oklahoma			X						
Texas	X	X	X		X		X		
Utah	X	X	X						
Virginia			X		X				X
Washington	X	X	X		X		X		X
New Brunswick	X	X					X		
Northwest Territories	X	X					X	X	
Total Agencies	9	10	15	2	10	2	6	2	5



42. Is general maintenance skills training required?

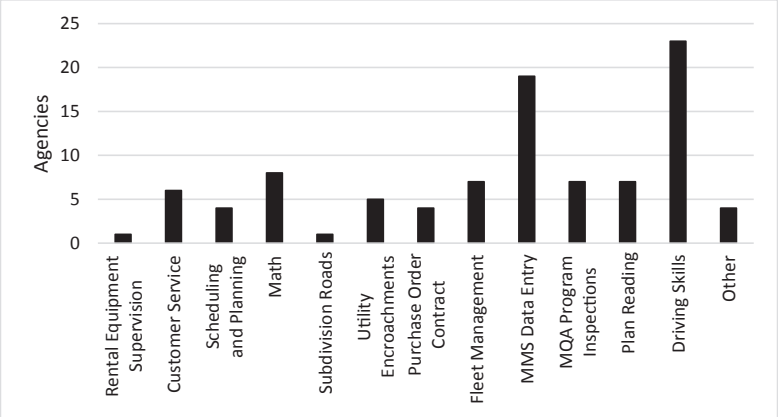
State	Yes/No
Alaska	No
Arizona	Yes
California	Yes
Colorado	Yes
Connecticut	No
Florida	Yes
Georgia	Yes
Idaho	Yes
Iowa	Yes
Kansas	Yes
Kentucky	No
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Michigan	Don't know
Minnesota	Yes
Missouri	Yes
Montana	Yes
Nevada	Yes
New Hampshire	Yes
New Mexico	Yes
New York	No
North Dakota	Yes
Ohio	Yes
Pennsylvania	No
Rhode Island	No
South Carolina	Yes
Tennessee	Yes
Texas	Yes
Utah	Yes
Virginia	Yes
Washington	Yes
Wyoming	No
Alberta	Yes
New Brunswick	Yes
Northwest Territories	Yes
Ontario	No
Quebec	Yes
Saskatchewan	No



Yes	29
No	9
Don't know	1

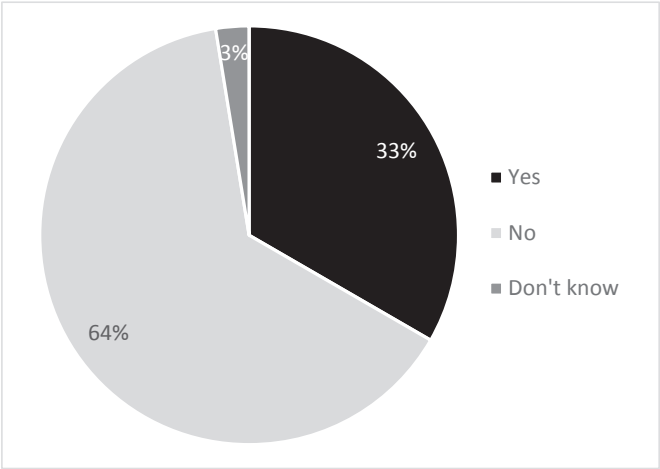
43. Select the general maintenance skills for which training is required.

State	Rental Equipment Supervision	Customer Service	Scheduling and Planning	Math	Subdivision Roads	Utility Encroachments	Purchase Order Contract	Fleet Management	MMS Data Entry	MQA Program Inspections	Plan Reading	Driving Skills	Other
Arizona			X	X			X	X	X	X	X	X	
California												X	X
Colorado		X	X				X	X	X			X	
Florida		X								X			
Georgia		X						X	X				
Idaho		X		X					X			X	
Iowa									X			X	
Kansas												X	
Maine				X					X		X	X	
Maryland									X			X	X
Massachusetts	X	X	X	X	X	X	X	X	X	X		X	
Minnesota												X	
Missouri						X					X		
Montana		X				X		X	X			X	
Nevada									X			X	
New Hampshire												X	
New Mexico									X			X	
North Dakota				X				X	X		X	X	X
Ohio				X						X	X	X	
South Carolina												X	
Tennessee				X							X		
Texas									X			X	
Utah				X					X	X	X	X	
Virginia									X	X			
Washington							X		X			X	
Alberta						X		X	X	X		X	
New Brunswick									X			X	
Northwest Territories			X			X			X			X	
Quebec													X
Total Agencies	1	6	4	8	1	5	4	7	19	7	7	23	4



44. Is certification in general maintenance skills offered?

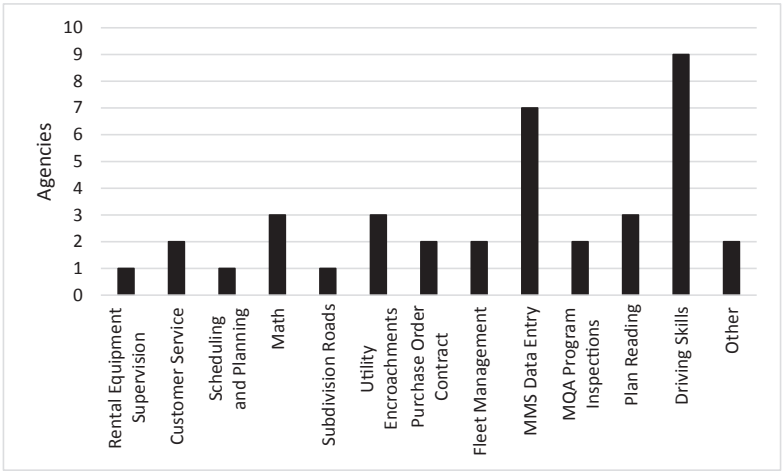
State	Yes/No
Alaska	No
Arizona	No
California	Yes
Colorado	No
Connecticut	No
Florida	Yes
Georgia	No
Idaho	No
Iowa	No
Kansas	No
Kentucky	No
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Michigan	No
Minnesota	No
Missouri	Don't know
Montana	Yes
Nevada	No
New Hampshire	Yes
New Mexico	Yes
New York	No
North Dakota	No
Ohio	No
Pennsylvania	No
Rhode Island	No
South Carolina	No
Tennessee	No
Texas	Yes
Utah	Yes
Virginia	No
Washington	Yes
Wyoming	No
Alberta	No
New Brunswick	Yes
Northwest Territories	Yes
Ontario	No
Quebec	No
Saskatchewan	No



Yes	13
No	25
Don't know	1

45. Select the general maintenance skills for which certification is offered.

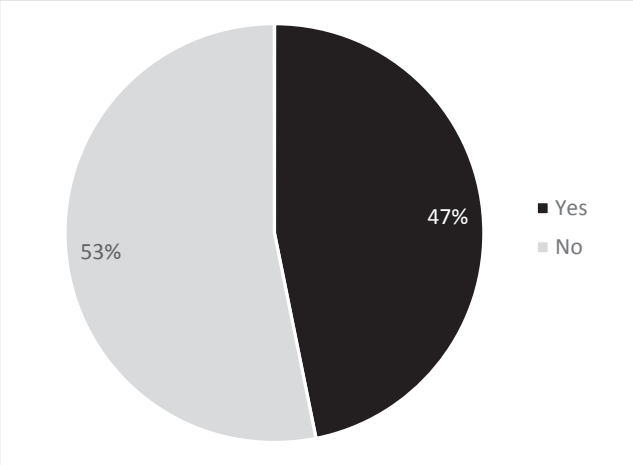
State	Rental Equipment Supervision	Customer Service	Scheduling and Planning	Math	Subdivision Roads	Utility Encroachments	Purchase Order Contract	Fleet Management	Maintenance Management System Data Entry	Maintenance Quality Assurance Program Inspections	Plan Reading	Driving Skills	Other
California				X							X	X	X
Florida										X			
Maine												X	
Maryland									X				X
Massachusetts		X	X	X	X	X	X	X	X	X	X	X	
Montana		X				X		X	X				
New Hampshire												X	
New Mexico												X	
Texas									X			X	
Utah				X							X		
Washington							X		X			X	
New Brunswick									X			X	
Northwest Territories	X					X			X			X	
Total Agencies	1	2	1	3	1	3	2	2	7	2	3	9	2



Inducements to Take Training

46. Does your organization provide incentives to encourage maintenance workers to participate in training?

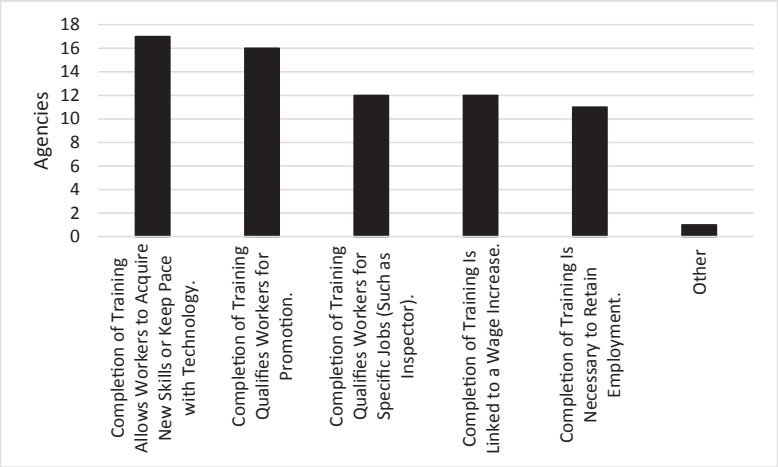
State	Yes/No
Alaska	No
Arizona	Yes
Arkansas	No
California	Yes
Colorado	Yes
Connecticut	No
Florida	Yes
Georgia	No
Idaho	Yes
Indiana	No
Iowa	No
Kansas	Yes
Kentucky	Yes
Maine	Yes
Maryland	Yes
Massachusetts	No
Michigan	Yes
Minnesota	No
Mississippi	Yes
Missouri	No
Montana	No
Nevada	Yes
New Hampshire	No
New Mexico	Yes
New York	Yes
North Carolina	No
North Dakota	Yes
Ohio	Yes
Oklahoma	Yes
Pennsylvania	No
Rhode Island	No
South Carolina	No
South Dakota	No
Tennessee	No
Texas	Yes
Utah	Yes
Virginia	No
Washington	Yes
West Virginia	No
Wisconsin	No
Wyoming	No
Alberta	Yes
New Brunswick	No
Northwest Territories	No
Ontario	No
Quebec	Yes
Saskatchewan	No



Yes	22
No	25

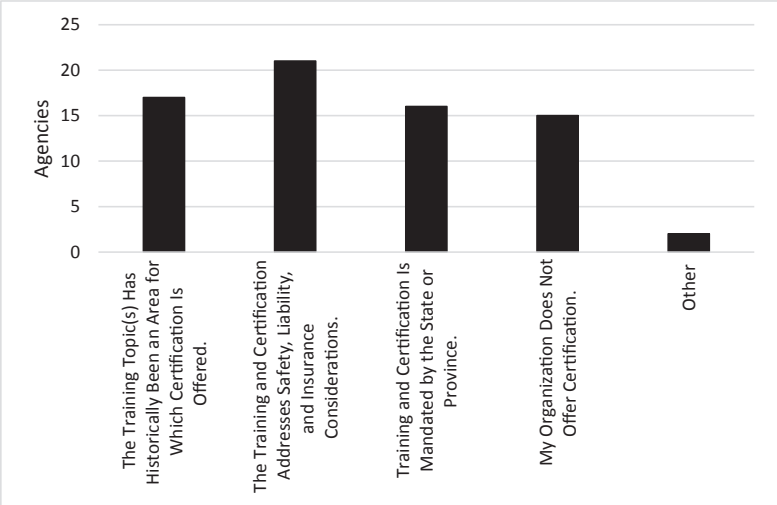
47. What incentives does your organization provide to encourage participation in training?

State	Completion of Training Allows Workers to Acquire New Skills or Keep Pace with Technology.	Completion of Training Qualifies Workers for Promotion.	Completion of Training Qualifies Workers for Specific Jobs (Such as Inspector).	Completion of Training Is Linked to a Wage Increase.	Completion of Training Is Necessary to Retain Employment.	Other
Arizona	X			X		
California	X	X	X		X	
Colorado		X		X		
Florida	X	X	X		X	
Idaho	X			X	X	
Kansas	X	X	X	X	X	
Kentucky	X					
Maine	X	X	X	X	X	
Maryland	X	X	X	X		
Michigan	X	X				
Mississippi		X				
Nevada	X	X	X		X	
New Mexico		X	X	X	X	
New York	X	X		X	X	
North Dakota	X	X	X	X	X	
Ohio	X	X	X	X		Workers are automatically promoted, resulting in a wage increase.
Texas	X		X			
Utah		X		X		
Washington	X	X			X	
Alberta	X	X	X		X	
Quebec	X		X			
Total Agencies	17	16	12	12	11	1



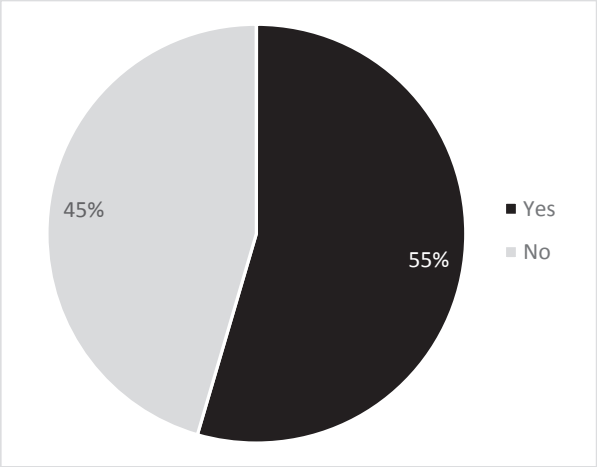
48. If your organization offers certification in a particular topic, please select the reason for offering certification.

State	The Training Topic(S) Has Historically Been an Area for Which Certification Is Offered.	The Training and Certification Addresses Safety, Liability, and Insurance Considerations.	Training and Certification Is Mandated by the State or Province.	My Organization Does Not Offer Certification.	Other
Alaska				X	
Arizona				X	
Arkansas	X	X	X		
California	X	X	X		X
Colorado	X				
Connecticut		X			
Florida			X		
Georgia				X	
Idaho	X	X			
Indiana		X			
Iowa		X	X		
Kansas	X	X	X		
Kentucky			X		
Maine	X	X	X		
Maryland		X	X		
Massachusetts	X	X	X		
Michigan				X	
Minnesota	X	X	X		
Mississippi		X			
Missouri				X	
Montana				X	
Nevada			X		
New Hampshire	X				
New Mexico			X		
New York	X				
North Carolina		X			
North Dakota			X		
Ohio	X	X			
Oklahoma				X	
Pennsylvania		X			
Rhode Island	X				
South Carolina					X
South Dakota				X	
Tennessee		X			
Texas	X				
Utah	X	X			
Virginia	X	X	X		
Washington	X	X	X		
West Virginia				X	
Wisconsin				X	
Wyoming				X	
Alberta				X	
New Brunswick	X	X			
Northwest Territories		X	X		
Ontario				X	
Quebec				X	
Saskatchewan				X	
Total Agencies	17	21	16	15	2



49. Does your organization align its training program offerings with maintenance worker performance requirements?

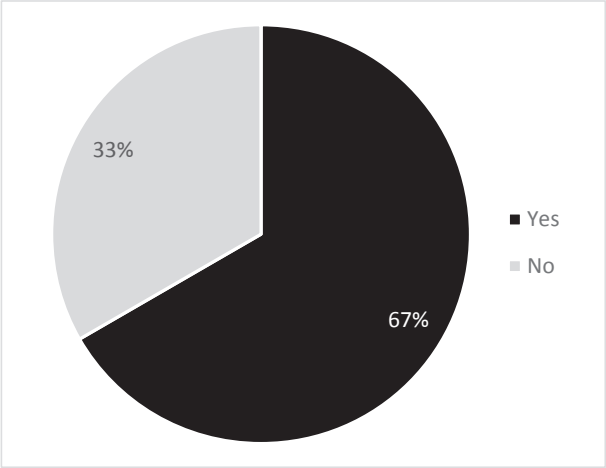
State	Yes/No
Alaska	No
Arizona	No
California	Yes
Colorado	Yes
Connecticut	No
Florida	Yes
Georgia	Yes
Idaho	Yes
Indiana	No
Iowa	No
Kansas	Yes
Kentucky	Yes
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Michigan	No
Minnesota	No
Mississippi	Yes
Missouri	Yes
Montana	No
Nevada	Yes
New Hampshire	No
New York	Yes
New Mexico	No
North Carolina	Yes
North Dakota	Yes
Ohio	No
Oklahoma	No
Pennsylvania	No
Rhode Island	No
South Carolina	No
South Dakota	No
Tennessee	Yes
Texas	Yes
Utah	Yes
Virginia	No
Washington	Yes
Wyoming	Yes
Alberta	Yes
New Brunswick	Yes
Northwest Territories	No
Ontario	No
Quebec	Yes
Saskatchewan	No



Yes	24
No	20

50. Is worker participation in technical training a factor in evaluating performance?

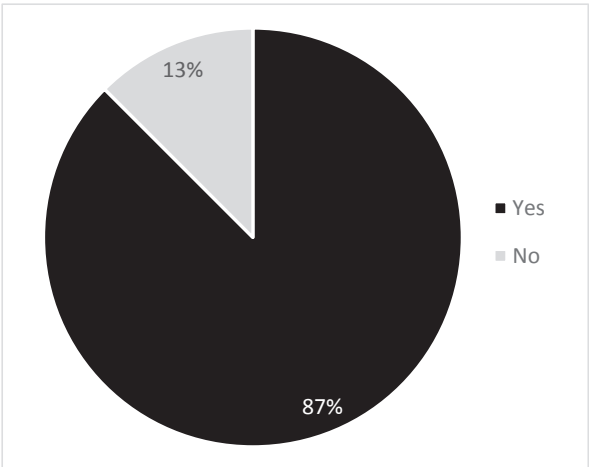
State	Yes/No
California	No
Colorado	Yes
Florida	No
Georgia	Yes
Idaho	Yes
Kansas	Yes
Kentucky	Yes
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Mississippi	No
Missouri	Yes
Nevada	No
New York	Yes
North Carolina	Yes
North Dakota	Yes
Tennessee	Yes
Texas	No
Utah	Yes
Washington	Yes
Wyoming	No
Alberta	Yes
New Brunswick	No
Quebec	No



Yes	16
No	8

51. Is worker participation in technical training formally documented on the performance evaluation?

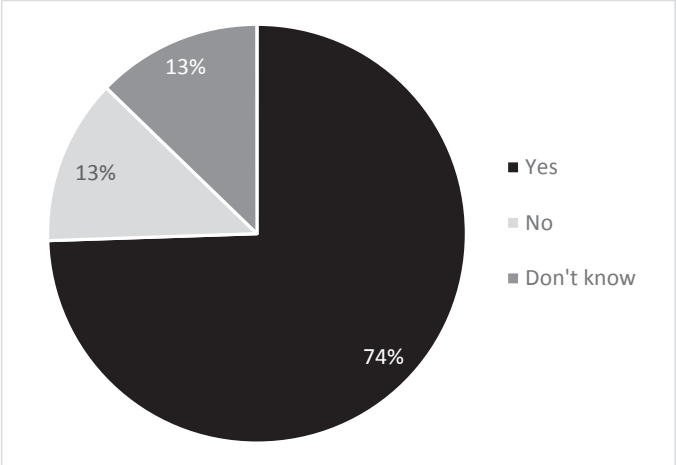
State	Yes/No
Colorado	Yes
Georgia	Yes
Idaho	Yes
Kansas	Yes
Kentucky	Yes
Maine	Yes
Maryland	No
Massachusetts	Yes
Missouri	Yes
New York	Yes
North Carolina	Yes
North Dakota	Yes
Tennessee	Yes
Utah	Yes
Washington	Yes
Alberta	No



Yes	14
No	2

52. Do supervisors regularly recommend training for maintenance workers to attend in order to improve performance and possibly advance?

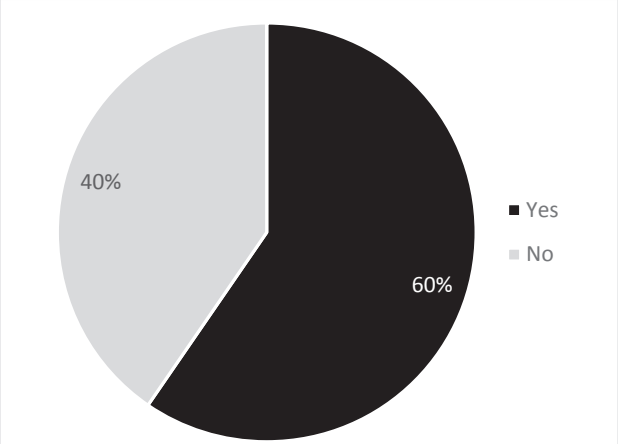
State	Yes/No
Alaska	Yes
Arkansas	No
Arizona	Yes
California	Yes
Colorado	Yes
Connecticut	Yes
Florida	Yes
Georgia	Yes
Idaho	Yes
Indiana	No
Iowa	Yes
Kansas	Yes
Kentucky	Yes
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Michigan	Yes
Minnesota	No
Mississippi	Yes
Missouri	Yes
Montana	Yes
Nevada	Yes
New Hampshire	Yes
New Mexico	Yes
New York	Yes
North Carolina	Yes
North Dakota	Don’t know
Ohio	Yes
Oklahoma	Don’t know
Pennsylvania	No
Rhode Island	Yes
South Carolina	Yes
South Dakota	Yes
Tennessee	Don’t know
Texas	Yes
Utah	Yes
Virginia	Yes
Washington	Yes
West Virginia	Yes
Wisconsin	Don’t know
Wyoming	Yes
Alberta	Don’t know
New Brunswick	Yes
Northwest Territories	Yes
Ontario	No
Quebec	No
Saskatchewan	Don’t know



Yes	35
No	6
Don't know	6

53. Is the promotion of a front-line maintenance worker dependent on the completion of certain training requirements?

State	Yes/No
Alaska	No
Arizona	Yes
Arkansas	No
California	Yes
Colorado	Yes
Connecticut	No
Florida	Yes
Georgia	Yes
Idaho	Yes
Indiana	No
Iowa	No
Kansas	Yes
Kentucky	No
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Michigan	Yes
Minnesota	No
Mississippi	Yes
Missouri	Yes
Montana	Yes
Nevada	Yes
New Hampshire	No
New Mexico	Yes
New York	Yes
North Carolina	Yes
North Dakota	Yes
Ohio	Yes
Oklahoma	Yes
Pennsylvania	No
Rhode Island	No
South Carolina	No
South Dakota	Yes
Tennessee	Yes
Texas	No
Utah	Yes
Virginia	No
Washington	Yes
West Virginia	Yes
Wisconsin	No
Wyoming	No
Alberta	Yes
New Brunswick	No
Northwest Territories	No
Ontario	No
Quebec	No
Saskatchewan	Yes

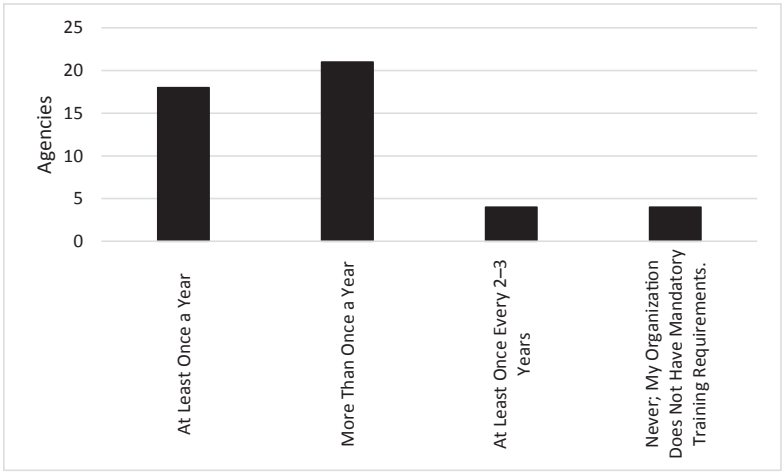


Yes	28
No	19

Frequency of Training Events and Tracking Participation

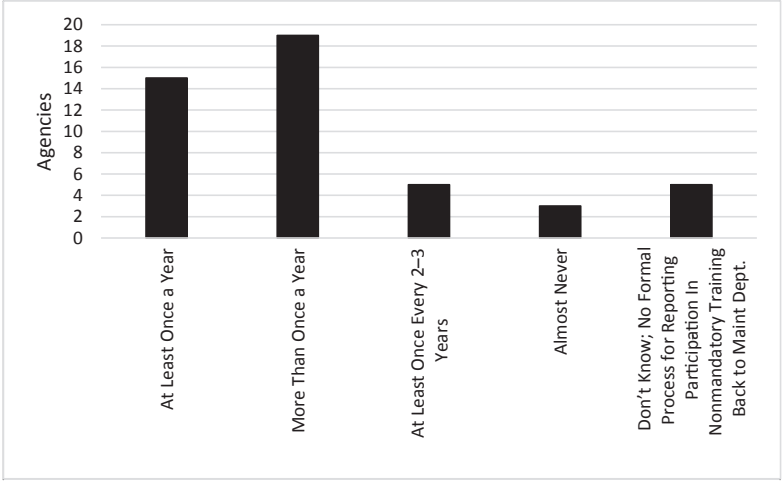
54. How often does the average maintenance worker participate in mandatory training?

State	Response
Alaska	Never; my organization does not have mandatory training requirements.
Arizona	More than once a year
Arkansas	At least once a year
California	More than once a year
Colorado	More than once a year
Connecticut	More than once a year
Florida	More than once a year
Georgia	At least once a year
Idaho	More than once a year
Indiana	At least once a year
Iowa	More than once a year
Kansas	More than once a year
Kentucky	More than once a year
Maine	More than once a year
Maryland	More than once a year
Massachusetts	At least once a year
Michigan	At least once a year
Minnesota	More than once a year
Mississippi	At least once every 2–3 years
Missouri	At least once every 2–3 years
Montana	More than once a year
Nevada	At least once a year
New Hampshire	More than once a year
New Mexico	At least once a year
New York	At least once a year
North Carolina	At least once a year
North Dakota	At least once a year
Ohio	More than once a year
Oklahoma	At least once every 2–3 years
Pennsylvania	More than once a year
Rhode Island	More than once a year
South Carolina	At least once a year
South Dakota	At least once a year
Tennessee	At least once a year
Texas	More than once a year
Utah	More than once a year
Virginia	More than once a year
Washington	At least once a year
West Virginia	Never; my organization does not have mandatory training requirements.
Wisconsin	Never; my organization does not have mandatory training requirements.
Wyoming	At least once a year
Alberta	At least once a year
New Brunswick	At least once every 2–3 years
Northwest Territories	More than once a year
Ontario	Never; my organization does not have mandatory training requirements.
Quebec	At least once a year
Saskatchewan	At least once a year



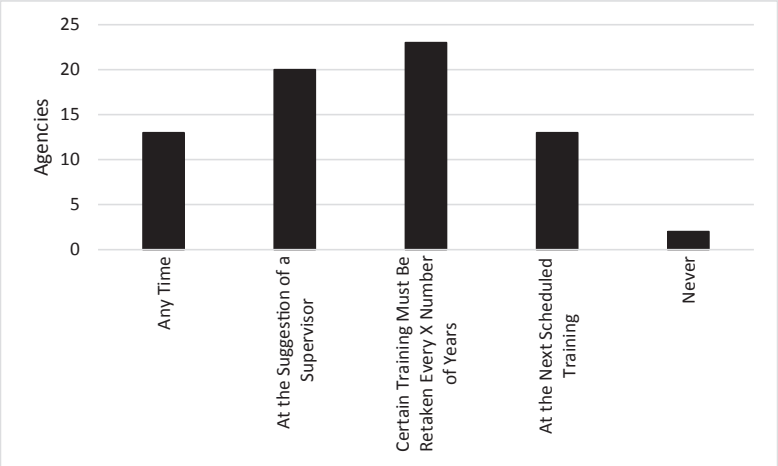
55. How often does the average maintenance worker participate in nonmandatory training?

State	Response
Alaska	At least once a year
Arizona	At least once a year
Arkansas	Don't know; there is no formal process for reporting participation in nonmandatory training back to the maintenance department.
California	Don't know; there is no formal process for reporting participation in nonmandatory training back to the maintenance department.
Colorado	At least once a year
Connecticut	More than once a year
Florida	At least once a year
Georgia	Don't know; there is no formal process for reporting participation in nonmandatory training back to the maintenance department.
Idaho	More than once a year
Indiana	At least once every 2–3 years
Iowa	More than once a year
Kansas	More than once a year
Kentucky	At least once a year
Maine	More than once a year
Maryland	More than once a year
Massachusetts	At least once a year
Michigan	More than once a year
Minnesota	More than once a year
Mississippi	At least once every 2–3 years
Missouri	Almost never
Montana	At least once a year
Nevada	At least once a year
New Hampshire	More than once a year
New Mexico	More than once a year
New York	At least once a year
North Carolina	At least once a year
North Dakota	More than once a year
Ohio	More than once a year
Oklahoma	More than once a year
Pennsylvania	More than once a year
Rhode Island	Don't know; there is no formal process for reporting participation in nonmandatory training back to the maintenance department.
South Carolina	More than once a year
South Dakota	At least once a year
Tennessee	At least once a year
Texas	More than once a year
Utah	At least once a year
Virginia	More than once a year
Washington	At least once a year
West Virginia	Almost never
Wisconsin	At least once a year
Wyoming	At least once every 2–3 years
Alberta	More than once a year
New Brunswick	At least once every 2–3 years
Northwest Territories	More than once a year
Ontario	Don't know; there is no formal process for reporting participation in nonmandatory training back to the maintenance department.
Quebec	At least once every 2–3 years
Saskatchewan	Almost never



56. How frequently are workers able to retake training to refresh knowledge and skills?

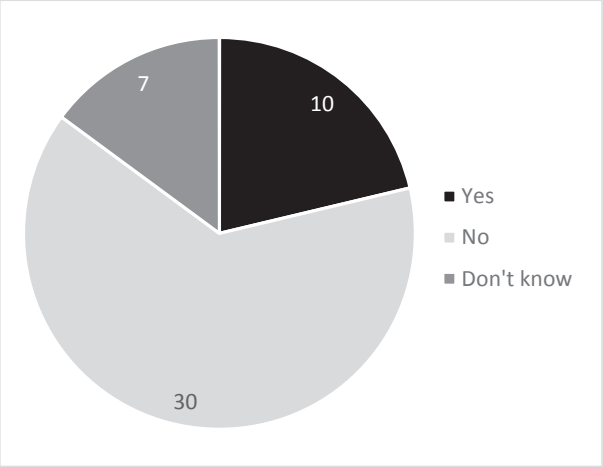
State	Any Time	At the Suggestion of a Supervisor	Certain Training Must Be Retaken Every X Number of Years.	At the Next Scheduled Training	Never
Alaska		X			
Arizona		X			
Arkansas				X	
California		X	X		
Colorado			X		
Connecticut				X	
Florida	X			X	
Georgia	X				
Idaho		X	X		
Indiana				X	
Iowa	X				
Kansas		X	X		
Kentucky					X
Maine		X	X		
Maryland			X		
Massachusetts		X	X		
Michigan		X			
Minnesota			X	X	
Mississippi		X			
Missouri		X	X	X	
Montana	X				
Nevada			X		
New Hampshire			X		
New Mexico	X				
New York	X				
North Carolina	X				
North Dakota	X	X	X		
Ohio			X	X	
Oklahoma				X	
Pennsylvania			X		
Rhode Island		X			
South Carolina	X		X		
South Dakota	X				
Tennessee			X		
Texas		X	X		
Utah	X	X	X		
Virginia		X	X		
Washington		X	X	X	
West Virginia					X
Wisconsin				X	
Wyoming		X			
Alberta	X	X	X	X	
New Brunswick			X	X	
Northwest Territories		X	X		
Ontario		X			
Quebec	X				
Saskatchewan				X	
Total Agencies	13	20	23	13	2



Evaluating the Effects of Training on Worker Performance and the Organization

57. Does your organization measure the effectiveness of training on worker performance?

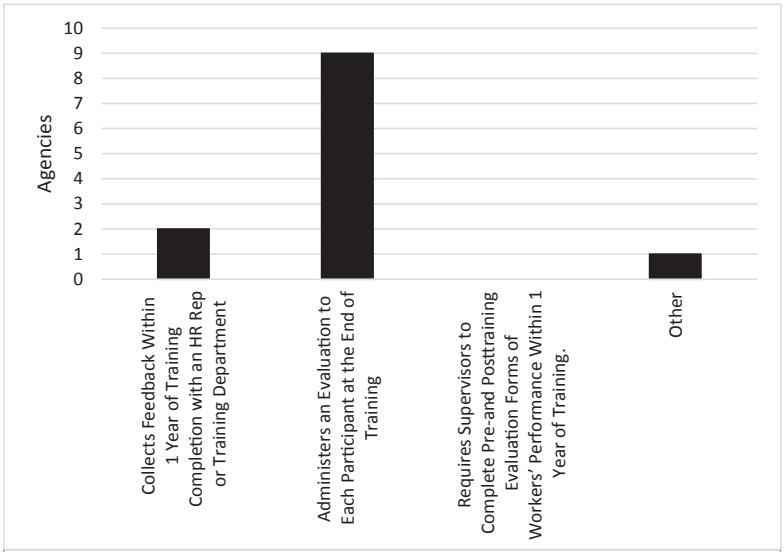
State	Yes/No
Alaska	No
Arizona	No
Arkansas	No
California	Don't know
Colorado	No
Connecticut	No
Florida	Yes
Georgia	No
Idaho	Yes
Indiana	No
Iowa	No
Kansas	No
Kentucky	No
Maine	Don't know
Maryland	Don't know
Massachusetts	Yes
Michigan	No
Minnesota	No
Mississippi	No
Missouri	Yes
Montana	No
Nevada	No
New Hampshire	No
New Mexico	Don't know
New York	Yes
North Carolina	Yes
North Dakota	Yes
Ohio	No
Oklahoma	No
Pennsylvania	No
Rhode Island	No
South Carolina	No
South Dakota	Don't know
Tennessee	No
Texas	No
Utah	Yes
Virginia	No
Washington	Yes
West Virginia	No
Wisconsin	No
Wyoming	No
Alberta	Yes
New Brunswick	Don't know
Northwest Territories	No
Ontario	Don't know
Quebec	No
Saskatchewan	No



Yes	10
No	30
Don't know	7

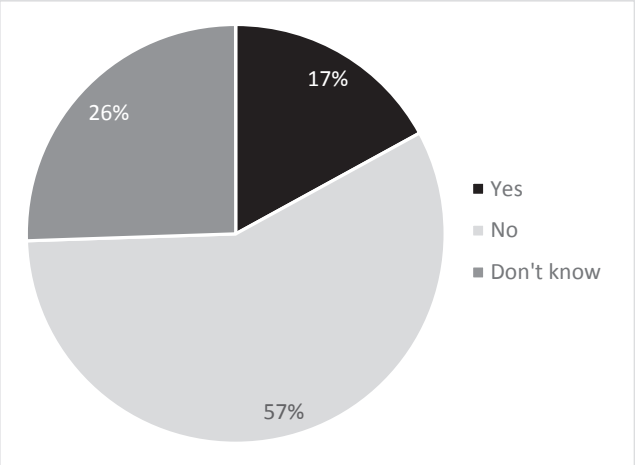
58. In order to determine whether training has impacted worker performance, my organization… Select all that apply.

State	Collects Feedback from Participants Within 1 Year of Training Being Completed via a Survey, Performance Evaluation, or Follow-Up Call with a Representative from the Human Resources or Training Departments	Administers an Evaluation to Each Participant at the End of Training That Includes Questions About Whether the Training Will Help Them Complete Their Work	Requires Supervisors to Complete Pre- and Posttraining Evaluation Forms of Workers' Performance; Posttraining Evaluations Are Completed Within 1 Year of Participant Attending Training	Other
Florida		X		
Idaho		X		
Massachusetts	X	X		
Missouri	X	X		
New York		X		
North Carolina		X		
North Dakota		X		
Washington		X		
Alberta		X		Ongoing assessment
Total Agencies	2	9	0	1



59. Does your organization measure the impact of training on the organization?

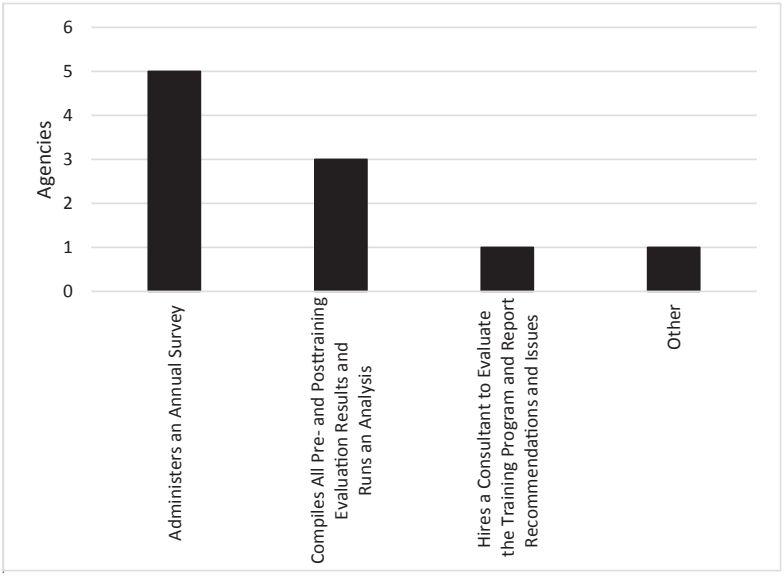
State	Yes/No
Alaska	No
Arizona	No
Arkansas	No
California	Don't know
Colorado	No
Connecticut	No
Florida	Yes
Georgia	Yes
Idaho	Yes
Indiana	Don't know
Iowa	No
Kansas	No
Kentucky	No
Maine	Don't know
Massachusetts	Yes
Maryland	Don't know
Michigan	No
Minnesota	No
Mississippi	No
Missouri	Don't know
Montana	Yes
Nevada	Don't know
New Hampshire	No
New Mexico	Don't know
New York	Don't know
North Carolina	No
North Dakota	Yes
Ohio	No
Oklahoma	No
Pennsylvania	Yes
Rhode Island	No
South Carolina	No
South Dakota	Don't know
Tennessee	No
Texas	No
Utah	No
Virginia	No
Washington	Don't know
West Virginia	No
Wisconsin	No
Wyoming	No
Alberta	Yes
New Brunswick	Don't know
Northwest Territories	No
Ontario	Don't know
Quebec	No
Saskatchewan	No



Yes	8
No	27
Don't know	12

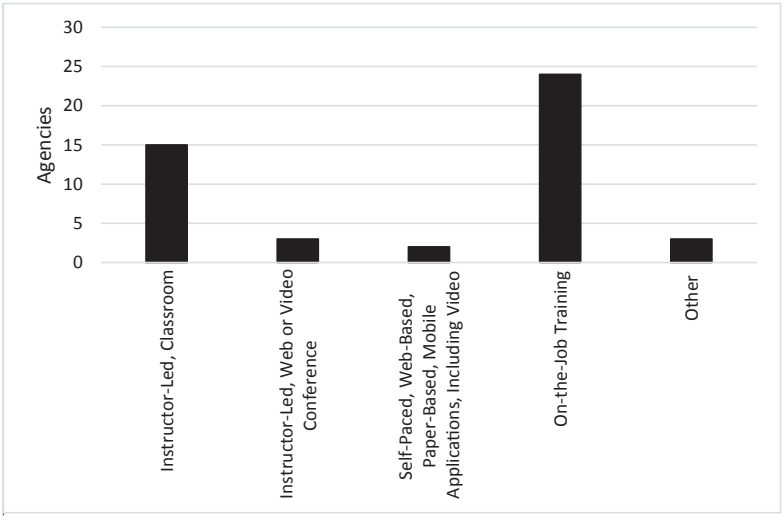
60. In order to determine whether training has impacted the organization, my organization… Select all that apply.

State	Administers an Annual Survey in Order to Gather Feedback on the Impact of Training on the Maintenance Program	Compiles All Pre- and Posttraining Evaluation Results and Runs an Analysis to Determine the Impact of Training on Worker Performance	Hires a Consultant to Evaluate the Training Program and Report Recommendations and Issues	Other
Florida	X			
Georgia	X			
Idaho	X			
Massachusetts	X		X	
Montana	X			
North Dakota		X		
Pennsylvania		X		
Alberta		X		In-house safety incident frequency
Total Agencies	5	3	1	1



61. Which of the following do you consider to be the most effective method of delivering training to maintenance workers?

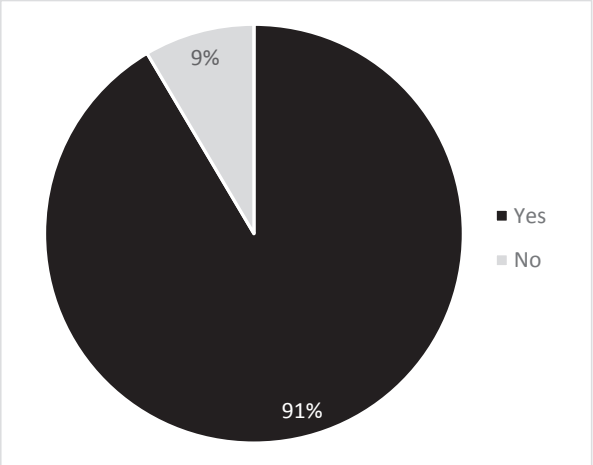
State	Yes/No
Alaska	Instructor-led, classroom
Arizona	Instructor-led, classroom
Arkansas	Instructor-led, classroom
California	On-the-job training
Colorado	On-the-job training
Connecticut	On-the-job training
Florida	Instructor-led, classroom
Georgia	Instructor-led, classroom
Idaho	On-the-job training
Indiana	Instructor-led, classroom
Iowa	Self-paced, web-based, paper-based, mobile applications, including video
Kansas	On-the-job training
Kentucky	On-the-job training
Maine	Other – Instructor-led with hands-on
Maryland	Other – a combination of instructor-led training and on-the-job training
Massachusetts	On-the-job training
Michigan	Instructor-led, classroom
Minnesota	Instructor-led, classroom
Mississippi	On-the-job training
Missouri	On-the-job training
Montana	On-the-job training
Nevada	On-the-job training
New Hampshire	On-the-job training
New Mexico	Instructor-led, web or video conference
New York	On-the-job training
North Carolina	On-the-job training
North Dakota	Instructor-led, classroom
Ohio	Instructor-led, classroom
Oklahoma	Instructor-led, classroom
Pennsylvania	Instructor-led, classroom
Rhode Island	Other – instructor-led with hybrid of classroom and practical application in the field
South Carolina	Self-paced, web-based, paper-based, mobile applications, including video
South Dakota	On-the-job training
Tennessee	On-the-job training
Texas	On-the-job training
Utah	Instructor-led, web or video conference
Virginia	On-the-job training
Washington	Instructor-led, classroom
West Virginia	On-the-job training
Wisconsin	Instructor-led, web or video conference
Wyoming	On-the-job training
Alberta	On-the-job training
New Brunswick	On-the-job training
Northwest Territories	Instructor-led, classroom
Ontario	Instructor-led, classroom
Quebec	On-the-job training
Saskatchewan	On-the-job training



Training Development

62. Do you develop training in-house?

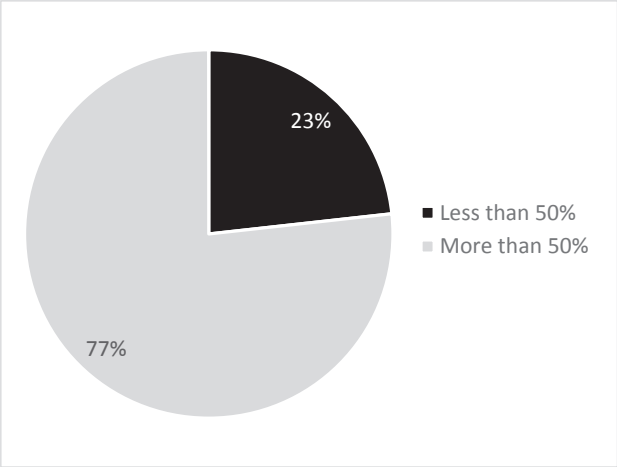
State	Yes/No
Alaska	Yes
Arizona	Yes
Arkansas	Yes
California	Yes
Colorado	Yes
Connecticut	Yes
Florida	Yes
Georgia	Yes
Idaho	Yes
Indiana	Yes
Iowa	Yes
Kansas	Yes
Kentucky	Yes
Maine	Yes
Maryland	Yes
Massachusetts	Yes
Michigan	Yes
Minnesota	Yes
Mississippi	No
Missouri	Yes
Montana	Yes
Nevada	Yes
New Hampshire	Yes
New Mexico	Yes
New York	Yes
North Carolina	Yes
North Dakota	No
Ohio	Yes
Oklahoma	No
Pennsylvania	Yes
Rhode Island	Yes
South Carolina	Yes
South Dakota	Yes
Tennessee	Yes
Texas	Yes
Utah	Yes
Virginia	Yes
Washington	Yes
West Virginia	No
Wisconsin	Yes
Wyoming	Yes
Alberta	Yes
New Brunswick	Yes
Northwest Territories	Yes
Ontario	Yes
Quebec	Yes
Saskatchewan	Yes



Yes	43
No	4

63. How much of your training is developed in-house?

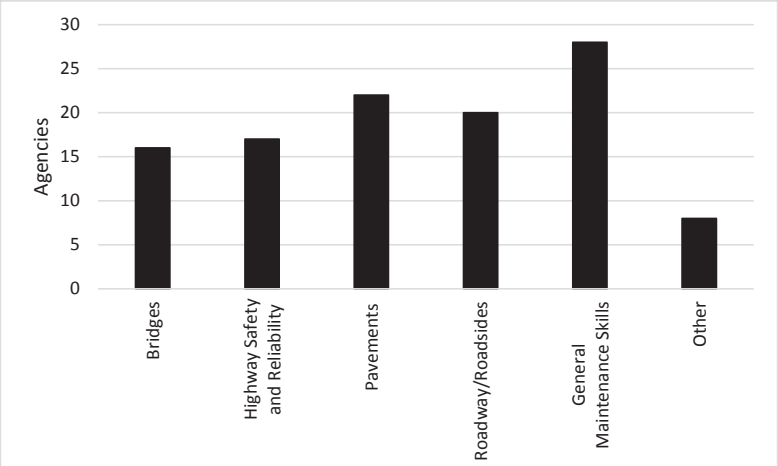
State	Yes/No
Alaska	Less than 50%
Arizona	More than 50%
Arkansas	More than 50%
California	More than 50%
Colorado	More than 50%
Connecticut	Less than 50%
Florida	More than 50%
Georgia	More than 50%
Idaho	More than 50%
Indiana	More than 50%
Iowa	More than 50%
Kansas	More than 50%
Kentucky	More than 50%
Maine	More than 50%
Maryland	More than 50%
Massachusetts	Less than 50%
Michigan	More than 50%
Minnesota	More than 50%
Missouri	More than 50%
Montana	More than 50%
Nevada	More than 50%
New Hampshire	More than 50%
New Mexico	More than 50%
New York	More than 50%
North Carolina	More than 50%
Ohio	More than 50%
Pennsylvania	More than 50%
Rhode Island	Less than 50%
South Carolina	Less than 50%
South Dakota	Less than 50%
Tennessee	More than 50%
Texas	Less than 50%
Utah	More than 50%
Virginia	More than 50%
Washington	More than 50%
Wisconsin	Less than 50%
Wyoming	Less than 50%
Alberta	More than 50%
New Brunswick	More than 50%
Northwest Territories	Less than 50%
Ontario	More than 50%
Quebec	More than 50%
Saskatchewan	More than 50%



Less than 50%	10
More than 50%	33

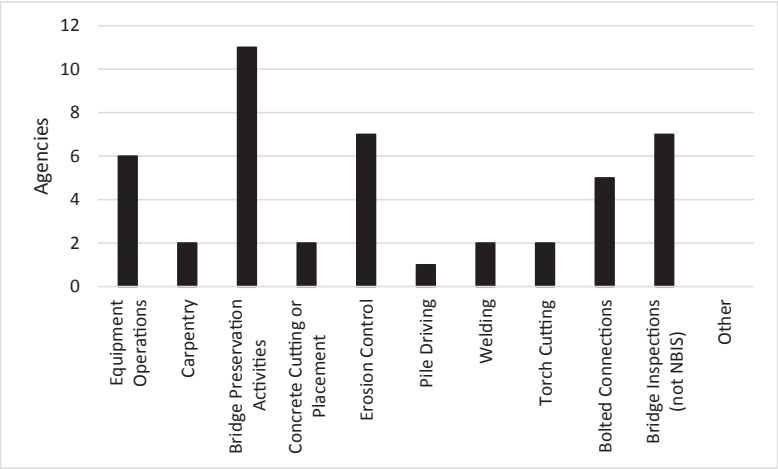
64. For which areas would you like to see training developed to address gaps?

State	Bridges	Highway Safety and Reliability	Pavements	Roadway/ Roadside	General Maintenance Skills	Other
Alaska		X	X			
Arizona			X			
Arkansas	X	X	X	X	X	Equipment operation and safety
California			X	X	X	
Colorado	X	X	X		X	
Connecticut		X	X	X	X	
Florida		X	X	X		
Georgia	X	X	X	X	X	
Idaho		X	X	X	X	
Indiana	X				X	
Iowa						None
Kansas	X	X	X			
Kentucky			X		X	
Maine						We develop courses as needs are identified.
Maryland					X	
Massachusetts					X	
Michigan		X	X	X	X	
Minnesota	X	X	X	X	X	
Mississippi			X	X	X	
Missouri		X				
Montana			X			
Nevada						I see gaps more in personal skills than in technical skills. If we do not have the technical skills, we contract the activity out.
New Hampshire	X	X		X	X	
New Mexico			X			
New York	X					
North Carolina		X	X		X	
North Dakota					X	
Ohio						Confined space
Oklahoma					X	
Pennsylvania	X				X	
Rhode Island	X		X	X	X	
South Carolina	X	X		X	X	
South Dakota					X	
Tennessee				X		
Texas						Unsure
Utah				X	X	
Virginia			X	X		
Washington						Soft skills, information technology
West Virginia					X	
Wisconsin			X	X	X	
Wyoming	X	X	X	X	X	
Alberta	X					
New Brunswick	X			X		
Northwest Territories	X	X		X	X	
Ontario						Don't know
Quebec					X	
Saskatchewan	X	X	X	X	X	
Total Agencies	16	17	22	20	28	8



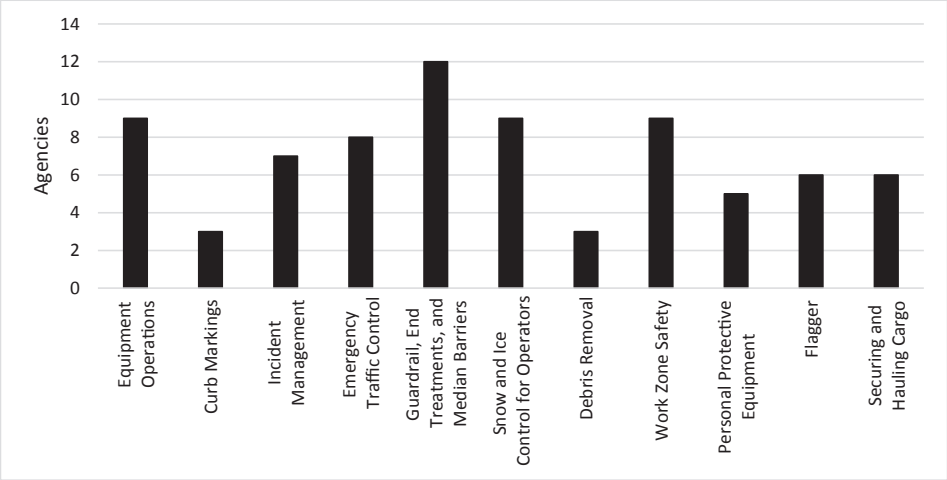
65. For which of the following bridge topics is additional training required? Select all that apply.

State	Equipment Operations	Carpentry	Bridge Preservation Activities	Concrete Cutting or Placement	Erosion Control	Pile Driving	Welding	Torch Cutting	Bolted Connections	Bridge Inspections (not NBIS)	Other
Arkansas					X					X	
Colorado	X								X	X	
Georgia	X		X		X						
Indiana											Joint repair and deck patching
Kansas			X	X							
Minnesota	X	X	X	X	X				X	X	
New Hampshire	X		X				X	X	X		
New York			X								
Pennsylvania			X								
Rhode Island	X		X		X		X	X			
South Carolina			X								
Wyoming			X		X					X	
Alberta		X				X			X		
New Brunswick										X	
Northwest Territories	X		X		X				X	X	
Saskatchewan			X		X					X	
Total Agencies	6	2	11	2	7	1	2	2	5	7	0



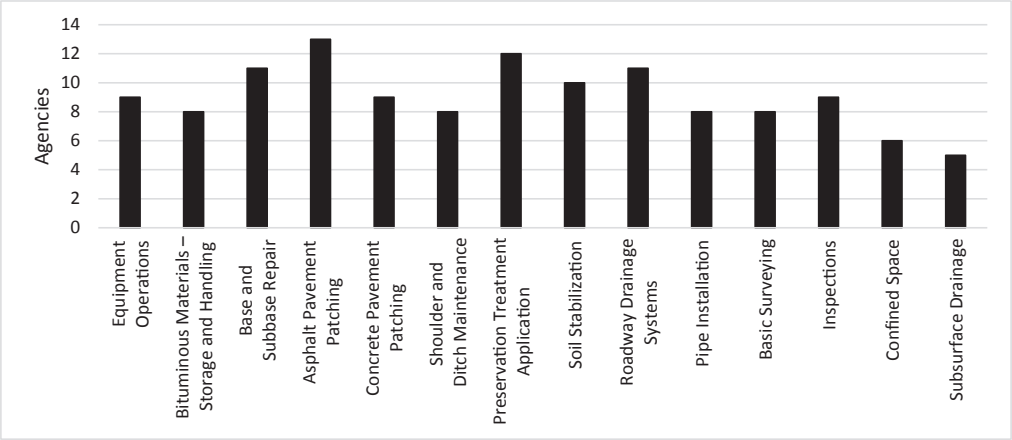
66. For which of the following highway safety and reliability topics is additional training required? Select all that apply.

State	Equipment Operations	Curb Markings	Incident Management	Emergency Traffic Control	Guardrail, End Treatments, and Median Barriers	Snow and Ice Control for Operators	Debris Removal	Work Zone Safety	Personal Protective Equipment	Flagger	Securing and Hauling Cargo
Alaska	X		X	X	X	X					
Arkansas				X		X		X		X	X
Colorado	X	X	X	X	X	X	X	X	X	X	X
Connecticut			X		X			X			
Florida	X	X			X			X	X	X	X
Georgia	X		X		X	X	X	X			
Idaho	X			X		X		X	X	X	
Kansas											X
Michigan	X				X						
Minnesota	X	X	X	X	X	X	X	X	X	X	X
Missouri											X
New Hampshire	X				X						
North Carolina						X					
South Carolina					X						
Wyoming				X	X	X		X			
Northwest Territories	X		X	X	X	X		X	X	X	
Saskatchewan			X	X	X						
Total Agencies	9	3	7	8	12	9	3	9	5	6	6



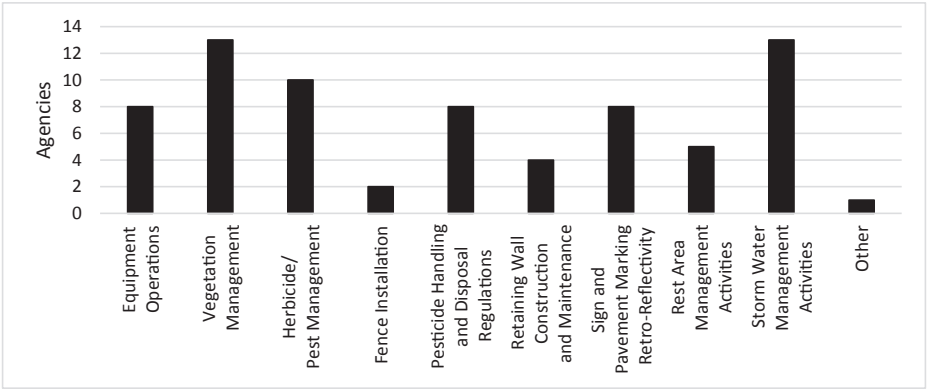
67. For which of the following pavement topics is additional training required? Select all that apply.

State	Equipment Operations	Bituminous Materials – Storage and Handling	Base/ Subbase Repair	Asphalt Pavement Patching	Concrete Pavement Patching	Shoulder and Ditch Maintenance	Preservation Treatment Application	Soil Stabilization	Roadway Drainage Systems	Pipe Installation	Basic Surveying	Inspections	Confined Space	Subsurface Drainage
Alaska	X			X		X	X	X	X	X	X			
Arizona								X		X		X		
Arkansas								X						
California													X	
Colorado	X			X		X	X	X	X		X	X	X	
Connecticut		X	X				X							X
Florida			X	X	X			X	X				X	
Georgia	X	X	X	X	X	X	X	X	X	X	X	X		X
Idaho	X										X			X
Kansas			X				X		X					
Kentucky	X	X	X	X	X	X			X	X	X	X		
Michigan				X	X	X								
Minnesota	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mississippi		X		X	X	X	X	X						
Montana	X	X	X						X	X	X	X	X	
New Mexico	X													
North Carolina												X		
Rhode Island	X	X	X	X		X	X	X	X	X		X	X	X
Virginia				X	X		X				X			
Wisconsin			X	X	X		X							
Wyoming			X	X	X		X		X	X		X		
Saskatchewan		X	X	X			X	X	X					
Total Agencies	9	8	11	13	9	8	12	10	11	8	8	9	6	5



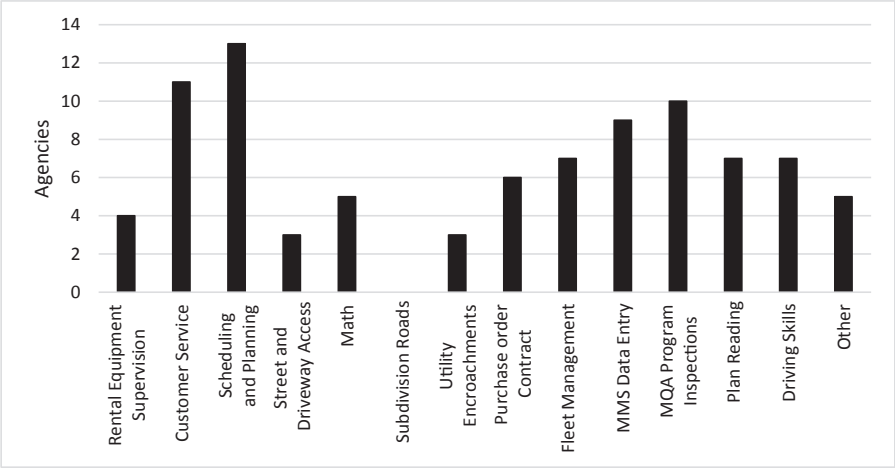
68. For which of the following roadway/roadside topics is additional training required? Select all that apply.

State	Equipment Operations	Vegetation Management	Herbicide/ Pest Management	Fence Installation	Pesticide Handling and Disposal Regulations	Retaining Wall Construction and Maintenance	Sign and Pavement Marking Retro-Reflectivity	Rest Area Management Activities	Storm water Management Activities	Other
Arkansas		X	X		X				X	
California									X	These topics are covered in nonmandated correspondence courses. We are in the process of developing instructor-led courses that will be mandated.
Connecticut				X	X					
Florida		X	X		X	X	X	X	X	
Georgia		X	X		X		X		X	
Idaho	X		X						X	
Michigan		X								
Minnesota	X	X	X		X	X	X		X	
Mississippi									X	
New Hampshire	X	X							X	
Rhode Island	X	X	X		X	X	X		X	
South Carolina	X									
Tennessee		X	X							
Utah	X									
Virginia		X	X		X		X		X	
Wisconsin		X	X					X	X	
Wyoming		X					X	X	X	
New Brunswick	X						X			
Northwest Territories	X	X		X			X	X		
Saskatchewan		X	X		X	X		X	X	
Total Agencies	8	13	10	2	8	4	8	5	13	1



69. For which of the following general maintenance skills is additional training required? Select all that apply.

State	Rental Equipment Supervision	Customer Service	Scheduling and Planning	Street and Driveway Access	Math	Subdivision Roads	Utility Encroachments	Purchase Order Contract	Fleet Management	MMS Data Entry	MQA Program Inspections	Plan Reading	Driving Skills	Other
Arkansas														Provided but not required
California													X	
Colorado			X		X				X	X	X	X		
Connecticut			X								X			
Georgia									X	X				
Idaho			X							X		X		
Indiana		X	X							X	X			
Kentucky	X	X	X		X			X			X	X	X	
Maryland														For the maintenance shop mechanics—more training on newer equipment to keep up with technology, for the high-way maintenance workers—refresher training on newer pieces of equipment to keep up with technological advances
Massachusetts			X				X			X	X	X		
Michigan												X		
Minnesota		X		X	X		X					X	X	
Mississippi		X		X										
New Hampshire		X												
North Carolina			X											
North Dakota		X		X				X						Forklift operations, crane operations
Oklahoma														There are no requirements.
Pennsylvania		X	X								X		X	
Rhode Island	X	X	X				X	X	X	X	X		X	
South Carolina			X						X					
South Dakota														None of these are required.
Utah					X			X				X	X	
Wisconsin									X		X			
West Virginia		X	X							X				
Wyoming		X	X					X						
Northwest Territories	X							X	X		X			
Quebec										X				
Saskatchewan	X	X	X		X				X	X	X		X	
Total Agencies	4	11	13	3	5	0	3	6	7	9	10	7	7	5



APPENDIX B

Survey Questionnaire (Web-Only)

This appendix is only provided in the version of the document published on the NCHRP website.

The Transportation Research Board (TRB) is preparing a synthesis on *Training and Certification of Highway Maintenance Workers.* This is being done for NCHRP, under the sponsorship of the American Association of State Highway and Transportation Officials, in cooperation with the Federal Highway Administration.

The purpose of this questionnaire is to identify and summarize the training and certification practices used by state and provincial highway agencies for highway maintenance workers. The results of the survey will be incorporated into a synthesis of highway agency practice, with the intent of helping agencies evaluate and improve their current maintenance training and certification programs.

This questionnaire is being sent to the voting member of the AASHTO Subcommittee on Maintenance for each state department of transportation and the Canadian provincial transportation agencies. You may want the assistance of the organization's Training Director to complete the survey. Directions on forwarding the survey are provided on the first page of the survey. Your cooperation in completing the questionnaire will ensure the success of this effort. **If you are not the appropriate person at your organization to complete this questionnaire, please forward it to the correct person.**

Please compete and submit this survey by February 26, 2015. We estimate that it should take no more than 20 minutes to complete. It is designed so you can exit and return to the survey if you need to allocate your time over several days. If you have any questions or problems related to this questionnaire, please contact our principal investigator Ms. Katie Zimmerman at (217) 398-3977 or kzimmerman@appliedpavement.com.

Questionnaire Instructions

1. To view and print the entire questionnaire. Select the following link and print using "control p." //surveygizmolibrary.s3.amazonaws.com/library/64484/PrintableSurvey.pdf

2. To save your partial answers and complete the questionnaire later, Select the "Save and Continue Later" link in the upper right hand corner of your screen. A link to the incomplete questionnaire will be emailed to you from *SurveyGizmo*. To return to the questionnaire later, open the email from *SurveyGizmo* and select the link. We suggest using the "Save and Continue Later" feature if there will be more than 15 minutes of inactivity while the survey is opened, as some firewalls may terminate due to inactivity.

3. To pass a partially completed questionnaire to a colleague, Select the "Save and Continue Later" link in the upper right hand corner of your screen. A link to the incomplete questionnaire will be emailed to you from *SurveyGizmo*. Open the email from *SurveyGizmo* and forward it to a colleague.

4. To view and print your answers before submitting the survey. Advance forward to the page following question 49. Print using "control p."

5. *To submit the survey,* Select "Submit" on the last page.

Thank you very much for your time and expertise.

Please enter the date (MM/DD/YYYY). _____

Please enter your contact information.

First Name _____

Last Name _____

Agency/Organization _____

Street Address _____

Suite _____

City _____

State _____

Zip Code _____

Country _____

E-mail Address _____

Phone Number _____

1. The synthesis will include three to five case examples to illustrate different training program practices being used. Would your organization be interested in participating in a case study?

☐ Yes

☐ No

Guidance

This questionnaire is specifically crafted to gather information about technical training and certification of front-line maintenance workers. Training designed for both front-line maintenance workers and maintenance supervisors can be considered for a response, but training specific to only maintenance supervisors should not. For the purposes of this questionnaire, training refers specifically to a structured, repeatable learning experience that follows a formalized plan. It may offer participant materials or an exam. As a survey of technical training and certification, respondents should consider pavement, bridges, roadside, equipment, and highway safety and reliability training offerings when providing answers rather than soft-skill training, such as sexual harassment or timesheet completion.

Definitions

The following definitions are used in conjunction with this questionnaire:

- **Instructor-led, classroom training** – training that is delivered in the classroom; an instructor is present to facilitate instruction.
- **Instructor-led, web or video conference training** – training that is delivered through a web or video conferencing system; an instructor is present to facilitate instruction.
- **On-the-job training** – training that is delivered by an experienced employee; often includes demonstration lessons and opportunities for inexperienced employees to practice new skills and receive feedback on performance.
- **Self-paced, mobile training** – training that is delivered through a mobile application via a cell phone or tablet; training is completed according to the participant's pace and schedule.
- **Self-paced, paper-based training** – training material is provided either in hardcopy or electronically; training is completed independently according to the participant's pace and schedule.
- **Self-paced, web-based training** – training that is delivered online via the Internet or intranet; training is completed independently according to the participant's pace and schedule.
- **Training** – a structured, repeatable learning experience that follows a formalized plan with the exception of informal, on-the-job training.

Reminders

- This questionnaire focuses **only** on training for front-line maintenance workers.
- Training exclusively designed for maintenance supervisors should **not** be considered.
- Only technical training should be considered.
- Do **not** consider administrative training required of all agency employees, such as sexual harassment training or training on completing timesheets.

General Information

1. The synthesis will include three to five case studies to illustrate different training program practices being used. Would your organization be interested in participating in a case study?
   - ☐ Yes
   - ☐ No
2. Select the state or province you represent: (State drop down menu)
3. Approximately how many front-line maintenance workers are employed by your state or provincial organization?
   - ☐ 0–500
   - ☐ 501–1,500
   - ☐ 1,500–3,000
   - ☐ Greater than 3,000
4. What percentage of maintenance work is performed by contract?
   - ☐ None (*advance to question 9*)
   - ☐ Less than 50%
   - ☐ Greater than 50%
   - ☐ 100%
5. Does your state or province require contract workers to be trained and certified beyond federal requirements?
   - ☐ Yes
   - ☐ No (*advance to question 9*)
6. Do you require documentation verifying training and certification requirements have been met?
   - ☐ Yes
   - ☐ No
7. In general, training and certification requirements are…
   - ☐ More stringent for state and provincial maintenance workers than contract maintenance workers.
   - ☐ Less stringent for state and provincial maintenance workers than contract maintenance workers.
   - ☐ The same for state, provincial, and contract maintenance workers.
   - ☐ Don't know.
8. For which training categories do you have more stringent requirements for state and provincial maintenance workers?
   - ☐ Bridges
   - ☐ Highway Safety and Reliability
   - ☐ Pavements
   - ☐ Roadway/Roadside
   - ☐ General Maintenance Skills
9. Do you share training materials with other organizations?
   - ☐ Yes
   - ☐ No (*advance to question 11*)

10. Select the organizations with whom you share materials. Select all that apply.

- ☐ Other state or provincial highway organizations
- ☐ Local technical assistance programs (LTAP)
- ☐ Transportation Curriculum Coordination Council (TCCC)
- ☐ Other _____

Training Content and Delivery

11. Do you offer technical training to front-line maintenance workers?

- ☐ Yes
- ☐ No (*advance to question 44*)

12. For which of the following areas do you offer technical training to front-line maintenance workers?

- ☐ Bridges (*answer 13 & 14*)
- ☐ Highway Safety and Reliability (*answer 15 & 16*)
- ☐ Pavements (*answer 17 & 18*)
- ☐ Roadway/Roadside (*answer 19 & 20*)
- ☐ General Maintenance Skills (*answer 21 & 22*)

13. Select the bridge topics for which your organization offers training.

- ☐ Equipment operations
- ☐ Carpentry
- ☐ Concrete cutting or placement
- ☐ Erosion control
- ☐ Pile driving
- ☐ Welding
- ☐ Torch cutting
- ☐ Bolted connections
- ☐ Bridge inspections (not NBIS)
- ☐ Bridge oreservation activities
- ☐ Other _____

14. Which of the following methods do you use to deliver bridge training? Select all that apply.

- ☐ Instructor-led, classroom
- ☐ Instructor-led, web or video conference
- ☐ Self-paced, web-based, paper-based, mobile applications, including video
- ☐ On-the-job training
- ☐ Other _____

15. Select the highway safety and reliability topics for which your organization offers training. (This category includes the following types of assets: signal, sign, pavement marking, pavement marker, guardrail end treatment, overhead sign structure, impact attenuator, protective barriers, traffic monitoring system.)

- ☐ Equipment operations

- ☐ Curb markings
- ☐ Incident management
- ☐ Emergency traffic control
- ☐ Guardrail, end treatments, and median barriers
- ☐ Snow and ice control for operators
- ☐ Debris removal
- ☐ Work zone safety
- ☐ Personal protective equipment
- ☐ Flagger
- ☐ Securing and hauling cargo
- ☐ Other _____

16. Which of the following methods do you use to deliver highway safety and reliability training? Select all that apply.

- ☐ Instructor-led, classroom
- ☐ Instructor-led, web or video conference
- ☐ Self-paced, web-based, paper-based, mobile applications, including video
- ☐ On-the-job training
- ☐ Other _____

17. Select the pavement topics for which your organization offers training. (This category includes the following types of assets: paved shoulders, unpaved shoulders, paved roadways, culvert, flume, curb and gutter, sidewalk, ditch or slope, drop inlet, underdrain and edgedrain.)

- ☐ Equipment operations
- ☐ Bituminous materials—storage and handling
- ☐ Base and sub base repair
- ☐ Asphalt pavement patching
- ☐ Concrete pavement patching
- ☐ Shoulder and ditch maintenance
- ☐ Preservation treatment application
- ☐ Soil stabilization
- ☐ Inspections
- ☐ Roadway drainage systems
- ☐ Pipe installation
- ☐ Basic surveying
- ☐ Confined space
- ☐ Subsurface drainage
- ☐ Other _____

18. Which of the following methods do you use to deliver pavement training? Select all that apply.

- ☐ Instructor-led, classroom
- ☐ Instructor-led, web or video conference

- ☐ Self-paced, web-based, paper-based, mobile applications, including video
- ☐ On-the-job training
- ☐ Other _____

19. Select the roadway/roadside topics for which your organization offers training. (This category includes the following types of assets: rest areas, weigh stations, fence, landscaping, plant beds, sound barriers.)

- ☐ Equipment operations
- ☐ Vegetation management
- ☐ Herbicide/pest management
- ☐ Fence installation
- ☐ Pesticide handling and disposal regulations
- ☐ Retaining wall construction and maintenance
- ☐ Sign and pavement marking retro-reflectivity
- ☐ Rest area management activities
- ☐ Storm water management activities
- ☐ Other _____

20. Which of the following methods do you use to deliver roadway/roadside training? Select all that apply.

- ☐ Instructor-led, classroom
- ☐ Instructor-led, web or video conference
- ☐ Self-paced, web-based, paper-based, mobile applications, including video
- ☐ On-the-job training
- ☐ Other _____

21. Select the general maintenance skills for which your organization offers training.

- ☐ Rental equipment supervision
- ☐ Customer service
- ☐ Scheduling and planning
- ☐ Street and driveway access
- ☐ Math
- ☐ Subdivision roads
- ☐ Utility encroachments
- ☐ Purchase order contract
- ☐ Fleet management
- ☐ Maintenance management system data entry
- ☐ Maintenance quality assurance program inspections
- ☐ Plan reading
- ☐ Driving skills
- ☐ Other

22. Which of the following methods do you use to deliver general maintenance skills training? Select all that apply.

- ☐ Instructor-led, classroom
- ☐ Instructor-led, web or video conference
- ☐ Self-paced, web-based, paper-based, mobile applications, including video
- ☐ On-the-job training
- ☐ Other

Which delivery method is predominant for the technical content areas?

Which delivery method is predominant for the technical content areas?	Instructor-led, classroom	Instructor-led, Web or video conference	Self-paced, Web-based, paper-based, mobile applications, including video	On-the-job training	Other

(*Rows are brought in based on answers to Q 12.*)

23. Who facilitates training for each technical content area? Select all that apply.

DOT employees	Contracted instructors	Equipment manufacturers	LTAP	Unions	Community College	Other

(*Rows are brought in based on answers to Q 12.*)

24. If you selected "other" as a facilitator option, please fill in the type of facilitator used.

(*Selections are brought in based on answers to Q12.*)

25. Is bridge training required? (*shown based on answers to question 13*)

- ☐ Yes
- ☐ No (*advanced to question 26*)
- ☐ Don't know

26. Select the bridge topics for which training is required.

(*Selections are brought in based on answers to Q 13.*)

27. Is certification in bridges offered? (*shown based on answers to question 13*)

- ☐ Yes
- ☐ No (*advanced to question 28*)
- ☐ Don't know

28. Select the bridge topics for which certification is offered.

(*Selections are brought in based on answers to Q 13.*)

29. Is highway safety and reliability training required? (*shown based on answers to question 15*)

- ☐ Yes
- ☐ No (*advanced to question 30*)
- ☐ Don't know

30. Select the highway safety and reliability topics for which training is required.

(*Selections are brought in based on answers to Q15*)

31. Is certification in highway safety and reliability offered? (*shown based on answers to question 15*)

☐ Yes

☐ No (*advanced to question 32*)

☐ Don't know

32. Select the highway safety and reliability topics for which certification is offered.

(*Selections are brought in based on answers to Q15*)

33. Is pavement training required? (*shown based on answers to question 17*)

☐ Yes

☐ No (*advanced to question 34*)

☐ Don't know

34. Select the pavement topics for which training is required.

(*Selections are brought in based on answers to Q17*)

35. Is certification in pavements offered? (*shown based on answers to question 17*)

☐ Yes

☐ No (*advanced to question 36*)

☐ Don't know

36. Select the pavement topics for which certification is offered.

(*Selections are brought in based on answers to Q17*)

37. Is roadway/roadside training required? (*shown based on answers to question 19*)

☐ Yes

☐ No (*advanced to question 38*)

☐ Don't know

38. Select the roadway/roadside topics for which training is required.

(*Selections are brought in based on answers to Q19*)

39. Is certification in roadway/roadside offered? (*shown based on answers to question 19*)

☐ Yes

☐ No (*advanced to question 40*)

☐ Don't know

40. Select the roadway/roadside topics for which certification is offered.

(*Selections are brought in based on answers to Q19*)

41. Is general maintenance skills training required? (*shown based on answers to question 21*)

- ☐ Yes
- ☐ No (*advanced to question 42*)
- ☐ Don't know

42. Select the general maintenance skills for which training is required.

(*Selections are brought in based on answers to Q21*)

43. Is certification in general maintenance skills offered? (*shown based on answers to question 21*)

- ☐ Yes
- ☐ No (*advanced to question 44*)
- ☐ Don't know

44. Select the general maintenance skills for which certification is offered.

(*Selections are brought in based on answers to Q21*)

Inducements to Take Training

44. Does your organization provide incentives to encourage maintenance workers to participate in training?

- ☐ Yes
- ☐ No (*advance to question 46*)

45. What incentives does your organization provide to encourage participation in training? Select all that apply.

- ☐ Completion of training allows workers to acquire new skills or keep pace with technology.
- ☐ Completion of training qualifies workers for promotion.
- ☐ Completion of training qualifies workers for specific jobs (such as inspector).
- ☐ Completion of training is linked to a wage increase.
- ☐ Completion of training is necessary to retain employment.
- ☐ Other _____

46. If your organization offers certification in a particular topic, please select the reason for offering certification.

- ☐ The training topic(s) has historically been an area for which certification is offered.
- ☐ The training and certification addresses safety, liability, and insurance considerations.
- ☐ Training and certification is mandated by the state or province.
- ☐ My organization does not offer certification.
- ☐ Other _____

47. Does your organization align its training program offerings with maintenance worker performance requirements? (*Shown based on responses to Q12*)

- ☐ Yes
- ☐ No (*advanced to question 50*)

48. Is worker participation in technical training a factor in evaluating performance?

- ☐ Yes
- ☐ No (*advanced to question 50*)

49. Is worker participation in technical training formally documented on the performance evaluation?

- ☐ Yes
- ☐ No

50. Do supervisors regularly recommend training for maintenance workers to attend in order to improve performance and possibly advance?

- ☐ Yes
- ☐ No
- ☐ Don't know.

51. Is the promotion of a front-line maintenance worker dependent on the completion of certain training requirements?

- ☐ Yes
- ☐ No

Frequency of Training Events and Tracking Participation

52. How often does the average maintenance worker participate in mandatory training?

- ☐ At least once a year
- ☐ More than once a year
- ☐ At least once every 2–3 years
- ☐ Never; my organization does not have mandatory training requirements

53. How often does the average maintenance worker participate in non-mandatory training?

- ☐ At least once a year
- ☐ More than once a year
- ☐ At least once every 2–3 years
- ☐ Almost never
- ☐ Don't know; there is no formal process for reporting participation in non-mandatory training back to the maintenance department.

54. How frequently are workers able to retake training to refresh knowledge and skills?

- ☐ Any time
- ☐ At the suggestion of a supervisor
- ☐ Certain training must be retaken every X number of years
- ☐ At the next scheduled training
- ☐ Never

Evaluating the Effects of Training on Worker Performance and the Organization

55. Does your organization measure the effectiveness of training on workers' performance?

- ☐ Yes
- ☐ No (*advance to question 57*)
- ☐ Don't know

56. In order to determine whether training has impacted workers' performance, my organization… Select all that apply.

- ☐ Collects feedback from participants within 1 year of training being completed via a survey, performance evaluation, or follow-up call with a representative from the Human Resources or Training Departments.
- ☐ Administers an evaluation to each participant at the end of training that includes questions about whether the training will help them complete their work.
- ☐ Requires supervisors to complete pre- and post-training evaluation forms of workers' performance. Post-training evaluations are completed within 1 year of participant attending training.
- ☐ Other _____

57. Does your organization measure the impact of training on the organization?

- ☐ Yes
- ☐ No (*advanced to question 59*)
- ☐ Don't know

58. In order to determine whether training has impacted the organization, my organization… Select all that apply.

- ☐ Administers an annual survey in order to gather feedback on the impact of training on the maintenance program.
- ☐ Compiles all pre- and post-training evaluation results and runs an analysis to determine the impact of training on worker performance.
- ☐ Hires a consultant to evaluate the training program and report recommendations and issues.
- ☐ Other _____

59. Which of the following do you consider to be the most effective method of delivering training to maintenance workers?

- ☐ Instructor-led, classroom
- ☐ Instructor-led, web or video conference
- ☐ Self-paced, web-based, paper-based, mobile applications, including video
- ☐ On-the-job training
- ☐ Other _____

Training Development

60. Do you develop training in-house?

- ☐ Yes
- ☐ No (*advanced to question 62*)

61. How much of your training is developed in-house?

- ☐ Less than 50%
- ☐ More than 50%

62. For which areas would you like to see training developed to address gaps? Select all that apply.

- ☐ Bridges (*answer Q63*)
- ☐ Highway Safety and Reliability (*answer Q64*)
- ☐ Pavements (*answer Q65*)
- ☐ Roadway/Roadside (*answer Q66*)
- ☐ General Maintenance Skills (*answer Q67*)
- ☐ Other _____

63. For which of the following bridge topics is additional training required? Select all that apply.

- ☐ Equipment operations
- ☐ Carpentry
- ☐ Bridge preservation activities
- ☐ Concrete cutting or placement
- ☐ Erosion control
- ☐ Pile driving
- ☐ Welding
- ☐ Torch cutting
- ☐ Bolted connections
- ☐ Bridge inspections (not NBIS)
- ☐ Other _____

64. For which of the following highway safety and reliability topics is additional training required? Select all that apply.

- ☐ Equipment operations
- ☐ Curb markings
- ☐ Incident management
- ☐ Emergency traffic control
- ☐ Guardrail, end treatments, and median barriers
- ☐ Snow and ice control for operators
- ☐ Debris removal
- ☐ Work zone safety
- ☐ Personal protective equipment
- ☐ Flagger
- ☐ Securing and hauling cargo
- ☐ Other _____

65. For which of the following pavement topics is additional training required? Select all that apply.

- ☐ Equipment operations
- ☐ Bituminous materials—storage and handling
- ☐ Base and sub base repair
- ☐ Asphalt pavement patching

- ☐ Concrete pavement patching
- ☐ Shoulder and ditch maintenance
- ☐ Preservation treatment application
- ☐ Soil stabilization
- ☐ Roadway drainage systems
- ☐ Pipe installation
- ☐ Basic surveying
- ☐ Inspections
- ☐ Confined space
- ☐ Subsurface drainage
- ☐ Other

66. For which of the following roadway/roadside topics is additional training required? Select all that apply.

- ☐ Equipment operations
- ☐ Vegetation management
- ☐ Herbicide/pest management
- ☐ Fence installation
- ☐ Pesticide handling and disposal regulations
- ☐ Retaining wall construction and maintenance
- ☐ Sign and pavement marking retro-reflectivity
- ☐ Rest area management activities
- ☐ Storm water management activities
- ☐ Other

67. For which of the following general maintenance skills is additional training required? Select all that apply.

- ☐ Rental equipment supervision
- ☐ Customer service
- ☐ Scheduling and planning
- ☐ Street and driveway access
- ☐ Math
- ☐ Subdivision roads
- ☐ Utility encroachments
- ☐ Purchase order contract
- ☐ Fleet management
- ☐ Maintenance management system data entry
- ☐ Maintenance quality assurance program inspections
- ☐ Plan reading
- ☐ Driving skills
- ☐ Other

Review

Here is a view of the entire questionnaire and any responses that have been made. You may print this using "control p." Please note that there are a few questions for which responses will not appear.

Thank You!

Thank you for taking our survey. Your response is very important to us. If you have any questions or comments, please feel free to contact Ms. Katie Zimmerman at:

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Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TDC	Transit Development Corporation
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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