The Effective Use of Computer-Based Training
for
In-Career Training and Knowledge Management

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ABSTRACT

The theme for the 2006 Transportation Association of Canada (TAC) Annual Conference, "Transportation without Boundaries" creates an image in the minds of most transportation professionals of what we would like to achieve within the next decade. However, our pragmatic side says there are institutional barriers that need to be breached and entrenched work cultures that must be changed in order to attain such a vision.

A computer-based training (CBT) program is helping transportation agencies in Canada and the United States (US) transcend traditional training boundaries of time and distance to improve winter maintenance operations. The CBT is being used in both individual and conventional group training modes. It is most effective and efficient as an individual self-paced instruction program. Both the group and individual modes are structured to serve a wide range of learning abilities in the student population, including those with challenges such as dyslexia or hearing loss.

In an effort to reach field forces more effectively, the American Association of State Highway and Transportation Officials (AASHTO) launched an Anti-Icing/Road Weather Information System (AI/RWIS) CBT into the winter maintenance training arena. Over 90% of US snow-belt states, three provinces and numerous cities in both countries have purchased the CBT.

This paper describes how the AI/RWIS CBT is being utilized in both countries and underscores the valuable lessons learned from successful and not-so-successful deployments. It also shows how institutional barriers were breached, entrenched work cultures changed, and how recent research is being incorporated into the instructional content to ensure that training material stays current.

TEXT

Introduction

The 2006 Annual Conference of the Transportation Association of Canada (TAC) has an overall conference theme of "Transportation without Boundaries". This theme as stated in the Call for Papers, "…reflects TAC's commitment to exploring critical issues facing the transportation sector. Providing an efficient, seamless and barrier-free transportation system for Canadians is of paramount importance to the future evolution of the country".

TAC's companion organization in the US is the American Association of State Highway and Transportation Officials (AASHTO). Like TAC, AASHTO is committed to support the state Departments of Transportation in their efforts to efficiently and safety move people and goods. The critical transportation issues in Canada and the US are so tightly interwoven that remarkable ingenuity and creativity are required to untangle them and make progress.

Three critical transportation issues ranking high on the priority list are improving safety and mobility while protecting the environment. This paper will focus on improving all three with more efficient and effective winter maintenance. The researched knowledge base is available in both Canada and the US to do this, but applying that knowledge is hampered by other critical transportation issues like inadequate finance, institutional barriers and entrenched work cultures.

Using the Knowledge Base

Both Canada and the US initiated and completed Strategic Highway Research Programs (SHRP in the US and C-SHRP in Canada) to provide the ingenuity and creativity in finding solutions to the difficult problems that were embedded within some of the critical transportation issues. Nearly all of the available funding was spent on the research with the belief that the results would be so obvious and compelling that the state and local agencies would simply adopt them. Implementing the results of that research, however, was more difficult than originally envisioned. The SHRP foundational winter maintenance research was completed in 1993 with major investigative works on 1) Road Weather Information Systems (RWIS) and 2) Anti-icing (AI) operations [1, 2].

An International Winter Technology Scanning Tour program followed the sunset of SHRP [5]. This 1994 winter maintenance operations scan of Japan, Germany and Austria provided new knowledge about how other countries were utilizing RWIS, AI, advanced material applications, and improved equipment design to achieve better winter mobility and improve safety. Additional tours were conducted in other countries in 1998 and 2002.

After completion of SHRP and the 1994 International Winter Scanning Tour, the Federal Highway Administration (FHWA) and AASHTO realized that the states were not recognizing the value of this completed research. The major products of the snow and ice control research, Road Weather Information Systems (RWIS) and Anti-Icing (AI) were only being implemented in limited areas of a few snow-belt states. A "Lead States" program was put in place to help

accelerate the technology transfer and implementation process. At the end of the Lead States program it was concluded that both RWIS and AI were complicated systems and would require initial and refresher training to achieve understanding and maintain user skills. The Lead State Team determined this training could best be accomplished with the development of an interactive computer-based, stand-alone, training program.

Development of the Computer-based Training (CBT) Program

When the Lead States program was sunset, the responsibilities for developing and implementing the computer-based training program was handed off to the AASHTO Snow and Ice Cooperative Program (SICOP). The Aurora Consortium, an RWIS research consortium, had RWIS training as one of its top program priorities. The Aurora Consortium and AASHTO SICOP agreed to partner in the development of a national AASHTO AI/RWIS CBT program with Aurora taking the lead in developing the scope of work and obtaining a contractor to build the computer-based training program. AASHTO was designated to be the lead agency in establishing a pooled fund program to provide the necessary financial support and technical guidance to develop an innovative AI/RWIS CBT program for state and local governments. SICOP was charged with soliciting and administering the necessary funding and managing the project. The American Public Works Association (APWA), the National Association of County Engineers (NACE) and over 90% of the snow-belt states contributed to the pooled fund program.

Two versions of the CBT program, one generic and the other customized were the end products of this pooled fund effort. Each version is a menu-driven, hyper-linked, interactive program manager. The student once logged in can work through this stand alone training from beginning to end, like a book, returning to the menu at intervals, as desired, to select another path. The content is photographs, illustrations, text, video, charts, animation, interaction, narration and other means of communications. There are opportunities at various points to assess the progress the user is making educationally, including quizzes, scenario-based problem cases, and exercises. The training can be individually administered or used in a group setting and can be the foundation for a certification program.

The CBT program was distributed in a CD ROM format in 2003. APWA and NACE selected the generic version while all but two states desired the customized versions. Some states promptly began the customization process, while others reviewed the generic content and found it satisfactory for immediate implementation. Those states delaying customization felt that they could do a more complete customization after their maintenance workers had a chance to become familiar with the program content and determine how well the generic material fit their particular snow and ice control operations and learning processes. Many of the states that chose to delay customization found the generic version met their training needs and opted not put the additional time into gathering material for the customization process.

A metric version of the CBT was prepared in 2005 for use in the Canadian Provinces. Converting to metrics was more than just doing the mathematics. Canadian maintenance field jargon and techniques were added to gain field acceptance. Value Added Meteorological Service (VAMS) vendor screen shots had to be added. Also maps and radar had to be extended northward to provide adequate coverage of the Canadian Provinces.

Performance and Payback

RWIS and Anti-icing

The National Cooperative Highway Research Program documented benefits and cost savings from RWIS and Anti-icing technologies in their March 2001 report [3]. These benefits included safer travel, increased level of service, cost savings and environmental quality. State departments of transportation reported 200 to 1300% return on investment, reduced labor and materials costs. The Insurance Company of British Columbia estimated $350,000 to $750,000 in accident savings in one city and annual province savings of $6 million in windshield damage. An Ontario study conducted during the winter of 2002-2003 found that anti-icing operations had a positive effect on reducing the number of crashes on their study route [4]. These savings were achieved before the computer based training program was available so it is anticipated even greater savings are occurring today as both operators and supervisors have a better understanding of the chemistry and physics of snow and ice control and how to optimize their operations.

Computer Based Training

Feedback from state DOTs and Canadian Provincial and city maintenance personnel and trainers has been the CBT exceeded their expectations. The CBT was easily installed on their computers and fit well into their training program. Lessons learned from a recent telephone survey indicates where the state DOT had a champion who promoted training, the CBT was being successfully deployed. State DOTs that experienced high staff turn over and lacked a training champion, made only minor use of the CBT. Computer availability is a problem in some states.

The Kansas DOT made the CBT part of their career ladder curriculum and provides an educational accomplishment bonus when the employee finishes the training program. More than 250 of their employees have completed the CBT. Iowa DOT uses a self-pace mode. They begin with a group session to complete Lesson 1 and then the student progresses at their own rate using non-peak work hours at the workplace to complete the other six lessons. Over 500 Iowa DOT employees have completed the CBT. Montana uses a combination of group teaching and individual progression. About 250 employees have completed the CBT.

The Idaho Local Transportation Assistance Program (LTAP) uses all instructor lead training with the CBT. The pre-tests and post tests provide LTAP instructors feedback on how well the students are grasping the material. North Dakota DOT also uses instructor lead training and is completing a classroom with 14 new networked computers. The City of Calgary very successfully uses “Smart Board” technology for teaching in a group setting. AASHTO is considering modifying the CBT so that those agencies using instructor lead training in a classroom with networked computers would be able to pretest each group of students to establish their base knowledge before presenting the material. The computer would aggregate the test results and instantly provide the instructor a key to guide their presentation and identify areas

that need special emphasis. Likewise the end of lesson exam would be graded by the computer and recorded to each student's record. The class results would be aggregated and instantly provided to the instructor so that a review of test material missed could be conducted while the exam is yet fresh in everyone's mind.

In summary, the CBT works well in either the group or individual training mode. The individual training mode is the most popular and efficient use. Being a stand-alone CBT program, operators can train inside during periods where field conditions or weather result in less productive outdoor work environment. Field operators and supervisors found the CBT very engaging and challenging. Most found two hours at a session fits best into their daily work schedule and does not mentally wear them out. Since the CBT is a stand-alone application on the garage computer, it is convenient and usually accessible. Depending on student experience and ability, time required to complete all seven lessons varies from 20 to 40 hours.

Feedback from users is the CBT has improved the skills of both supervisors and operators thus increasing the efficiency and effectiveness of all snow and ice control operations. Pre-testing and post testing of each student on each lesson provides the student and the training administrator a record of how much learning has been accomplished, how much time is being invested and pin points areas of difficulty where addition emphasis needs to be placed.

Program content in the CBT is consistent with the program content in the FHWA Maintenance Decision Support System (MDSS) deployed during the 2005-2006 winter in the US. Combining the skills taught in the AI/RWIS CBT with the optimization techniques found in the MDSS ensures the right chemistry and maintenance operations get applied at the optimum time which will result in the highest level of service for the least amount of cost and lowest impact on the environment. The Iowa DOT estimates they save 1/3 of their snow and ice removal costs by using trained personnel and the MDSS.

Cost of a customized CBT that reflects an individual state's policies, procedures, equipment, etc is $30,000. Considering the average state has over 1,000 field operators, supervisors and managers, the average cost per student calculates to be less than $30 making the CBT a very economical training investment. APWA and the Ontario Good Roads Association are marketing the generic version of the CBT to their membership for $400 which makes this type of training very affordable to local governmental agencies.

Staying Current with Emerging Research

Updating training material and adding new content is a never ending process with emerging new equipment, chemicals, proactive snow and ice control processes and newly found research results being discovered on a daily basis. The CBT is currently being revised to include the results of a three year research effort by National Cooperative Highway Research Program (NCHRP) Report 526, "Snow and Ice Control: Guidelines for Materials and Methods" published in 2004. Results of another NCHRP research project 6-16, "Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts", were released in March 2006. Changing CBT content is quick, easy and inexpensive using a process known in the industry as 'externalize the media'. Components of the program such as graphics, narration, etc are in separate folders, so

new material is easily swapped out. The results of Report 526 were swapped out within the seven existing lessons. The results of the NCHRP 6-16 report are being field reviewed now and will probably require creating a new unit in either Lesson III or VII to present the new ideas and processes for maintenance personnel and likely a separate CD-ROM for materials testing personnel.

Conclusion

Optimizing winter maintenance operations decision-making is a multi-disciplinary process. It involves both earth and atmospheric sciences, multifaceted application of physics and chemistry and effective communication and analysis of roadway and weather conditions. Optimization depends upon an integrated systems approach combining the skills of the meteorologists and maintenance operations personnel. Moving from reactive snow and ice control operations to a proactive/systematic cultural involves learning new concepts, breaking old paradigms, changing behavior, and shaping new processes. The AASHTO AI/RWIS CBT has had general acceptance in field maintenance facilities in the US and Canada as an effective, interesting, challenging self-study interactive training media. Applications in other countries beyond North America that have to deal with the perils of winter needs to be explored.

References

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