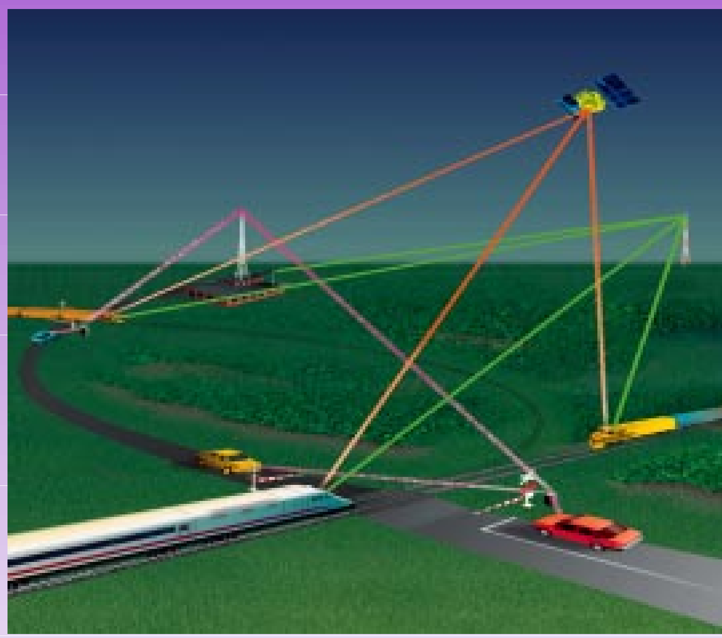
ITS TECHNOLOGY AT HIGHWAY-RAIL INTERSECTIONS:

"PUTTING IT TO THE TEST"



Proceedings from the
ITS Joint Program Office
Highway-Rail Intersection Evaluation Workshop
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Introduction

The U.S. Department of Transportation's Federal Highway Administration (FHWA), Intelligent Transportation Systems Joint Program Office (ITS/JPO) has a General Working Agreement (GWA) with the U.S. Department of Transportation, Research and Special Programs Administration's John A. Volpe National Transportation Systems Center (hereafter referred to as "the Volpe Center"). Recent Departmental emphasis in the area of Highway-Rail Intersection (HRI) Safety Research has expanded the GWA to include support from the Volpe Center's Accident Prevention Division on ITS/HRI evaluations, cost/benefit analyses, technology testing, and dissemination of information on ITS/HRI demonstration sites nationwide. It should be noted that the terms "rail-highway grade crossings" or "highway-rail grade crossings" used by those in the railroad industry are interchangeable with the term "highway rail intersections" or "HRI" used by those in the ITS industry.

Throughout the first seven years of the National ITS Program, several tests of ITS technologies to improve safety at HRIs were undertaken as well as development of "User Service #30" of the National ITS Program Plan relating to HRIs. Concern for safety at HRIs and the realization that HRIs need to be considered by ITS because of the potential safety benefits led to the creation of User Service #30. Under this service, HRIs have become part of the Travel and Traffic Management service of ITS and they were integrated with the National ITS Architecture in 1997. User Service #30 establishes the need for including HRI safety in the ITS Vision and notes that certain factors need to be considered and researched, first, in order to improve safety at HRIs. User Service #30 envisions that these systems will also provide improved train and highway traffic control via exchange of real-time data.

In October 1995, a school bus-commuter train crash fatally injured seven students in Fox River Grove, Illinois. Soon thereafter, a team was tasked to address Departmental-wide, safety-critical activities related to HRIs. This team was to have become a pioneer, "ONE DOT" team, consistent with the U.S. DOT Secretarial initiative that promotes modal administrations to work better with their customers by working better together. The team consists of the FHWA, Federal Railroad Administration (FRA), Federal Transit Administration (FTA), and the National Highway Traffic Safety Administration (NHTSA). This multi-modal team identified seven high-priority ITS/HRI demonstration projects. Although these projects test technologies with similar functions, they use different and often competing technologies to perform these functions. Furthermore, there has been little attempt to focus analytical resources on these projects to draw out similarities and differences in their test results.

In response to the need for a comprehensive review of these ITS/HRI projects, the Volpe Center in Cambridge, Massachusetts hosted the first Intelligent Transportation Systems Highway-Rail Intersection Evaluation Workshop on May 6-7, 1999, sponsored by the ITS/JPO. Nearly 60 representatives from Federal and State government and the private sector met to discuss ITS technologies and compare several ITS/HRI projects currently deployed or under development.

Speakers representing both headquarters and field staff of numerous modes within USDOT, university and private sector project evaluators, State DOTs, railroads and transit authorities, the National Transportation Safety Board, the Volpe Center, and the Jet Propulsion Laboratory participated. Seven nationwide demonstration project sites were discussed, representing sites in California, Maryland, Texas, Connecticut, Illinois, Minnesota, and New York. There were also several panel discussions, covering comparative analysis study development, ITS implementation issues, ITS passive crossing issues, and ONE DOT next steps.

May 6, 1999 – Day One

Richard John, Director of the John A. Volpe National Transportation Systems Center (Volpe Center), welcomed participants to the workshop and noted that:

"Innovation is the key. And the Department of Transportation's call is to be a catalyst for innovation as well as a forum for government and industry cooperation, in the spirit of ONE DOT."

ITS Joint Program Office, Program Assessment Coordinator, Joe Peters, asked the group to concentrate their attention on what he termed "a few good measures."

The ITS/JPO has developed the following performance measures that track progress toward National ITS Program goals: safety (injury and fatal crashes avoided); mobility (delay reduction, customer satisfaction); efficiency (goods or people moved per unit time); productivity (cost reduction); and energy and emissions (fuel consumption, emissions reduction). Evaluators were also asked to keep in mind what non-technical, institutional lessons have been learned.

Mike Onder, JPO Program Lead for Highway-Rail Intersection Safety, described ONE DOT ITS Next Steps, which could include random deployment, coordinated deployment, deploying with metropolitan ITS, or deploying with a freight focus.

He commented that, "The role of ITS is to support Congressional earmarks and Corridor projects, develop an HRI/ITS National Architecture, and provide coordinated leadership. . . but to do it all together is the challenge. There are many safety and mobility issues to consider and the [following] presentations may help to show us the way."

Demonstration Sites

Jim Curry, PB Farradyne, California Demonstration Site

The technology being demonstrated is a "Second Train Warning" sign where two-direction, light rail train traffic is more frequent than usually encountered by most pedestrians. The system had not yet been installed at the time of the workshop. The objective of this project is to aid in reducing train/pedestrian accidents in stations with two trains present and/or approaching through the intersection. The preliminary phases of the project that are currently complete include the selection of text and graphic sign alternatives and pedestrian feedback that identified public preference for a graphical depiction rather than a text sign. Four signs have been selected for testing in the formal demonstration project.

A video recording system, pedestrian interviews, and surveys will be used to document behavioral effects. Operational site characteristics include two trains in the crossing 20 times a day. During the sign selection phase the investigators measured 600 exposure events using videotape and hard data.

Installation of the equipment is expected to be completed and testing initiated during the fall 1999, with testing of the system in winter and spring 2000. The project is expected to be complete and a final evaluation report available by December 2000.

Emad Elshafei, Sabra Wang & Associates, Maryland Demonstration Site

The technology being demonstrated is a "Second Train Warning" sign where two-direction, light rail train traffic is more frequent than usually encountered by most motorists. The goals of the project were to identify and demonstrate an active warning sign to alert motorists that a second train is coming while the motorist is stopped at a light-rail grade crossing, and to measure the effectiveness of the warning sign. Evaluation techniques included a survey of local residents to substantiate results from video recording of public behavior at the crossing. The demonstration site had multiple tracks, high traffic volume, and a frequent number of Second Train Coming (STC) incidents due to train schedules.

The technology selected to display the warning was a high-intensity Light Emitting Diode (LED) lighting device. The technology was microprocessor based and capable of displaying animation. The mounting of the sign was on the existing cantilever structure of the active warning device. The sign installation included modified signal circuits to control an STC sign and a strobe light operating with the sign to attract attention. Pedestrian signals were also installed, with control based on train detection (train circuits). Measures of effectiveness include monitoring current behavior of motorists during STC incidents with the installation of four closed-circuit television cameras/recorders and modifying the signals' circuitry to trigger recording during STC events. A study of risky behavior (any behavior that increases the risk of an accident) was conducted. Notable improvement was documented after three periods of studying risky behavior at the crossing. Videotaped observation of people's behavior around the crossing revealed that one type of risky behavior by drivers decreased by 26 percent after installation of the system. Another type of driver risky behavior decreased by 86 percent after installation of the system. The opinion survey conducted showed public reaction to the system to be overwhelmingly positive.

Testing of the second train warning system took place in fall 1998 and winter 1999. A final report is currently in draft form and is expected to be published in fall 1999.

Charles St. Onge, Science Applications International Corp., Texas Demonstration Site

The Advanced Warning for Railroad Delays (AWARD) system was designed to help motorists avoid delays due to railroad operations at crossings that cross frontage roads. TxDOT included AWARD as part of its ITS Metropolitan Model Deployment Initiative (MMDI) proposal. This project was a deployment of this type of system, not a field test. AWARD is not a stand-alone project but was integrated with several other ITS projects. System components included Doppler radar to detect train speed and acoustic sensors to detect train presence. Information flows to traveler information services and the traffic management center functions within San Antonio's area-wide traffic information database. The real-time traffic information was disseminated using several different types of media, including in-vehicle navigation units, kiosks, a Web page, and variable message signs.

Focus groups and questionnaires were used to discern whether users of traveler information were aware of the AWARD information. Results suggest that users are not yet aware of this information. Technical functionality has been demonstrated, but the true value of AWARD will be seen in the months to come when it is fully tested. Six institutional issues were identified that affected the outcome of the project. First, six minutes of advanced warning time is needed for motorists to choose an alternate route. Second, sensors could not be physically placed within the railroad right-of-way. Third, the particular grade crossing used had complex ("tight") roadway geometry. Fourth, multiple jurisdictions were responsible for traffic control signals. Fifth, train travel was not on a set schedule. Finally, budget constraints hampered both the system deployment and evaluation.

The system became operational in summer 1998. A final report is currently in draft form and is expected to be published in March 2000.

Debra Williams Chappell, USDOT/RSPA/Volpe Center, Connecticut Demonstration Site

This project demonstrates the use of a railroad systems approach to the HRI warning device technologies. Multiple components are integrated and consist of four-quadrant gates, obstacle detection, and train control via track circuitry and wayside controls. The train control component sends a message to the train as it approaches the grade crossing to bring it to a stop if an obstacle is detected. This system is a prototype whose goal is to provide a safe alternative to expensive and unsightly grade separation. The research project started in 1997 with collection of "before" data and moved into the collection of "after" data in March 1999. Data collection efforts will continue through the 1999 calendar year. The objectives of the research are to evaluate operational performance, document costs, evaluate institutional issues, document user acceptance, and provide information on the potential impacts on safety at the crossing.

The project includes a driver behavior analysis, a technology prototype evaluation, and a determination of public acceptance. Remote video monitoring is used to collect driver behavior data, warning device operational data, pedestrian behavior, and climatological data. Redundant hard-wired systems also capture track circuitry information for correlation to video data. The Average Daily Traffic (ADT) is approximately 650 vehicles per day. The frequency of trains is 17 per day. To date, over 1,800 events have been captured. Institutional issues have been documented and local community reactions are being captured in a logbook at the town offices.

The project is expected to be complete and a final evaluation report available by June 2000.

Rahim Benekohal, University of Illinois, Illinois Demonstration Site

The pilot study was initiated in May 1997 and sought to provide roadway vehicles approaching railroad grade crossings with an on-board, advisory warning of a train crossing. Three hundred (300) vehicles were outfitted with the on-board warning system. The vehicle population included school buses, transit vehicles, municipal vehicles, other public sector vehicles, and commercial vehicles that regularly operate in the area of the five grade crossings. The evaluation emphasized the reaction/perception of drivers to the warning information provided and the drivers comprehension of the warning information. Critical factors in evaluating the system's performance were driver acceptance and credibility of the system.

There were five pilot study locations with five different conditions represented: two residential sites on the Metra-Milwaukee North Line (Deerfield and Morton Grove); Central Business District (CBD) – Northbrook; Industrial – Glenview; High Speed Arterial – Northbrook. The in-vehicle receiver was capable of providing visual, audible, and combination visual/audible warnings. Driver surveys were chosen as the evaluation approach.

The trackside equipment was installed in spring 1999. In-vehicle warning displays will be installed in the test vehicles and driver training will be conducted in the fall 1999. The system is expected to be fully operational late November 1999, at which time a one-year testing period will begin. The project is expected to be complete and a final evaluation report available by December 2000.

Erik Minge, SRF Consulting Group, Minnesota Demonstration Site

The objective of this project was to demonstrate and test the viability of in-vehicle signing in school buses at railroad grade crossings and its impact on driver behavior. The test site chosen was in Glencoe, Minnesota, and the system was operational during the 1997-98 school year. Five signalized crossings were studied. Twenty-nine (29) school buses were part of the study. The in-vehicle displays provide an "Alert" to motor vehicle drivers on approach to the railroad crossing as well as a "Warning" of approaching trains to the crossing. The evaluation goal in Part 1 of testing was to examine the impact of the in-vehicle warning system on driver behavior, accident reduction, and driver perception. The Part 2 evaluation goal was to examine the performance of the technology used by the in-vehicle warning system in terms of reliability and accuracy.

The results captured the system's impact on driver behavior, operating speed of motor vehicle, dwell time at crossing, motor vehicle stop location, driver scanning, and accident reduction potential. The system was found to perform reliably, but with some failures. Because the scope of deployment was so small, the impact of the system on the performance measures (such as the number of crashes reduced) could not be measured directly. Instead, the school bus drivers were surveyed to determine their perception of the system. The subjects of the experiment stated their perception of the system was that it enhances awareness of crossings and trains. Eighty percent (80%) of the drivers surveyed thought that the system provided valuable warning information, although it did not affect their driving behavior. Only 15 percent of drivers surveyed reported that the system affected their driving behavior. One survey respondent said that the system helped her avoid a crash.

The project was completed in September 1998 with the publication of a final report. The future direction of this demonstration project is to include an application of the previously tested system at a passive crossing using solar panels and battery power. It is hoped that, after this next step is completed, the results will support product commercialization.

Rick McDonough, NYSDOT, New York Demonstration Site

The New York State Department of Transportation (NYSDOT) conceived the idea of an Intelligent Crossing System (ICS) linking on-board Positive Train Control (PTC) with an Intelligent Grade Crossing (IGC), and to Emergency Medical Services (EMS) vehicles through the ITS network being developed by the FHWA. NYSDOT was awarded an ITS grant from FHWA for research and development of an Intermodal Intelligent Grade Crossing System which allows the trains to communicate with the crossing and the crossing to communicate with EMS vehicles, such as ambulances, fire engines, etc. The project was initiated in 1995-1996. According to Rick McDonough, this is the only intermodal grade crossing project in the country incorporating intelligent transportation system functions.

Operational characteristics of the selected site include over 200-plus trains per day with traffic volumes reaching 13,000 per day. The "intelligent" train using a radio-based and fail-safe PTC system, constantly and accurately determines its own location by tracking itself on an on-board map by communicating with beacons at known locations (GPS systems in the future). The train reports its location and speed to the IGC every second, using secure military-style spread spectrum radio communications. The IGC, in turn, communicates with emergency vehicles that receive the information through in-vehicle receivers.

The IGC, tied to the highway traffic signals adjacent to the grade crossing, turns the traffic lights to green to allow highway traffic to exit the grade crossing to aid in clearing any backed up traffic queue. The IGC also sends a secure message to the PTC-equipped train, as it approaches the grade crossing, to bring it to a stop. The Intelligent Grade Crossing minimizes gate down times and makes the operation of the signal system more reliable to the traveling public. According to Mr. McDonough, this optimization of the grade crossing signal operation provides "tremendous efficiencies for highway traffic by reducing congestion previously created by unnecessary gate operation." The Intelligent Grade Crossing allows highway variable message signs to be displayed with messages to motorists such as "Train in Station," "Another Train is Approaching," "Do Not Enter Crossing – Exit Blocked," etc. This capability allows railroad information to be passed along to vehicle operators, thereby reducing the potential for driver-related problems.

The New York State DOT will develop an evaluation plan in fall 1999. Several system components will be installed and tested at the crossing throughout 1999-2000. A demonstration of the fully operational system is scheduled for fall 2000, which will mark the conclusion of the project.

Summary

California, Maryland, and Texas each shared similar objectives, a need to alert motorists and pedestrians to critical information that trains are passing through the HRI. Various text and graphic sign alternatives were studied and signs were selected and tested. Workshop participants agreed that deployment of these variable message sign systems at multiple track crossings is most feasible, given the data on driver behavior and maintenance costs. Illinois and Minnesota experimented with on-board advisory warnings of an HRI and the approach of a train to the intersection. The Minnesota project tested on-board advisories with school buses. Both found some success but there is more research and testing needed. Furthermore, deployment costs of these systems are still unknown. The Connecticut and New York sites use the intelligent railroad systems tied into motorist warning devices. Workshop participants agreed that these intelligent railroad systems should be targeted for future research funding.

Implementation Panel

The panel discussion that followed was on ITS implementation, moderated by Amy Polk of the Jet Propulsion Laboratory. Panelists from Minnesota DOT, Union Pacific Railroad, Illinois Central Railroad, and Illinois Commerce Commission came to consensus on the following points:

- The "Second Train Warning" variable message sign, tested in two light-rail transit projects, is the most mature technology of all those presented. Railroads are interested in installing these systems on multiple track crossings, given more data on the impacts on driver behavior and long-term maintenance costs. Hard numbers are needed on benefits and on maintenance costs, expected to be three times the cost of the hardware.
- Four-quadrant gate systems may be bypassed by the railroads in favor of high-tech and low-tech solutions. Median barriers offer a low-tech solution to the gate running problem.

- Research and testing of highly experimental systems, such as the automatic train control systems being tested in Groton, Connecticut, and Long Island, New York, should continue to be supported on a Federal level, even though the widespread deployment of such systems might not be achievable in the short term.
- Research into new types of sensors used in railroad operations is needed.
- Partners of the in-vehicle warning testing in Minnesota announced that funding from the State's FY99 ITS earmark had been allocated to a Phase II testing of the system at passive crossings.
- The workshop also made it clear that the application of ITS technologies to railroad crossing safety is not solely a metropolitan issue; it is also a rural issue. Two of the seven projects profiled are in rural areas.
- It should also be noted that passive crossings are most common in rural areas, and safety at passive crossings has been given heightened Federal scrutiny in response to the National Transportation Safety Board (NTSB) study and recommendations on passive crossings issued July 1998.

May 6, 1999 - Wrap-up

Joe Peters provided some revealing imagery as he presented his wrap up of the first day of the HRI Evaluation Workshop. He talked about when ITS was formed within the Intermodal Surface Transportation Efficiency Act (ISTEA) legislation, FHWA used a phrase, “The train is coming” — in all the meanings that it conveys. By interpreting all the ITS technologies as a moving train – with its large mass that is very hard to stop once it accelerates – the challenge in harnessing a train to do something quickly becomes very apparent.

Joe Peters further noted that ISTEA christened the ITS program as a “research program” where ascertaining the feasibility of intelligent transportation systems technology was the issue. ISTEA acknowledged the end of an era – putting an end to the building of interstate highway systems. As with managing the airways, the idea is to take the existing surface transportation infrastructure resources and manage them more efficiently. The new legislation, *Transportation Equity Act for the 21st Century (TEA-21),* is about looking forward in an operations sense. The challenge in this new era, then, is identifying benefits and sharing the results to educate the larger community (the buying public).

It is important to note that benefit/cost information is not yet widely available and, for the most part, has not been presented at this workshop. As ITS infrastructure of HRI is now in deployment, benefits of the systems need to be demonstrated to the buying public. In order for local decision-makers to make investment decisions, they need to know about the relative benefits and costs. Joe Peters reiterated that ITS is not only at “the leading edge” of evaluation research but is also at the “bleeding edge” of technology. Therefore, critical feedback of information is needed to direct the rest of the Nation in appropriate ways. The train has come, that is to say, the technology, is here. Now, he said, we need the means to communicate the results and benefits. Joe Peters said the workshop had been an eye-opening experience, and called for introspection in determining the content of the cross-cutting study. “There’s a lot to be done. We moved a long step forward in getting these seven projects together to hear what each other is doing.”

May 7, 1999 – Day Two

In Mike Onder's introduction to the second day of the workshop, he stated that some of what the workshop made clear the previous day was that applying ITS technologies to railroad crossing safety is more than a metropolitan issue – it is often a rural issue as well. He said it should also be noted that passive crossings are most common in rural areas, and safety at passive crossings has been given increased Federal scrutiny as exemplified by the NTSB study and recommendations for passive crossings issued July 1998.

ITS Passive Grade Crossing Issues

A discussion was held about NTSB recommendations and the response of the DOT modes to those recommendations. The participants acknowledged that passive crossings need to be addressed in the ITS arena in the future.

Miriam Kloeppel from the NTSB gave a presentation on the safety study and recommendations that concluded that many of the collisions at the passive crossings examined could have been prevented had ITS technology been in place.

John Hitz of the Volpe Center presented the formal DOT response to NTSB's July 1998 recommendations. The two ITS-related recommendations were to: 1) encourage the USDOT to initiate a program to develop standards related to HRI/ITS, and 2) encourage the various modal administrations within the USDOT to work cooperatively with each other and with external organizations in the development and testing of HRI/ITS technologies. The first recommendation has been addressed and is described in the next section of these proceedings. The second recommendation was addressed by the modes within the ITS/HRI projects that are the focus of this workshop.

HRI Standards Status

Rick Weiland of Weiland Consulting discussed HRI standards status and invited participants to attend the upcoming workshop on "ITS Standards for the Highway-Rail Intersection" scheduled for July 22-23, 1999 in Arlington, Virginia. Some of the questions attendees will consider include: What are the safety issues? What are the research issues? What is the state of available technology? How does it interface with the ITS architecture? What groups should participate in standardization activities? The breakout groups will cover wayside equipment and rail operations, roadway and vehicle subsystems, traffic management subsystems, human factors, and special cases.

ONE DOT Next Steps Panel

DOT modes were heard from in a panel session entitled Next Steps moderated by Anya Carroll of the Volpe Center. A focal point for the next steps panel was a draft strategic plan developed in 1997 for an intermodal team coordinated by the ITS Joint Program Office within FHWA. Although the draft plan was not complete, it has served as a working document. This document was shared with the modal speakers as a basis for their comments on the ONE DOT next steps.

Within this document, the HRI Vision displays the goals for HRI safety to be enhanced by the end of a 20-year time period. The ITS Architecture Vision has been adjusted to fit the HRI Vision and is listed below:

Current Status in the Year 1997

- Some HRIs interconnected with nearby highway traffic signals.
- Research continues on new signs and warning devices.
- A 1-800 number available at some HRIs for reporting problems.

HRIs in the Year 2002

- Static data available and shared between the railroads and the State DOTs.
- Intelligent vehicles more common among populace.
- Research and testing being done for in-vehicle signing.
- Advanced intersection collision avoidance for HRIs in use.
- Advanced warning devices and signals deployed in high-speed rail corridors.
- Rail and roadway signals interconnected and coordinated.
- Vehicle entrapment detection on the high-speed rail corridors.
- Motorist warning signs improved and standardized.
- Existence of a Mayday support system for emergencies and automated collision avoidance.
- A 1-800 number at the HRI for reporting problems is universally available.

HRI Status in the Year 2012

- Cooperation between the State DOTs, the railroads, the Traffic Management Centers (TMC), and the Train Control Centers (TCC) exists.
- Connections between the TCC and the TMC, make real-time data exchange possible.
- Advanced in-vehicle equipment universally available.
- Improved technology has led to high-speed trains in some corridors.

To focus panel members on the ultimate goal of HRI/ITS activities and increased safety, Bruce George of the FRA Office of Safety was asked by the moderator, Anya Carroll, to provide current highway-rail intersection collision statistics to the attendees of the workshop. “Data from last year (1997) showed a (vehicle or pedestrian) collision rate of one every 100 minutes. Preliminary data from 1998 shows the number has been reduced to one every 115.9 minutes — approximately once every two hours. We are going in the right direction,” he noted. “We’re reducing the frequency of the collisions and that is the we way want to keep it going.”

Shown from left to right, Joe Peters - ITS/JPO, Walt Kulyk - FTA,
Ron Engle - NHTSA, and Jim Smailes - FRA

Joe Peters talked about the two main components of his job as Program Assessment Coordinator at the ITS Joint Program Office. The first component is measuring outputs of the National ITS Program, which involves counting how much ITS is "out there" through the ITS Deployment Tracking effort. The second component is measuring the outcomes of the National ITS Program, which involves measuring the benefits of ITS technology applications. The ITS Deployment Tracking effort is measuring how much ITS is "out there" at rail-highway grade crossings in the 75 largest metropolitan areas. This survey effort has found deployment of HRI/ITS technology at highway-rail grade crossings to be limited: 80 percent of active crossings are interconnected with nearby traffic signals, but there is almost no deployment of more advanced technology at these locations. Learning about the benefits of HRI/ITS technologies is one of the objectives of this workshop. However, benefits data from most of the seven high-priority projects are not yet available because these projects are still in the testing phase. Once the benefits of these technologies become known, it is the mission of ITS Joint Program Office to disseminate this information to the general public.

Walt Kulyk of the FTA noted that it was crucial and important that the attendees were gathered here at this workshop. He noted that 1) "rail ITS should be an integral part of the entire ITS program," 2) departmental and industry coordination/cooperation is key, 3) human factors must be considered along with, 4) operational performance, 5) standards development and 6) cost-benefit data.

Ron Engle of NHTSA mentioned the importance of the use of Section 402 funds for railroad grade crossing safety activities. He discussed partnering with American Association of Motor Vehicle Agencies (AAMVA) to develop driver-training materials to avoid crashes at highway-rail intersections. He also discussed the importance of human behavior regarding crashes.

Jim Smailes represented FRA on this panel. He noted that the biggest potential impact that FRA has is tying into ITS architecture through Positive Train Control. He also mentioned how ITS can help with passive crossings. He talked about the potential for intelligent grade crossing control (and tying into highway traffic signals) as is being planned for the Long Island Rail Road project that was discussed earlier in the workshop.

Site Visit to MBTA Four-Quadrant Gate Demonstration

The last item on the agenda was a visit to the Massachusetts Bay Transportation Authority's (MBTA) safety-enhanced four-quadrant gate grade crossing project site. Led by Lorraine Pacocha of the MBTA, the group had a chance to view the Wales Street crossing in action at a nearby location. The site visit to the MBTA's Wales Street crossing provided an informational setting in which to continue lively discussions of ideas initiated at the workshop.

Conclusions

The workshop provided an opportunity for members of the seven project teams and other stakeholders to get together and share findings. This was a first for the group to meet and discuss the details of each project, provide insights into what went well and what did not. It was also an opportunity to obtain peer critique and to give feedback to the Federal government on other potential directions for the program. It is important to keep in mind that most of the seven projects were underway before the HRI component of the National ITS Architecture was complete. Therefore, some of the results reflected early entry into this subject matter of applying integrated technology to an HRI.

Generally, there was consensus from both public and private stakeholders that the application of integrated technology at HRIs is the focus of the future. Although railroad representatives were quick to point out that they could not see their way toward making major investments in technology infrastructure, they did generally agree that if more passive crossings could be closed, they would be willing to negotiate an investment in the new HRI architecture, especially if the closings reduced their liability exposure.

There was also general consensus that a Federal champion is needed for the HRI program. Thus far, FRA has championed the development of the HRI architecture and the FRA representatives expressed a willingness to champion the deployment of HRI technology with the assistance of the ITS Joint Program Office and the other modal administrations. FTA also expressed strong support from their administration of FRA's leadership in this effort.

Following Rick Weiland's discussion on standards for HRI, there was general agreement that standards are critical to the success of the program, especially since the interaction of vehicles with crossings should be uniform across the North American continent. Therefore, interoperability is critical to the success of new technology integration, and interoperability is highly unlikely without standards.

Emphasis was also given to the expansion of the law under TEA-21, which provides eligibility for ITS projects to use Highway Trust funds. That means that HRI projects can be built with highway trust funds over and above Section 130 funds and even beyond the allowable use of highway trust funds that were eligible for use in the past. There are no restrictions on the use of these funds for ITS at highway-rail grade crossings other than to be compliant with the National ITS Architecture and to abide by published standards.

In summary, the general points of consensus were:

- The HRI program needs to be continued and expanded.
- A Federal champion is needed for the program and FRA is the likeliest candidate.
- FTA is a strong supporter of FRA taking the lead on this subject and pledges to assist financially wherever possible. Construction funds are good candidates.
- Any new technology chosen for HRI-equipped crossings must meet fail-safe tests.
- Standards are essential to the success of integrating new technology in highway-rail intersections.
- Innovative financing must be found and coordinated. Pooled funds with Canada, FTA, and NHTSA are highly likely candidates.
- Railroad companies will assist with investments in new integrated technology if their exposure to liability is lessened, such as the liability associated with passive and private crossings.
- Passive crossings may be able to become much safer using ITS technology that communicates directly to the vehicle from the wayside.

The next steps are to compile an understanding of the lessons learned from the seven projects reviewed at this workshop. That report is expected to be available in mid-2000. Additionally, an updated version of the Manual On Uniform Traffic Control Devices is expected to be issued by the end of FY 2000. The new manual is expected to include a provision for HRI technology. Following these activities, the U.S. DOT will focus on standards that are needed for deployment. The standards activity is expected to continue through 2000. In conjunction with standards development, the U.S. DOT hopes to develop a strategic plan that gets the buy-in from top management and can be used as a guide to standards development and deployment of HRI technology at highway-rail crossings throughout the United States and, hopefully, North America.

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