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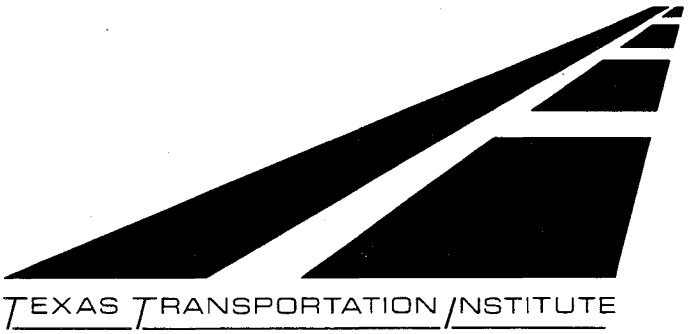

Implementation Action Items
for Research Study Number 7-2987

Research Study 7-2987

Cooperative Research Program

TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS

TEXAS DEPARTMENT OF TRANSPORTATION

in cooperation with the
Texas Department of Transportation

IMPLEMENTATION ACTION ITEMS
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Evaluation of Automated Highway-Railroad Grade Crossing Enforcement Systems

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Project 7-2987
Evaluation of Automated Highway-Railroad Grade Crossing Enforcement Systems
Implementation Action Items

OVERVIEW

Senate Bill 1512, which was passed into law by the 74th State Legislature in 1995, requires the Texas Department of Transportation (TxDOT) to install and operate automated highway-railroad grade crossing enforcement systems as a demonstration project. Six sites with gates, relatively high traffic and train volumes, and a minimum number of accidents were selected for the demonstration study. Potential vendors responded to a formal request for proposals to demonstrate their abilities. Because of problems encountered at three sites, automated enforcement equipment was installed and demonstrated at three (rather than six) sites in Texas by two vendors.

The equipment at the sites photographed vehicles violating the gate arms. The information was then sent to a processing center either in the form of a film canister or as a data file over a voice-grade phone line. Once at the processing center, the violation was confirmed by a clerk, who then recorded the license plate number of the vehicle and the vehicle's characteristics. After the vehicle owner information was provided by TxDOT's motor vehicle registration department, the vendor took the necessary steps to have an educational letter produced. At one site, the vendor mailed the letter, and at the other two sites, the information was provided to the local police department for processing.

The project clearly demonstrated that automated enforcement equipment can be used at highway-railroad grade crossings to record violations, identify the license plate and owner of the vehicle, and mail educational materials. The demonstration project resulted in no statistical differences between the violations during the before period compared to the after period. However, because the project was a short-term demonstration project, public education concerning the automated enforcement systems and a fine for the violation were not included and therefore were not factors.

A violation study was conducted to identify roadway geometric and operational characteristics that influence violations at gated highway-railroad grade crossings. The violation study revealed that on average, one violation occurs for each gate activation at a gated crossing and that one typically enforced violation occurs for every two gate activations. A typically enforced violation was defined as a violation occurring after the gate arms had been in motion for more than two seconds or when the arms were in the horizontal position and prior to the train arrival. Several models were developed to predict the expected number of violations at a site.

OBJECTIVES

The objectives of this project were to:

- identify available automated highway-railroad grade crossing enforcement systems,
- facilitate various steps of the demonstration project for TxDOT,
- identify operational and geometric relationships that may influence violations at gated highway-railroad grade crossings, and

- determine the effects of sending educational letters to motorists recorded as violating the gate arms.

CONCLUSIONS

Demonstration Project

- Automated enforcement equipment was installed and demonstrated at three highway-railroad grade crossings with automatic gates.

- The equipment at the sites photographed vehicles violating the gate arms. Violations photographed by the equipment included: driving under the gate 2 seconds or more after it began to be lowered, and driving around the gate after it was fully lowered.

- The violation information was sent to a processing center either in the form of a film canister or as a data file transmitted over a voice-grade phone line.

- At the processing center, the violation was confirmed by a clerk, who then recorded the license plate number of the vehicle and the vehicle's characteristics. The vehicle owner information was obtained from TxDOT's motor vehicle registration database.

- The vendor took the necessary steps to have an educational letter produced. At one site, the vendor mailed the letter; at the other two sites, the information was provided to the local police department for processing.

- In summary, this project demonstrated that automated enforcement equipment is usable at highway-railroad grade crossings with automatic gates.

- Six sites were initially selected for the demonstration project. Additional sites (up to 10) would have been included if funds and time had been available.

- Over 80 companies expressed interest in the demonstration project. Seventeen individuals representing 13 companies attended the pre-proposal conference. TxDOT received proposals to demonstrate automated enforcement systems at highway-railroad grade crossings from seven companies.

- Three companies' proposals demonstrated both high technical quality and considerable previous experience in the implementation and operation of automated enforcement systems. The Proposal Review Team agreed that it was desirable to award at least one site to each of those three companies.

- Automated enforcement systems were not demonstrated at three of the six selected study sites because:

- The necessary signal interconnect agreement between the State and the railroad company was not executed for two sites.

- The representatives of the city and police department at one of the sites initially indicated interest; however; the time available for the demonstration project was insufficient to complete all the necessary steps required for approval of the system at the location.

- Lessons learned concerning the implementation of automated enforcement systems for the sending of educational letters include:

  - Communication between all stakeholders is critical during all stages of the process. Keeping the various stakeholders informed during the project also assists in maintaining positive relationships.

  - Installing an automated enforcement system in an area where all major players are very positive about the concept results in a smoother implementation. Major players include the agency with jurisdiction over the roadway (e.g., TxDOT, or a city or county public agency), the railroad, and the local law enforcement agency.

  - In the context of a demonstration project, it may be possible to successfully implement the project without the active cooperation and involvement of a single participant, but this course of action is not recommended. For example, the local law enforcement agency at one site was an active participant in the project planning and coordination, but was not an active participant in the operation of the automated enforcement system due to certain limitations on its statutory authority. If the project had not been for demonstration purposes only, these limitations would have effectively terminated the project. Under some circumstances, the inability or failure of a single stakeholder (e.g., the railroad company) to cooperate can effectively terminate the project, regardless of whether or not it is a demonstration project.

  - The vendor needs to have a good understanding of when to consider a motorist's action to be a violation. It is a shared responsibility of the vendor, the railroad company, and the project sponsor to ensure that such an understanding exists. In one situation, the vendor believed that two seconds after the signals began flashing was considered a violation. This resulted in numerous letters being mailed to citizens when the gate arms had not been in motion (and could not be seen in the photo evidence). Several of the complaints received were concerned with this situation. The operational definition of a violation for this project was defined in the request for proposal as "driving any vehicle around, under or though a crossing gate arm under any of the following circumstances: (1) two seconds or more after the gate arm has started its downward motion, or (2) while the gate arm is in its full horizontal position." The vendor had to reset the equipment during the demonstration project in order to comply with this requirement.

  - It is important to communicate with and involve railroad officials and personnel early in the project planning process. With thousands of miles of track and thousands of employees,

Class I railroad companies are very large organizations; their operations and personnel are widely dispersed over many states. Class I railroads have centralized headquarters staffs and regional offices which may or may not be located near the project site. The railroad may choose to involve only a few key personnel in the project, or it may prefer to include many officials in the "communications loop" as the project proceeds. These needs and concerns should be identified early and considered throughout the life of the project.

- As a business enterprise operated for-profit, the needs and priorities of the railroad company may differ from those of a public agency. Projects which enhance or promote grade crossing safety will generally be well-received by the railroad company if they are implementable. The experience of working with three large railroad companies during this project demonstrated that the railroads' public works officials are open to discussing new solutions to grade crossing issues and the implementation of feasible solutions. In a business environment with many competing demands, however, an automated enforcement project may not receive top priority.

- Railroad officials and personnel can have a positive effect on project implementation by providing accurate and complete information about the grade crossing warning system timing and operation. Similarly, the railroad company can aid a project's implementation schedule by approving and signing the necessary agreements in a timely manner.

- Vendor personnel located at or near the site can become familiar with site-specific operational characteristics of the grade crossing, which may need to be considered in order for the automated enforcement program to be successful.

- While most problems were corrected within a reasonable amount of time, the general opinion of the research team is that knowledgeable individuals located near the automated enforcement site provide additional assurances that the system is functioning well and that problems could be addressed in a timely fashion.

- Representatives of some of the law enforcement agencies contacted during this study have concerns about sending educational materials rather than issuing citations to violators.

- Signs informing drivers that the downstream crossing is being monitored were not used in this project. Although other agencies have employed specially designed signs for this purpose, no standard sign exists in the Manual on Uniform Traffic Control Devices (MUTCD). The lack of a standard, approved sign was a barrier to the use of automated enforcement warning signs during this demonstration project. Several agencies, however, indicated interest in having such signs near the monitored crossing. This concern is more critical when citations are being issued.

Violation Study

- Three types of violations were observed at the study sites: flashing light (which occurred when the warning lights were flashing and the gate arms were vertical or during the initial two seconds of the gate arm descending), typically enforced violations (which occurred after the gate arms had been in motion for two seconds or when the arms were in the horizontal position prior to the train arrival), and after train violations (which occurred after the train departed the site but before the gates were completely raised).

- Approximately 50 percent of the violations were in the typically enforced violation category. The flashing light category represented 45 percent of observed violations. The after train category contained 5 percent of the observed violations, with most of the violations at one site. If that site would have not been included, the after train category would have had only about 1 percent of the observed violations.

- On average, one violation occurs for each gate activation at a gated crossing. For typically enforced violations only, approximately one violation occurs for every two gate activations at an active crossing.

- Exposure, which is the product of average daily traffic and train volume, can be used to predict flashing light violations. Exposure and warning time are used to predict typically enforced violations.

- Warning time is correlated with the number of typically enforced violations. Minimum variation in number of violations and low violation numbers are observed when the warning time is less than 35 seconds; however, when the warning time is greater than 35 seconds, there is considerable variability and higher numbers of violations.

- Two types of models were developed from the data collected in this study: (1) regression models that can be used to predict the number of expected flashing light violations and typically enforced violations at a site and (2) logistic models that can be used to predict whether a driver will commit a flashing light violation or a typically enforced violation.

- Given that the logistic models were developed using a much greater number of data points than the linear regression models, and that the regression models used averages over the 24-hour period for the independent variables rather than the specific value present during the compliance or violation at the crossing, the logistic models are recommended for comparing the relative safety at different sites. If the expected number of violations is desired, the multiple regression equations should be used.

Before-and-After Study

- Although violations and typically enforced violations both increased between the before and after periods, the increase was not statistically significant at the 95th percentile confidence level.

- The results of the before-and-after study indicate that the effects of sending educational materials to motorists recorded as violating the gate arms have no effect on the violation rate. However, the project limitations included not fining the violator and minimal public education. Given a more permanent automated enforcement program with appropriate public education and fine value, the violation rates would have probably decreased, as found in other studies.

RECOMMENDATIONS

Demonstration Project

- This project clearly demonstrated that automated enforcement equipment can be used to detect and identify suspected violators at highway-railroad grade crossings. What was not demonstrated was (1) the process of issuing citations and (2) the efforts needed to successfully implement an automated enforcement program. Several issues are associated with the processing and mailing of citations and with the public relation needs of this type of project. Additional research is needed to identify those issues and how they should be addressed if the mailing of citations is to occur in Texas.

- Enforcement options are potential countermeasures to unsafe and illegal motorist behavior at highway-railroad grade crossings. It is often not feasible to have a law enforcement presence at all highway-railroad grade crossings due to the large number of crossings, the relative infrequency of train arrivals at the crossings, the limited resources for law enforcement activities, and the high demands for enforcement at other locations. Automated enforcement should be considered as one of the many tools available to improve safety at highway-railroad grade crossings.

Violation and Before-and-After Studies

- The logistic models developed in this research should be considered when prioritizing highway-railroad grade crossing improvements as a supplement to accident prediction models and indices, and to identify locations that could benefit from additional enforcement efforts. The model can be used to predict the number of violations given the operational and geometric characteristics of the crossing, and thus be a reflection of the degree of hazard present at the crossing.

- If an automated enforcement program is to be implemented at highway-railroad grade crossings, public education and an appropriate fine value should be considered a priority. Proper education of the public should result in a reduction in violations.

IMPLEMENTATION OF FINDINGS

1. Senate Bill 1512, which was passed into law by the 74th Legislature in 1995, requires TxDOT to conduct an automated highway-railroad grade crossing enforcement system demonstration

project. Following the conclusion of the project, TxDOT is to deliver a report to the Governor, the Legislature, and the director of the Legislative Budget Board on the results of the project. Report 2987-2F documents the process used during the demonstration project and presents the conclusions made as a result of the project. The project clearly demonstrated that automated enforcement equipment can be used at highway-railroad grade crossings to record violations, identify the license plate and owner of the vehicle, and mail educational materials.

2. Several lessons were learned during the project on the importance of effective communication and cooperation between stakeholders. These lessons learned are valuable not only to TxDOT but to any agency, both public and private, that is considering an automated enforcement program. Several additional issues, however, were not covered in the demonstration project. Currently, citations for highway-railroad grade crossing violations cannot be mailed in the state of Texas. Rather than citations, educational materials were sent to those recorded as violating the crossing during this demonstration project. If an agency desires to mail citations, several other issues must be investigated or addressed. Identification of those issues and the steps appropriate for resolving the issues within the state of Texas is needed.

3. Enforcement options are potential countermeasures to unsafe and illegal motorist behavior at highway-railroad grade crossings. It is often not feasible to have a law enforcement presence at all highway-railroad grade crossings due to the large number of crossings, the relative infrequency of train arrivals at the crossings, the limited resources for law enforcement activities, and the high demands for enforcement at other locations. Automated enforcement should be considered as one of the many tools available to improve safety at highway-railroad grade crossings.

4. As part of the agreement between TxDOT and TTI, TTI was to conduct a study evaluating the before-and-after effect of the automated enforcement equipment on violations at the equipped crossings. The before-and-after results indicate that automated enforcement of gated highway-railroad grade crossings is feasible; however, to expect a reduction in violations, consideration of public education and appropriate fine values is needed. TTI also conducted a violation study which linked geometric and operational characteristics to crossing violations. The results of the violation study can be used by an agency planning on increasing enforcement at gated highway-railroad grade crossings. The results can assist in identifying the sites where the greatest potential for reduction in violations can be expected.