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Project 0-4366: In-Service Performance Evaluation of Roadside Safety Features

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PROJECT SUMMARY REPORT

An Overview of the Development of a TxDOT In-Service Performance Evaluation Process for Roadside Safety Features

Over the last 30 years remarkable progress has been made in the mitigation of roadside safety problems. Unfortunately, roadside crashes remain a serious problem—more than 14,000 people are killed and almost 1 million injured in vehicle run-off-the-road collisions annually, at an estimated cost to society exceeding $80 billion per year.

The Texas Department of Transportation (TxDOT) installs several different roadside safety devices to reduce the severity of run-off-the-road crashes. The devices currently in use include guardrails, concrete barriers, end treatments, crash cushions, and special sign support designs. Figure 1 shows an example of an end treatment.

Figure 1. Example of a Roadside Safety Device in Use by TxDOT: The ET-2000 End Treatment.

As of 1993, devices undergo a series of crash tests to receive approval for highway use by the Federal Highway Administration (FHWA). When a roadside safety feature is installed in the field, there is an assumption that the device will perform as intended. While necessary, crash tests are only one measure of the future success of a device. The ultimate measure lies in the in-service performance of the device and its ability to save lives and reduce injury.

Research has recommended in-service performance evaluation (ISPE) since 1971, and various national and regional research projects have been conducted on the subject. Although ISPE seems to be a simple process, numerous factors influence the methodology one chooses. Available and maintained information sources, procedures within the road safety management process, organizational structure, and state-specific characteristics (e.g., size, geographic location, etc.) must be considered. Further, failure to take program and budget constraints into account when developing and implementing an ISPE process will have a definite influence on the quality of data collected, the benefit the particular state department of transportation will obtain, and the sustainability of the ISPE process.

What We Did...

Researchers at the Texas Transportation Institute (TTI) developed a customized ISPE process for TxDOT and evaluated the process in a six-month pilot test at four local maintenance offices: Central Houston Section, San Antonio Metro Maintenance Section, Fort Worth Central Maintenance Section, and Buffalo Maintenance Section.A detailed project report (0-4366-1) includes training material for the ISPE process and guidelines for analyzing data and implementing an ISPE process in Texas.

What We Found...

Although the pilot test was designed to test methodology, it also demonstrated that the ISPE process can be implemented with success in Texas.

Major Constraints

Two major constraints had to be considered during the development of the ISPE process:

- limited personnel and fiscal resources to devote to an ISPE process and activities and
- limitations in the existing information systems in use by TxDOT.

Limited resources. TxDOT required that data collection efforts during the ISPE process could not interfere with the day-to-day responsibilities and duties of maintenance personnel, resulting in limited data that can be collected at the site. Traveling distances within Texas prohibited on-site inspection of every instance of impacts with roadside safety features before the feature was repaired or replaced.

Information systems. Existing information systems used by TxDOT presented constraints that influenced the design of the ISPE process. Limitations include the following:

- Current TxDOT data information systems do not have provisions for the items that would be required to integrate the ISPE process. Changes to existing databases are not likely to be a top priority.
- TxDOT does not have a roadside safety hardware inventory system, and it is unlikely that such a system would be developed in the near future.
- Concerns regarding the accuracy and completeness of the TxDOT Maintenance Management Information System (MMIS) reduced the attractiveness of using or linking MMIS data as part of the ISPE process.
- Accident data are normally a requirement in the ISPE process. The Texas Department of Public Safety (DPS) database does not distinguish between the different types of roadside safety hardware used in replacement or repair operations. Data entry typically lags two years behind, and timely crash data would need to be coded directly from the accident report form as part of the ISPE process.

ISPE Comparison

During the project, we found that a number of changes were necessary to existing ISPE methodologies currently used in other states. These changes can be categorized as follows:

- preparation for an ISPE study,
- staged approach to an ISPE,
- site inspections,
- data sources and management,
- involvement of the contractor conducting the ISPE, and
- data analysis and statistical analysis.

Preparation for an ISPE study. We defined a preparation process prior to the implementation of an ISPE process (including specifying a background study for the devices to be included in the ISPE process to determine specific issues that should be included and estimating the data collection period to ensure sufficient sample sizes).

Staged approach to an ISPE. We found that a two-phased approach, allowing for a screening process in Phase I to identify devices that should be subjected to a more detailed ISPE process during Phase II, would be a cost-effective approach toward an ISPE.

Site inspections. The pilot test demonstrated that maintenance personnel who visit the site after an impact (i.e., cases in which the device requires repair or replacement) can successfully conduct a site investigation using either a Phase I or a Phase II site inspection form. We also determined that periodic inspections to help quantify unreported crashes from the ISPE process would not be part of the TxDOT ISPE process: the benefits of these data are not sufficient to warrant the additional effort required to collect the information.

Data sources and management. For the pilot test, photographs were collected of the impacted device, vehicle paths, and other vehicles at the crash scene. Data included other aspects noticed at the site inspection that might provide additional information regarding the type of impact and the performance of the roadside safety feature. We found that recorded data significantly improved understanding of the impact while the photographs provided the extent of the damage and information regarding the geometric characteristics of the crash site.

Use of ISPE case study files were beneficial to the data management process. Using this system, the ISPE site inspection form, accident report, maintenance-related documentation, letter-size grayscale printouts of the photographs taken at the site, floppy disk with the digital version of the photographs, and any other information deemed necessary for understanding of the impact and the results thereof are filed together.

Training maintenance personnel involved in the pilot test was successful in terms of preparation for the data collection process. It also increased the awareness of maintenance personnel in terms of the influence installation and maintenance practices can have on the performance of roadside safety devices.

Involvement of the contractor in the ISPE. During the pilot test one of the members of our research team made visits on a monthly basis to the participating offices. These visits allowed for the timely detection of data collection aspects that might reduce the effectiveness of the ISPE process. They also provided the opportunity to participating maintenance personnel to ask questions and engage in discussions regarding the ISPE process. This activity acted as an important indicator to the participating maintenance personnel that the ISPE process is important and that their participation and tasks as part of the process are valued.

Data analysis and statistics. Although a number of ISPE studies have been conducted in other states, none of the reported studies thus far have met the minimum sample sizes required to ensure statistically significant results. The project report provides guidelines for data and statistical analysis. Potential for bias in the data analysis process exists in parameters such as the comparison of devices installed at locations with different geometric layouts and operational conditions.

The Researchers Recommend...

We recommend the implementation of a two-phased ISPE process in Texas. In Phase I, the screening phase, a device is continuously monitored or on a dedicated one-year track, i.e., identifying potential problem areas with some or all of the roadside safety devices included in the ISPE process. During Phase II, a detailed ISPE is performed on a particular device that warranted further investigation based on the findings of Phase I. Maintenance personnel visiting the sites where roadside safety devices have been impacted and require repair or replacement would conduct the site investigation.

Phase I ISPE

The Phase I site inspection form contains two basic questions:

- What particular device type is involved?
- Did the device perform as intended (i.e., whether the device failed or not)? Figure 2 shows a device that performed as intended.

During Phase I, a low-cost assessment is made of the failure rate of a given device. If the failure rate for a particular device is unusually high, it would be flagged for a more in-depth Phase II ISPE under which the nature and cause of the failures would be investigated. As part of the data collection, the maintenance worker conducting the site inspection takes photographs at the site and adds all maintenance-related paperwork to the ISPE Phase I case study file. If available, even at a later date, the accident report is added to the file.

The project report describes the data analysis and statistics related to determining failure rates of systems. Alternatively, TxDOT can use feedback from maintenance offices, district offices, or state legal advisors to identify the particular device or device type that should be included in the ISPE process.

Phase II ISPE

During Phase II a detailed site inspection form is completed, photographs are taken, and the same additional data as in Phase I are collected by the maintenance personnel. In a case for which the assessment of individual device failure is problematic, the maintenance office should notify the contractor performing the ISPE, who will then visit the site before any repair or replacement takes place, i.e., very shortly after the impact. Results from the Phase II ISPE process determine the particular problems related to the failed device. TxDOT can use this information to change approvals for use of devices, improve installation details (such as flare rates, roadside grades, etc.), identify problems related to installation and/or maintenance, and identify locations where use of a particular device could be problematic.

Implementation of an ISPE Project in Texas

We recommend that TxDOT implement a continuous ISPE process at the Phase I level or, alternatively, over a period of at least a year on a rotational basis to identify the devices that should be studied in a Phase II process. We also recommend the implementation of Phase II analyses where needed.

Figure 2. Photograph Taken during Pilot Test of an ET-2000 Single Guardrail Terminal That Performed as Intended.

For More Details...

The research is documented in Report 0-4366-1, *Developing an In-Service Performance Evaluation (ISPE) for Roadside Safety Features in Texas.*

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YOUR INVOLVEMENT IS WELCOME!

Disclaimer

This project was conducted in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA).

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