RESEARCH ADMINISTRATION
Bureau of Field Services
Michigan Department of Transportation

Research Spotlight

Monitoring highway assets using remote sensing technology

Collecting inventory data about roadway assets is a critical part of MDOT's asset management efforts, which help the department operate, maintain and upgrade these assets cost-effectively. Federal law requires that states develop a risk-based asset management plan for highways that includes strategies to meet condition and performance targets.

Project Information

REPORT NAME: Monitoring Highway Assets with Remote Technology

START DATE: July 2012

REPORT DATE: July 2014

RESEARCH REPORT NUMBER: RC-1607

TOTAL COST: $489,997

COST SHARING: 20% MDOT, 80% FHWA through the SPR, Part II, Program

MDOT Project Manager

Tim Croze, P.E.

Operations Field Services Division
Michigan Department
of Transportation
6333 Lansing Road
Lansing, MI 48917
crozet@michigan.gov
517-322-3394

Problem

MDOT's extensive catalog of roadway assets includes highways, bridges, signs, traffic signals, guardrail, weigh stations and a variety of other items, both large and small. The traditional asset inventory method is to manually collect information about the location, number and condition of these assets. While effective, this method is expensive and time-consuming, making it less practical as MDOT faces budgetary pressures and reductions in maintenance staff. Manual data collection also brings maintenance staff into close proximity with the roadway, which creates safety risks for both MDOT staff and drivers.

A sample image collected by a mobile imagery vendor during the pilot project. The asset extraction software allows users to simultaneously zoom in on multiple points in a single image.

To improve safety, reduce costs and improve data quality, MDOT initiated a research project to investigate technology-based approaches to inventory data collection.

Research

MDOT provided the research team with a list of 27 highway assets that needed to be inventoried (such as total lane miles, number of signs and number of culverts). The researchers grouped these assets into six categories based on their location relative to the road: roadway, overhead,

(continued)

> *"MDOT is creating a plan to inventory our assets that will reduce our reliance on manual data collection and will be considerably cheaper and safer than having our staff collect data manually."*
>
> **Tim Croze**
> Project Manager

roadside, in the right of way, under the roadway, and large assets.

The researchers conducted a literature review to identify current technologies suitable for inventory data collection. These included:

- LiDAR laser scanning systems.
- Aerial photography from an airplane, helicopter or unmanned aerial vehicle.
- Satellite imagery.
- Mobile imaging (pictures of the roadway typically taken every 50 feet from a vehicle driving at highway speeds).
- Manual data collection.

A pilot project evaluated the cost of manual data collection, mobile imaging, mobile (ground-level) LiDAR and helicopter LiDAR on a 176-mile route that included several road classifications. The researchers used each technology to collect data for a separate section of the route, and used all technologies in a 5-mile control section to compare the results. Following the pilot study, researchers asked several vendors to provide cost estimates for a statewide data collection effort.

Results

The researchers identified mobile imaging as the most effective technology for collecting data on the assets defined within the project scope. Mobile imaging produced high-resolution data quickly, although the asset extraction software had difficulty capturing measurements of mowable areas because they lacked clearly defined boundaries. Mobile imaging was by far the least expensive technology in the pilot project, with a cost of $369 per trunkline mile. Based on potential economies of scale, the vendor estimated a statewide cost of $89 per mile.

LiDAR can create three-dimensional models of any surface within a line of sight of the LiDAR instrument. While useful for some applications, such as design surveys, this level of detail is more than is necessary to develop an inventory of the assets defined in this study. LiDAR was also the most expensive approach. Aerial LiDAR cost $818 per mile in the pilot project, while mobile LiDAR cost $933 per trunkline mile. Another vendor who was not able to participate in the pilot project provided an estimate of $542 per trunkline mile for statewide mobile LiDAR data collection.

Manual data collection was found to be effective, and was the preferred method to collect data on assets such as culverts that are not visible from the roadway. This method requires minimal equipment other than a handheld GPS device, can effectively target small sections of roadway, and allows for close inspection of an asset. However, manual data collection is time-consuming, introduces the possibility of human error, and can expose DOT staff to a potentially hazardous traffic environment. Manual data collection cost $429 per mile in the pilot study.

Value

This research meets a critical need for MDOT, and the results are ready for implementation. The researchers developed an implementation plan that includes the development of a Request for Proposal (RFP) for statewide data collection.

The implementation plan recommends incorporating a proof-of-concept provision into the RFP. This would allow vendors to propose the use of other technologies—for example, photo or video logging supplemented by LiDAR for culverts—but puts the responsibility on vendors to demonstrate the technologies' effectiveness.

This project has received national attention, including a presentation of preliminary results at a committee meeting of the American Association of State Highway and Transportation Officials.

Research Administration

Principal Investigator

Rob Zilay, PMP
Dye Management Group, Inc.
10900 NE 4th St. #1910
Bellevue, WA 98004
rzilay@dyemanagement.com
425-637-8010

Contact Us

PHONE: 517-241-2780
E-MAIL: mdot-research@michigan.gov
WEB SITE: www.michigan.gov/mdotresearch

This final report is available online at

www.michigan.gov/mdot/0,1607,7-151-9622_11045_24249---,00.html.

Research Spotlight produced by CTC & Associates LLC.