MAINTENANCE AND ROADWAY OPERATIONS WORKSHOP

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NEWPORT, RI

PEOPLE, PARTNERSHIPS & PROGRESS

IBTTA
TOLLING. MOVING SMARTER.

The IBTTA Maintenance and Roadway Operations Workshop brought together maintenance and operations professionals in the tolling industry to share ideas and best practices intended to help them better serve and provide value to their customers.

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AT FORT ADAMS, VOLUNTEERS EMBODIED THE TRUE MEANING OF SERVICE

Fort Adams had been closed to the public so long, some Newport, Rhode Island residents didn't know it was there. Until recently, the historic structure had been fenced off and shielded by sixty years' worth of shrubs, weeds and overgrowth.

But in May 2016, more than 200 volunteers – including IBTTA members – spent the day sawing, raking and pruning until the moats were cleared and the stone walls were once again visible. Fittingly, the project involved building a new bridge across the outer moat in addition to cleaning up debris.

By day's end, the previously inaccessible attraction was open to the public again. "This is one of the greatest assets that the state of Rhode Island has," said Eric Offenberg, director of engineering for the Rhode Island Turnpike and Bridge Authority.

The event was organized in conjunction with IBTTA's annual Maintenance & Roadway Operations Workshop. Each year, the association gives back to the local community in the form of a service project. IBTTA volunteers were joined by the local Boys and Girls Club in Newport County, and the James L. Maher Center, a group that integrates individuals with developmental challenges into the workforce.

The community effort didn't end with the clean-up. It also created jobs. "The fort is going to employ some folks from the Maher Center," said Tracey Cunningham, director of adult day and employment services at the center.

"Service projects are not just one-off," said Jim Ely, another IBTTA past president. He noted that the industry is service-oriented by nature, as the toll roads and bridges that customers use are integral parts of communities.

ROADSIDE SAFETY INNOVATIONS, TOOLS & POLICIES

ACTIVE TRAFFIC MANAGEMENT IN JAPAN

Toll operators face similar challenges around the world. Toshiyuki Oka, engineer at NEXCO–Central, told IBTTA Maintenance & Roadway Operations Workshop attendees how his company manages traffic on Japan's expressways.

In the past, the company has widened highways, but land is scarce, so it has implemented programs to manage existing lanes. Over the years, "we have accumulated experience and expertise on how to improve the ability of expressways," said Oka.

The company engages in numerous Active Traffic Management (ATM) activities. The premise is that providing drivers with dynamic information can change drivers' behavior.

For example, when there's congestion, digital signs provide dynamic information about estimated travel times for different routes. This allows drivers to choose the most appropriate route. The signs are placed before the highways branch, so the information is available before exits at all interchanges and junctions. Signs also alert drivers to slow down when a bottleneck is ahead. They encourage quick restoration of driving speed when congestion is reduced.

The company also employs trained "road squads" that patrol the expressways for accidents, broken-down vehicles and obstacles in the road. They respond by deploying a vehicle-mounted display to caution drivers while the obstacle/events are being addressed.

Together, the combination of signs and ground operations reduces congestion, said Oka. And reduced congestion increases the value of the road asset.

As its ATM program evolves, the company is exploring predictive management, dynamic route guidance and incentive pricing.

PENNSYLVANIA TURNPIKE PARTNERS WITH WAZE

The Pennsylvania Turnpike has partnered with Waze (a phone based traffic guidance app) in an attempt to discover and respond to traffic incidents more quickly. Robert Taylor, manager of traffic operations, shared key features of the partnership with IBTTA Maintenance & Roadway Operations Workshop attendees.

Although the Turnpike operates variable messaging signs to let drivers know about traffic conditions, it wanted to get that information to drivers inside their vehicles. Because so many people use their smartphones for navigation, the Turnpike wanted to take advantage of that access. “It’s a delicate situation. If we can get it hands-free into this device, we can really let people know, but we don’t want to be a distraction,” said Taylor.

The Turnpike has developed a telephone app for drivers to download. But they also partnered with Waze, which has far more users. “It’s another way to complement what we’re doing, to improve situational awareness,” said Taylor.

The partnership involves data-sharing between the two entities. That can be challenging, depending on how your operation formats its data, said Taylor. Once that was worked out, the Turnpike began sharing planned and unplanned road closures with Waze. Then Waze reports those closures through its app. For example, during the papal visit to Philadelphia in 2015, all road closures were noted by Waze ahead of time, and the app sent a notification to users within 250 miles of the city that they should avoid the area during the event.

Likewise, Waze sends email alerts to the Turnpike when its users note that there’s a traffic incident. Typically, the Turnpike’s traffic control already knows about the incident, but Waze users sometimes share important information about the incident that the center didn’t know.

And there are times when incidents are reported to Waze long before someone calls 911. Taylor showed an example of an incident that was reported on Waze 19 minutes before a call came to their office.

Some research suggests that Waze users report incidents an average of five minutes before 911 emergency call centers find out. “From an emergency management standpoint, if we can find out about events five minutes earlier, that’s huge,” said Taylor.

ACTIVE TRAFFIC MANAGEMENT ON ILLINOIS’ I-90 SMART CORRIDOR

When construction began on the I-90 corridor in Chicago, the agency wanted to improve mobility and reduce congestion. It also wanted to accommodate alternate transit options (specifically, buses) and incorporate new technologies related to roadway safety. “The agency’s philosophy is they’re a bridge from where they’re at now to where the transportation network is going,” said John Benda, senior technology project manager at HNTB Corporation. Benda updated attendees on the corridor’s progress during IBTTA’s Maintenance & Roadway Operations Workshop.

Benda talked about the West part of the corridor first. He said there was an issue with supplying power to the digital signs. So they installed a transmission line underground to ensure power would be available and reliable, particularly during weather events.

The corridor is also outfitted with cameras every mile or two. The network overall has high communication, reliable power and an array of devices to capture and disseminate information, said Benda.

On the eastern part of the corridor, the agency has built a flexible system so that ATM activities can be added as traffic use evolves. A series of high-tech gantries is placed every half mile to provide real-time information to drivers. They share information about the nature and status of traffic incidents and they facilitate the flow of cars and trucks to allow emergency vehicles to safely navigate the roadways and reach the incident scene more quickly, said Benda. There is a much greater density of cameras in the eastern corridor than the western. Despite the cost, the agency believes it will help manage congestion more effectively, as that section is more heavily traveled.

DRONES – MORE THAN JUST AN IRRITATING BUZZ

The Minnesota DOT has been conducting ongoing studies to determine the feasibility of using drones for bridge inspection. Jennifer Zink, bridge inspection engineer and Barritt Lovelace, regional manager at Collins Engineers, shared their experiences with drones during IBTTA's Maintenance & Roadway Operations Workshop.

Lovelace noted that not a lot of work had been done before with unmanned aircraft systems (UAS) and bridge inspections at the time their demonstration project began. "I'm not sure if we were brave or naïve going into this…probably both," he said. The team looked at four rural bridges to learn about UAS safety and effectiveness. During this phase, the drone they used did not have a camera on top, limiting its ability to do the inspections under bridges.

One of the bridges was a steel truss in Morrison County. The wooden deck couldn't handle the weight of a snooper truck, so it was a good candidate for UAS inspection. "We were really pleased by the detail from the images," said Lovelace. The images showed concrete deterioration, corrosion and even small cracks.

One goal was to take the typical inspection process and apply it with drone technology. In other words, in a typical inspection, they would categorize the bridge into different elements and grade each element. If they used this process with drones, would they reach the same conclusions?

The team also discovered that working with drones sped the process. "The really powerful thing about it is we were able to do it in about 20 minutes in the field and about two hours of processing time," said Zink.

During the second phase of the project, the team conducted a cost comparison to see what money would be saved by using a drone. They also wanted to put together a best-practices document and incorporate the drone into an actual inspection.

They chose the Blatnik Bridge, which is the second largest bridge in Minnesota. They conducted the inspection in December. The bridge, which is part of the Lake Superior system, gets a lot of wind. "We were interested to see how well the drones held up on the winds," said Zink.

From the launch site, the team set up two monitors – one to fly the drone and one to operate the camera.

The team also tested the drone's infrared camera at the Nielsville Bridge, which traverses Minnesota and North Dakota. The bridge was closed due to deterioration of its deck. The drone's infrared images showed delamination. The team also acquired a 3D point cloud that details timber debris build-up. "It's amazing the level of detail we're getting from this drone, and it only weighs about 3.5 pounds," said Zink.

MAINTAINING MOBILITY WHILE MAKING IMPROVEMENTS

REVIEWING PRODUCTIVITY ON THE PENNSYLVANIA TURNPIKE

Although the Pennsylvania Turnpike had issued a Foreman's Manual with a set of productivity standards for maintenance and repair, nobody knew whether they were realistic or not. So Cory Greene, technical manager II at Michael Baker International, was charged with finding out.

Greene studied six core activities: joint sealing, sweeping, clearing drainage outlets, mowing, line painting and delineation. He observed each of the activities, which included mapping the processes and number of personnel. The purpose was twofold – to establish benchmarks and make sure that what the crews reported was in line with the actual work.

In some cases, the reporting was inconsistent. For example, Greene found that crews reported higher numbers of inlets cleaned than what was actually observed. The problem was in the manual's wording. It assumed that the crews were cleaning the inlets, but crews were counting inlets that were inspected but already clean.

Ultimately, Greene responded with recommendations to improve the manual, so that it reflected the crew's actual productivity. One significant change was to remove a three-mile work zone restriction to allow a four-mile work zone during joint sealing. "By lifting that three-mile restriction, they were able to get a lot more work done," said Greene, because the time saved meant they were available for other projects.

IN-HOUSE BRIDGE PRESERVATION

Many of the 349 bridges on the Kansas Turnpike have the same birthday, said Eric Becker, director of roadway operations at the Kansas Turnpike Authority. That made scheduling maintenance a challenge. So he and his team looked for ways to manage the process while making it more efficient.

In 2007, they started putting a polymer layer over the bridges. The process involved 10 people and took too long. So an enterprising employee took an old pressure pot (used in abrasive blasting), hooked it to an air compressor and used it to spread rock. Now the process required one person instead of many employees with shovels.

With a few additional modifications, the crew was able to treat more bridges in a year. The required crew has dropped from 10 to five people. "What we'll do is shut down a lane and try to get multiple bridges in a row by having two guys with shot blasters," said Becker. He also seeks bids from outside contractors to ensure that the method is cost-effective. "So long as it's worthwhile for us to continue to do it in-house, we will," he said.

MAINTAINING MANAGED LANES IN NORTHERN VIRGINIA

Nic Barr, vice president of operations at Transurban, talked about his company's management of express lanes in northern Virginia. Safety concerns are a key component of the maintenance program, along with the company's contractual obligation to maintain minimum speeds required by MAP-21. Another factor is driver satisfaction. Maintaining the lanes is also important so that drivers continue to find value in using them, but they also want their trips to run smoothly and reliably. As a result, Transurban delivers its maintenance outside peak travel periods.

Barr noted that accidents on the general lanes often affect the express lanes, which are only separated by a small barrier. "The biggest challenge we face are accidents originating in the general purpose lanes and sweeping across into the express lanes," he said. It also creates a hazardous situation for maintenance crews.

One solution is the use of a mobile barrier that guards workers. Along the I-95 corridor, the express lanes have guardrails, so the risk is lower. However, that particular section is reversible, so there's added complexity in keeping crews safe. For example, crews working in one direction need to switch their signs and arrow boards before the lanes reverse and vehicles come from the opposite direction.

Snow and ice management also poses a challenge. Because traffic volume is lower at night, sometimes the treatments are less effective. To work around this problem, Transurban will sometimes lift the tolls in order to achieve the volume necessary to make the chemical treatments effective.

As a private entity, Transurban also faces challenges when VDOT works with new subcontractors. At times, those operators set up their maintenance vehicles in express lanes without authorization.

Barr also stressed the importance of community outreach. For example, Transurban gave community residents an option to close a nearby bridge entirely for six months or to leave one lane open but for a construction period of two years. The community chose to close the bridge entirely for six months. "The community can certainly be your ally in advocating for you if you engage them early," said Barr.

GETTING THE MOST UTILITY FROM ROADWAY IMPROVEMENTS

BEFORE YOU BAN A RIGHT TURN…

On the New Jersey side of the Holland Tunnel, vehicles exiting on the 14th street corridor were backed up. Daniel Jacobs, general manager of transportation and revenue at The Port Authority of New York & New Jersey, wanted to do something about it. You don't want stationery vehicles in the portal," he told attendees at IBTTA's Maintenance & Roadway Operations Workshop.

The backup was caused by a service road that had been built when former industrial sites were turned into commercial and residential neighborhoods. Tunnel traffic had to be stopped in order to allow traffic from the service road to progress. Furthermore, traffic signals at the intersections had short cycles.

After an initial analysis, Jacobs proposed banning right turns from the tunnel, allowing a longer cycle for the tunnel traffic without stopping service-road traffic. But after meeting with other agencies, he realized he needed more information. "I think this is where the people and partnerships and progress come in," he said. The traffic turning right would be diverted somewhere, and traffic engineers were worried it would head north and affect pedestrian crossings at Jersey Avenue. A facility manager worried that drivers would divert into the left lane.

Jacobs acquired aerial footage of the intersection that traced where vehicles were going. They found that most were heading north. Concerns about overloading the pedestrian intersection at Jersey Avenue won out. The ban on right turns was abandoned.

As an alternative, Jacobs lengthened the traffic signal cycles. With longer cycle times, "we dramatically improved the travel times and throughput coming out of the tunnel," he said.

THE EMERGENCE OF MOBILE ANALYTICS

How do you optimize infrastructure when you don't know where customers are coming from or going to? Matt Milligan, managing partner at Milligan Partners LLC, said that the data is in fact available. Connected, electronic devices such as tablets and smartphones, are a kind of infrastructure that travels up and down your roads all the time, and it's going other places.

Using the retail industry as an example, Milligan described the use of mobile location analytics to understand customer behavior and predict patterns. Every device has a MAC address that is virtually unique to the device it's assigned.

Though the technology and applications are emerging, Milligan posed the idea that mobile location data could help the industry know where to build roads, when to build them, and what improvements to make. He cited a Google project in New York City, where kiosks with hotspots are installed in major corridors. The data collected from wireless devices could support the DOT's ambition to encourage Smart Cities. For instance, bus schedules could be dynamically altered according to demand.

To optimize the use of this data, Milligan called for strong public-private partnerships. Agencies alone aren't set up to make the most of the data, so they'll have to work with private entities that are incentivized by different revenue streams.

GROWING THE NETWORK IN HARRIS COUNTY, TEXAS

The Harris County toll road in Texas serves one of the densest, fastest-growing regions in the country, including the Houston metro. With that in mind, the toll authority decided to invest in capacity improvement. Quinton Alberto, assistant director of maintenance and traffic engineering at Harris County Toll Road Authority, described the ins and outs of the project to attendees at IBTTA's Maintenance & Roadway Operations Workshop.

The agency decided to take a broad look at the network. Instead of just widening lanes, it decided to breathe life into the facility by making it as new as possible. Ultimately, the infrastructure improvements will cost about $165 million dollars.

Among its improvements, the roadway was widened from four lanes to six. The agency also took the opportunity to do capital maintenance, including improving retaining walls, and replacing joints and bearings. One bridge required $7 million in overhaul replacements, said Alberto. The agency also upgraded its signage, so that it is all overhead and the reflectors are brighter. Wrong-way countermeasures were added. The toll road will also become all-electronic as part of the program.

The project timeline is two years, so many of the improvements are being made at the same time. To ensure the best service and quality, the agency set out multiple contracts to bid rather than seek a general contractor. For example, one contractor works on widening the roads and another is responsible for structural repair. The main reason for this was accountability. If something isn't done, then typically the general contractor blames the subcontractor. In this arrangement, the contractors are separate and wholly responsible for their work. "We broke them up into groupings so we'd get a good bid, we'd get a qualified vendors and it's their specialty," said Alberto.

ROADWAY MAINTENANCE FOR TODAY

WHAT TO DO ABOUT WRONG-WAY DRIVERS

From 2007 to 2011, Florida ranked third in states with wrong-way crashes. Some of those crashes happened on the turnpike system. Wanting to change that statistic and reduce fatalities, the state engaged in a pilot project.

One initiative was to add warning signs at a lower height — four feet rather than seven feet off the ground. Other states had found this to be an effective countermeasure, said Eric Gordin, assistant traffic operations engineer at Florida's Turnpike Enterprise.

They also installed ramp detection systems designed to alert the traffic management center if someone entered the turnpike going the wrong way. The detection systems include an LED illuminated wrong-way signs. If drivers failed to

heed the signs, two radar units would confirm that the vehicle didn't turn around before entering the turnpike. A camera would also take a photo to ID the vehicle.

Kelly Kinney, TMC team manager at Florida's Turnpike Enterprise, noted that the units needed to be calibrated and monitored. The camera images would sometimes be hazy from moisture. Also, vibrations from traffic would produce false alarms if the units weren't installed correctly in concrete foundations.

When a wrong-way vehicle is detected, the traffic center receives an audible alert. Law enforcement is immediately notified, and dynamic signage alerts drivers for 10 miles in each direction.

The camera image is critical in confirming whether the vehicle entered the wrong way. Seeing brake lights may indicate that the driver realized their mistake and turned around. The images help determine whether the alarm is false. For instance, lawn maintenance crews have been found using the ramps inappropriately to get to their job sites.

During the program's pilot, 33 valid detections resulted in 30 vehicles turning around. Three vehicles carried on. Two vehicles either self-corrected after the fact or were stopped. One caused a fatal crash. During the project's next phase, the Turnpike will expand the units to more ramps and look for opportunities to integrate connected-vehicle and gantry technology.

SNOW AND ICE OPERATIONS IN DENVER

Derek Slack, roadway maintenance manager at the E-470 Public Highway Authority in Aurora, CO, started a conversation about snow and ice operations on the E-470 corridor. Each year, the area gets between 57 inches and 118 inches of snow. The single biggest event was 46 inches.

A good thing about living in the Denver metropolitan area is that the sunshine will warm up pavement, but snow removal and maintenance is still a big issue. The area is also challenging because of its elevation. The weather is somewhat unpredictable. The variance in any given event means that the organization has to be flexible.

On this particular road, there are areas without many trees or developed land, so winds will blow snow across the road and diminish visibility. Safety is the ultimate goal, along with keeping the road open as much as possible. A contractor does the actual snow and ice maintenance. The authority provides four maintenance support sites, with liquid and solid deicer. They don't use salt or sand, because it contributes to the brown cloud (pollutants) in Denver. In a typical year, the contractor will go through 200,000 miles driven, 6,000 truck hours, and 4,500 tons of solid deicer and 1 million gallons of liquid deicer.

Nicki Beckford, operations technical manager, talked about her team's responsibility to keep the revenue stream going in spite of snow and ice conditions. She noted that there's no perfect way to determine how much revenue is lost due to weather conditions. However, to get an idea of what it could be, she counted images from the toll's cameras that were rejected due to weather. Using the lowest possible toll rate, she estimated that it can be hundreds of thousands of dollars that are lost.

So maintaining the roads and keeping them open is important. One of the maintenance crew's duties is to keep snow and ice off the roadside equipment.

She shared some of the lessons they've learned. The first is to manage when crews start working. The crews used to go out as soon as the snow started. They would clear the equipment and then it would get covered up again.

Now when snow is heavy, they wait, especially in rural areas where the cameras will just get covered up again anyway. To stay ahead of the storm, they use 42 cameras to monitor the quality of the road. They might plow the ramps but not the parking areas for instance. They also make sure there are safe spaces to park in the mainlines.

Beckford also noted it's important to use the right products. They formerly used a product to clean the camera screens but found that it was eating away the seals. They tested different products until they found one that worked. They also build special cabinets to protect gantry-mounted monitors from deteriorating.

Landscaping is also affected by snow and ice. They found that chemicals were killing the vegetation and causing erosion, so they started replacing vegetation with decorative rock.

The authority uses cameras, weather services, weather stations, pavement sensors and road weather information systems (RWIS) to project what the weather is going to be, said Slack. They use a weather performance index promoted by the Idaho DOT to benchmark how well their maintenance operations are performing. For example, they use a factor called "grip" to determine how wet the pavement is. Below a certain number, there's a higher potential for cars to go off road.

The system also takes pictures every 10 minutes, so they can verify that they have snow building up and confirm if the contractor is performing maintenance efficiently. They should be able to clear every lane in a 20- to 30-minute cycle, Slack said. The trucks are outfitted with GPS units, so they can track the crew's performance and recognize instances when the weather conditions are worse than anticipated.

CONTROL THE DRIVERS, PROTECT THE EMPLOYEES

Eric Hemphill, director of system and incident management for the North Texas Tollway Authority, shared his group's efforts to mitigate incidents from wrong-way drivers and to protect road crews.

The first tools they used were reflective tape to put arrows pointing the direction where drivers were supposed to go. They found that LED lights didn't work when used in areas with a lot of lights, but they did work in areas with low light conditions. "You gotta look at where you put them and how you put them," he said.

Lowering signs also helped reduce incidents. The authority sponsored an experiment that showed wrong-way incidents were lowered 56 percent just by lowering the warning signs. They also made the signs brighter and with a bigger font.

To address inebriated drivers about to go the wrong way, they put more signal cues on the ground. They put arrows down earlier on the route than is required by law, in an attempt to get to drivers before they made a wrong-way mistake. By having more arrows and setting them down earlier, they would reinforce that drivers were going the wrong direction. Hemphill called it a simple, easy fix worth making even if it's not required.

When it made sense, the authority also worked with the municipalities to improve the layout of routes connecting with the toll road. In one instance, drivers turning left to get to a residential street were mistakenly driving onto an off-ramp to the toll road. They modified the layout so that drivers could no longer make that left turn.

The authority also looked to technology to help mitigate incidents. When a vehicle goes the wrong way, an alert is sent to the traffic management center, which dispatches state troopers and alerts municipalities in the area. The TMC follows the vehicle with its cameras and relays its location to law enforcement. They're also testing a technology that would send alerts to drivers' smartphones when a vehicle is going the wrong way. Like an Amber Alert, it would be restricted to a specific geographic area.

Knowing that it can't prevent every wrong-way incident, the authority also seeks to protect employees. The first step was making them 'brighter,' said Hemphill. That means they applied reflective sheeting to employees' apparel and on the back of trucks.

Crews also utilize rumble strips and signs that warn drivers about upcoming lane closures. "We're starting to get people to comply a lot earlier than normal," said Hemphill. The authority also owns two mobile barrier trailers, and it developed a barrel delivery truck in-house. Employees are protected by a cage while the cones are delivered to them via hydraulic lift. "Protecting your employees is not just about protecting them from the right-side drivers. It is and will be about protecting them from both ways," said Hemphill.

ACHIEVING A "STATE OF GOOD REPAIR"

TOTAL ASSET MANAGEMENT REDUCES COSTS IN JAPAN

It is the task of NEXCO-Central to provide high-quality infrastructure to society with the lowest possible costs, said Jun Takeuchi, the company's technology project manager. At the IBTTA Maintenance & Roadway Operations Workshop, he talked about how the company's pavement management system (PMS) plays a role.

The PMS is built on a database that integrates road surface property data, structural evaluation data, road information data and maintenance history data. Building a PMS database requires care, because missing data or incorrect data affects outcomes, said Takeuchi.

When the company built its database, it had to choose which predictive model it would use. It considered three common models:

- the regression analysis model,
- a dynamic model using a prediction formula with a calibrated coefficient, and
- the Kyoto model, which uses the Markov model to predict the regularity of deterioration processes.

The company selected the Kyoto model because of its ability to predict deterioration efficiently with less input data, said Takeuchi. The model also allows for benchmarking, as deterioration can be compared by section and evaluated at the entire network level. Finally, it served a practical purpose by meeting the company's budget requirements.

A PRIMER ON THE ROLLING WHEEL DEFLECTOMETER (RWD)

Measuring pavement deflection under a moving wheel traveling at normal highway speeds has been a monumental technical challenge, said Curt Beckemeyer, senior vice president of transportation at Applied Research Associates. He told attendees at the IBTTA Maintenance & Roadway Operations Workshop that the challenge had been overcome. A technology called the rolling wheel deflectometer (RWD) now exists to evaluate the structural condition of pavement.

The RWD is mounted on a tractor-trailer. A series of lasers mounted on the trailer establishes a baseline on the undeflected pavement. It's able to collect many data points in a short distance.

Beckemeyer said that the RWD is not meant to replace a falling weight deflectometer (FWD). They have different roles in managing a pavement network. It's the RWD's role to indicate the structural capabilities of that pavement at the network level.

Applied Research Associates tested the RWD on 1,000 miles of road in Oklahoma to evaluate the potential benefits of integrating RWD data into the agency's PMS.

The Oklahoma DOT uses a pavement quality index (PQI) based on ride quality, rutting and distress. The model it uses prescribes three treatment categories: preservation, rehabilitation and replacement.

Applied Research Associates first looked at what the PQI said about the test roads. Then it looked at two additional models, in which it interjected an RWD rating, which takes the deflections and compares them to a maximum allowable deflection based on traffic volumes. Finally, it rated them as good, fair or poor.

The RWD models identified areas in medium- and high-volume roads with good structural conditions where the DOT could do preservation rather than rehabilitation to extend the life of the pavement. RWD could possibly generate a 10 percent cost savings, said Beckemeyer.

TOLL FACILITIES – PROVIDING CUSTOMERS WITH VALUE THROUGH COLLABORATION

BUILD A DATABASE OF UNUSUAL EVENTS

Advanced Solutions Road Systems operates four concessions in Israel. Over the past 12 years, the company has developed a unique database that includes a record of every 'unusual event' that has happened on its network.

The database acts as a special information system that allows the company to analyze the network for safety concerns. For example, the database revealed a pattern of accidents taking place on shoulders. So the company implemented programs to reduce accidents, including public relations efforts to explain that shoulders aren't safe places to park. It also established special warnings via electronic signs and hired special alert patrollers, whose job is to position themselves behind vehicles until drivers continue on their journeys.

The rationale behind the database is that you don't have to wait for a problem to occur before you start solving it, said Hagai Tal, CEO, to attendees at IBTTA's Maintenance & Roadway Operations Workshop. So the company tracks every incident on its roads, regardless of whether it warrants the attention of police, fire, medical or insurance. For example, if debris falls from a truck, the incident is recorded and stored in the database.

To help record the information, the company uses its patrol units. Members of each unit are assigned to the same sections of roadway, so they're familiar with the section's weak spots.

Besides helping the company mitigate future incidents, the database has also positioned it as an expert in road safety. The company shares the data it gathers with government stakeholders by hosting safety expert forums.

PLANNING FOR THE POPE'S VISIT

When the pope visited Philadelphia last year, the Pennsylvania Turnpike Commission had to coordinate with local, state and federal agencies to ensure the event went smoothly. Anticipated attendance was very large and regionwide congestion and stoppages were expected that would impact both attendees and through traffic in the region.

The event was designated a National Special Security Event. The U.S. Secret Service was in charge of security. Anytime you deal with federal agencies, they don't tell you a whole lot, said Timothy Scanlon, director of traffic engineering and operations at the Pennsylvania Turnpike Commission. Stakeholders are told what to do and then expected to do it.

To prepare for the meeting, the Commission created an operational plan, along with an intranet site where everyone involved could go to find out their roles and responsibilities. Team members met more than 100 times in a 100-day period.

Before the event, the Commission communicated to its drivers through its app, signage, Waze and social media that there would be massive delays. The team also added mobile CCTVs to its response vehicles; stocked up bottled water and snack bars; contracted with a towing company; procured portable toilets for its service plaza outside Philadelphia; and other planning measures. Ultimately, traffic was effectively managed and no worst-case scenarios materialized.

NAVIGATING SHARED MAINTENANCE RESPONSIBILITIES

The Bay Area Toll Authority operates and maintains seven bridges in California. Increasingly, BATA has taken on more maintenance responsibilities from Caltrans (the State DOT). The agency now does 40 percent of the maintenance activities that Caltrans was responsible for five years ago, said Angela Louie, toll facilities maintenance program manager at BATA.

With that shift, there has been growing confusion about who is responsible for what. When there's an issue, operators don't know whether to call BATA or Caltrans, and then which department inside each organization. For example, if you're a toll collector and you have a problem with a door, who do you contact? Caltrans is responsible for the door itself, but BATA is responsible for the door locks. Similarly, Caltrans is responsible for elevator maintenance, but BATA is responsible for emergency repairs to elevators.

In an effort to improve communication and prioritize safety, BATA has tried establishing check-in procedures with staff before work is done. It issues bulletins about maintenance and also instructs them how to contact its maintenance contractor. Nonetheless, there are still challenges. Things don't go as planned, said Louie. In one example, a BATA employee was trapped in an elevator after a Caltrans repair project cut off power to the site without notifying the toll agency staff.

BATA tries coordinating with Caltrans to perform shared maintenance together. But in one instance, the Caltrans crew didn't show up, so the BATA contractor did those repairs too, including replacing crash cushions and broken signs, and removing broken cameras. "While we like to have faith…sometimes we have to be prepared to do the work ourselves first and then ask for forgiveness later," said Louie.

COOPERATIVE CONTRACTORS MINIMIZE DELAYS

Customers view transportation networks as a whole, not individual jurisdictions run by multiple stakeholders. So partnerships are key to providing a seamless experience. To illustrate how that can work, Christopher Poe, assistant director of connected and automated transportation at the Texas A&M Transportation Institute, shared a case study with attendees of IBTTA's Maintenance & Roadway Operations Workshop.

The project is a 100-mile stretch of I-35 in Texas (between Dallas and Austin) that TxDOT put under construction using multiple contractors. The rural nature of the section created a communications challenge. The work is mostly done at night and off-peak, when drivers don't expect to hit congestion. The communications effort required coordination with six different contractors, law enforcement and local agencies and the state's public information office.

Contractors are required to request lane closures seven days in advance. To minimize congestion, Poe collected the requests and forecast whether they would cumulatively result in delays of more than a half-hour. When they did, he we would go back to the contractors, and they worked together to optimize their schedules. It was a voluntary effort on the part of contractors to minimize long projected delays.

Feedback also provided important intelligence. Each morning, stakeholders would receive a report on the previous night's impact. The report assigned a grade based on the length of delays, providing a quick way to communicate performance to upper management and project management. Analysis showed that less than five percent of closures

resulted in delays of more than 30 minutes, so the mitigation activities were successful. Public sentiment also seems positive, as 87 percent of customers surveyed said they believed the information they were receiving was accurate.

KEEPING OUR BRIDGES SAFE

FLORIDA'S TURNPIKE ENTERPRISE TURNS DATA INTO INFORMATION

Debbie Meyer, deputy maintenance engineer for Florida's Turnpike Enterprise talked about how the state manages its bridge maintenance. She noted that Florida has comprehensive maintenance and inspection programs that result in a lot of data. Like many organizations, however, the enterprise was data-rich and information-poor, she said. They embarked on a project to transform data into useful information that would allow the agency to make better decisions.

They started with a data strategy, an information strategy and a knowledge strategy. To develop a data strategy, they asked questions like 'how do we use data,' 'where do we store it' and 'who has access to it?' "These are simple questions but unfortunately they don't always have simple answers," said Meyer.

Having all the data in one place isn't enough. Organizations need to process data so that it's useful. She noted, however, that the value of the information is in the eye of the beholder.

A knowledge management strategy takes the process a step further. By taking scattered information and making sure it's shared, it unearths trends that can help make informed decisions. In other words, a knowledge management strategy is a way to capture the organization's intelligence, said Meyer.

So with this roadmap in place, the team collected all available data, such as inspection reports, historical data, shop drawings – everything to do with a structure. The process took time because that data was scattered throughout different parts of the system.

Having gathered the data, they proceeded to organize it into a standard file-naming system. In the past, different groups organized their files differently – some by project ID and some by asset, for example. While organizing the data, they eliminated files that were clutter. Finally, they chose Google Earth as a user interface that would allow them to visualize the data.

Aran Lessard, structures maintenance engineer for Florida's Turnpike Enterprise, talked about the effect of the project on decision-making. He said that the new file system provides a one-stop-shop where all pertinent information about a bridge is located. The new file-naming convention begins with the structure code, followed by date and then some extra information about what the file contains. Because the naming is standard, the files can easily be organized by ID and chronology.

Just by looking at the file names, they can learn right away about a bridge's maintenance history. Specifically, they can get a good sense of how recurring the repair program has been. For example, in one folder, they can look at work-order recommendations and then see if there are work orders that followed to address the recommendations. The repair contractors provide photo documentation that is also added to the folders. Because inspectors always review past history before an inspection, their comments create a giant feedback loop, said Lessard.

As a work platform, Google Earth allows users to visualize data as well. The enterprise uses a template to organize information. Each structure is identified on the map by an icon. By clicking on the icon, a user will see a pop-up box with useful data, such as asset type, structure material and so on. The box also includes links to folders in the shared drive, where all the other reports can be accessed.

With Google Earth's street view, users can also look below a bridge. They can also use the platform to measure distances. And the enterprise integrated a tool that allows them to access real-time streaming video from cameras on the highway.

This is useful when there are incidents. For instance, after a truck lost control and impacted a bridge pier, they were able to relay observations about the condition of the bridge in real-time. "We can be miles away and still be actively involved in a response effort," said Lessard.

MDTA GOES FROM DEFECT TO ASSET MANAGEMENT

Bill Pines, deputy director of engineering for the Maryland Transportation Authority, said that 112 of the bridges his authority maintains are more than 50 years old. To manage these bridges and others, along with two highway tunnels, the authority developed a departmental-level asset management plan. He was referring specifically to day-to-day activity of those in the field.

Pines said that most departments juggle lists of projects, but MDTA has created a system that allows them to understand in detail their normal constraints, how important a structure is, what investments they should be making and what the scope should be to maximize system performance – as opposed to individual bridge performance. "As owners in a tolling agency, we need to do our best to use our customers' hard-earned money to do things that give them value," he said.

In terms of maximizing performance, many bridge owners think that means reducing the number of structurally deficient bridges. Pines said it goes beyond that. By investing in preventative maintenance with more frequent, yet smaller cost-effective treatments, owners can have sustained performance levels for longer periods of time. This is in contrast to a "worst-first" approach where structures are allowed to deteriorate to the point of structural deficiency before owners make a large investment to rehabilitate and eventually replace them. Early corrective actions save money and result in lower damage levels to structures. "The literature shows this is the right way to do things," said Pines.

The agency conducts inspections annually. MDTA doesn't generalize defects, said Pines. If there's a pier cap with four bearing defects, it's coded as four defects, not one defect with four things that need to be repaired. That data is rolled into different levels, so that an emphasis on defects doesn't overshadow concerns about the bridge overall.

SAFETY MEASURES USED BY HALIFAX HARBOUR BRIDGES

To keep customers and employees safe, Halifax Harbour Bridges employs a number of initiatives. Frank Robinson, maintenance engineer, shared some of those activities at the IBTTA Maintenance & Roadway Operations Workshop.

One measure the operator takes is to employ five patrol vehicles, which run back and forth between the two bridges it operates. The bridges are outfitted with 120 cameras, with infrared capabilities. Robinson noted there's significant traffic from pedestrians and bicyclists at night. The operations center also uses forensic browsing software. If someone stops along the bridge or a car idles too long, patrol vehicles will be dispatched.

One of the bridges is undergoing a major renovation, so coordinating with the local port authority, a nearby navy base and the coast guard presents an operational challenge. The concessionaire keeps in touch with all these stakeholders through regular communication. It also purchased a radio system that can cross-patch into their systems.

COLLABORATION AND INNOVATION TO ENHANCE SAFETY AND PRESERVE INFRASTRUCTURE

VIRTUAL WEIGH STATIONS COME TO MARYLAND

Nikola Ivanov, deputy director of the CATT Laboratory at University of Maryland, talked about efforts by the state of Maryland to minimize infrastructure damage from commercial vehicles. He pointed out that road damage from one 18-wheeler is equivalent to 9,600 cars, according to the U.S. Government Accountability Office. In other words, most road damage is caused by commercial vehicles. Also, the damage is exponential. When you add a pound of weight, it adds exponentially more damage, not one more unit of damage, he noted.

The laboratory partnered with Maryland to integrate virtual weigh stations. The weigh stations include a weight motion sensor and a loop detector, and an over-height detector and camera with infrared. The virtual weigh stations calculate the approximate weight of a commercial vehicle and snap a picture – all for much less than the cost of a traditional weigh station.

There were challenges, though. “It’s not just that you install this technology and you’re done,” said Ivanov. At first, the usefulness of the technology was limited because only one person could monitor the station at a time.

Ivanov’s team built an application to optimize the virtual weigh station technology. The app shows weather systems, incidents, lane closures, pavement temperature and so on. “It gives you situational awareness for the entire region,” he said. When vehicles go through a virtual weigh station, the app shows the axle spacing, and each axle is shown in terms of its weight. A vehicle that’s in violation of the weight limit will be highlighted. State troopers sit a mile down the road and watch the app in real-time. When a vehicle is highlighted, the trooper can pull them over and verify the violation and issue tickets.

Perhaps more important than one-off violations are repeat offenders. The archived data can be used to filter by vehicle class, time of day and so on. Users can generate a report of all the violations that occurred in a given location and can see if more violations are occurring at certain times and dates, for instance. So at a particular location where lots of violations are happening, law enforcement can deploy its resources more efficiently. In Maryland, milk trucks were running through with heavy trucks in the early morning. After seeing this pattern, enforcement was able to target when it patrolled the area.

The application can also generate a notice to operators that warns them to stop violating the weight restriction. If they continue to violate the restriction, they may end up meeting with the Maryland State Highway Administration.

The program has been successful, so the state wants to expand to 25 new sites. They also plan to add license-plate recognition, so the virtual stations can track other violations and stolen vehicles as well. “What we found is the freight enforcement people and the state troopers love it,” said Ivanov.

SAFETY MEASURES THAT WORK IN AUSTRIA

In 2010, the European Road Safety Charter set targets to cut road fatalities in half. Since then, fatalities have dropped from 31,000 to 25,000, said David Kollenhofer, manager of international relations at ASFINAG in Vienna. At the IBTTA Maintenance & Roadway Operations Workshop, he shared what his organization is doing to contribute to the decline.

ASFINAG operates about 240 miles of roadways and tunnels, over 5,000 bridges and generates toll revenues of nearly $2 billion USD. Although fatalities are declining, about two percent of all accidents in Austria and about 11 percent of all fatalities take place on their network.

To promote safety, ASFINAG uses speed enforcement and distance control measures. Speed cameras are deployed in high-risk sections, such as before tunnels and long-term roadwork areas. The company also enforces height control in front of tunnels and deploys thermal cameras that can tell if a vehicle is overheating. If a truck's brakes are too hot and at risk of catching fire, for instance, it will be stopped from going into the tunnel.

Along the system, there are multifunctional traffic inspection points where enforcement can take place. ASFINAG also uses Weigh in Motion technology to act as virtual weigh stations. Trucks are alerted immediately if they're overweight or otherwise in violation.

ASFINAG also operates three trucks that are equipped with roadside inspection capabilities. They conduct random checks every day to inspect vehicles' brakes, emissions and overall condition. The purpose is to increase drivers' awareness of the overall safety of their vehicles.

MAINE RATES BRIDGES USING REFINED METHODOLOGIES

To accurately rate different bridges for weight loads sometimes requires different methodologies. Kristi Van Ooyen, engineering program manager at the Maine Turnpike Authority, talked about a program her group led to establish which structures had substandard load capacities that required strengthening.

The program's goal was to calculate and maximize the safe load rating of the bridges. The methodologies they started with were simple and also overly conservative. So to get more refined answers, they tried different analyses.

When using a basic analysis, which measures existing bridges on the network compared to new structure design standards, half the bridges didn't rate. So the group conducted a Legal Load limit analysis, which allowed the model to use loads you actually see on the bridge. Another 20 percent of the bridges passed using this method.

Still, 25 percent didn't pass, so the group tried an even more refined analysis. This model allows you to consider operational use. If the bridge has a wide shoulder, for example, the weight is spread over the girders. The default in the code is to consider the entire width of the bridge, but if drivers are only using one lane at a time, some bridges will pass. They also used 2D and 3D modeling to see how loads actually distribute on individual bridges. This method is more refined than models that assume a simple girder line analysis. Using this method, nearly all the bridges in the network passed. The few bridges that didn't pass with acceptable load ratings were strengthened and the agency planned for rehabilitation.

Tim Cote, structural department manager at HNTB Corporation, elaborated on the group's work. He pointed out that the AASHTO code is overly conservative and meant to help generate quick solutions.

For example, take non-prismatic beams (a beam which does not have the same cross-section along its entire length). The code doesn't address what happens if the cover plate doesn't end where it's supposed to. But old bridges weren't compliant, so an analysis would suggest that those bridges don't have the correct capacity.

When Cote and his team looked at an actual bridge, they found no structural deficiencies. So they sought more refined ways to determine the real capacity. Searching the literature, they found refined methods for reviewing girder sections. By applying the refined methods, they gained significant capacity. Although it took, time, the cost of extra engineering work was far less than doing additional and unnecessary strengthening.

When the literature doesn't help, there are other methods. One involves diagnostic testing to see how a structure sheds the load. In this case, you drive a vehicle over the structure and capture data so you can calibrate your design model and say how it behaves in real-world applications.

Proof loading is another method. In this case, you drive a vehicle over the bridge and see how it holds up. If the structure remains intact, the load rating holds. However, you have to account for extra weight and bridge deterioration "If you're trying to verify that a 50,000-pound vehicle is okay, you may have to add 200,000 pounds of weight on it," said Cote. For this reason, it's not a method that's used very often.

When all else fails and a bridge doesn't rate, you can post a load limit, Cote said. When posting isn't an option, you strengthen the structure. You may even strengthen critical structures that passed but barely. Cote highlighted the Androscoggin River Bridge as an example. Although it passed using refined models, the bridge is so operationally important that they decided they wanted it to rate acceptable based on current design codes. Engineers came up with a simple way of strengthening the bridge so that it would add the necessary capacity.