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Big Job – Big Impact

Major freeway closure impacts traffic in entire Detroit metro region.



ITS Smooths the Way

ITS technologies facilitate real-time communication to help minimize disruptions.



Getting Started

Traffic counts and traffic modeling help determine impact and needs.



Continuous Improvement

Continuous evaluation and experimentation leads to significant refinements and improvements.



Significant Enhancement

Travel time via alternate routes maximizes traffic handling capacity through work zone.



Motorists Appreciate Communication

FHWA study and anecdotal evidence from MDOT indicate that communication helps to minimize traffic disruptions in work zones.

ITS enables innovative work zone traffic control on major freeway project

Clear and accurate communication is key to smooth traffic flow through region impacted by construction

You're driving to work in early May. A light rain the night before combines with the pale yellow of the spring sun to create a richness of color that reminds you of an oil painting. You're at least 20 minutes on the early side of rush hour, so your speed is comfortable. You glance at your watch and decide you'll be sitting comfortably at your desk before traffic slows this route to a crawl later this morning. Then you notice the big orange sign that reads ROAD WORK AHEAD. Your shoulders slump a little and your attitude deteriorates a notch or two. A long line of brake lights materializes when you round the next curve. Your speed evaporates as you take your place among others who are similarly inconvenienced. Being here is not enjoyable. Watching the massive machines dig, scrape and move the earth is interesting, and the roadways and structures taking shape around you are impressive, but you'd much rather be moving quickly in the direction of your office. Glancing at your watch, time slows to a crawl.

A few miles and several minutes later your outlook improves. The END ROAD WORK sign indicates the beginning of the rest of your commute. You feel better as the line of cars shakes loose and pulls you ahead, toward the open road.

Michigan Department of Transportation (MDOT) safety engineers know exactly how you feel. Their main job is to ensure your safety and the safety of the men and women

who operate the massive machines and build the roads and structures that carry you to and from work every day. Their secondary job is to minimize the inevitable inconvenience created by road construction. In the language of an MDOT safety engineer, safety and mobility are top concerns – in that order. Communication plays a key role in achieving both.

Road Work Ahead

Looking at an aerial view of downtown Detroit, you'll notice two ribbons that snake outward from the heart of the city along the Detroit River. One of the ribbons is I-375, which connects to I-75 and carries traffic north to Warren, Pontiac, Flint, and beyond. The other is M-10, which connects downtown Detroit to Highland Park, Southfield, Farmington Hills and everything lying to the northwest. Locally, M-10, a strip of concrete and asphalt that stretches three lanes wide in each direction, is called *the Lodge*, which is short for the John C. Lodge Freeway.

When MDOT planned to close the Lodge between I-696 and downtown Detroit, a team of engineers led by Will Mathies, Safety Engineer for MDOT's metro region, began mapping out a strategy to minimize a great deal of inconvenience. The \$140 million project involved reconstructing or rehabilitating 14 miles of pavement, and replacing or repairing 50 bridges. The closure was scheduled to last from February to June 2007. Results of region-wide traffic studies indicated that maintaining one lane of traffic in each direction

through the work zone would have resulted in gridlock. Maintaining two lanes of traffic in each direction would have greatly extended the project time line and would have doubled the cost of the project.

“Shutting down a major artery like the Lodge is disruptive to say the least. The impact stretched across the entire region,” Mathies explained. His team had to devise a strategy for managing traffic in an area nearly 300 square miles in size. In addition to an extensive communication campaign, called *Dodge the Lodge*, the MDOT team had a new tool at their disposal that they could use to monitor and manage traffic on a real-time basis throughout the entire region. “Establishing alternate routes of travel was important,” Mathies said. “But we really focused on keeping motorists informed as they drove through the Detroit area. Communication was the key to smoothing the disruption as much as possible.”

ITS Technology Makes it Possible

The system developed for the Lodge project was the first of its kind in the world. Fully implemented, it included 75 traffic sen-

sors, 20 roadside displays, 8 live video cameras, 4 portable changeable message signs (PCMS), and various connections to and from the Michigan Intelligent Transportation System (MITS) Center (see Figure 1). All roadside components were solar powered and all communication took place through the ITS-standard 5.9 GHz wireless spectrum. At full capacity the system cost approximately \$1400 per managed lane mile per month to operate.

Traffic Technologies, LLC of Minneapolis implemented the system for MDOT, and then managed everything through *JamLogic*, Traffic Technologies’ proprietary Web-based control system. “We refer to this as technology-enhanced traffic control,” Eric Johnson, President of Traffic Technologies, explains. “It’s basically a wireless distributed control system.” Within MDOT, it’s called a Real Time Information System. It uses microwave and Doppler Radar sensors along a roadway to collect traffic speed and volume data. This data is transmitted to a central server where it is processed and then sent to a roadside display to communicate traffic conditions to motorists.

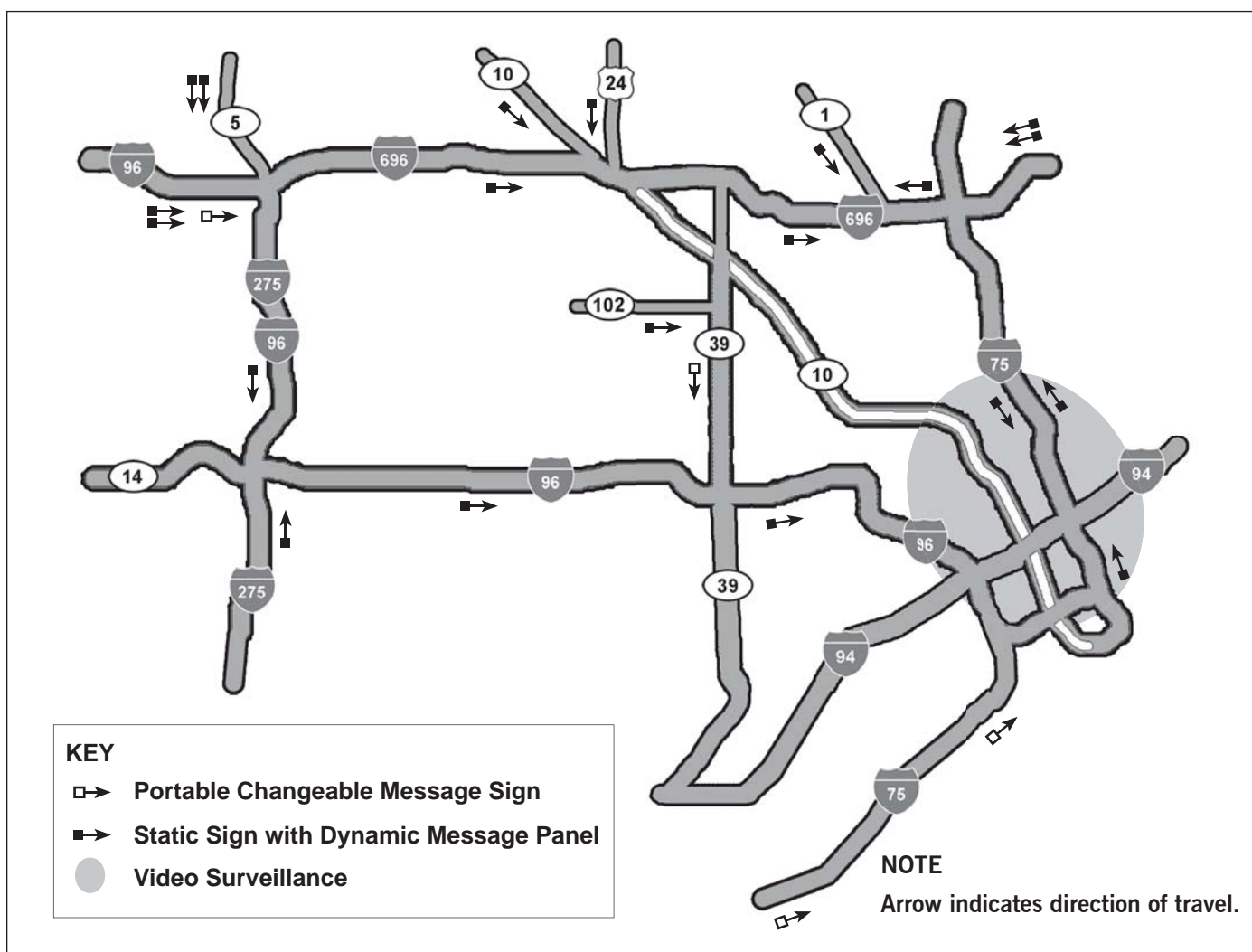


Figure 1. Locations of Travel Time Displays and Message Signs on Major Corridors Around the M-10 Project.

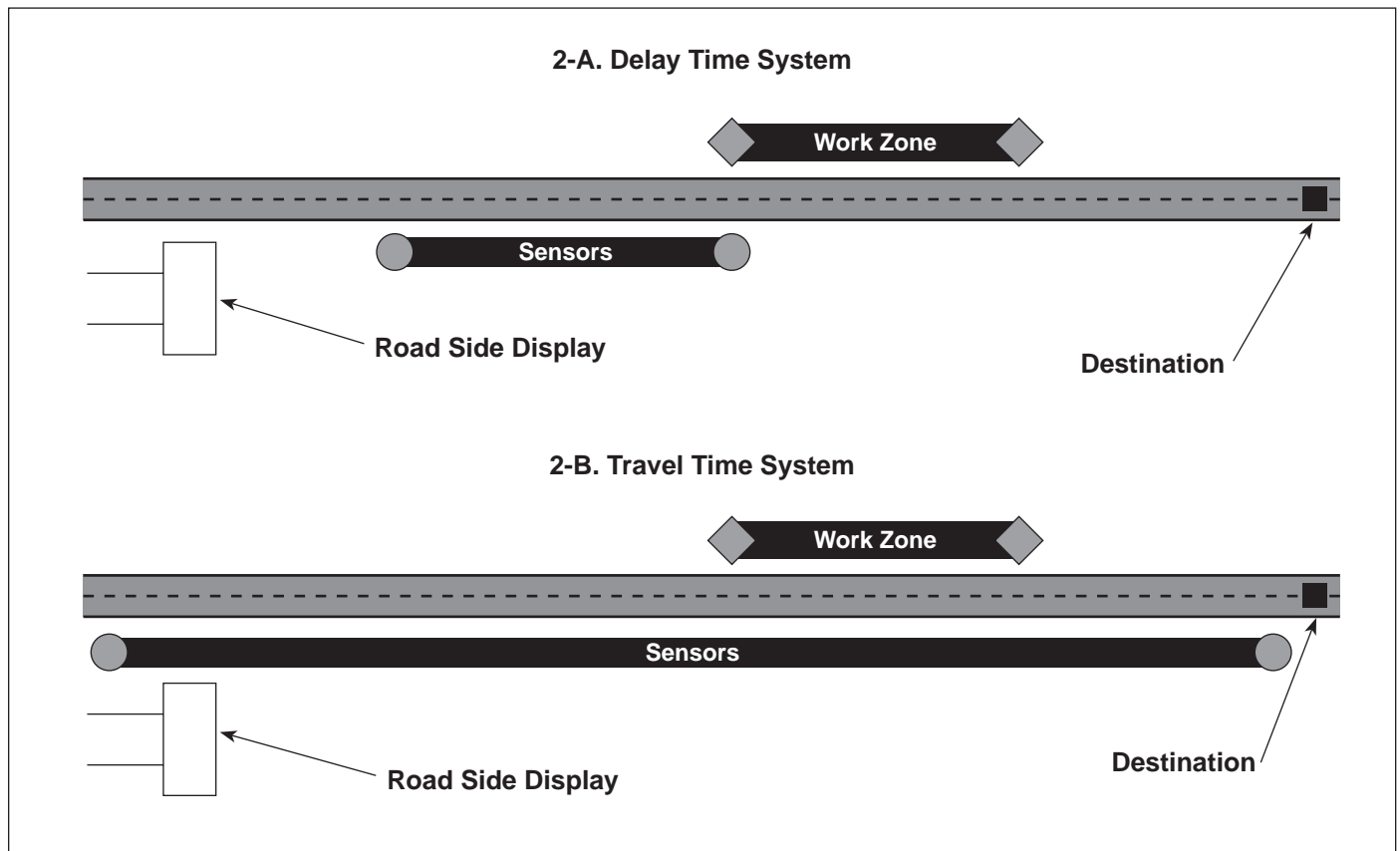


Figure 2. Layout of a Real Time Information System: Delay Time vs. Travel Time.

MDOT used live video feeds from various cameras to monitor construction progress, and the MITS Center used the feeds to monitor congestion and crashes in the region. The MITS center also provided local radio and television stations access to these video feeds for traffic reporting purposes.

Engineers in Michigan and other states have successfully used variations of this type of system on construction projects, but never on the scale used for the Lodge project.

Getting Started

The first step toward initial rollout of the system involved determining the peak and average daily traffic volumes along major routes through the metro area. From there, traffic modeling techniques were used to project the impact the M-10 closure would have on the entire region. After various routes were identified and analyzed, sensors were placed along them, and roadside displays were installed in locations that would keep motorists informed about travel times. The MDOT traffic safety group conducted the traffic studies and route analyses. Traffic Technologies placed the sensors, installed the displays and configured the entire system.

Evaluating and Improving

During the 2005 and 2006 construction seasons, the MDOT team used similar configurations of sensors and displays to com-

municate variations of delay time caused by construction zones and travel time through construction zones. For the Lodge project, they standardized on travel time instead of delay time.

"Delay time is helpful, but it doesn't provide a view of the big picture like travel time does," Mathies explained. A delay time system uses sensors to measure traffic volumes and speeds leading into a work zone. It communicates to motorists the amount of delay caused by the work zone only (see Figure 2-A). A travel time system uses sensors along an entire route, taking into consideration all impacts on traffic flow between two points to communicate total travel time to a specific destination (see Figure 2-B).

In early applications, the team exclusively used PCMS units mounted on trailers and positioned on the roadway shoulder, for roadside displays. As the team gained experience, they created a static sign with a dynamic, two-digit message panel and mounted it on breakaway posts outside of the clear zone (see Figure 3-A, on page 4). The clear zone is the unobstructed, relatively flat area beyond the edge of the main road surface that allows a driver to stop safely or regain control of a vehicle that leaves the roadway. They found that while the PCMS provided flexibility both in positioning along a roadway and in the amount of information that could be communicated, the static sign with a dynamic message panel was a better choice for two reasons. First, a sign mounted on

breakaway posts outside of the clear zone is safer from a traffic obstruction standpoint than a trailer-mounted sign on the shoulder. Secondly, the layout of the sign, with static route and destination information and a simple two-digit dynamic travel time display, is easier to read and understand than two or three lines of text on a PCMS. In terms of the MDOT safety engineers' top priorities, safety and mobility, a static sign with dynamic display is far superior to a PCMS unit.

Through these early applications the team also learned to avoid stop-controlled intersections. "Traffic lights and stop signs introduce too many variables," Mathies explained. "The accuracy of the predicted travel time drops considerably when sensors are distributed across a stop-controlled intersection."

To measure the accuracy of the displays, MDOT technicians drove each route randomly and compared the travel time on the display to the actual travel time. If actual travel time exceeded the estimated travel time by more than three minutes, adjustments would be made to the system. Adding or moving sensors solved any problems.

Empowering Motorists to Make Route Decisions

The most significant enhancement to the system occurred after Mathies' team noticed places in the region where motorists could possibly take more than one route to a given destination. By adding information for two different routes and including a second dynamic message panel, the team created a dual display sign (see Figure 3-B). "Providing motorists travel time information and route choices helps maximize the capacity of the road network," Mathies explained. "When one route slows down, motorists choose the other. With the real-time displays, traffic volume between two routes can literally regulate itself." The team ultimately adopted this configuration for use in three different locations in the region.

Results

"We didn't collect hard data to measure system operation or public opinion," Mathies said. "But we received plenty of phone calls from motorists who appreciated the accuracy and readability of the signs." A recent Federal Highway Administration study (2007) of successful deployments of similar ITS technologies in work zones determined that:

- 50 to 85 percent of drivers change their route in response to travel time, delay time, or alternate route estimates provided by work zone ITS.
 - 56 to 60 percent reductions in queue lengths are possible with work zone ITS.
 - 41 to 75 percent reductions in system-wide delay time were projected through ITS work zone traffic control simulations.
- During next year's construction season, Mathies and his team

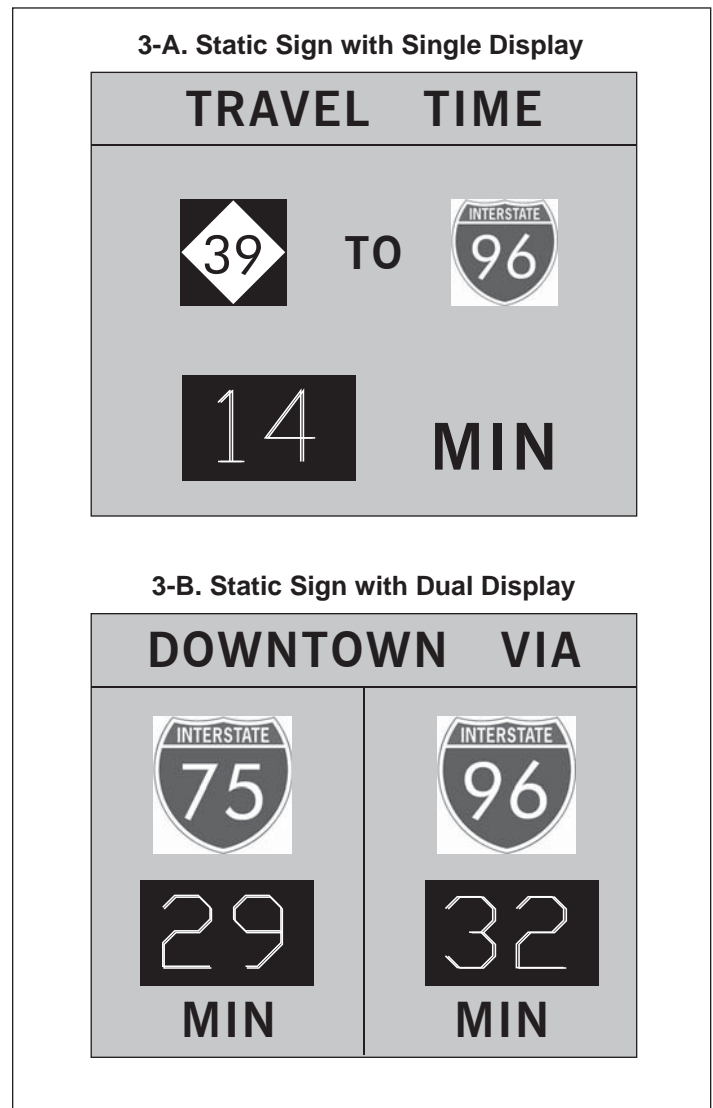


Figure 3. Static Signs with Single and Dual Displays.

plan to collect traffic speed and volume data before and after establishing ITS in a work zone. This effort will allow them to more closely determine the impact of the work zone on traffic flow, and measure the effectiveness of traffic control around and through it.

Reference

U.S. Department of Transportation, 2007, *Intelligent Transportation Systems for Work Zones*. FHWA-JPO-07-003.

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