Introduction

This factsheet is based on past evaluation data contained in the ITS Knowledge Resources database at: www.itskrs.its.dot.gov. The database is maintained by the U.S. DOT’s ITS JPO Evaluation Program to support informed decision making regarding ITS investments by tracking the effectiveness of deployed ITS. The factsheet presents benefits, costs and lessons learned from past evaluations of ITS projects.

ITS applications for operations and maintenance can improve planning for roadway maintenance, enhance safety, and facilitate traffic movement through and around construction work zones. Smart work zones, automated enforcement, traveler information systems, and operations planning tools are a few of the most widely deployed solutions. Evaluation data clearly show these technologies can improve performance; however, with limited budgets and growing demand that exceeds capacity in most metropolitan areas, transportation agencies have adopted new more practical measures to increase benefits and justify costs. Mitigation strategies have shifted from a capacity-oriented approach that relies on increasing capacity to reduce travel times, to a reliability-oriented approach focused on maintaining existing capacity while minimizing disruptions to improve travel time reliability. Using work zone ITS, agencies can better plan and actively manage work zones, increase driver awareness, and improve quality of service.

Both portable and permanent work zone ITS solutions are in use today. Portable Traffic Management Systems (PTMS) can be rapidly deployed to improve safety and mobility regardless of work zone location. Using queue sensors, dynamic message signs (DMS), video cameras, communication equipment, and other hardware and software components, these systems can automatically monitor traffic conditions and communicate with vehicles and drivers to improve situational awareness, harmonize traffic flow, and lessen the impacts of reduced capacity at work zones. More permanent solutions can be implemented for longer term projects or where ITS can be integrated into initial construction. Permanent work zone solutions are generally used as freeway or arterial management systems during time periods without construction activities. These systems often provide broader coverage and use traveler information networks such as 511 services, DMS systems, traffic detection networks, and agency websites to improve system operations, trip-planning and traveler behavior.
Benefits

Work zone ITS can have a wide range of benefits and costs. Benefit-cost ratios can exceed 2:1 depending on the work zone design and technologies used. Specific benefits include construction schedule compression; reductions in traffic volumes, vehicle speeds, queue lengths, and crashes; and fewer and shorter periods of congestion and unexpected delay. Additional benefits related to travel time reliability should become available as guidance on these measures is released through the Second Strategic Highway Research Program (SHRP 2) in 2014.

Figure 1 below highlights benefit ranges for several ITS work zone technologies based on entries in the ITS Knowledge Resource database at: http://www.itsknowledgeresources.its.dot.gov/. Benefits can be seen with many different measures across multiple goal areas including mobility, safety, and the environment. Dynamic Lane Merge Systems have demonstrated their ability to reduce the number of stops per vehicle, as well as the number of dangerous driving maneuvers at work zones. Variable speed limits and queue warning systems have shown promise in crash reduction. Automated enforcement systems have reduced speeding, and automated work zone information systems have reduced delays for trips that travel through work zones.

The online versions of the factsheets feature interactive graphs that contain all the data points included in the ranges. Here, each metric has a number after the text, representing the number of data points used to create the range; no number means only there was only one data point.

Agencies under pressure to improve operations and reduce lifecycle maintenance costs can use ITS tools in conjunction with sound planning and asset management strategies to improve the efficiency of maintenance operations. In areas where work zones are required, modeling and analysis tools can be used to coordinate multiple work zone schedules, and design and test alternate work zone plans and mitigation strategies, including ITS applications where appropriate, before and during construction. In Detroit, for example, a large transportation network micro-simulation model was used to estimate the impacts of changing traffic patterns, coordinate work zone activities, and implement efficient work zone management plans during major freeway closures on I-75 during the Ambassador Bridge Gateway Project. Improved traffic management saved freeway users more than $1.63 million per day during reconstruction of the I-75/I-96 interchange (2013-00862).
Cost

Costs for ITS at work zones represent one to six percent of total construction costs depending on the size and duration of the project, temporary and permanent functions required, and if ITS components such as DMS units, traffic sensors, and portable cameras are purchased or leased. Overall, estimates vary widely ranging from $100,000 to $2.5 million, with the majority of systems costing $150,000 to $500,000 over the first year (2006-00109).

Table 1: System Costs for Smart Work Zones.

<table>
<thead>
<tr>
<th>Smart Work Zone Location</th>
<th>Project Duration</th>
<th>System Cost</th>
<th>Percentage of Total Project Costs</th>
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</thead>
<tbody>
<tr>
<td>In North Carolina, NCDOT leased a smart work zone system for a construction project on I-95 near Fayetteville. (2006-00106)</td>
<td>10 months (2002–2003)</td>
<td>$235,000</td>
<td>-</td>
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<tr>
<td>In Illinois, IDOT implemented work zone ITS on a 7.7 miles section of I-64. (2007-00126)</td>
<td>30 months (2005–2007)</td>
<td>$435,000</td>
<td>1%</td>
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<td>In Illinois, IDOT leased a real-time work zone traffic control system for a major bridge and highway reconstruction project along a 40-mile section of I-55. (2006-00107)</td>
<td>16 months (2001–2002)</td>
<td>$785,000</td>
<td>2%</td>
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<td>In Arkansas, contract bid estimates were provided for an automated work zone information system on a 6.3 mile section of I-40 in Lonoke County. (2004-00068)</td>
<td>12 months (2000–2001)</td>
<td>$322,500</td>
<td>-</td>
</tr>
<tr>
<td>In Arkansas, contract bid estimates were provided for an automated work zone information system on an 8.6 mile section of I-40 in Pulaski County. (2004-00068)</td>
<td>33 months (2001–2003)</td>
<td>$490,000</td>
<td>-</td>
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<td>In Arkansas, the Arkansas State Highway and Transportation Department leased an automated work zone information system for a 3-mile section of I-40 in West Memphis. (2004-00072)</td>
<td>&lt;18 months (2000-2002)</td>
<td>$495,000</td>
<td>&lt;4%</td>
</tr>
</tbody>
</table>

Lessons Learned

Realize that ITS solutions are just one part of a successful work zone management plan.

ITS components can be instrumental in improving the safety of a work zone; however, it is not a cure all for eliminating travelers’ exposure to hazards at work zones.

- Allow for sufficient start-up time when deploying an ITS application. Unanticipated issues may arise that will take time to address (2005-00061).
- Follow accepted guidelines to create concise, effective DMS messages to notify motorists of slow traffic and queuing ahead (2007-00336).
- Conduct outreach and permit drivers to become comfortable with new work zones by allowing an adjustment period (2005-00041).
Case Studies - SafeTrip 21 Initiative

Through the SafeTrip-21 initiative, federal and state agencies collaborated to test and evaluate a variety of technologies designed to reduce congestion, improve efficiency, and enhance safety on the nation’s roadways. Findings from two case studies that evaluated work zone applications are highlighted below.


The North Carolina DOT tested the use of portable traffic-monitoring devices (PTMDs) and the U.S. DOT conducted interviews with agency staff to evaluate their experience (2013-00860). The following benefits were cited:

- **Accurate speed counts.** PTMDs resembled traditional work zone drums to mitigate data skewing that can occur when traffic-monitoring devices are more visible to drivers. The data reported were confirmed by on-site.

- **Ease of installation and operation.** Devices were battery powered, equipped with wireless communications, and designed to easily replace traditional work zone drums. Data were accessible using a web-based interface.

- **Data warehousing capability.** In addition to providing real-time data, the web-based system was designed to archive data for up to five years, giving NCDOT staff the flexibility to analyze historical data.

- **Safety benefits.** PTMDs allowed personnel to collect traffic volume data without requiring them to work in the travel lane, reducing the potential for injuries.

- **Staff Productivity.** Staff could monitor sites remotely and limit site visits, saving staff time.

Experience with Prototype Testing on San Francisco Freeways

In San Francisco, recent studies suggest that vehicle-infrastructure (V2I) applications can further improve benefits achieved through work zone ITS. A field study of 24 vehicles equipped with in-vehicle traveler information systems designed to provide auditory alerts of “slow traffic ahead” effectively smoothed the driving profiles of drivers approaching end-of-queue traffic on a congested freeway (2013-00823). These data agree with previous research in Minneapolis where portable traffic management systems were found to reduce speed variability by 70 percent and slow speeds of approaching vehicles by 9 mph (2007-00411). Considering evidence that suggests an 8.4 percent increase in crash risk for each 1 mph increase in the standard deviation in speed, variable speed limit (VSL) systems that produce smoother driving profiles may have significant safety benefits [1]. The information provided to drivers, however, must be accurate, reliable, and delivered at the right time. Studies show that when drivers are directed to change speeds at 2-minute intervals, crash potential increases; however, when recommendations are made at 5- or 10-minute intervals, crash potential is reduced [2].

References


All other data referenced is available through the ITS Knowledge Resources Database, which can be found at [http://www.itsknowledgeresources.its.dot.gov/](http://www.itsknowledgeresources.its.dot.gov/).