

**NCHRP 20-68A
US Domestic Scan Program**

Scan 08-04

**BEST PRACTICES IN WORK ZONE ASSESSMENT,
DATA COLLECTION
AND
PERFORMANCE EVALUATION**

Summary Report

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**Submitted to:
Scan 08-04 Co-Chairs
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OVERVIEW

On September 9, 2004, the Federal Highway Administration (FHWA) amended its regulation (23 CFR Part 630) that governs traffic safety and mobility in highway and street work zones. One of the provisions of the rule is for states to collect and analyze both safety and mobility data to support the initiation and enhancement of agency-level processes and procedures addressing work zone impacts. Specifically, states are to develop and implement systematic procedures that assess work zone impacts in project development, and states need to manage safety and mobility during project implementation. Presently, many agencies have little experience in collecting, analyzing, and utilizing work zone performance data. It was believed that those agencies would benefit greatly by learning how other agencies are approaching this task. As a result, a domestic scan of practices pertaining to work zone assessment, data collection, and performance measurement was proposed and selected for funding under the *NCHRP 20-68A Domestic Scan Program*.

A 10-member team from both state departments of transportation (DOTs) and the Federal Highway Administration (FHWA) was recruited to conduct the scan, as listed below:

- J. Stuart Bourne, North Carolina DOT (co-chair)
- Chung Eng, FHWA (co-chair)
- Diana Gomez, California DOT
- Dave Holstein/Reynaldo Stargell, Ohio DOT*
- Ron Lipps, Maryland DOT
- Denise Markow, New Hampshire DOT
- K.C. Mathews, Colorado DOT
- Tracy Scriba, FHWA
- Brian Zimmerman, Michigan DOT

* Dave Holstein participated in the scan during the first week, and Reynaldo Stargell participated in the scan during the second week.

Accompanying the team was Gerald Ullman, who served as the subject matter expert (SME) charged with preparation of the reports and presentation documenting the scan efforts and findings, and Thomas Dowd of Arora and Associates, who provided on-site logistical and other support throughout the duration of the scan.

The scan was designed to investigate best practices in work zone assessment, data collection, and performance measurement, and how practices are being employed to ensure safety and minimize congestion in work zones. The scan team identified four main themes to target:

- How does your agency assess the safety and congestion/operational performance of your work zones? In other words, how do you know if your work zones are operating well (safely/smoothly/efficiently)?
- How is your agency collecting the data for these measures?
- How is your agency using/planning to use the data to make improvements in work zone performance and management?

- What processes, methods and/or tools your agency using to assess impacts during various stages of project development (planning, design, construction)?

A desk scan was performed in Fall 2009 to identify agencies across the country that had implemented or were implementing procedures under one or more of these themes. Through this effort the team identified agencies that were potentially noteworthy and might serve as an example to other agencies striving to improve their procedures in this area. Based on that effort, a total of 14 agencies were identified for further investigation during the field scanning phase of the project:

- California DOT
- Florida DOT
- Illinois Tollway Authority
- Indiana DOT
- Maryland DOT
- Michigan DOT
- Missouri DOT
- New Hampshire DOT
- New Jersey DOT
- New York State DOT
- Ohio DOT
- Pennsylvania DOT
- Oregon DOT
- Washington State DOT
- Wisconsin DOT

A combination of on-site interviews, reverse scans (where the agency travels to meet with the scan team at a location), and webinars/videoconferences were employed to gather the desired data from these agencies. The scanning effort was completed over two weeks in March 2010. The Oregon DOT was unable to participate in the scan, but did provide pertinent documents regarding its processes relative to the topic area for consideration by the scan team.

SUMMARY OF INITIAL FINDINGS

The scan team found a range of approaches being taken by agencies towards work zone impact assessment, data collection, and performance measurement, and identified various useful techniques and tools the agencies have developed to facilitate their efforts. The initial findings of this scan are summarized below.

Key Role of Management Level Personnel

Organizations that are successful in addressing this topic area have support at the executive management level and have committed to managing their system rather than simply maintaining their assets. Work zone impact assessment, data collection, and performance measurement does not happen without a significant effort by agency staff. As budgets continue to tighten and workloads increase and pull agency staff in multiple directions, it is important that upper management make work zone safety and mobility management a priority within the organization. Such emphasis allows staff to commit the time and effort needed to consider and mitigate the public impacts of work zones throughout the planning, design, and construction process.¹ This emphasis also allows agencies to continuously improve agency processes and procedures to further reduce public impacts in the future.

Work Zone Impact Considerations during the Project Development Process

Agencies have found that the earlier in the project development process that work zone impacts are considered, the better end product that is obtained. Several agencies noted the importance of identifying the potential for major impacts of a project as early in the process as possible (e.g., during project scoping) so that major bridge structures can be designed wide enough and the costs for mitigation efforts can be adequately budgeted into the project scope. In addition, agencies noted that beginning this process early allows for a wider range of options in accommodating work zone traffic, available mitigation strategies, etc. For example, early acknowledgement of potential impacts by some agencies has resulted in changes to the environmental document or to the right-of-way acquisition process. In other instances, early recognition of the need to reduce traffic demand through the work zone has influenced work zone design decisions (and the need to involve local officials in the decision process) as when and where to implement ramp closures or other demand mitigation strategies. In general, earlier consideration of possible impacts greatly increases the flexibility that the agency has to design and implement a work zone that minimizes public impacts.

Capacity analyses, and permitted lane closure charts based on capacity analyses and/or other analytical tools, are used by many agencies to eliminate or minimize mobility impacts of work zone projects. Some agencies have developed their own in-house tool to facilitate quick analysis by project designers. Agencies also tended to use more complex modeling tools on high-impact projects in urban areas, and were more likely to have an outside entity (e.g., consultant, Metropolitan Planning Organization) help on these more-involved analyses.

A lack of continuous monitoring capabilities in work zones currently limits the ability of agencies to move towards work zone safety and/or mobility performance-based specifications in project contracts. Even agencies that have fairly sophisticated and institutionalized processes to analyze work zone impacts continue to use method or design specifications rather than

¹ For simplicity of presentation, the term construction throughout this report is meant also to include reconstruction, maintenance, surveying, and other highway activities that are performed in a area of a highway commonly called a work zone.

performance specifications to manage safety and mobility impacts in work zones during construction.

Work Zone Data Collection Considerations

Agencies that have good work zone safety and mobility data management systems tend to make better use of the data than those with less structured systems or no system at all. The existence of data management systems also indicates a commitment by the upper management of an agency to considering safety and mobility impacts throughout project development and delivery. This commitment is important, as data gathering, processing, and preparation of desired performance measures does require an outlay of resources. In several states, the work zone safety data assessment systems and processes were more evolved than mobility data assessment systems, due in large part to the availability of statewide crash report data that could allow the extraction of work zone crashes for periodic assessment.

Electronic crash data entry can significantly speed up the availability of safety data and makes it feasible for use in evaluating ongoing project impacts. For ongoing evaluation of current work zones to occur, the DOT must have prompt access to the crash database. States without electronic crash entry must rely on staff to manually gather and analyze crash reports in order to accomplish the same monitoring activity. This manual gathering and analysis is a time-consuming activity and one that is not commonly employed by agencies. Waiting for crash reports to be entered into a statewide database often involves a delay of several months before it can be accessed. By that time, the work zone is often already removed or has changed significantly, limiting the usefulness of the crash data to identify safety problems and take remedial actions.

Many agencies have found the development and implementation of an electronic database system to track and approve future and current lane closures very useful. The database institutionalizes the notification process of proper individuals and groups within the agency, and ensures that closures are to be performed during acceptable times during the day. The database can also be useful for coordinating multiple lane closures on a given facility or route, can facilitate their advance notice to the public, and can assist in targeting monitoring efforts of impacts during the closures. However, only a few agencies are using their databases in this manner at this time.

For many agencies, the Transportation Management Centers (TMCs) play a key role in managing lane closures throughout the region and informing the public about them. TMCs have staff and other resources that make it the logical focal point of information collation and dissemination to the public. TMCs are also useful for providing real-time information to drivers when traffic queues develop at a project as a way to encourage diversion and mitigate the magnitude of the queues. Unfortunately, TMC coverage in most regions is limited to urbanized high-volume, high-speed facilities only.

The increased availability of low-cost technologies and data sources are making the collection of mobility data in work zones more feasible for agencies. Although full work zone intelligent transportation system (ITS) deployments have traditionally been expensive to implement, the

expansion of permanent ITS resources and the increased availability of low-cost portable devices to monitor work zones is making the collection of mobility data in work zones more accessible to agencies. In addition, many agencies are obtaining access to third-party mobility data on routes without agency surveillance and control equipment, which is also making work zone mobility data more readily available.

There are continuing challenges in obtaining appropriate data, which influences the work zone performance measures that an agency uses. Both the importance of certain measures and availability of data drive what performance measures are used by a given agency. However, the performance measures most desired by an agency may not always be usable because the data needed to compute those measures are not reasonably available.

Work Zone Performance Measure Considerations

Agencies that have clearly established performance measures tend to effectively track those measures and consider them throughout the project development process. Consistent with previous findings already stated from this scan, having clearly established goals and performance measures shows a level of commitment by the agency.

Many agencies are using work zone performance measures without realizing it. Most agencies have policies and procedures in place that are based on mobility and/or safety performance measures. For example, values used in incentive/disincentive clauses and decisions on permitted lane closure times are typically based on assessments of delays or queues.

To date, agencies have tended to emphasize either safety measures/analyses or mobility measures/analyses, but not both. In some cases, this focus on one type of impact over the other is a function of limitations in available agency resources to devote to work zone performance measurement and the extent to which data are available. In other instances, specific events (such as an unusual number of work zone fatalities in a given year) prompted the additional emphasis on a particular set of measures.

Presently, work zone safety performance measures tend to be developed and examined mostly at the agency program level. The scan team did observe a few instances where efforts were being made to use safety data and performance measures at the project level (either in monitoring impacts of ongoing projects or in considering the potential safety concerns of upcoming projects), but these tended to be the exception rather than the rule. Of course, even when crash data entry are timely, crashes in a particular work zone are often not frequent enough to be of use in problem identification or in safety performance measurement.

Conversely, work zone mobility performance measures tend to be developed and examined mostly at the project level. Agencies tend to have tools and methodologies in place to evaluate the potential mobility impacts of individual projects during work zone design. In addition, methods and technologies are becoming more widely available in work zone monitoring to allow mobility performance measures to be computed fairly easily. However, these computations and monitoring efforts tend to be sampling activities (e.g., estimating the worst-case condition or noting the existing of unacceptable impacts during inspection). This type of sampling does not

lend itself easily to consolidating across multiple projects into program-level mobility performance measures.

Most agencies are moving away from lane rental provisions in project contracts. A major reason for this reduction in lane rental consideration is due to concerns that contractors will go ahead and pay excessive fees to close lanes and create significant mobility impacts. Many agencies are simply not willing to tolerate such impacts, and so prefer to use permitted lane closure times and liquidated damages for violations of those times.

Use of Performance Measures and Data for Work Zone Safety and Mobility Improvement

Having established measures of performance, and collecting or having access to data from which the measures can be computed, allows agencies to monitor and modify their policies, processes, standard operating procedures, etc. and improve work zone safety and mobility. The scan team encountered several specific examples of agencies that have been successful in utilizing work zone safety and mobility data and measures to effectively identify deficiencies or gaps in their approach to project delivery. Additionally, these agencies have made changes based on these assessments that were verified as having a benefit on future projects. For instance, entrance ramp design criteria were significantly modified when an agency determined that a disproportionate number of crashes were occurring in its work zones where entrance ramp acceleration lanes were temporarily removed or reduced dramatically.

A correlation was observed between an agency's access to real-time data (safety or mobility) and that agency's ability to modify existing work zones to improve safety and mobility. The desire to monitor each work zone and ensure that it is operating safely and with minimal mobility impacts was a common theme amongst all the agencies included in the scan. However, a lack of timely data, be it delays of several months in accessing crash data occurring at a project or the inability to constantly monitor and quantify the queues or delays occurring at each project, kept most agencies from being able to meet those desires.

Not all agencies have fully explored the availability and usefulness of data it has available for use in work zone safety and mobility improvement. In many instances, agencies that are making use of work zone safety and/or mobility data recognize that additional analyses could be performed of the available data to further improve agency processes. However, a lack of resources (time, expertise, other supporting data, etc.) was often cited as a reason why more was not done with the data that was available.

RECOMMENDATIONS

In addition to the key findings summarized above, the scan team also identified some key recommendations relative to work zone impact assessment, data collection, and performance measurement. These recommendations are summarized below.

Work Zone Impact Considerations during the Project Development Process

Clearly defining how and where work zone safety and mobility impacts assessment fits into the project development process increases the chances that impacts will be better mitigated, costs

will be accounted for, and the project will go more smoothly. The project development process followed by many agencies is highly structured. At a minimum, it is critical to include impact assessment and mitigation as specific steps in the process in order to ensure that they are considered at appropriate points by the appropriate personnel. However, the most successful agencies appear to have integrated the consideration of impacts throughout their processes, periodically revisiting early assumptions and making revisions and refinements as project development progresses.

It is important to scale the level of the transportation management planning effort of a project to the level of impacts that are anticipated. As has been alluded to several times in this summary report, agency staff and time resources are extremely limited, and continue to be strained even further as budgets are regularly cut. As agencies look for ways to continue to streamline their operations and become more efficient, having improved data as to which projects, locations, etc. have resulted in significant impacts in the past will aid agencies in better predicting which projects are most likely to cause significant impacts and to identify mitigation strategies that have the best chance of alleviating those impacts.

Work Zone Data Collection Considerations

An agency must pursue the collection of quality data in order to engage in effective work zone performance measurement. Specifically, the data must exist (or be easily converted) in a readily-usable format, and must be accurate and timely enough to allow an agency to make decisions based on that data. Ultimately, agency management must ensure that data are collected in enough detail, frequently enough, and quick enough to allow it to be useful to its staff.

Transportation management centers (TMCs) can play a key role in collecting mobility and safety data, identifying issues that arise, and providing information to the public regarding current work zones within its surveillance zone. However, it is important that TMC staff be properly trained and procedures established on how data collection, monitoring, and public information dissemination efforts are to occur. Any temporary losses of permanent surveillance should be offset to the extent possible through the use of temporary surveillance devices and/or third-party data sources. In addition, information on work zone activities that are impacting safety or mobility (e.g., temporary lane closures) should be meshed with the TMC data in order to be able to maintain the connection between work zone project decisions and the resulting impacts upon the public.

Work Zone Performance Measure Considerations

The performance measures used by an agency should relate to the goals and objectives that the agency has set for itself relative to mobility and safety impacts. The scan team uncovered a number of different work zone safety and performance goals specified in agency policies and procedures (maximum tolerable delays, maximum queue lengths and durations, no increase in the crash rate of a roadway section during construction, etc.). The performance measures tracked and monitored during the project should relate to those measures.

Work zone performance measures must be used rationally. Whereas work zone impacts on the traveling public are key considerations throughout the project development and construction process, they are not the only ones an agency must consider. Costs, productivity, environmental

concerns, and other factors also must be considered by the agency. The use of work zone performance measures is an important tool for agencies to use, but must be applied appropriately within the overall goal of accomplishing the required road work activities.

Use of Performance Measures and Data for Work Zone Safety and Mobility Improvement

Agencies should strive to improve how work zone safety and mobility data that is collected is fully analyzed and utilized to continuously improve agency processes and procedures. This effort to improve may involve bringing in additional data sources, such as work zone exposure information, to allow the data to be normalized across projects, roadway types, work activities, etc.

PLANNED IMPLEMENTATION ACTIONS

In addition to the final report, the scan team identified 7 potential dissemination avenues for the results of this scan. These avenues are listed below.

- Presentation of scan findings at relevant conferences and meetings
- Publication of summary article(s) regarding the scan findings in pertinent journals and trade publications
- Development and presentation of webinars
- Development of research problem statements and inserting them as appropriate into the funding cycles of various research sponsors
- Development of a summary brochure that can help “market” the scan report and its findings to agencies
- Development of demonstration workshops highlighting innovative practices and technologies identified through the scan
- Development of a marketing video that would raise the awareness of the scan report and its findings amongst agencies

The following paragraphs give further details of these dissemination avenues.

A number of potential conferences and meetings were identified as priority venues for presentation of all or part of the scan findings. Specifically, a one-half day workshop is being tentatively planned for the 2011 TRB annual meeting, sponsored by the work zone traffic control technical committee. The scan team also considered the results of the scan to be appropriate for peer-to-peer exchanges with agencies looking for assistance in establishing or improving their processes and use of work zone monitoring and performance measurement. Smaller presentations, utilizing the scan summary presentation or a portion thereof, were also identified as of potential interest to several AASHTO committees and subcommittees (e.g., systems operations and management, traffic engineering, construction, maintenance, and design). The conferences and/or expositions of several trade and professional associations were also identified as potential presentation venues, including:

- American Traffic Safety Services Association (ATSSA),

- American Road Transportation Builders Association (ARTBA),
- International Municipal Signal Association (IMSA),
- Institute of Transportation Engineers (ITE), and
- Intelligent Transportation Society (ITS) America.

Other possible presentation venues identified by the scan included a meeting of the I-95 corridor coalition, local transportation assistance program (LTAP) meetings, Associated General Contractors (AGC) meetings, and possibly presentations at one or more of the California DOT Training Academies. Team members Tracy Scriba and Denise Markow agreed to take the lead in coordinating and emphasizing efforts by all of the scan team members in this implementation strategy.

The scan team viewed the preparation and submission of one or more articles into journals and trade publications as another key implementation activity. Publications initially identified for targeting include the ITE Journal, Roads and Bridges magazine, the FHWA Focus and Public Roads publication, and a short article for incorporation into the TRB Transportation News magazine. Gerald Ullman and Diana Gomez agreed to serve as the coordinators of these efforts.

The scan team was also in agreement that one or more webinars would be appropriate for disseminating the results of this scan. As a minimum, a TRB-sponsored webinar of the scan results was envisioned; additional webinars to disseminate the processes and procedures of one or more agencies scanned as examples of best practices were also suggested. These additional webinars could be conducted as part of outreach funding already in place for the FHWA Highways for Life effort, or as a topic presented through the National Work Zone Safety Information Clearinghouse (the latter of which has experienced registrations as high as 600+ viewers for previous webinar offerings). Chung Eng and K.C. Mathews agreed to take on the leadership role for organizing and coordinating such webinar offerings.

At the conclusion of the scan effort, it was clear to the team that many questions remain as to the best ways and means of work zone monitoring and performance measurement. A number of specific problem statement ideas were generated, including:

- Determination of the best method to mesh the various sources of data for work zone performance measurement
- Development of guidelines or best practices on the use of transportation management centers (TMC) for work zone monitoring and performance measurement
- Development of guidelines on how to best utilize work zone performance measures and data
- Assessment of the benefits of electronic crash reporting for work zone safety performance monitoring and measurement
- Evaluation of the effectiveness of contract incentives for improving work zone traffic impacts

Gerald Ullman and Stuart Bourne agreed to take the lead in developing one or more of these ideas into formal problem statements and identifying appropriate funding sources to submit the statements.

The team discussed the possibility of developing a brief overview of the scan activity and key findings that could be converted into a brochure for widespread dissemination. This brochure would serve as a marketing tool to increase awareness about the existence of the scan report and encourage agencies to look into the topic of work zone safety and mobility performance measurement more closely. Stuart Bourne and Chung Eng agreed to further examine the feasibility and potential effectiveness of this implementation effort.

Next, a number of innovative technologies and tools were identified through the scan effort that would warrant more widespread acknowledgement of their existence and potential applicability to various agencies. Examples include the use of the CA4PRS analysis tool and the PeMS traffic database developed and in use by Caltrans. Chung Eng and Diana Gomez agreed to lead the effort to identify those tools and technologies with greatest potential, and to coordinate efforts to demonstrate those tools and technologies. Possible demonstration venues and mechanisms include a workshop or presentation as part of a conference, or a direct peer-to-peer exchange effort between agencies.

A final implementation resource identified for consideration was the development of a short video documenting the purpose and key findings of the scan. Such a video could serve as another marketing tool of the full report regarding the scan, and lead to other implementation efforts (such as a peer-to-peer exchange activity). However, questions were raised as to the feasibility and costs of creating such a video. Brian Zimmerman and Denise Markow agreed to take the lead in examining the practicality and desirability of this implementation strategy more closely.