

# Work Zone ITS

## Historical Use of Work Zone ITS in WSDOT

The use of ITS elements in WSDOT work zones began some 15 to 20 years ago employing the following technologies and devices:

- Portable Changeable Message Sign (PCMS) – early flip disk systems were used for advance warning and driver information. These PCMS's operated independently. An early test of remote controlled PCMS (cell modem) occurred during the 1990 Goodwill Games with limited success.
- Variable Message Sign (permanent systems)VMS)) – urban area Traffic Management Centers (TMC's) (Seattle area) with existing ITS elements coordinated the use of work zone messages displayed on the permanent VMS system.
- Highway Advisory Radio (HAR) – several urban locations used permanent HAR stations to broadcast work zone driver information messages. Permanent HAR's were not very effective (we did a couple of driver surveys) since drivers did not always correlate their location with the project location.
- Portable Signal Systems – typically deployed on bridge reconstruction projects with single lane alternating traffic control. Overall good success.
- Overheight Detection System – used in a few bridge construction projects where falsework temporarily created a substandard vertical clearance condition. Marginally successful as some bridges were still struck by overheight loads. Best option is to ensure the bridge office designs the falsework to maintain minimum clearances.
- Flashing stop/slow paddles (FSSP) were originally developed in the federal SHRP program and WSDOT evaluated many of these devices. Unfortunately only 2 were initially approved for use and one is no longer available and the other became too cost prohibitive for purchase. Good idea that just did not take off for a variety of quality, performance and cost issues. MUTCD & WSDOT have since relaxed the requirements for the device and this has opened the door for new manufacturers to enter the market. The device is allowed for use in WSDOT but has not become a common tool
- Intrusion alarms – great concept but a substantial testing effort showed that most intrusion alarms did not offer adequate warning or perform on a reliable enough basis to be depended on. A loud audible warning device used by a flagger or spotter may be more useful.

## Current Work Zone ITS Technologies

The following ITS elements have been used, are currently in use or are under evaluation.

- Portable HAR units – these trailer mounted units have had great success the past few years when integrated into a construction project with high driver interest due to traffic impacts. Timely accurate messages have brought us very positive comments from drivers. Portable HAR's are currently used in many work zones around the state where permanent systems are not available and provide flexibility to go where the work operation is.

- Intrusion Alarms – the safety products team is involved in evaluating new intrusion alarms as they are developed. We recently evaluated a “low tech” device called the Sonoblaster. This device is a traffic cone that contains a CO2 powered alarm horn that sounds when tipped over. Intrusion alarms as a group may only have a marginal effect on worker safety based on our evaluation efforts and national experience. The Olympic Region Work Zone crew currently uses the Sonoblaster in their maintenance work zones.
- Smart Zone System – this trailer mounted “mini traffic management system” was initially deployed on a pilot project with the WSP in the Northwest Region to evaluate work zone enforcement procedures. The device experienced some operational & communication problems early on but the South Central Region managed to correct the problems and has used the device with good success the past few years on many projects within their region, currently the device is being used on the I-90 Rock Fall Stabilization project.
- Speed Detection/Display Units – typically trailer mounted units used to detect speeding vehicles and provide feedback to drivers by displaying the vehicle speed. Studies have shown reductions in work zone speeds when using these devices. NWR owns 2 of these units from the WSP pilot project.
- Speed Violation & Deterrent System – similar to photo radar technology, but this system is used to track speeding vehicles by license plate & vehicle type. The vehicle license number and speed are displayed on a roadside PCMS so the driver can see it. Privacy issues may also apply to this system as with photo radar. This system can also be used for work zone travel time/speed data gathering and display. Not currently in use. Initial evaluation shows some potential benefit depending on the type of application and with the recent legislative approval to move forward with photo enforcement in work zones, HQ traffic is looking for potential work sites to experiment with the technology.
- Work Zone Photo Radar Speed Enforcement –WSDOT recently gained legislative approval to go forward with photo enforcement in work zones but we are still working through the legal issues associated with the enforcement. Nationally this technology seems to be on the decline along with the so called “double fines fizzle” but there are a couple states that have been experimenting with the photo radars. There is also a privacy issue related to this type of enforcement.
- Project Information Web Pages & Project Information Phone Numbers – currently in use on many WSDOT projects around the state. Many positive public comments have been gathered on several of the project web pages with ongoing driver information updates.
- Variable Speed Limit – NCR has pursued a “low tech” version of this technology on several paving projects the past few years by using conventional speed limit signs as part of the daily traffic control signing. Very good comments from WSP and PEO. Observations show reduced traffic speeds through the work zone. This method will be captured in the upcoming revised speed reduction directive.
- Automated Flagger Assistance Device (AFAD) – this device shows good potential in removing human flagger from the roadway to a safe location off the roadway while controlling the device. With interim FHWA approval is actively being promoted for use on projects around the state.
- PCMS – new computer and lighting technologies have greatly improved PCMS performance. Both trailer and truck mounted versions are very useful and have

- become standard equipment for many work zone operations. The newer “Smart” PCMS’s show great potential benefit in many work zone applications.
- **Dynamic Lane Merge System** – this system incorporates a queue detector, flashing beacons and no pass signing to operate a no pass zone that moves in conjunction with the lane closure queue. The system is intended to improve work zone capacity and reduce crashes, (studies show minimal improvement) but it’s greatest value may be the merge control or direction it provides drivers approaching the lane closure. This in turn (when combined with active enforcement) reduces queue jumping and blocking. Currently not deployed but HQ traffic is looking for opportunities to evaluate the product.
  - **Queue Detection System** - a portable device that utilizes a microwave detector that is able to detect changes in traffic flow, and send out an alarm to advance signs to warn motorists if a backup is forming. Currently not deployed but HQ traffic is looking for opportunities to evaluate the product.
  - **Travel Time Estimation System** – Travel time estimation obtains real-time traffic data and uses computer software to predict the current travel time on a section of roadway. The information can then be displayed to the driver on a PCMS, displayed on the internet, or sent to a pager/cell phone/PDA. Currently not deployed but HQ traffic is looking for opportunities to evaluate the product.
  - **Work Zone Traffic Management** – this concept can employ several technologies and is slowly starting to move ahead on some projects, but requires some detailed advance planning and design. The most common case to date is moving permanent ITS elements (usually cameras) into contracts that allow those elements to become operational during construction of that project or future overlapping project work zones. The ultimate example of this would be a work zone TMC that would manage multiple or complex work zones on large or multiple projects within a corridor. A more practical example might be to combine temporary work zone ITS with permanent ITS managed through the region TMC.
  - **Over height Detection System** – our recent experience on I-5 in Seattle showed that this system might appear to be an attractive application. In reality with such a downside for even one failure of a truck to stop, this system is a poor choice. A design decision to remove the conflict, instead of warning for it would have been the correct decision. Any future consideration of this system should be carefully examined.

The above technologies & applications cover most of our experience. We recognize that others may exist and new technologies will develop or are currently developing.

### **Work Zone ITS Future & Priorities**

Work zone ITS is currently underutilized by WSDOT and yet has some of the greatest potential for new work zone solutions. Technology is becoming more readily available, costs for these systems has become more reasonable and efforts to incorporate work zone ITS elements into our projects should be moved ahead.

What the public wants (from surveys, e-mail, news articles and studies)

- *What the heck is going on and how can I avoid it!*
- *Is there an alternate route?*

- *I'm willing to wait my turn as long as I get my turn (queue jumping).*
  - *I'm from \_\_\_\_\_ (out of the local area) and had no idea the road was closed.*
  
  - *My normal route and the alternate route are all under construction.*
- Typical work zone impacts that could be improved through ITS:
- Work zone delays & congestion
    - Queue detection
    - Smart PCMS (driver info & alternate routes)
    - SmartZone traffic monitoring (part of work zone TMC)
    - Traffic Management System (corridor or regional TMC)
  - Road Rage
    - WSP Enforcement, roving or assigned (using remote monitoring)
    - Surveillance/Monitor System
    - PCMS enforcement messages, "WSP WORK ZONE" "PATROL IN PROGRESS"
    - Speed Detection/Display Units
  - Lane closure efficiency
    - Dynamic lane merge
    - Static lane merge (low tech approach, signed no pass zone)
    - Lane closure metering (concept – applies ramp metering to lane closure merging)
    - Queue detection
  - Traffic Safety
    - PCMS Advance warning (unexpected queues)
    - Work Zone Monitoring (crashes, incidents, etc.)
    - Speed Violation & Deterrent System
  - Worker safety
    - Intrusion alarms (past & current evaluations indicate poor performance)
    - Automated Flagger Assistance Devices
    - Portable Signal
    - Speed Detection/Display Units

Based on the above summary of public concerns, work zone impacts and available technology the following priority list indicates which ITS elements we should consider for inclusion in upcoming construction projects as well as some maintenance work zones.

1. Queue Detection System, with advance PCMS warning/information.
  2. Dynamic Lane Merge
  3. Traffic Management System and plan.
  4. Advance Congestion Warning Systems
  5. Smart PCMS
  6. Surveillance/Monitoring System
  7. Automated Flagger Assistance Devices
  8. Speed Detection/Display
  9. Portable Signals
  10. Speed Violation & Deterrent System
- (some of these systems & technologies overlap, depending on the application)

## **Implementation Roadblocks**

Roadblocks to implementation are always present and can be difficult to overcome . The following roadblocks are typical of what we face when implementing new devices and systems.

- Funding
- Project Selection & Region concurrence
- Design Effort – new spec's, plans, details, estimates and other details are sometimes difficult to develop.
- Identification of cost/benefit (justification)
- Ownership during construction & maintenance

“Turn Key” systems, “below the line” state provided equipment/systems or independent pilot projects may offer a better approach to moving work zone ITS initiatives ahead.

## **Summary**

Any expected benefits from work zone ITS depends heavily on selecting the appropriate project work zone application. Work zone ITS is like the caulking around the windows, you don't design a project around an ITS system you include the ITS to help manage and mitigate traffic as part of a traffic management plan. For example, minor mobility benefits may be achieved though driver information messages on PCMS's, as we frequently implement on projects, but a much greater benefit would be realized if the PCMS's directed traffic to an available alternate route that is not under construction. The greater Puget Sound area and the I-5 corridor is probably the best example of an area with already limited alternate routes that is further limited because of uncoordinated programming of projects.

Expertise in work zone ITS needs to be extended to the region level through training, awareness and tools like specifications, cost estimates and appropriate guidance in our manuals. Also, a decision matrix for work zone ITS applications in construction and maintenance work zones should be useful.

The top 3 work zone ITS priorities that have been identified by the HQ Traffic office to move forward with possible implementation are:

- **Dynamic Lane Merge System**
- **Queue Detection System**
- **Work Zone Traffic Management**

Further discussion and action on these issues should be facilitated to formulate an approach to move work zone ITS into our new work zone policy and procedures.