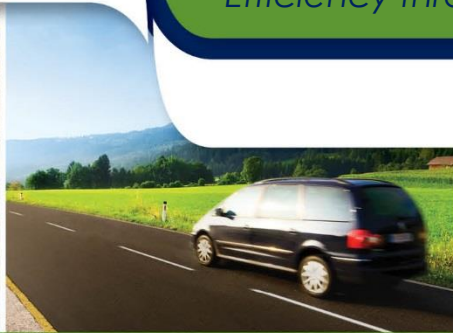


Smarter Work Zones

SWZ Program

DLM Systems

Efficiency through technology and collaboration



U.S. Department of Transportation
Federal Highway Administration

Smarter Work Zones

OVERVIEW



What are Smarter Work Zones?

Innovative strategies designed to optimize work zone safety and mobility

- Policies and practices used to incrementally and continuously improve WZ operations
- Tools to reduce WZ crashes and delays
- Tools to enhance WZ management strategies



What are Smarter Work Zones (cont.)?

Project Coordination

Coordination within a single project and/or among multiple projects within a corridor, network, or region, and possibly across agency jurisdictions

Technology Applications

Deployment of Intelligent Transportation Systems (ITS) for dynamic management of work zone traffic impacts, such as queue and speed management

Today's Focus



Types of Technology Applications Include...

- Real-Time Traveler Information
- Queue Warning
- Dynamic Lane Merge
- Incident Management
- Variable Speed Limits
- Automated Enforcement
- Entering/Exiting Construction Vehicle Notification
- Performance Measurement

For more information check out the SWZ TA website

<https://www.workzonesafety.org/swz/swztechnology-application/types-of-applications/>



Several States are already Utilizing SWZ!

- Over **40 states** have implemented technology applications, including:
 - Formalizing processes for planning and operating technology applications
 - Implementing “on-call” regional ITS SWZ contracts
 - Implementing steps towards institutionalizing technology:
 - Developing systems engineering documents
 - Developing specs to bid on technology
 - Piloting technology applications
 - Evaluating pilot to determine effectiveness for wider implementation
 - Fully implementing technology applications
 - Utilizing project funds to implement ITS – leading to institutionalization



Why Implement SWZ?

Capabilities of Technology Application

- **Improved driver awareness**
 - Changing traffic patterns
 - Downstream congestion
 - Construction vehicle ingress/egress
 - Expected delay / travel time
- **Dynamic and actionable guidance to drivers**
 - “Road work ahead” vs “Traffic Stopped 1 mile ahead”
 - “Road work – expect delays” vs. “Road Work I-95 past Exit 52 Use Alternate Routes”
- **Enhanced tools for on-site traffic management**
 - Speed monitoring
 - Automated speed enforcement
 - Queue formation



Why Implement SWZ?

Benefits of Technology Application

- **Empowers drivers to be proactive in responding to work zones**
 - Awareness of downstream hazards
 - Facilitates real-time decision-making and trip planning
- **Streamlines traffic management functions through partial automation**
 - Speed enforcement
 - Data collection
 - Performance measurement
- **Information increases customer satisfaction**
 - The More you Know...



Smarter Work Zones

DLM SYSTEMS



Dynamic Lane Merge (DLM) Overview

- **What is it?**

- Systems that encourage motorists to merge at specific points as they approach a lane closure, depending on current operating conditions
 - Systems alternate merging strategies (early and late merge)

- **How does it work?**

- Uses technology (e.g., sensors) to monitor real-time traffic characteristics
- Conveys instructions through portable changeable message signs (PCMS) placed in advance of a lane closure
- Uses site-specific algorithm
- Detects a change in traffic conditions (e.g., changes in speed, density, and occupancy) to switch merge strategies
- Provides lane use instructions to drivers



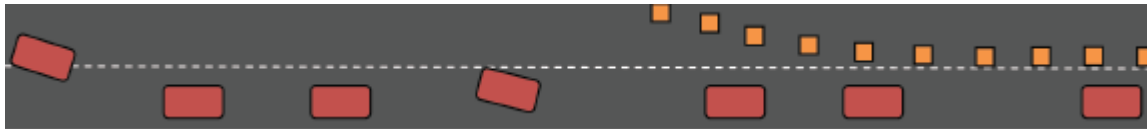
DLM Strategies

- Early Lane Merge
 - Often used in low-volume conditions
 - Reduces the occurrence of high-speed merging at the point of lane closure
- Late “Zipper” Lane Merge
 - Often used in high-volume conditions
 - Reduces the length of the queue



Early Lane Merge

- Advises drivers to move out of closed lane well before the forced merge point
- Works best when there is a low traffic volume combined with high average speeds
- Benefits:
 - Reduction of aggressive driving and unsafe merge maneuvers
 - Provide significant advanced warning to allow drivers adequate distance to merge
 - Gives positive instructions on lane usage



Source: https://www.workzonesafety.org/fhwa_wz_grant/atssa/atssa_dynamic_lane_merging



Source: Minnesota DOT

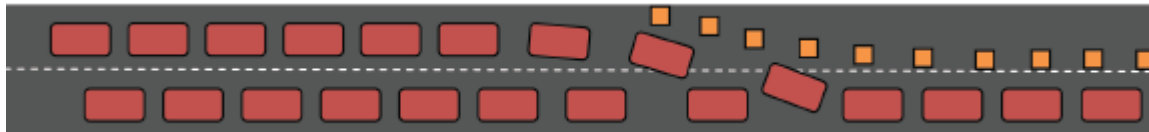


Late Lane Merge

- Advises drivers to use both lanes up to the merge point
- Works better for high traffic volumes, situations where queueing upstream of work zone is expected to occur
- Benefits:
 - Maximize available storage upstream of work zone for reducing total queue length.
 - Reduces confusion between drivers who think they should merge early vs. drivers that use open lanes as far as possible.
 - Clarifies right-of-way at merge point (“alternate merge”)



Source: Hallmark, Mudgal, Stout, & Wang, 2011



Source: https://www.workzonesafety.org/fhwa_wz_grant/atssa/atssa_dynamic_lane_merging



Implementing DLM

- **Where?** Most useful in work zones experiencing fluctuating traffic demands
- **How?** Techniques used to implement DLM:
 - Microwave signals to identify traffic volume
 - Video analysis to track traffic volume, lane occupancy, and queue
 - Doppler radar to determine average speed
 - Pneumatic tubes to calculate traffic volume
 - Computer simulations to optimize dynamic merging algorithms
- **How Much?** Costs vary based on detection technology, number of PCMS, and product manufacturer



DLM Considerations

- Considerations prior to implementing a DLM system:
 - Sign placement
 - Road geometry, expected queue length, and average expected speed
 - Driver awareness with roadway
 - Entrance/exit ramp proximity to merging area
 - Police enforcement
 - Proven useful, especially with early merge
 - Focus on reducing aggressive, non-compliant drivers
 - Outreach methods
 - Driver confusion and steep learning curve
 - Public information campaigns on lane closures and how DLM systems work
- Considerations during implementation:
 - Ensure signs are displaying reasonable messages
 - Engage in real-time sign feedback



Benefits of Using DLM

- Reductions in speed differentials between open lanes in advance of the lane closure
- Reduced driver frustration by creating a “sense of fairness”
- Reduction in queue lengths
- Reduction in work zone delays



Examples of DLM Signing

Dynamic Signing

- **Early Lane Merge**
 - DO NOT PASS/WHEN FLASHING
- **Late Lane Merge**
 - STAY IN YOUR LANE / MERGE AHEAD
 - USE BOTH LANES / TO MERGE POINT
 - TAKE YOUR TURN / MERGE HERE
 - SLOW TRAFFIC AHEAD / USE BOTH LANES
 - STAY IN YOUR LANE / MERGE AHEAD XX MILES
 - TAKE YOUR TURN / MERGE HERE
 - USE BOTH LANES
 - STOP TRAFFIC AHEAD
 - MERGE HERE
 - TAKE TURNS

Other Signing

- Deployment may also include passive/non-activated mode for when merge strategy is no longer necessary
- Example:
 - LEFT (or RIGHT) LANE CLOSED / XX MILES AHEAD
 - LEFT (or RIGHT) LANE CLOSED



Examples of Dynamic and Supporting Signs

Dynamic Signing



Support Signing



Source: https://www.workzonesafety.org/training-resources/fhwa_wz_grant/atssa_dynamic_lane_merging/

Additional DLM Resources

Guidance

- Guidance for the Use of Dynamic Lane Merging Strategies
https://www.workzonesafety.org/training-resources/fhwa_wz_grant/atssa_dynamic_lane_merging/
- SWZ Webinar Series Webinar #6: Technology Application Case Studies: Variable Speed Limit and Dynamic Lane Merge
https://www.workzonesafety.org/files/documents/SWZ/webinar6_slides.pdf

Description

- Description of a Late Merge System by MnDOT
<http://www.dot.state.mn.us/trafficeng/workzone/doc/When-latemerge-zipper.pdf>

Deployment Evaluation

- Evaluation of MnDOT Deployment
<http://www.dot.state.mn.us/trafficeng/workzone/doc/2004DLMS-Evaluation.pdf>
- Evaluation of MD SHA Deployment <http://trrjournalonline.trb.org/doi/abs/10.3141/1948-10>
- Evaluation of FDOT Deployment http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_CN/FDOT_BD548-24_rpt.pdf



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