Evaluation of ITS Technologies

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ITS in Work Zones

Presentation Overview

- Need for evaluations
- Types of evaluations
- Test evaluations

Need for Evaluation

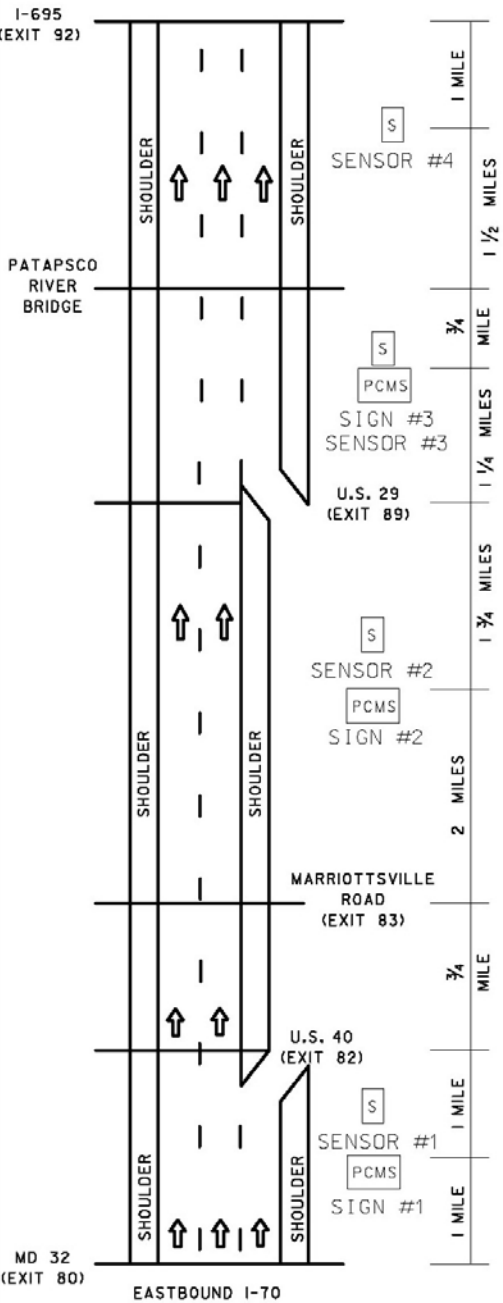
- Determine effectiveness of strategies
- Determine reliability of systems
- Determine accuracy of information
- Conduct benefit/cost analysis
- Efficient use of ITS technologies in WZ
- Management buy-in

Travel Time Estimation Systems

- Objectives:
  - Reduction in anxiety/stress
  - Pre-trip planning using historical database and real-time info
  - En-route travel planning/alternative route information

Microwave radar sensors

Video Image Recognition Systems



KEY:

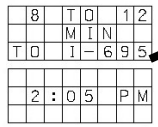
DIRECTION OF TRAFFIC

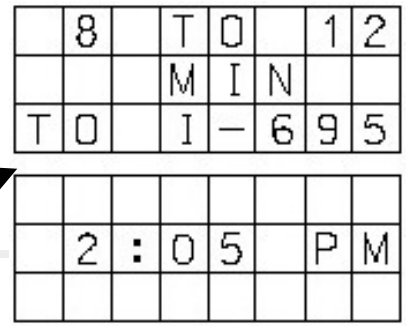
PCMS — PORTABLE CHANGEABLE MESSAGE SIGN

S — TRAFFIC SENSOR

MESSAGES FOR PORTABLE CHANGEABLE MESSAGE SIGNS

FOR EXAMPLE IF THE CALCULATED TRAVEL TIME IS 9 MINUTES.





THRESHOLDS FOR SIGNS

SIGN #1 (MIN)	SIGN #2 (MIN)	SIGN #3 (MIN)
8 TO 12	4 TO 8	< 4
12 TO 16	8 TO 12	4 TO 8
16 TO 20	12 TO 16	8 TO 12
20 TO 24	16 TO 20	12 TO 16
24 TO 28	20 TO 24	
28 TO 32		
> 32 MIN THE SIGN WILL TURN OFF	> 24 MIN THE SIGN WILL TURN OFF	> 16 MIN THE SIGN WILL TURN OFF

NOTE: IF THE CALCULATED TRAVEL TIME IS EQUAL TO THE UPPER LIMIT OF THE THRESHOLD, THEN THE SYSTEM WILL DISPLAY THE LONGER TRAVEL TIME RANGE. FOR EXAMPLE, THE CALCULATED TRAVEL TIME IS TWELVE (12) MINUTES THEN THE SIGN WILL DISPLAY 12 TO 16 MIN.

Travel Time Estimation Systems

- Test Evaluation: WI (I-94)
  - Accurate prediction, at least for means
  - Diversion of up to 10% from I-94 attributed exclusively to TIPS during peak traffic periods
  - Little congestion observed

- Test Evaluation: MD (I-70)
  - Accuracy decreases with increase in distance
  - Accuracy decreases during congested peak hours especially during short peaks or transition periods
  - Acceptable performance during stable conditions

Travel Time Prediction Systems

- TT Prediction System: I-70 (MD)
  - 25 mile segment (10 sensors)
  - Ongoing research on TT Prediction System with minimal temporary sensors

Relative Error			07/11	07/08	07/07	07/06	07/05	06/30	06/28
Morning peak	< 5%	N.N.	89.50%	90.61%	98.34%	86.74%	100.0%	90.06%	82.32%
		H.M.	91.16%	90.61%	97.13%	89.69%	99.45%	91.16%	87.98%
	< 10%	N.N.	100.0%	100.0%	100.0%	97.79%	100.0%	99.45%	100.0%
		H.M.	99.90%	100.0%	100.0%	96.69%	100.0%	99.45%	98.90%
Afternoon peak	< 5%	N.N.	99.59%	82.99%	98.76%	93.36%	100.0%	80.50%	90.87%
		H.M.	99.59%	90.04%	98.76%	94.19%	100.0%	85.89%	90.87%
	< 10%	N.N.	100.0%	95.85%	100.0%	99.59%	100.0%	92.53%	100.0%
		H.M.	100.0%	97.51%	100.0%	99.17%	100.0%	93.36%	99.17%

License Plate Recognition Systems

- Capture license plate images and match encrypted info to estimate travel times
- Test Deployment: I-95 (MD)
  - 7.4 mile segment, 4 lanes, 2 cameras
  - AM Peak evaluation for 5 days
  - Average capture-ability: 25%
  - Average recognition rate: 67%
  - Match rate: 10% to 16%
  - TT estimate accuracy: 66% to 100%
  - TT estimates lag the actual TT (lag increases with distance and level of congestion)

License Plate Recognition Systems

- Reconstruction of 13 Mile section of SR-68 (AZ)
- Normal conditions (55 MPH, 17 min)
- During construction (35-45 MPH, 21 min)
- Travel Time Incentive Provision
  - TT not to exceed 27 min
  - Averaged over 10 min periods
  - $400,000 incentive
  - Fine - $21.50 per min per lane
- License Plate Recognition System (60% capture rate and 11% match rate)
- Contractor successful in lane closure and traffic impact planning (only $9594 charged)

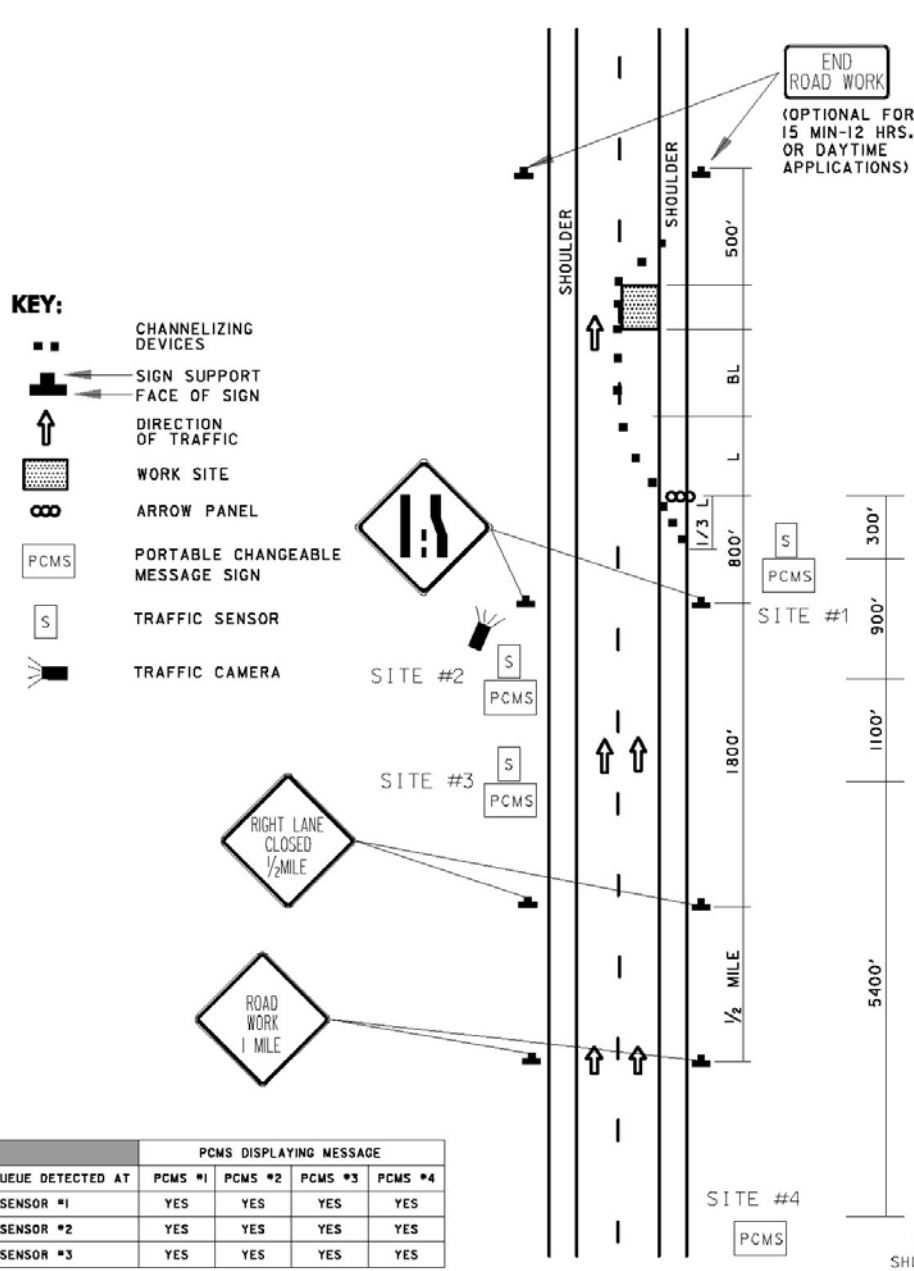
Dynamic Late Merge System

- Objectives:
  - Reduction in anxiety/stress
  - Reduce unnecessary lane changing
  - Even lane traffic distribution
  - Reduce last second forced merges
  - Reduce queues and improve traffic flow

Test Evaluations:

- MD, MN, KS
- Positive results

DYNAMIC LATE MERGE TYPICAL APPLICATION



	PCMS DISPLAYING MESSAGE			
QUEUE DETECTED AT	PCMS #1	PCMS #2	PCMS #3	PCMS #4
SENSOR #1	YES	YES	YES	YES
SENSOR #2	YES	YES	YES	YES
SENSOR #3	YES	YES	YES	YES

MESSAGES FOR PORTABLE CHANGEABLE MESSAGE SIGNS

SITE #1

TAKE YOUR TURN
MERGE HERE

TAKE YOUR TURN
MERGE HERE

SITE #2

USE BOTH LANES
TO MERGE POINT

USE BOTH LANES
TO MERGE POINT

SITE #3

USE BOTH LANES
TO MERGE POINT

USE BOTH LANES
TO MERGE POINT

SITE #4

TRAFFIC BACKUP
USE BOTH LANES

TRAFFIC BACKUP
USE BOTH LANES

NOTE: ALL FRAMES WILL BE SHOWN FOR TWO (2) SECONDS EACH.

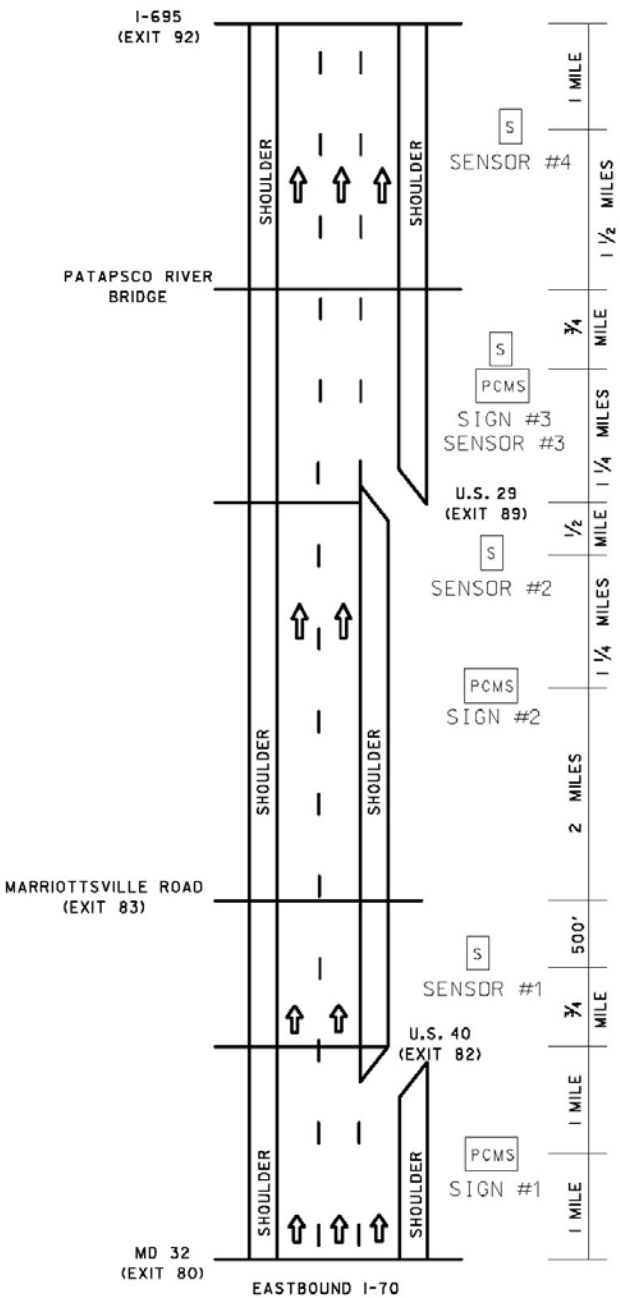
Dynamic Early Merge System

- Creates a dynamic no-passing zone based on detected traffic volume and back-up
- Test Evaluations: I-94 (MI)
  - Peak hr volumes 2/1: 2000-3000 vph
    3/2: 3000-3800 vph
  - AM Peak:
    - # of probe veh stops: 1.75 to 0.96
    - Av speed increased from 40 to 46 MPH
    - Delay decreased from 95 to 69 ec/veh/10,000 ft
  - PM Peak:
    - Aggressive maneuvers dec from 2.88 to 0.55
  - No crashes during deployment

Advisory Speed Ahead Systems

Real-time Advisory Speed Information

- Objectives:
  - Reduction in anxiety/stress
  - Reduce possibility of rear-end accidents
  - Reduce traffic speed variance
  - Alternate route concept



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MESSAGES FOR PORTABLE CHANGEABLE MESSAGE SIGNS

FREE FLOW
(GREATER THAN 50 M.P.H)

	S	P	E	E	D		
	L	I	M	I	T		
	6	5		M	P	H	

NOTE: FRAME WILL BE ON FOR TWO (2) SECONDS AND OFF FOR 0.5 SECONDS.

CONGESTED
(30 M.P.H TO 50 M.P.H.)

	R	E	D	U	C	E	
	S	P	E	E	D		

	S	P	E	E	D		
	A	H	E	A	D		
	X	X		M	P	H	

THE SIGN WILL DISPLAY THE SPEED AHEAD IN 5 MPH INCREMENTS FROM 50 M.P.H. TO 30 MPH.

HEAVY CONGESTION
(0 M.P.H TO 30 M.P.H.)

	T	R	A	F	F	I	C
	B	A	C	K	U	P	
	A	H	E	A	D		

		S	T	A	Y		
		A	L	E	R	T	

NOTE: FOR CONGESTED AND HEAVY CONGESTION MESSAGES, FRAME 1 WILL BE ON FOR THREE (3) SECONDS AND FRAME 2 WILL BE ON FOR TWO (2) SECONDS.

THE MESSAGE ON SIGN 1 IS CONTROLLED BY THE TRAFFIC CONDITIONS AT SENSOR 1.

THE MESSAGE ON SIGN 2 IS CONTROLLED BY THE TRAFFIC CONDITIONS AT SENSOR 2 OR SENSOR 3. WHICH EVER SENSOR DETECTS THE LOWEST SPEED CONDITION WILL BE DISPLAYED.

THE MESSAGE ON SIGN 3 IS CONTROLLED BY THE TRAFFIC CONDITIONS AT SENSOR 4.

Advisory Speed Ahead Systems

- Test Evaluation: WI (US 41)
  - Little diversion attributable to VMS
  - Diversions reported same delay as work zone
  - More sensors needed
  - Little congestion observed

- Test Evaluation: MI (I-70)
  - Slowed approaching traffic in congested conditions
  - Less effect for free flow conditions

Variable Speed Limit Systems

- Objectives:
  - Analyze current traffic conditions and estimate optimal/safe speeds
  - Credible real-time speed limits
  - Reduces speed variance

- Michigan Test Deployment
  - 18 Mile section along I-96
  - More uniform speeds during off-peak
  - TT increased as higher speed limits when appropriate
  - Median crossover speeds lower during VSL deployment
  - 10 crashes in direction of static signs as compared to 2 crashes in direction of VSL displays

Traffic Management Systems

Project Details:
- Main Route: I-95 (Fayetteville, NC)
- Alternate Route: US 301.
- Duration: 4 months (max 10 months)
- Project Cost: $235,000

ITS Evaluation:
- Queues reduced on average to 2 miles or less
  (Before deployment, queues exceeded 4 miles)
- No recorded “rear end” crashes and no Fatalities
- Delay information was accurate
- Some utilization of alternate routes
- A lot of positive response from media and motorists

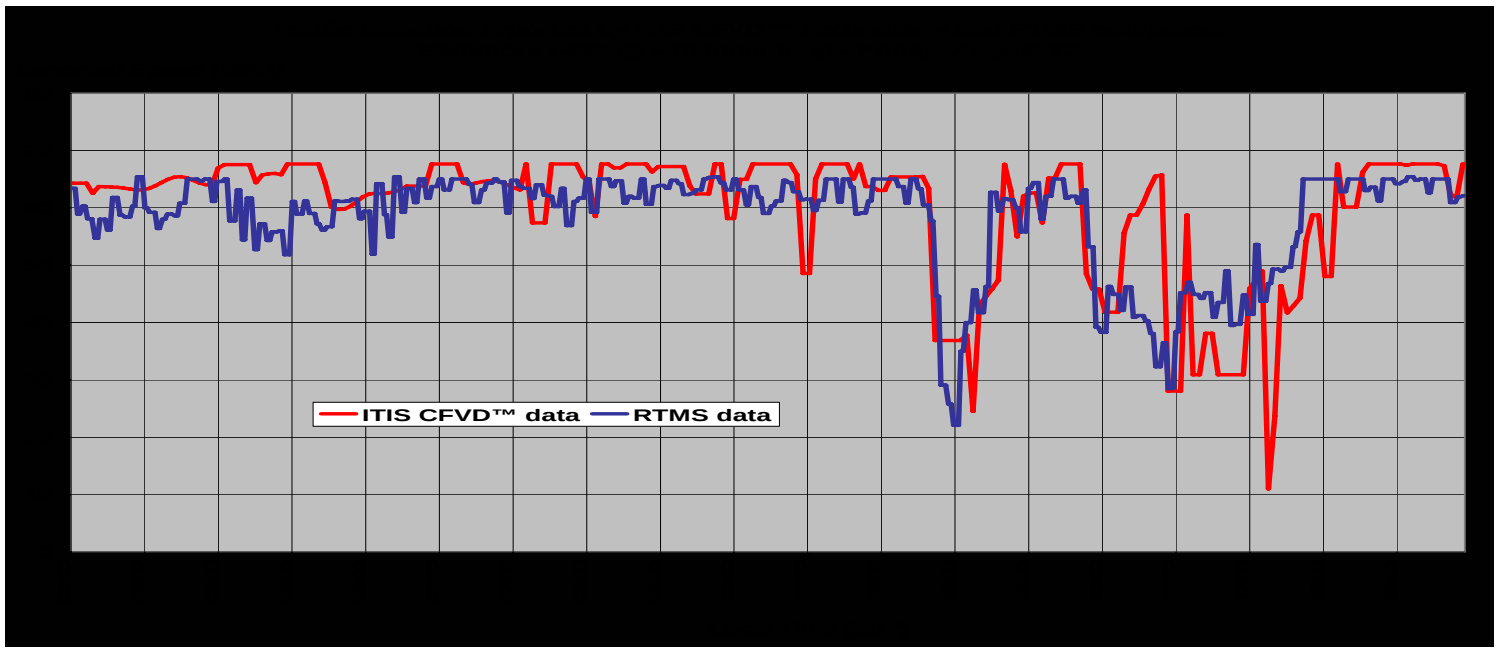
Incident Detection Systems

- Big I Project (I-40/I-25)

  - 12 DMS, 12 cameras, 4 HARs
  - Traffic monitoring resulted in reduction of incident response and clearance time to 25 minutes as compared to 45 minutes (historically)
  - Reduction in congestion due to secondary crashes and rubbernecking
  - Identification of problem spots

Cellular Phone Detection Systems

- I-695 (Baltimore, MD)
  - Track cellular phones (vehicles)
  - Filters to identify cell phones in vehicles
  - Network-wide presence



Misc. Applications and Tests

Wet Pavement Application

- I-85 Project (NC)
- Standing water problem during construction
- Pavement sensors
- Standing water messages

Sensor Evaluation

- RTMS and SmartSensor (Caltrans)

Automated Speed Enforcement

- Technology is reliable
- More evaluation on logic and its impact