MIDWEST SMART WORK ZONE DEPLOYMENT INITIATIVE

MwSWZDI

FHWA POOLED FUND STUDY

Report Title

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Safety Warning System

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Supplemental Notes

Abstract
The Safety Warning System (SWS) takes advantage of the capability of modern radar detectors to decipher a message encoded in a broadcast radar stream and display and/or announce it to the driver. Triggering a driver's radar detector focuses driver attention on the driving task, while the message provides important information, such as "work zone ahead: right lane closed." If it can be assumed that radar detectors tend to be used by drivers who choose speeds well above average for the entire driving population, then the SWS also has the advantage of targeting only the fastest drivers, potentially reducing speed variation among drivers. In this test, the SWS did not result in any statistically significant changes in traffic speed characteristics. It is expected that the system would affect driver behavior, but that the installed base is too small for the changes to be detected in traffic stream at large.

SAFETY WARNING SYSTEM

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Description

The Safety Warning System is a vehicle-mounted or semi-portable stationary radar detector alert system that transmits a fixed message to all SWS compatible receivers, notifying them of up-coming road or traffic conditions.

The Safety Warning System was installed near the north end of the project to provide advance notice to southbound traffic equipped with SWS-compatible receivers of the up-coming road and traffic conditions.

Study site

I-135, from the Harvey/Sedgwick County line north to 0.3 miles south of the South K-15 interchange, Harvey County.

Performance Measures

The objectives of this application and the associated performance measures are shown in Table 3-14.

TABLE 3-14 Safety warning system: objectives and performance measures.

Objectives	Performance Measures
Provide advance warning to vehicles	1. Lane distribution upstream of the project 2. Vehicle speeds upstream of the project

Experimental Design

Study type: Before and after.

Data Collected

Lane distribution at locations 500 ft, 1000 ft, and 1500 ft upstream of taper

Collection method: pneumatic tubes and automatic traffic recorders.
Sample size: one 24 hr day before and one 24 hr day after installation.
Analysis technique: comparison of lane distributions before and after installation.

Speed of vehicles upstream of taper

Collection method: pneumatic tubes and automatic traffic recorders
Sample size: one 24 hr day before and one 24 hr day after installation.
Analysis technique: comparison of 85th percentile speeds, average speeds, and percent of vehicles exceeding the posted speed limit before and after installation.

Speed of vehicles in the cross-over

Collection method: pneumatic tubes and automatic traffic recorders
Sample size: one 24 hr day before and one 24 hr day after installation.
Analysis technique: comparison of 85th percentile speeds, average speeds, and percent of vehicles exceeding the posted speed limit before and after installation.

Evaluation Results

As detailed in the discussion of the LightGuard Lighted Raised Pavement Markers, the SWS resulted in no significant change in the lane distributions 500 ft upstream of the taper. Speeds in the crossover showed statistically significant reductions with the activation of the SWS for passenger cars at night and for both cars and trucks during the day. In all cases, the reductions in both the mean and the 85th percentile speeds were 1 mph or less, and thus probably not of practical significance. The percentage of vehicles equipped with SWS compatible devices is unknown. Non-compatible radar detectors are triggered by the SWS, although the warning message cannot be decoded by these devices. The statistical parameters for passenger cars at night, for passenger cars during the day, and for trucks during the day are shown in Table 3-15, Table 3-16, and Table 3-17, respectively.

TABLE 3-15 Safety warning system: comparison of means for cars at night.

free cars	Before	After	Total
Count	471	517	988
Mean	57.1	56.2	56.6
Std Dev	6.4	6.4	6.4
85th %-ile	63.0	62.0	
Sum	26910	29040	55950
SumSq	1556910	1652086	3208996
SS	19441	20903	40572

Source	SS	df	MS	F	P
Effect	229	1	228.82	5.592	0.018
Error	40344	986	40.92		
Total	40572	987			

TABLE 3-16 Safety warning system: comparison of means for cars during the day.

free cars	Before	After	Total
Count	1089	1056	2145
Mean	57.2	56.3	56.8
Std Dev	5.9	6.0	6.0
85th %-ile	62.8	62.0	
Sum	62295	59504	121799
SumSq	3600915	3391396	6992311
SS	37401	38436	76229

Source	SS	df	MS	F	P
Effect	392	1	392.26	11.085	0.001
Error	75837	2143	35.39		
Total	76229	2144			

TABLE 3-17 Safety warning system: comparison of means for trucks during the day.

free other	Before	After	Total
Count	562	555	1117
Mean	57.2	56.5	56.9
Std Dev	5.5	5.4	5.5
85th %-ile	62.0	62.0	
Sum	32138	31383	63521
SumSq	1854912	1790741	3645653
SS	17099	16160	33372

Source	SS	df	MS	F	P
Effect	114	1	114.06	3.824	0.051
Error	33258	1115	29.83		
Total	33372	1116			

The percent of drivers exceeding the posted limit decreased by more than 20% for passenger cars during the day and at night, both statistically significant at a 95% confidence level. Reductions for trucks were 16% during the day and 8% at night. The daytime reduction was statistically significant while the nighttime reduction was not. It was expected that the SWS would be less effective for trucks than for cars because most SWS compatible devices are radar detectors, which are illegal for commercial vehicles. While SWS receivers are available which cannot operate as a standard radar detector—making them legal for use in commercial vehicles—these devices are relatively new and have not yet achieved a significant market penetration. The statistical comparison of the percent of vehicles exceeding the posted limit before and after system activation is shown in Table 3-18.

TABLE 3-18. Safety warning system: before and after comparisons of percent speeding.

Cars, Day	% Exceeding Posted Limit	Total Vehicles	p	avg p	sigma 1-2	z	0.10	0.05	0.01
Before	680	2359	0.28826	0.26119	0.01324	4.38	1.645	1.960	2.576
SWS	475	2063	0.23025				DIFFERENT	DIFFERENT	DIFFERENT
	Percent Reduction: 20%								
Cars, Night									
Before	136	472	0.28814	0.25427	0.02765	2.33	1.645	1.960	2.576
SWS	117	523	0.22371				DIFFERENT	DIFFERENT	no change
	Percent Reduction: 22%								
Trucks, Day									
Before	280	1171	0.23911	0.22175	0.01808	2.13	1.645	1.960	2.576
SWS	193	962	0.20062				DIFFERENT	DIFFERENT	no change
	Percent Reduction: 16%								
Trucks, Night									
Before	83	337	0.24629	0.23591	0.03271	0.64	1.645	1.960	2.576
SWS	76	337	0.22552				no change	no change	no change
	Percent Reduction: 8%								

Conclusions

The Safety Warning System (SWS) is designed to inform drivers of an upcoming work zone through a message encoded in a radar signal broadcast from a trailer mounted transmitter. The system consists of two components: a transmitter that broadcasts messages encoded in a radar signal, and an in-vehicle receiver capable of interpreting the messages. Millions of radar detectors are in use today, but only a small percentage are SWS-compatible. Of course, the SWS will trigger a standard radar detector, as mentioned previously, so some speed reductions may still occur for so-equipped vehicles. However, this begs the issues of whether the SWS is superior to a radar drone, given the current market penetration of SWS-compatible receivers, and what level of market penetration can reasonably be expected in the near future.

Regardless of whether the effects of the SWS are due to the message being broadcast to SWS-equipped vehicles or to the system triggering standard radar detectors, the reductions in speeds were not practically significant (i.e., 1 mph or less) in and of themselves. However, an important safety concern, particularly at highway work sites, is that of inattention among drivers. Though the speed reductions were small, they were statistically significant, indicating that the system was effective at drawing drivers' attention to the driving task. The resulting safety benefits are real, although very difficult to quantify.

Recommendations

Based on the results from this evaluation, the SWS cannot be recommended on the basis of speed reduction alone. However, as a supplemental device for alerting drivers that unusual roadway conditions deserve extra attention, the device has potential for being an asset to highway work zone safety, especially as SWS-compatible devices proliferate.