Evaluation of Automated Wind Warning Systems

Manjunathan Kumar P.E.
Western transportation Institute

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Overview

- Introduction
- Evaluation Plan
- Operational Benefits Summary
- Safety Benefits Summary
- Motorist Survey Results
- Future Research
- Conclusions

Introduction

- US 101 – Frequent High Winds (Above 35 mph)
- Two locations in Oregon (Port Orford, Yaquina Bay Bridge) and one location on Interstate 5 (Yreka) in California
- Systems detect high wind events, turn on warning beacons and send notifications

System Characteristics

Charactersitics of the System	AWWS at Yaquina Bay Bridge, OR	AWWS at South Coast, OR	Interstate 5, Siskiyou County,
Flashing/Non-Flashing	Flashing	Flashing	CMS
Static/Dynamic	Static (to be upgraded to CMS)	Static	Dynamic (CMS)
Message sent to sign (manual / automated)	Automated	Automated	Manual (To Be Automated in 2007)
Message posted on Web (manual / automated)	Automated	Manual	N/A
Archiving of the Wind Data	Yes	No	No
TOC notification of sign activation (manual / automated)	Automated	Automated	To be Automated
TOC notification of wind data (manual / automated)	Automated	Automated	Automated
Location of signage	US Route 101, MP 141.27 (SB) and 142.08 (NB)	US Route 101, Mileposts 300.10 to 327.51	Interstate 5, Siskiyou County

COATS Showcase

- A bi-state partnership to improve rural transportation through the demonstration and evaluation of advanced technologies
- Provide information to improve the performance of existing ITS elements
- Provide data to justify, support or direct future deployment of ITS in the COATS study area

COATS Showcase Partners

- California Department of Transportation, Division of Research and Innovation
- Oregon Department of Transportation
- USDOT, Research and Innovative Technology Administration
- Western Transportation Institute / Montana State University

Project Objective

- To answer the following questions
  - Have these systems contributed to safety improvement?
  - Are motorists responding to the information presented to them?
  - Does the system expedite the dissemination of the information? What are the other benefits that accrued due to this system?
  - What are the strengths and weaknesses of each system?

Evaluation Plan

- Selected Measures of Effectiveness (MOEs)
  - Reduction in Wind Induced Accident Frequency and Severity (Safety Benefits)
  - Traveler Awareness of the Systems (Motorist Survey)
  - Traveler Perception of the Usefulness of the Systems (Motorist Survey)
  - Traveler Perception of the Reliability of the System (Motorist Survey)
  - System Accuracy (Technology Assessment)
  - Operational Cost Savings (Operational Benefits)

Safety Benefits

- Wind events are very spot specific
- Wind causation not part of standard accident reporting form

Descriptive Variable	Predominant Value	2nd Predominant Value
Number of Vehicles Involved	Two Vehicles	Single Vehicle
Type of Vehicle Involved	Passenger Car / Pick Up / SUV	Trucks
Type of Collision	Run-off-the-road (ROR) Crashes / Hit Object	Other / Unknown / Rear End
Severity of Collision	Property Damage Only (PDO) Crashes	Complaint of Pain / Non-Incapacitating Injury
Road Surface Condition	Inconclusive	Inconclusive

Safety Benefits - South Coast System

	Number of Crashes		Crash Rate (per million VMT)	
Year	Wind Season	Total	Wind Season	Total
1997	10	21	1.20	0.83
1998	3	12	0.36	0.46
1999	3	10	0.35	0.37
2000	3	12	0.37	0.44
2001	6	21	0.68	0.74
2002	6	14	0.68	0.48
2003	10	19	0.99	0.66
2004	5	17	0.55	0.58

Safety Benefits – Yaquina Bay System

	Number of Crashes		Crash Rate (per million VMT)	
Year	Wind Season	Total	Wind Season	Total
1997	6	8	3.33	1.59
1998	4	8	2.07	1.46
1999	3	5	1.54	0.93
2000	2	3	0.96	0.94
2001	1	1	0.53	0.18
2002	0	0	0.00	0.00
2003	1	1	0.48	0.18
2004	1	1	0.55	0.35

Safety Benefits (Contd.)

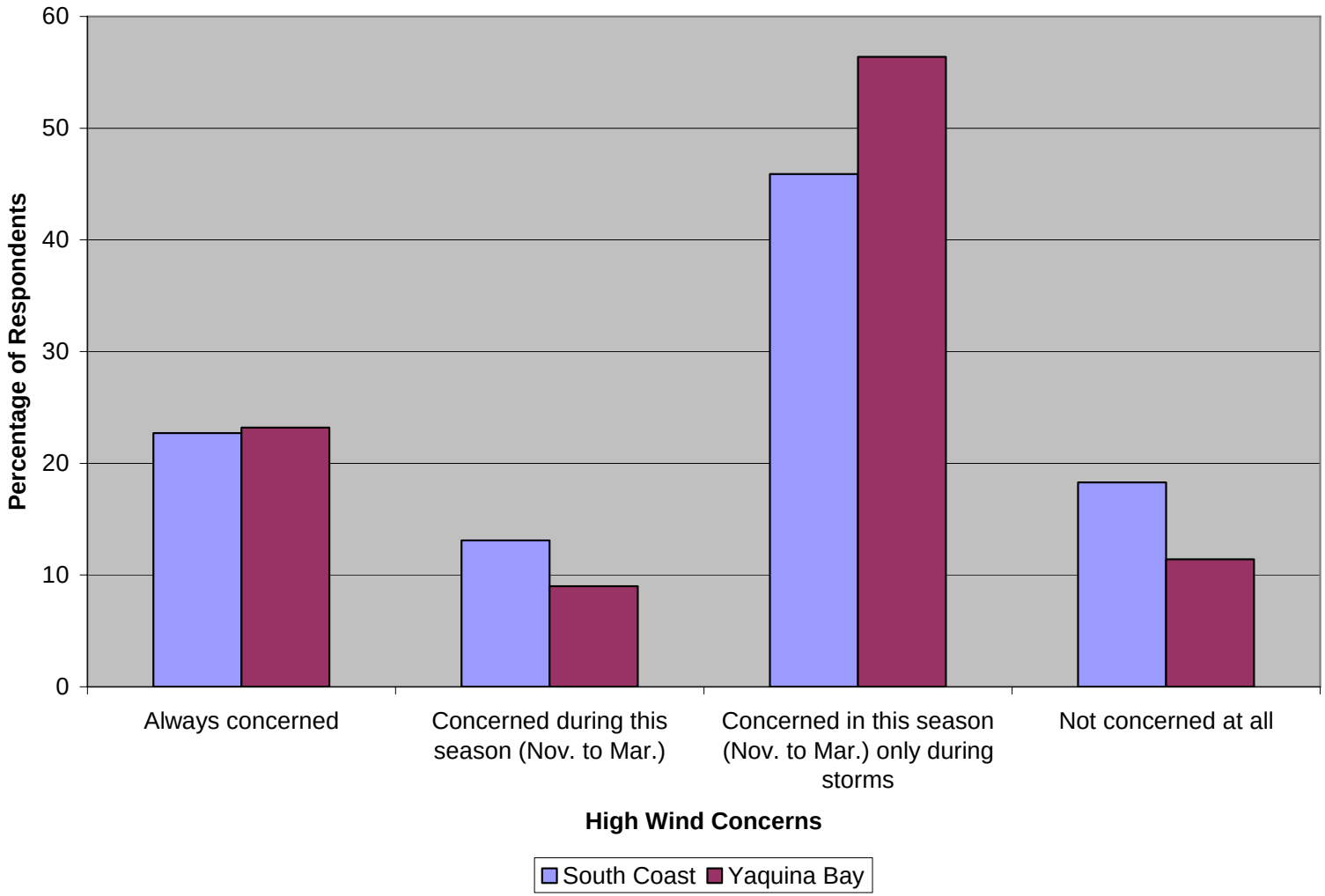
- Challenges
  - High winds not listed in accident form in Oregon
  - Too small a sample size for statistical testing of significance
- Used HSIS crash database for California

Motorist Survey Results

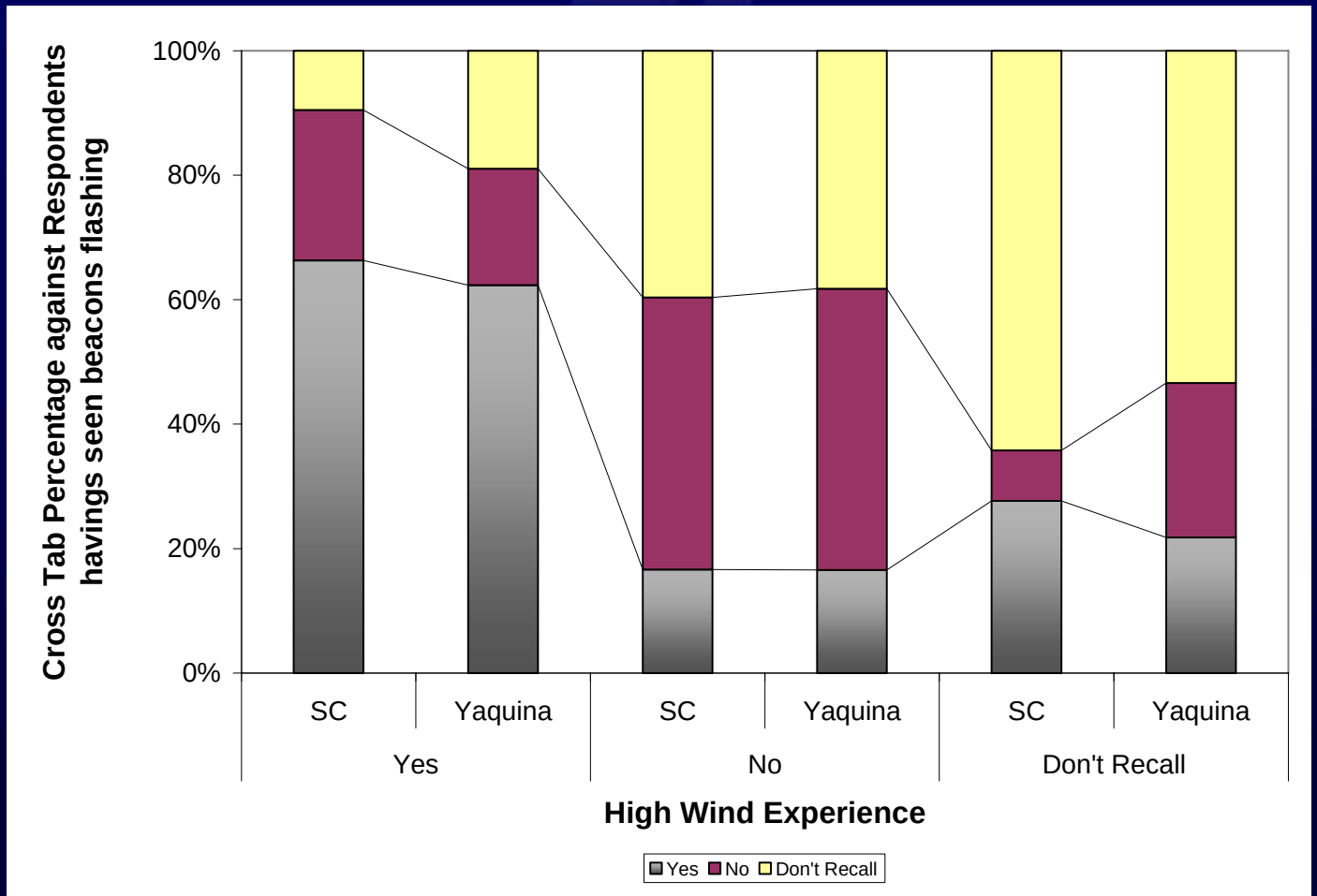
- Questionnaire Mailed Out in May 2004

System Location	Counties	Surveys Distributed			Survey Responses	Responses Desired	Pct.
		Motorists	Truckers	Total			
Yaquina Bay	Lincoln	2,200	200	2,400	407	384	17
South Coast	Coos Bay, Curry	2,200	200	2,400	343	384	14.3

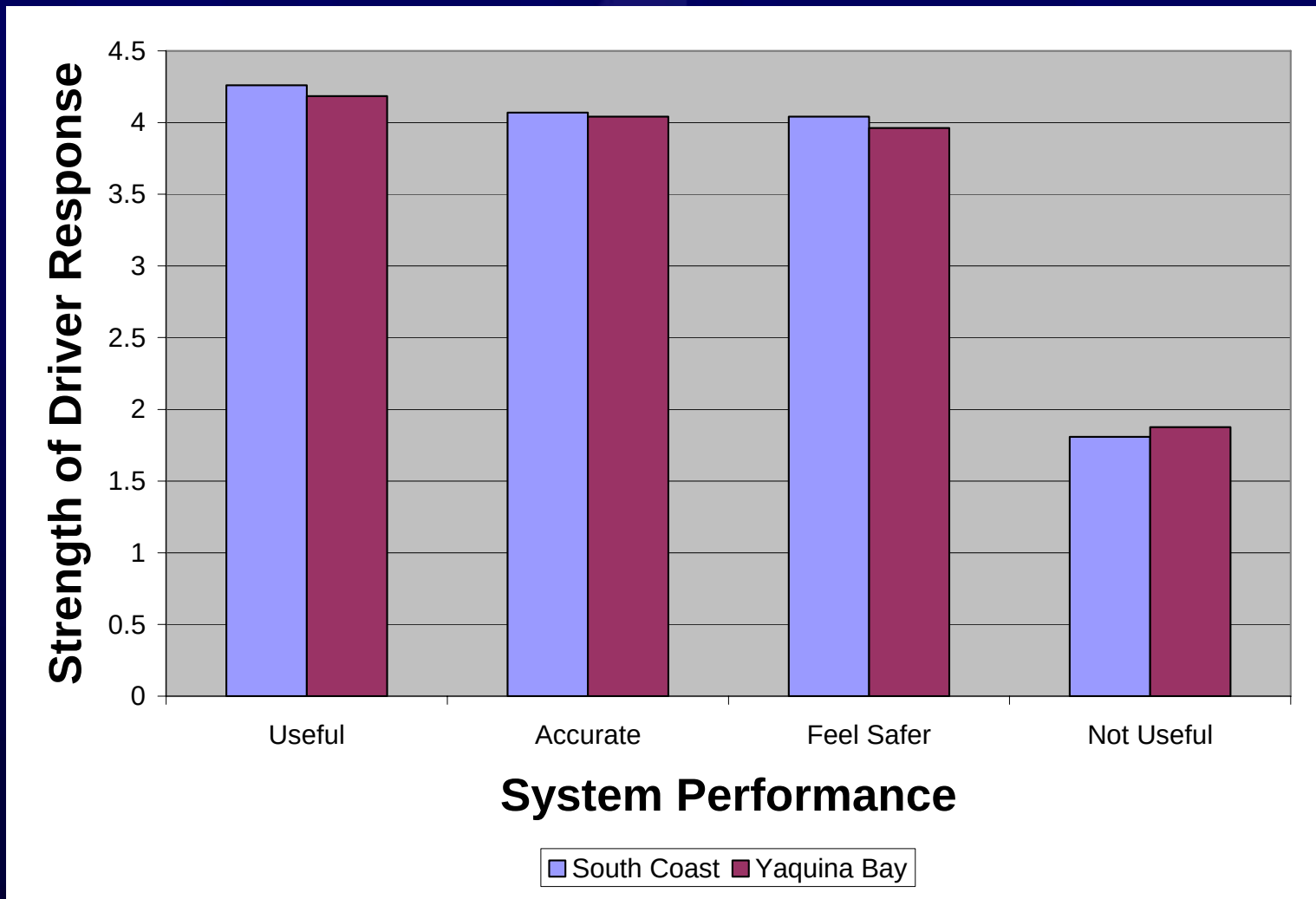
Motorist Survey Results (Contd.)



Motorist Survey Results (Contd.)



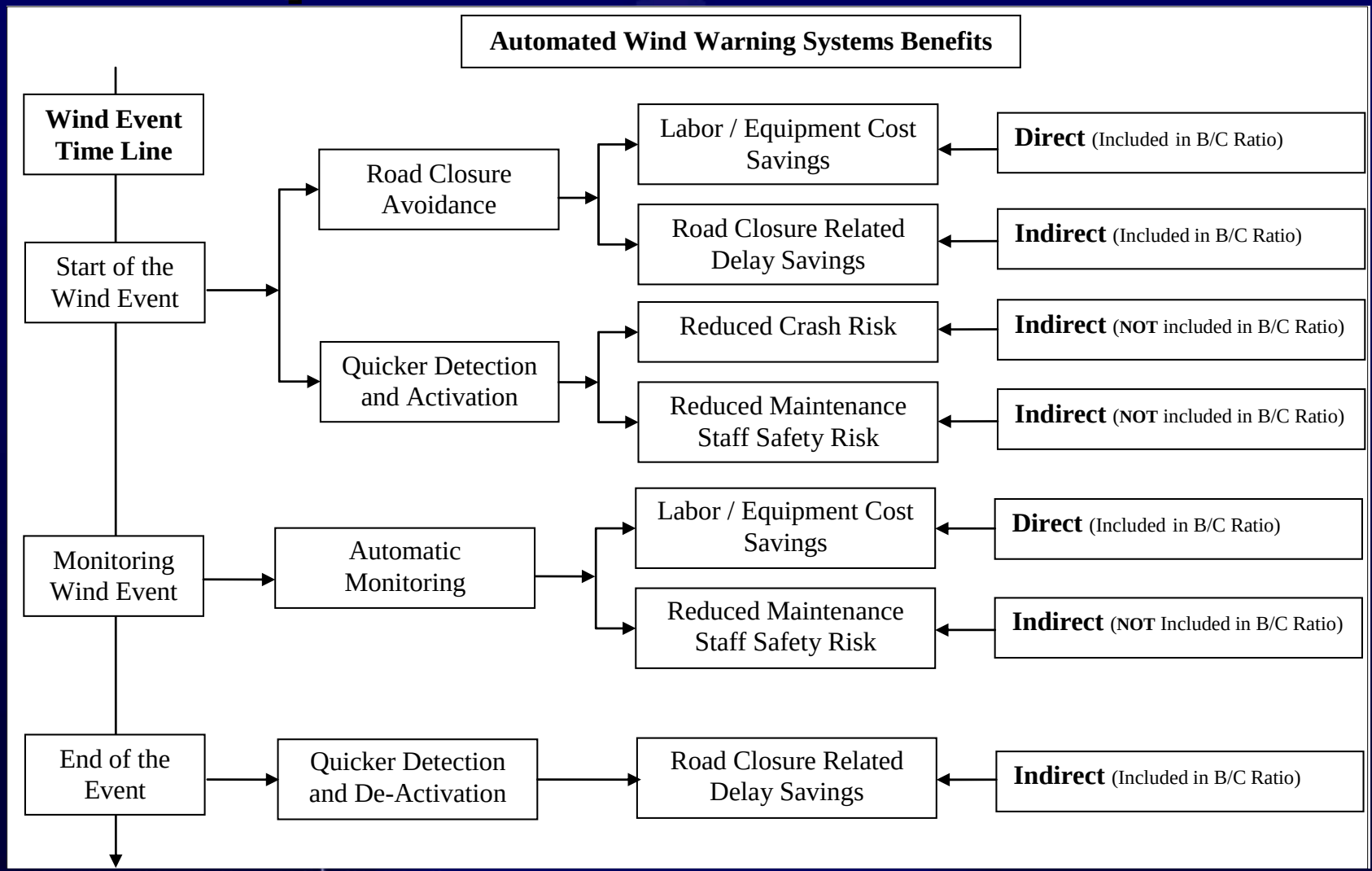
Motorist Survey Results (Contd.)



Technology Assessment

- South Coast System - 83 percent of the activation records verified using the wind speed data from Port Orford RWIS
- Yaquina Bay Bridge System - 50 percent of the activation and deactivation records verified using the wind speed data from Hatfield Center

Operational Benefits



Benefit-Cost Ratio

	South Coast		Yaquina Bay Bridge	
	Average*	High**	Average*	High**
Number of Closures per Year	*5*	*10*	*20*	*30*
Benefits				
Direct Savings from Non-Closure	$ 5,135	$ 10,270	$ 11,940	$ 17,910
Delay Reductions from Non-Closure	$ 41,715	$ 73,725	$ 242,570	$ 465,200
Delay Reductions from Quicker Deactivation	$ 2,980	$ 5,275	$ 18,960	$ 36,350
Costs				
Initial Installation Costs (non-recurring)	$90,000		$90,000	
Power, Communiation and Maintenance (recurring)	$3,000		$3,500	
*B/C Ratio****				
Direct Benefits Alone	0.87		1.46	
Direct and Indirect Benefits	4.13		22.80	
Number of Years Before Benefits Exceed Costs				
Direct Benefits Alone	12 years		7 years	
Direct and Indirect Benefits	3 years		1 year	

* - "Average" scenario includes average number of wind events and average traffic volumes

** - "High" scenario includes high number of wind events and high traffic volumes

*** - B/C ratio is calculated based on "average" benefits

Future Research

- Evaluate California AWWS when implemented for comparative benefits of CMS / VMS
- Crash analysis with ample after-implementation crash data
- Other manual road closure or warning operations may be further investigated to be automated

Conclusions

- Most of the wind-related crashes involve single vehicle or run-off-the-road type of crashes
- 80 percent of respondents said wind speeds would be useful along with warnings
- Dynamic information systems and spot design improvements to address run-off-the-road and hit object crashes

Contact Details

Manjunathan Kumar P.E.
Email: mkumar@coe.montana.edu
Phone: (406) 994-7909

PO Box 174250
Western Transportation Institute
Montana State University
Bozeman, MT, 59717