

# The Temporary Portable Rumble Strip:

## Road Safety Reinvented

**Tim Cox**

International Sales Manager  
Plastic Safety Systems

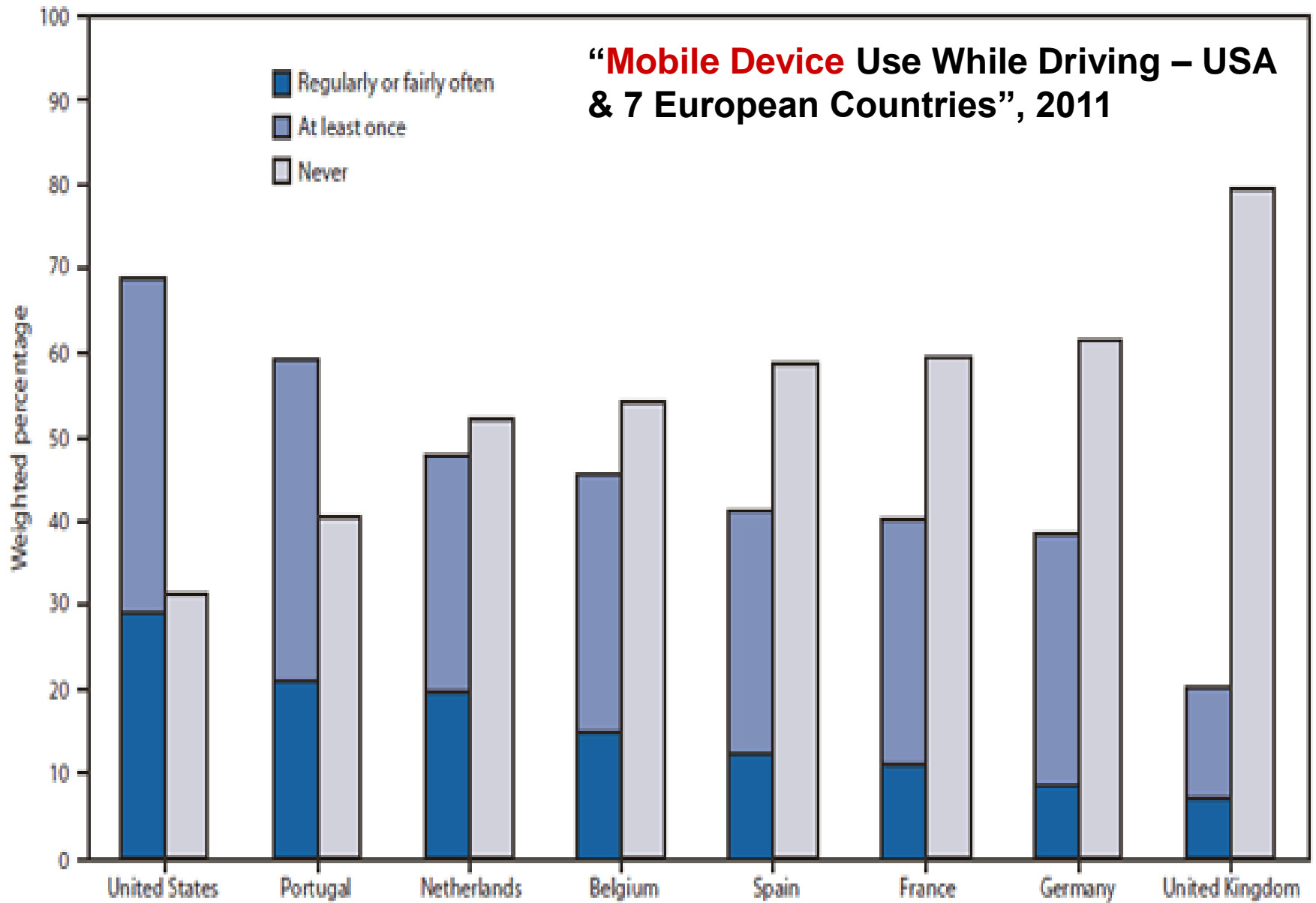
**William Jamieson**

Marketing Manager  
Plastic Safety Systems

**Charles Mettler**

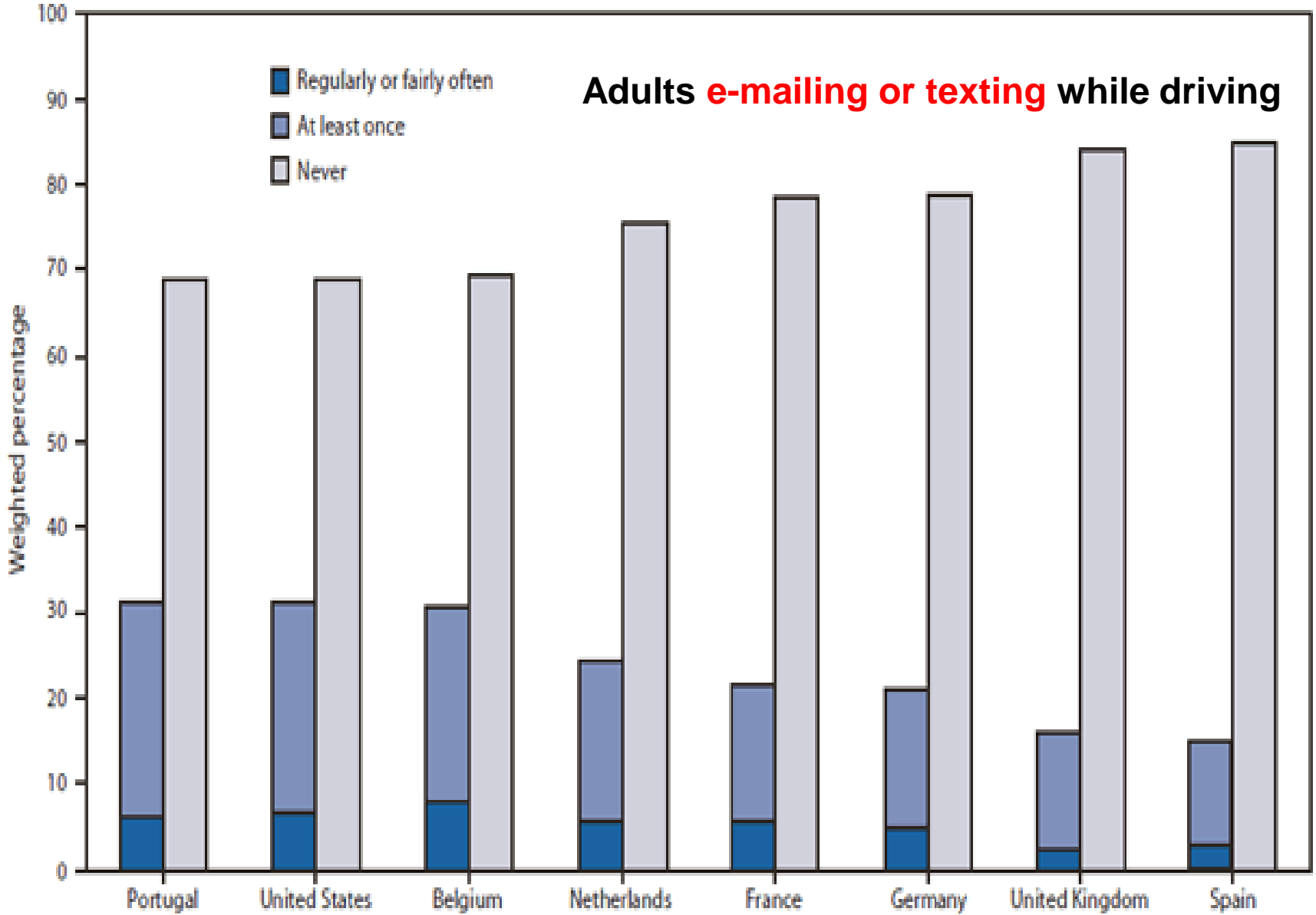
Research and Design Engineer  
Plastic Safety Systems

# “Mobile Device Use While Driving – USA & 7 European Countries”, 2011



Center for Disease Control Report Country

# Adults e-mailing or texting while driving



Center for Disease Control Report

Country

# Distracted Driving: A worldwide crisis.



**Australia:** 14% of crashes  
**Canada:** 11% killed, injured  
**Colombia:** 9% of crashes  
**New Zealand:** 10% of fatalities

**Spain:** 37% crashes  
**Netherlands:** 8% of crashes  
**USA:** 11% of fatalities

-World Health Organization (WHO) Report, 2011

**Picture: Work Zone Crash, 1 Fatality, Distracted Driving, End-of-Queue Accident, Nova Scotia, CN, July 2013**

# Canadian Driver Survey

<b>Distraction</b>	<b>Witnessed</b>	<b>Admitted</b>
Make-up	63%	3%
Hair	57%	7%
Making Out	24%	3%
Lap Dogs	66%	4%
Road Rage	60%	23%
Yelling at Passenger	40%	8%
Radio, GPS	61%	Nearly 50%

# General Objective: Reduce Crashes in Work Zones. Save lives.

## Causes of Work Zone Crashes:

- Speeding
- Tailgating
- Improper lane changes
- Distracted Driving



Picture: WZ Crash, 3 Fatalities, Distracted Driving, End-of-Queue accident, WY, USA, May 2014

# Specific Objective: Reduce Distracted Driving in Work Zones

## Sources of driver distraction:

- adjusting temperature controls
- changing radio, MP3 player
- dialing, talking on phone
- emailing, texting
- eating or drinking
- searching for an object
- talking to passengers
- smoking
- playing with pets
- daydreaming
- driving while fatigued



**Distractions are manual, cognitive or visual.**



# **A New Traffic Safety Countermeasure: Origins of the Temporary Portable Rumble Strip (TPRS)**

## **US 50, Kansas**

- Summer of 2004**
- 6 week time period**
- 3 separate crashes**
- 9 fatalities**



**Picture: Work Zone Crash, 7 Fatalities, Distracted Driving, End-of-Queue Accident, Indiana, USA, Aug 2013**



# Reaction to Highway 50 Accidents

Kansas Department of Transportation (DOT) determined:

Speed, fatigue and distracted driving caused Highway 50 accidents.

Construction work zone warning signs followed DOT plans.



**New, effective traffic safety countermeasures were needed.**

# Design Concepts & Requirements

Requirements for a commercially viable temporary transverse rumble strip\*:

## **Rumble Strips shall:**

- provide significant sound & vibration
- alert drivers to upcoming work zones
- allow drivers to maintain control
- cover an entire lane of traffic

## **Rumble Strips shall be:**

- a temporary device, easily installed and removed
- for short-term work zones, 8 hours or less
- able to retain their original, installed position, with little movement
- effective in high speeds & extreme weather

\*Modeled on Kansas DOT temporary rumble strip. Made from asphalt, at the job site, the mound of asphalt covered an entire lane. Difficult to install and remove, the asphalt strip was used on long-term, stationary work zones.

# Evolution of the TPRS

**PSS identified 2 additional design requirements:**

- generate sound & vibrations equal to permanent, ground-in rumble strips.
- bond to the road without adhesive or fasteners, with little movement in traffic.



**PSS has created and tested 48 full-size, prototype, temporary portable rumble strips since 2005. Four major prototypes follow...**

# Prototype Rumble Strip # 7: The Mat



## The Mat, Spring 2005:

- 6 transverse rumble strips, 3.4 m long
- connected by 2 longitudinal strips
- longitudinal strips added weight, reduce movement
- Significant sound & vibration

## Lessons Learned:

- Multi-strip array is effective; drivers successfully alerted.
- Device “fluttered” when vehicles crossed; unacceptable movement.
- Device too heavy, unwieldy; difficult installation and removal.



# Prototype Rumble Strip # 9: The One-Piece

## The One-Piece, Fall 2007:

- No longer connected; now individual strips
- # of strips in an array now dictated by speed limit
- internal ballast to add weight 100 lbs.
- Covers entire lane



## Lessons Learned:

- drivers applied brakes in tests; drivers alerted.
- reported movement; borderline between pass/fail.
- 1 strip cracked; material required more strength.

# Prototype Rumble Strip # 10: RoadQuake™ Temporary Portable Rumble Strip



## RoadQuake, Spring, 2009:

- 3.4 m L x 30.5 cm W, 2.06 cm thick, 47 kgs; traverses an entire lane
- improved material; use in temps 5-65° C
- 12° bevel added 1 side for impact stability; diamond-shaped pattern increased friction

**Prototype Rumble Strip # 10 became the 1<sup>st</sup> production unit.**

# The Current Model: RoadQuake 2™ Temporary Portable Rumble Strip

## RoadQuake 2, Spring 2012:

- Modular design: 3 sections make 1 strip, 3.4 m L
- Designed to offer alternative to RoadQuake Rumble Strip
- 114 cm L, 33 cm W, 1.9 cm thick, 15 kg
- Improved material, now rated for -18° to 82° C.
- Beveled edges on both sides



**RoadQuake 2 Rumble Strip, introduced in Spring, 2012, has replaced RoadQuake Rumble Strip.**



# Testing Temporary Portable Rumble Strips

**Movement is a major point of failure or success.**

## **Types of Movement:**

**Vertical Movement:** Strip moves in the air in vacuum from large vehicles.

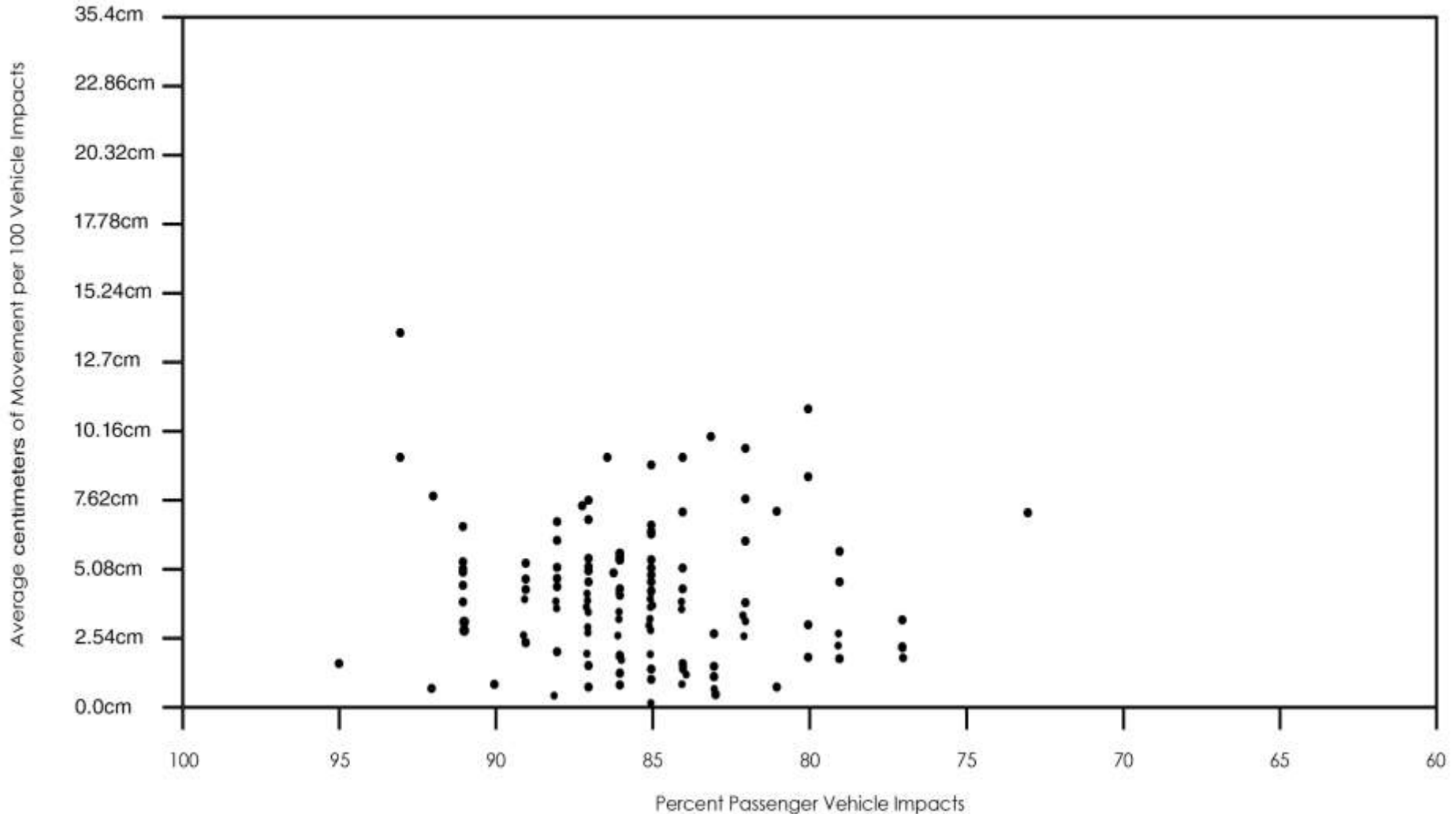
**Lateral Movement:** strip moves side-to-side, from shoulder to centerline.

**Longitudinal Movement:** strip moves in direction of traffic, or away. May move to a non-parallel, or skewed position.



# RoadQuake TPRS Movement: 43,000 Impacts @ 105 Kph

PSS RoadQuake TPRS Movement: Total of 43,799 Vehicle Impacts @ Posted Speed of 105 Kph February - December, 2013



# Test Results: Movement



- Hundreds of tests conducted, with thousands of impacts, in various weather, conditions, different road surfaces, significant traffic, in speeds up to 129 kph
- Tests prove that PSS Temporary Portable Rumble Strips show little movement.
- Product approved in over half of US States
- Mandated for us in 2 US States, 1 Canadian Province

**Utah, Kansas, Iowa have issued Public Interest Findings**

# Test Results: Sound and Vibration

## Vibration:

- Plastic TPRS generates more vibration than adhesive strips
- Matches levels of ground-in rumble strips

## Sound:

- More sound than adhesive strips
- Compares well with ground-in rumble strips



University of Kansas Study, Lawrence KS, May, 2009

# Test Results: Speed Reduction



- Tested in 7 Work Zones

- 6 - 23 Kph speed reductions

- Conclusion: will improve safety in Work Zones

Ohio University Study, Athens OH, USA,  
2010



# Report: Risk Analysis

## “Risk Analysis Report of TPRS”:

- Management of risk in work zones starts with drivers.

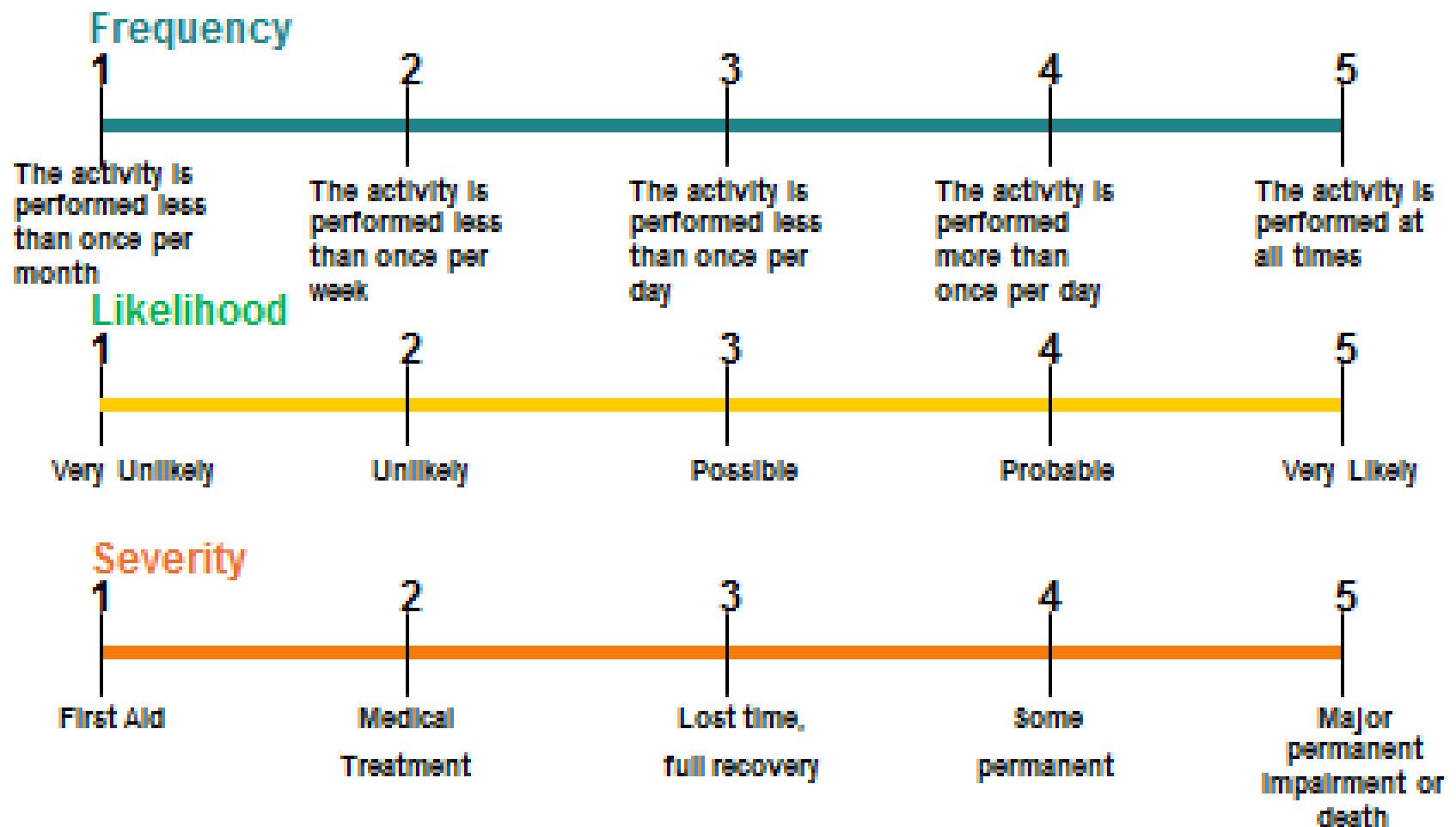
- Challenges faced by drivers:

- Distractions
- Drowsy Driving
- Confusing Signs or Directions



Picture: Driver ignores road closure, Ohio, USA, Nov 2012

# Liberty Mutual R3 Residual Risk Reduction Matrix





## An R3 Analysis

### Lane Closure/ Shift on Freeway or Two-Lane Road

Event of Concern	Existing Controls	New Controls	F	L	S	R
Vehicle collisions – Traveling public	Advance Warning messages, arrow boards, and signs		5	4	5	100
Work Zone Intrusion Freeway	Advance Warning messages, arrow boards, and signs		5	4	5	100
Work Zone Intrusion Freeway & Vehicle collisions – Two-Lane Road	Advance Warning messages and signs, arrow boards, flaggers/temporary traffic signals		5	4	5	100

**Residual Risk = 300**

# An R3 Analysis

## Lane Closure/ Shift on Freeway or Two-Lane Road

Event of Concern	Existing Controls	New Controls	F	L	S	R
Vehicle collisions – Traveling public	Advance Warning messages, arrow boards, and signs	Addition of TPRS	5	3	5	75
Work Zone Intrusion Freeway	Advance Warning messages, arrow boards, and signs	Addition of TPRS	5	3	5	75
Work Zone Intrusion Freeway & Vehicle collisions – Two-Lane Road	Advance Warning messages and signs, arrow boards, flaggers/temporary traffic signals	Addition of TPRS	5	3	5	75

**Residual Risk = 225**

**Residual Risk Reduction = 25%**

# Risk Reduction @ 25%

2012

WZ Event

without TPRS

with TPRS

Driver, Passenger Fatalities	500	375
Worker Fatalities	100	75
Injuries	4,000	3,000
Total Cost of Fatalities	\$774 Million	\$580.5 Million

From "Risk Analysis Report of TPRS", S&J Risk Management, May 2014

# **Risk Analysis Report: Conclusions**

## **TPRS Reduces Risk:**

- **Drivers**
- **contractors**
- **insurance companies**
- **government agencies**

## **TPRS Reduces Cost:**

- **Lost wages**
- **Lost productivity**
- **Medical expenses,**
- **Worker compensation**
- **Administrative costs  
(police, legal, insurance)**
- **Property or vehicle  
damage.**

# Towards Universal Adoption



**PSS RoadQuake TPRS is an effective traffic safety countermeasure designed to alert drivers, reduce accidents, and save lives in work zones.**

# Thank You!

**For more information:**

**Tim Cox**

**International Sales  
Manager**

**Plastic Safety Systems**

**216-244-3207**

**[tjcox@plasticsafety.com](mailto:tjcox@plasticsafety.com)**

