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EASTERN TTAP
Eastern Tribal Technical Assistance Program

Highway Safety Course Overview

U.S. Department of Transportation
Federal Highway Administration

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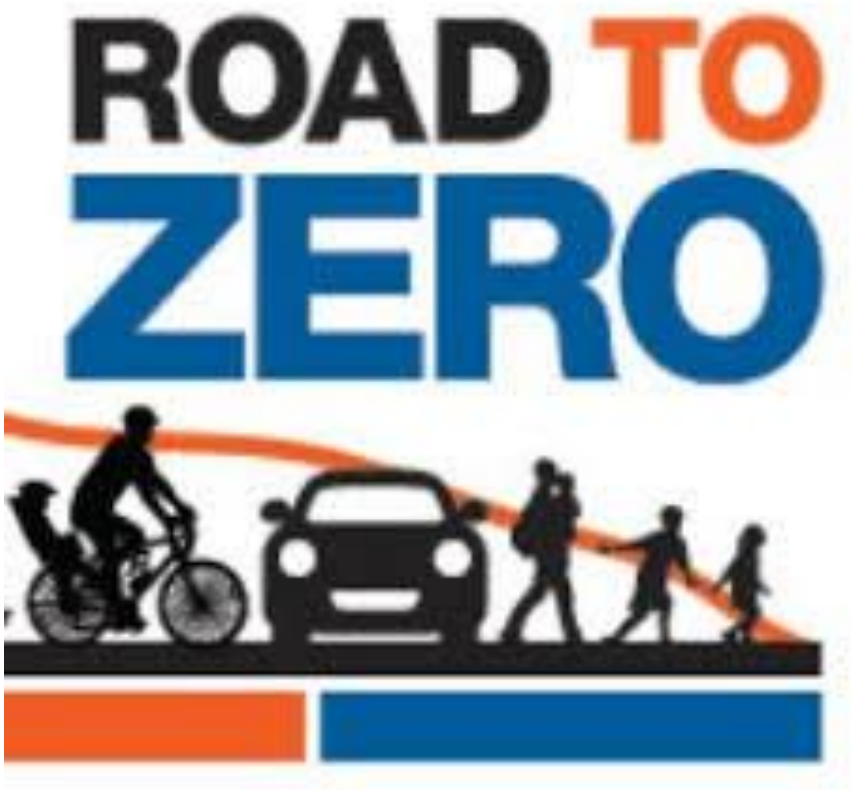
National Traffic Safety Goal

- Reasonable goal ?
- Who's Involved?
- What can you do?
- How are we doing?



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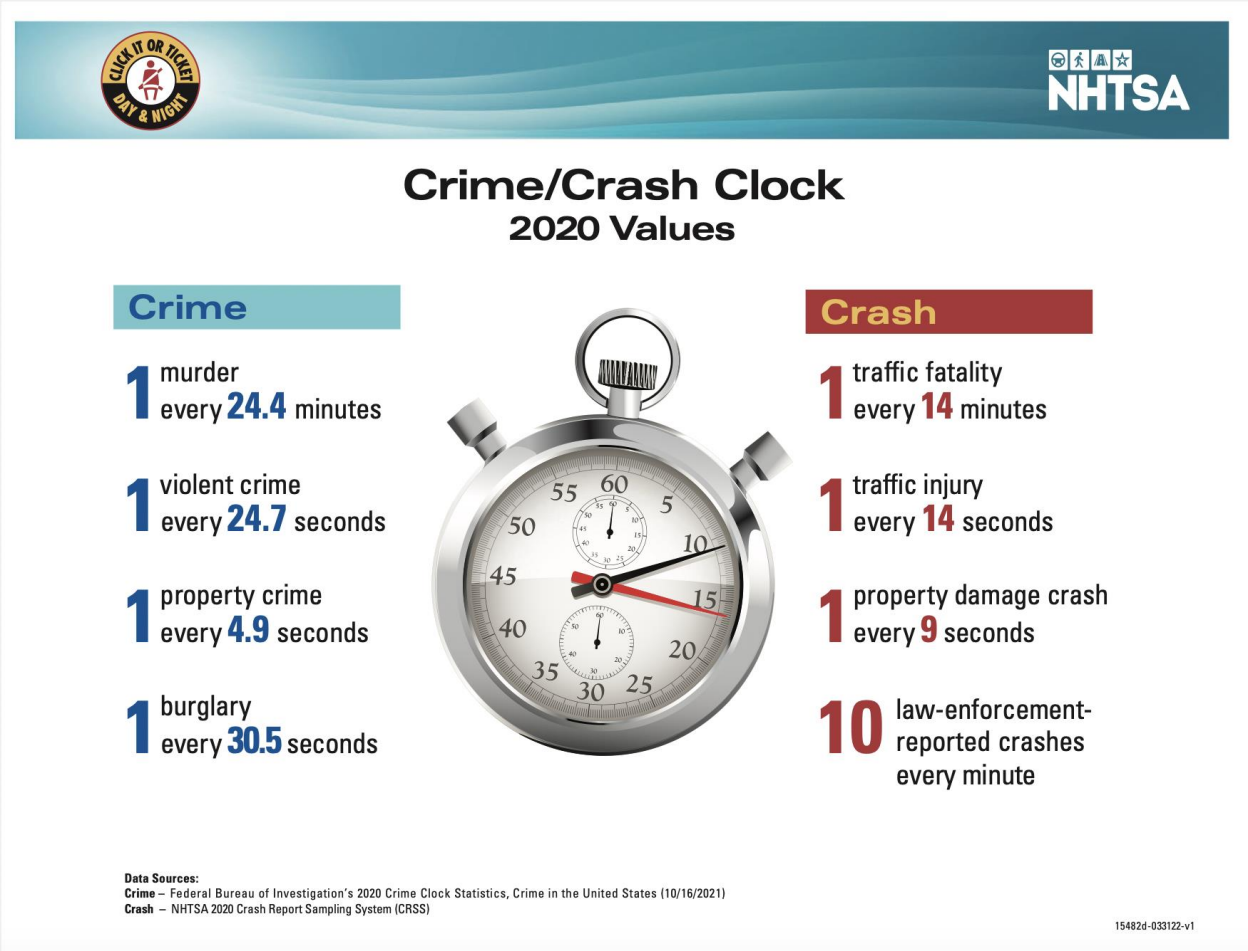
Crime/Crash Clock



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Contributing Factors to Traffic Fatalities

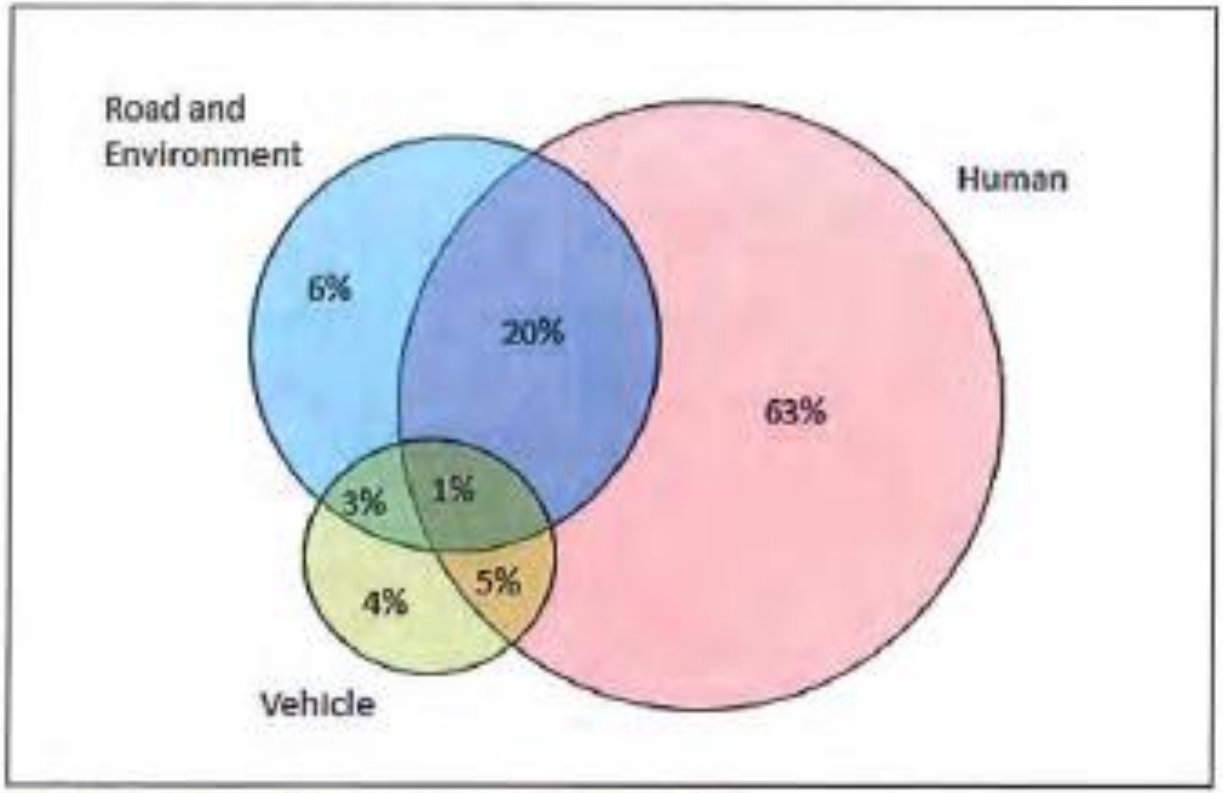

Figure 2: Contributing Factors to Traffic Fatalities

If the driver is the primary contributing factor, what do town officials do to reduce their risk?


Engineering
Law Enforcement

Principles of The Safe System Approach

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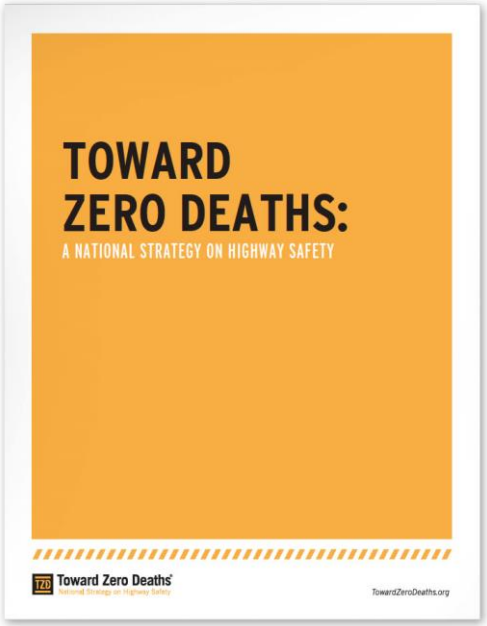
Toward Zero Deaths

A National Strategy on Highway Safety (2014)

National Goal:

"A highway system free of fatalities through a sustained and even accelerated decline in transportation-related deaths and injuries."



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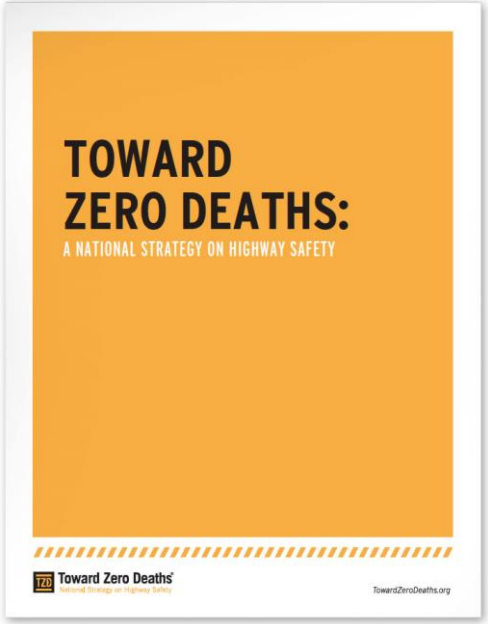
Toward Zero Deaths: Urban Areas

- “Improve speed management and enforcement in urban areas to reduce the risk of fatalities.”
- “Improve design and operations.”
- “Educate drivers on safer driving practices in urban areas.”
- “Educate workers on safety practices.”
- “Educate judges, prosecutors and law enforcement on…risks related to urban areas.”
- “Enact legislation…including pervasive automated speed enforcement and applications for school and other sensitive locations.”



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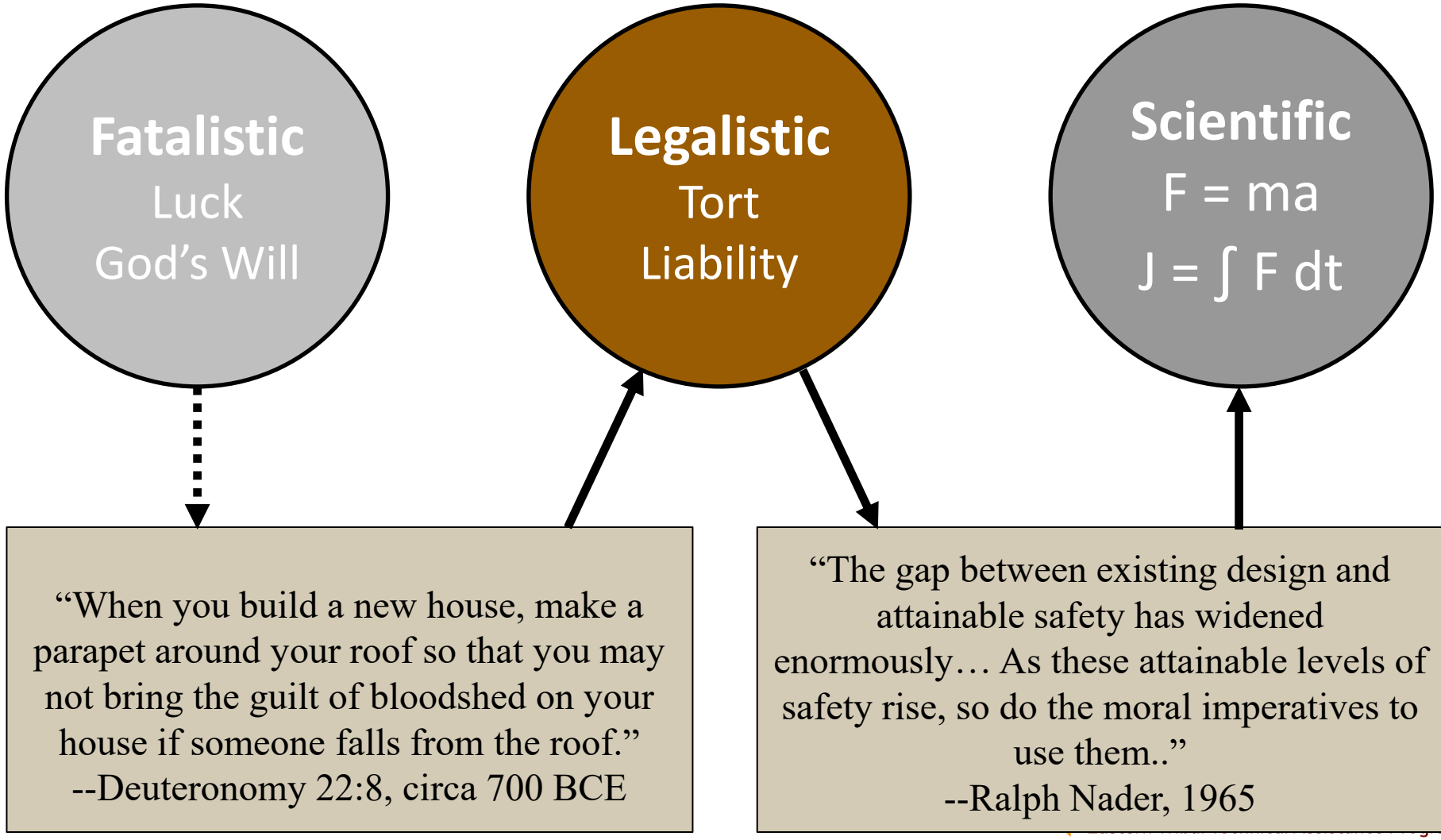
Perspectives on Safety



Design Makes a Difference: Nissan Versa vs Nissan Tsuru

https://www.youtube.com/watch?v=85OysZ_4lp0

Performance Comparison

Control: blue grease paint identifies where driver's head strikes the "A" pillar

Reverse: driver protected by airbags and crumple zones

How safe are we?

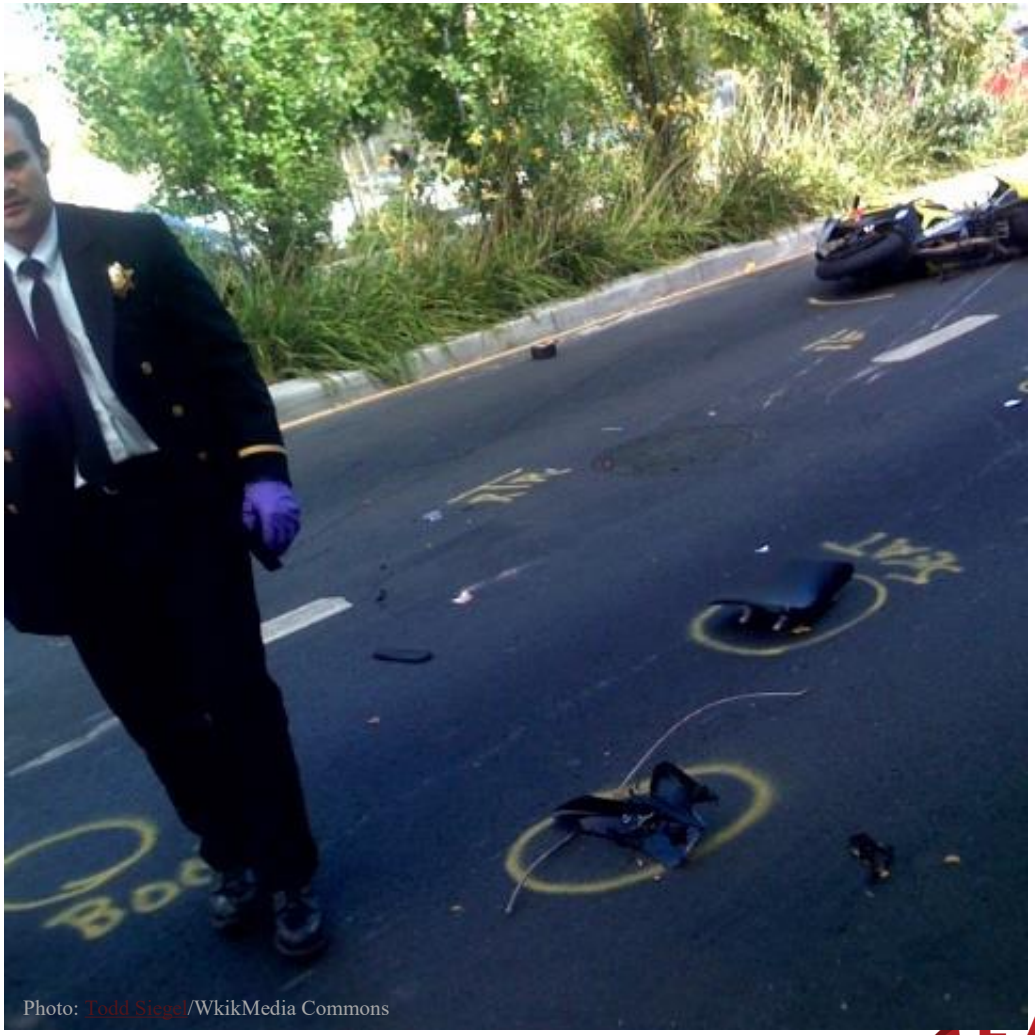


Photo: Todd Siegel/WkikMedia Commons

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2020(*) Olympic Medal Count

Country	Medals		Country	Medals
Australia	46		China	88
Canada	24		Poland	14
France	33		South Korea	20
Germany	37		Spain	17
Italy	40		Sweden	9
Japan	58		Switzerland	13
Netherlands	36		Great Britain	65
New Zealand	20		**United States**	**113**

Source: NBC

We're the best!

Fatal Roadway Crashes per 100,000 People

Country	Rate		Country	Rate
Australia	6.1		Norway	4.3
Canada	6.8		Poland	11.8
France	6.4		South Korea	14.1
Germany	4.7		Spain	5.4
Italy	7.2		Sweden	3.0
Japan	5.2		Switzerland	4.3
Netherlands	3.9		United Kingdom	3.7
New Zealand	9.1		**United States**	**11.4**

Source: World Health Organization

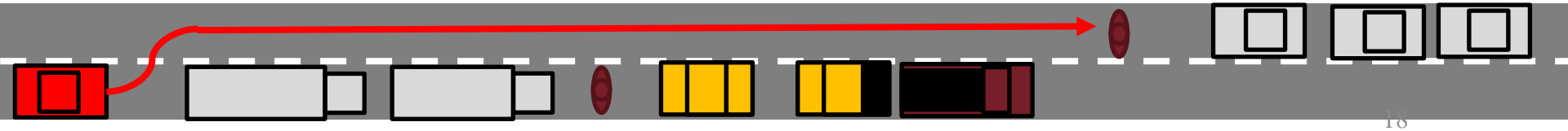
Most of our peers are doing much better than us.

What Goes Wrong?

Case Example: Worker Fatality in Saskatchewan

Facts & Circumstances

- Asphalt paving operation on flat, straight two-lane rural highway about 50 miles north of US border
- Statutory 60 km/h (35 mph) workers-present work zone limit
- Victim (age 18) a newly-trained flagger struck from behind and killed by vehicle driven by Driver (age 44)
- Victim's fiancée (paving crew) witnessed crash and interviewed by national media
- Driver told police he was distracted looking for a dropped paper
- Driver had three prior citations for minor traffic violations
- No evidence of alcohol/drug use
- Analysis showed 51-62 mph speed at time of impact
- Criminal justice process took more than 3 years



Case Example: Possible Contributing Factors

Driver:

- Distraction
- Excessive speed

Victim:

- Standing too close to open lane?
- Inexperience?

Roadway:

- Lowest statutory work zone speed limit in North America (35 mph). (Will drivers comply?)
- Lack of clarity about workers-present and workers-not-present speed limits

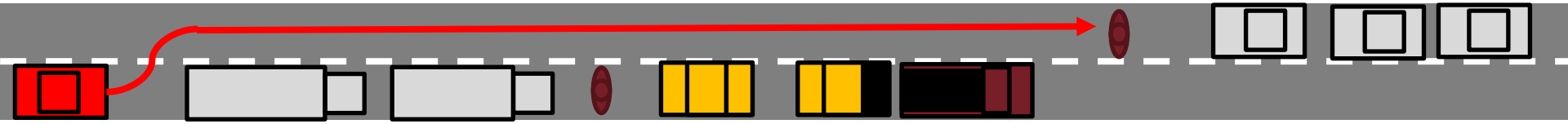
Case Example: Outcomes

Criminal Justice

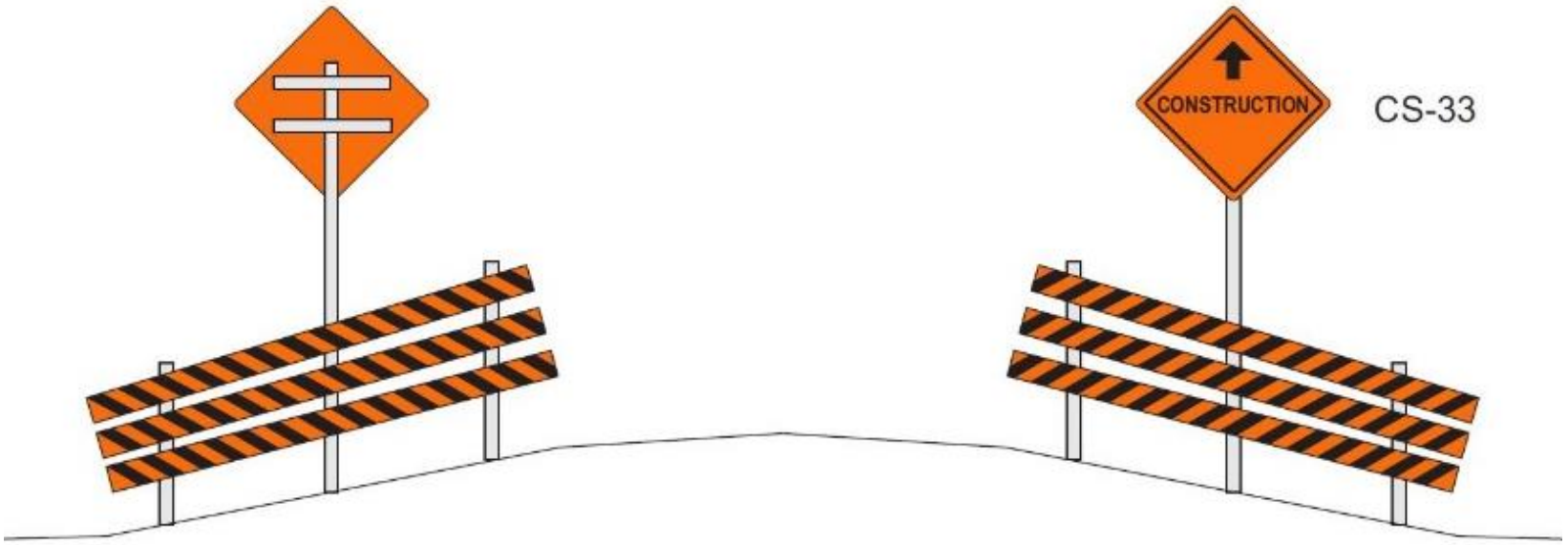
- Driver convicted of Dangerous Driving Causing Death and sentenced to two years imprisonment (currently under appeal) but acquitted of Criminal Negligence Causing Death.

Administrative & Legal

- Redesign of work zone approach signage
- Contractual changes to assure that 60 km/h (35 mph) speed limit signage is removed promptly when workforce leaves the site
- Increased use of rumble strips at flagger station approaches.
- Introduction of “gateway treatments” at work zone approaches
- Three-year pilot program for automated speed enforcement in work zones



Gateway Treatment

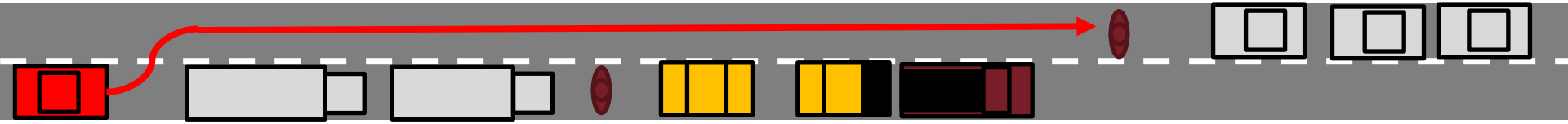


ENTERING A WORK ZONE

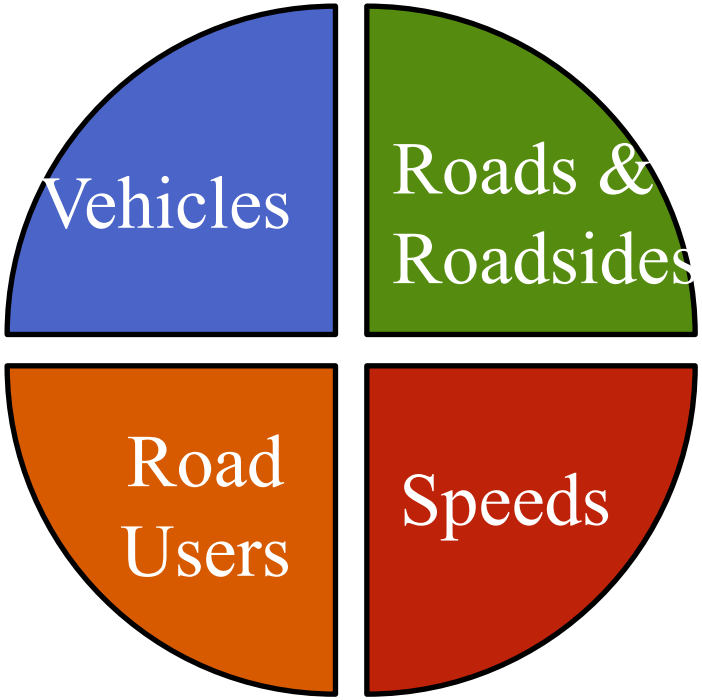
- The converging slanted boards are intended to make the roadway feel like it is suddenly getting narrower.
- The signage and colors shown above are consistent with the Canadian MUTCD and would require minor modification to meet the US MUTCD requirements.

Case Example: Human Impacts

- Driver: “I am truly, truly, truly sorry. I have a daughter about the same age and I can’t imagine.”
- Victim’s Manager at Company: “There are no winners. He could get 20 years and that’s not going to bring her back.”
- Witness / Fiancée : “I am depressed and considered suicide… I drink myself to sleep every night.”



The Safe System Approach



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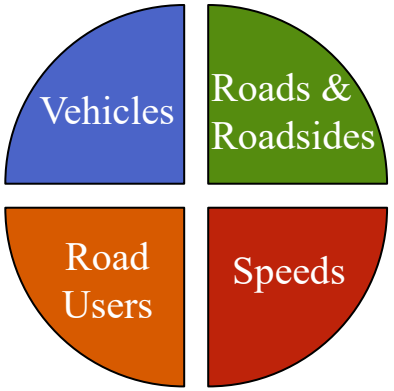
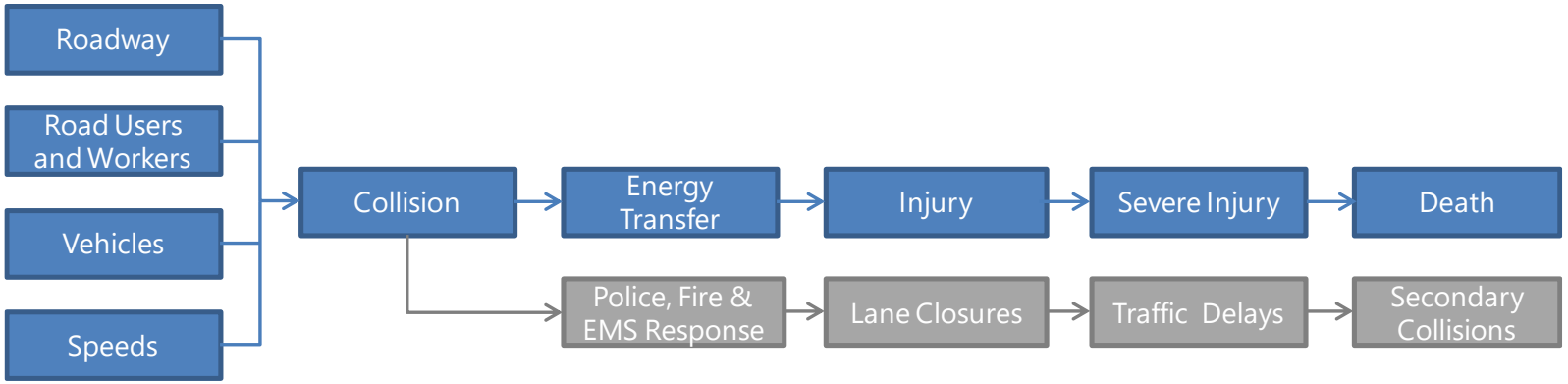
Making the Roadway a "Safe System"

- Traffic crashes usually involve a chain of events: *Mistakes – Mishaps – Behaviors*
- Primary Goal: Break the chain before a mistake turns into a serious incident
- Fallback Goal: Reduce incident and injury severity





Trauma Chain for a Fatality

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100 Years of Vehicle Safety Engineering

World's Best-Selling Automobile 1916

World's Best-Selling Automobile 2016

What safety features were standard in 1916? In 2016?

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Traditional Approach: The 3 (or more) E's

"Every road safety problem can be solved by applying the 3Es"

Engineering • Education • Enforcement

Emergency Medical Services • Evaluation

Example • Encouragement • Everyone

- Developed circa 1915 and promoted by auto industry
- Works best for issues that involve a relatively small number of agencies and stakeholders
- Can be difficult to apply to problems that cut across professional disciplines or agency boundaries

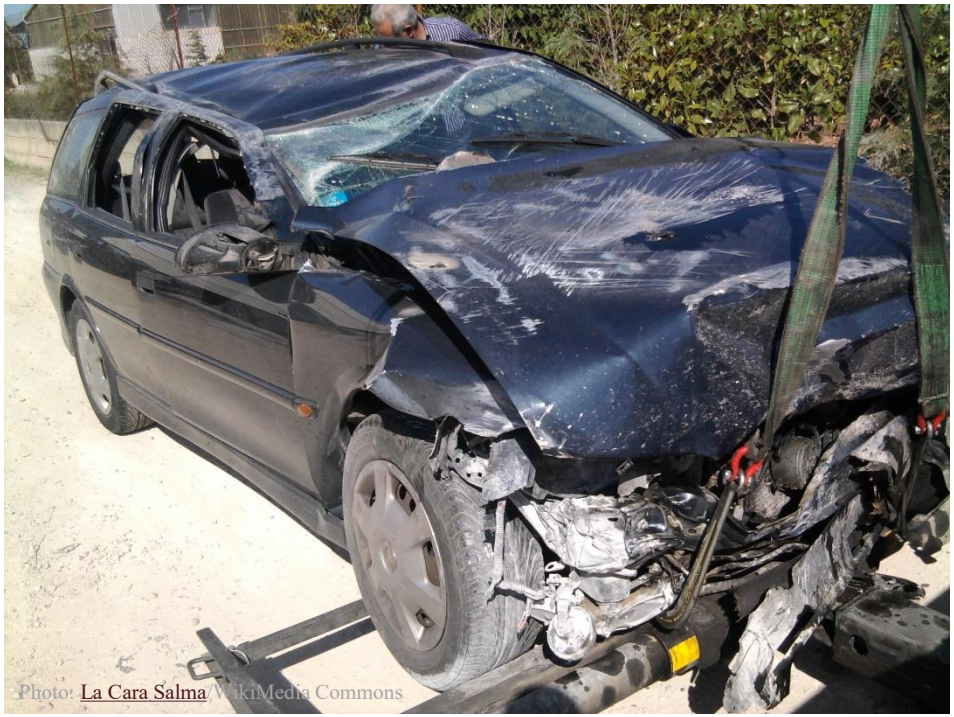
Example of Difficulties with 3Es Approach

Single-vehicle run-off-the-road crashes involving fatigued drivers.

Engineering:
Not isolated to specific locations, roadway reconstruction expensive

Enforcement:
Unsuitable for targeted enforcement – can happen almost anywhere

Education:
Public outreach effectiveness limited



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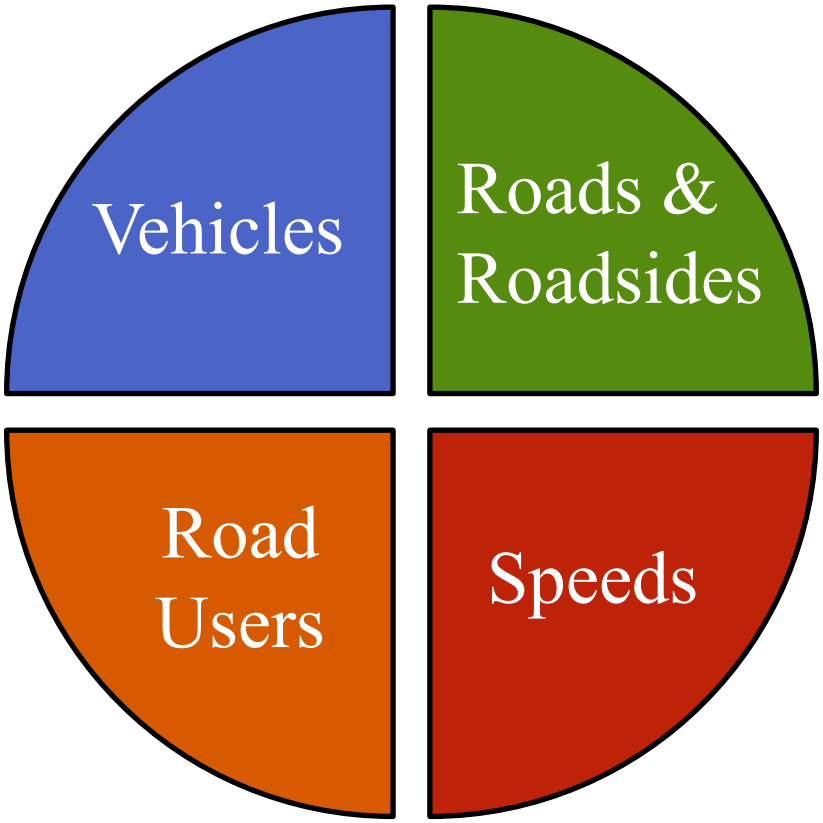
The Safe System Approach



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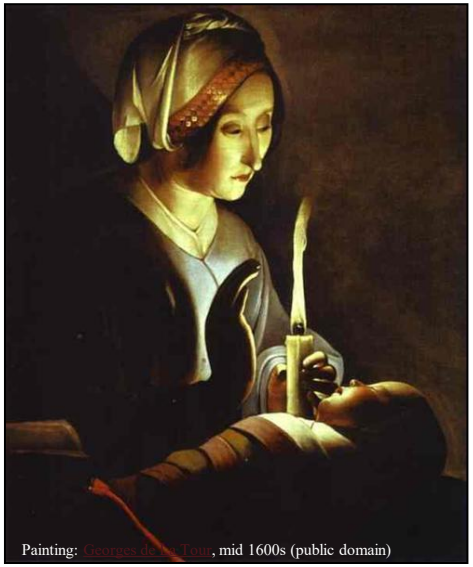
Hazard vs Risk

- In everyday speech we often use these two words interchangeably.
- In Safety Science, there is a distinction:
  - **Hazard:** A condition which could result in a casualty (injury or death)
  - **Risk:** The likelihood and consequences of a hazard



Low Hazard, High Risk

High Hazard, Low Risk

Risk Matrix

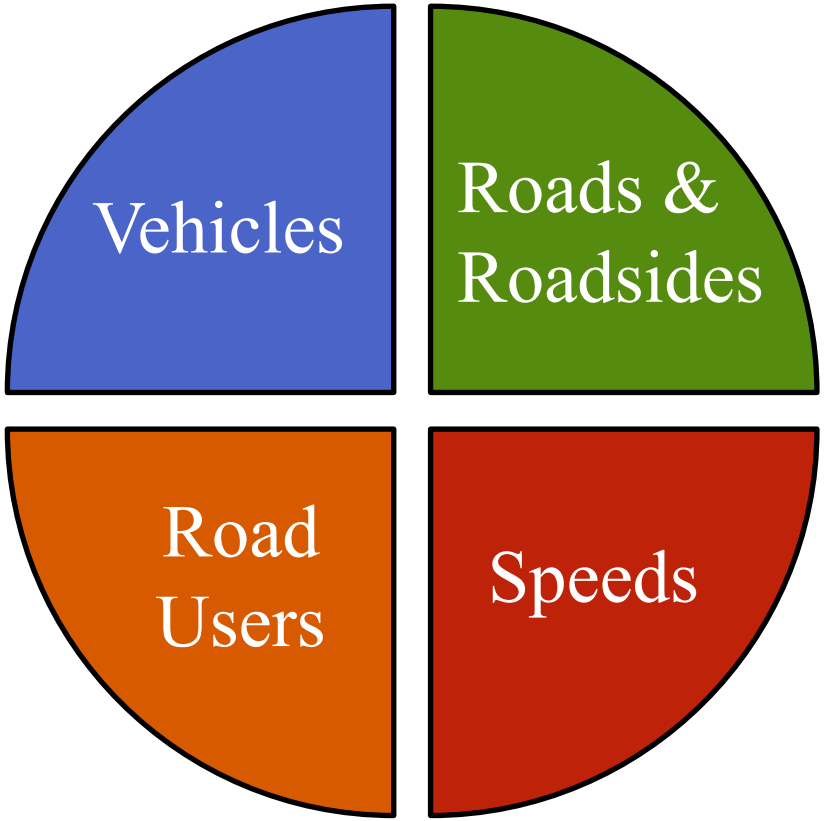
Likelihood			Potential Consequences				
			L6	L5	L4	L3	L2
			Minor injuries or discomfort. No medical treatment or measureable physical effects.	Injuries or illness requiring medical treatment. Temporary impairment.	Injuries or illness requiring hospital admission.	Injury or illness resulting in permanent impairment.	Fatality
			Not Significant	**Minor**	**Moderate**	**Major**	**Severe**
	Expected to occur regularly under normal circumstances	**Almost Certain**	**Medium**	**High**	**Very High**	**Very High**	**Very High**
	Expected to occur at some time	**Likely**	**Medium**	**High**	**High**	**Very High**	**Very High**
	May occur at some time	**Possible**	**Low**	**Medium**	**High**	**High**	**Very High**
	Not likely to occur in normal circumstances	**Unlikely**	**Low**	**Low**	**Medium**	**Medium**	**High**
	Could happen, but probably never will	**Rare**	**Low**	**Low**	**Low**	**Low**	**Medium**

Image: University of Sydney

Elements of a Safe System

Developed in 2008 by safety experts from 21 countries

Based on rigorous analysis of factors that cause crashes



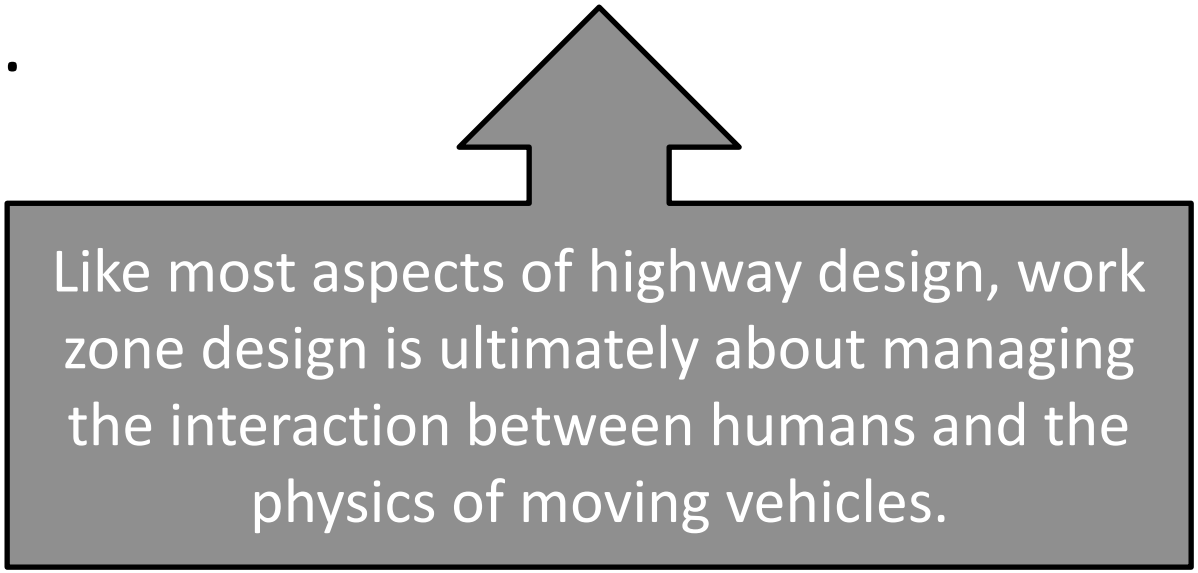
US represented by NHTSA, FHWA and FMCSA

Grounded in work by Dr. William Haddon, first NHTSA director.

If one element of the system fails, other elements help minimize the consequences of failure.

Safe System Principles

- Human bodies don't withstand crash forces well.



Physics 101

SUV 4400 lb (2000 kg)

Kinetic Energy = ½mv²

At 20 mph (30 km/h): KE = 0.5 x 2000 x (30000/3600)² = 70 kJ

At 30 mph (50 km/h): KE = 0.5 x 2000 x (50000/3600)² = 190 kJ

At 60 mph (100 km/h): KE = 0.5 x 2000 x (100000/3600)² = 770 kJ

Doubling speed quadruples kinetic energy

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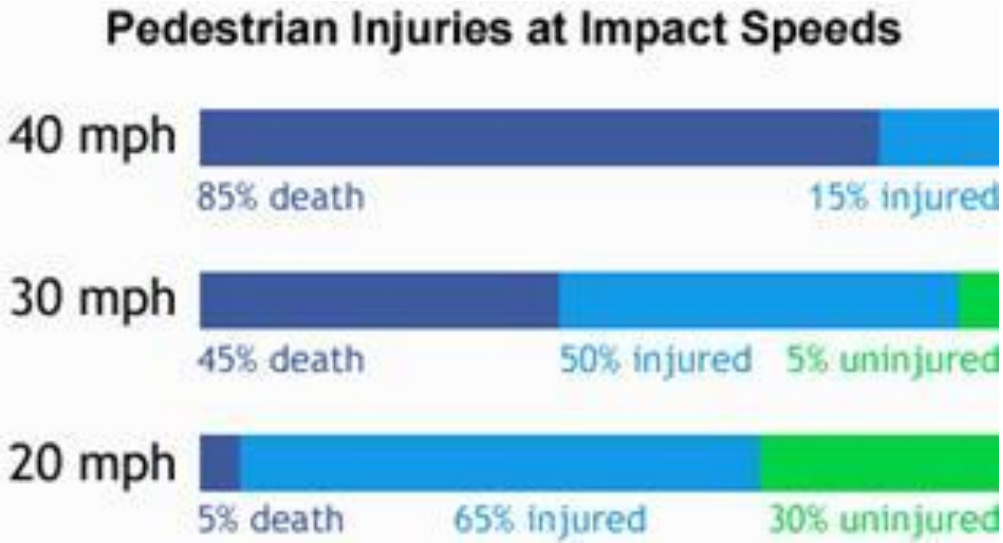
Pedestrian or Worker-On-Foot Struck by Car: Probability of Death



Graph: FHWA

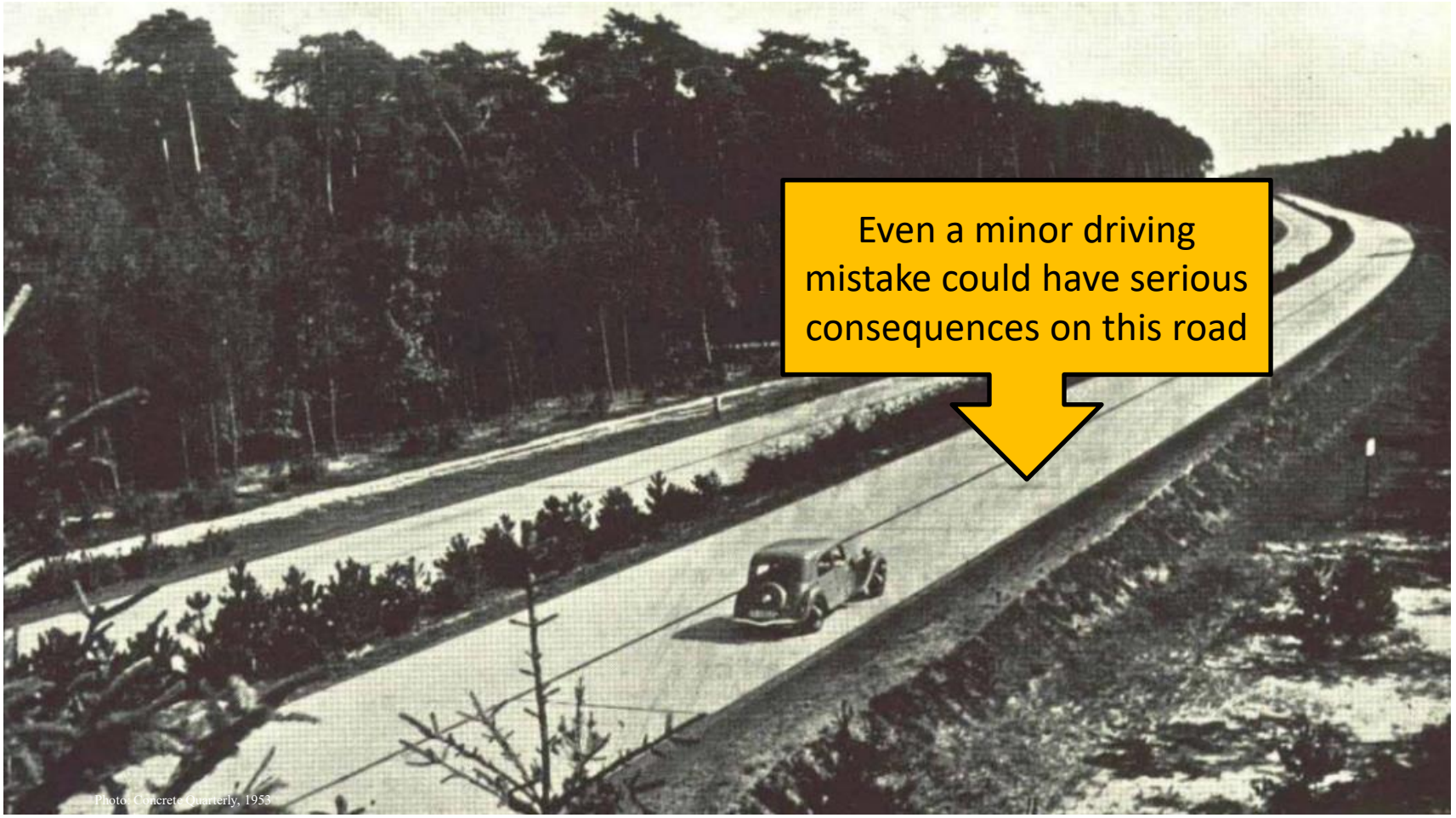
Safe System Principles

- Human bodies don’t withstand crash forces well.
- Instead of trying to eliminate all crashes, focus on preventing death and serious injury from crashes.
- Although some crashes involve an element of misbehavior, many are due to simple mistakes such as momentary inattention.

Drivers make mistakes.
Can we make our projects more forgiving of driver error?

An Unforgiving Driving Environment

German Autobahn, 1953



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60 Years of Roadway Safety Engineering

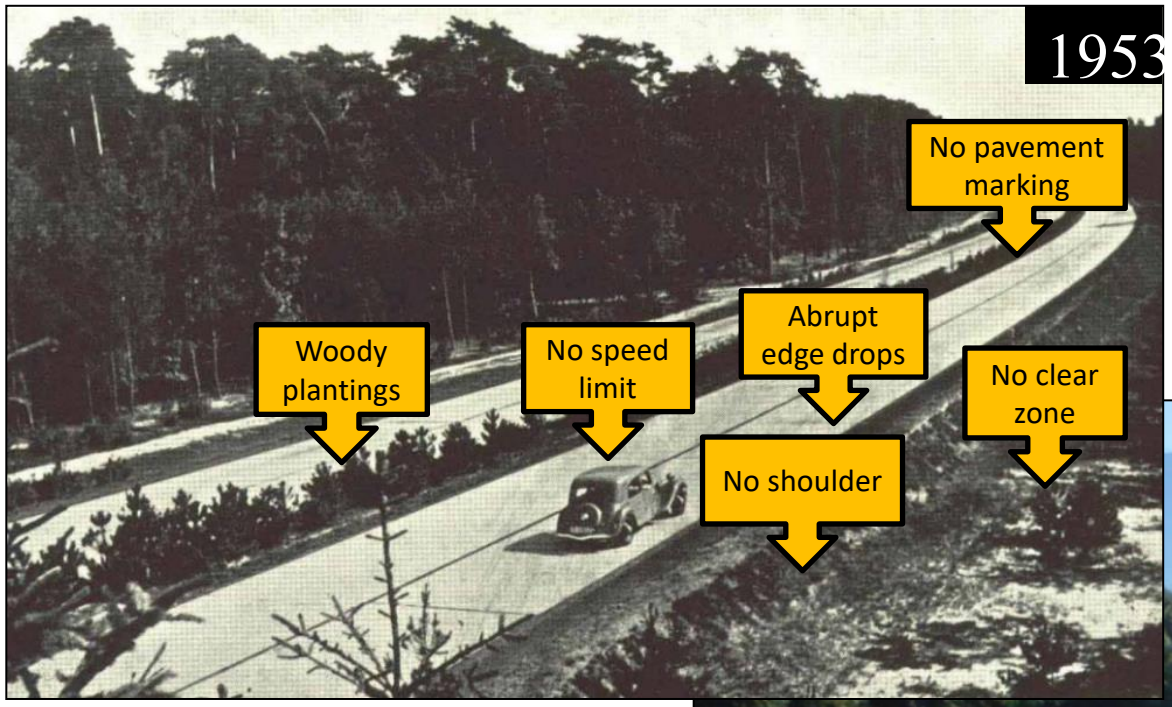


Photo: Concrete Quarterly

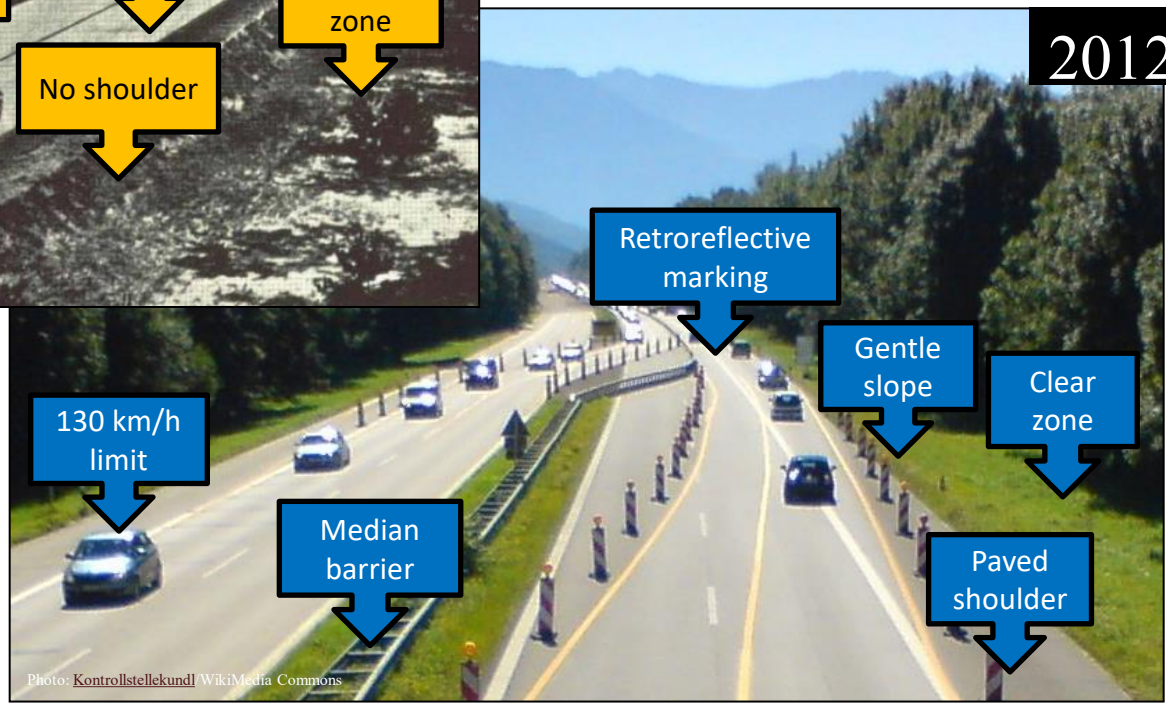


Photo: Kontrollstellekundl / WikiMedia Commons

Safe System Principles

- Human bodies don't withstand crash forces well.
- Instead of trying to eliminate all crashes, focus on preventing death and serious injury from crashes.
- Although some crashes involve an element of misbehavior, many are due to simple mistakes such as momentary inattention.
- Strengthen all parts of the system: roads and roadsides, speeds, vehicles, and users.
- System designers and system users must share responsibility for managing crash forces to a level that doesn't result in death or serious injury.

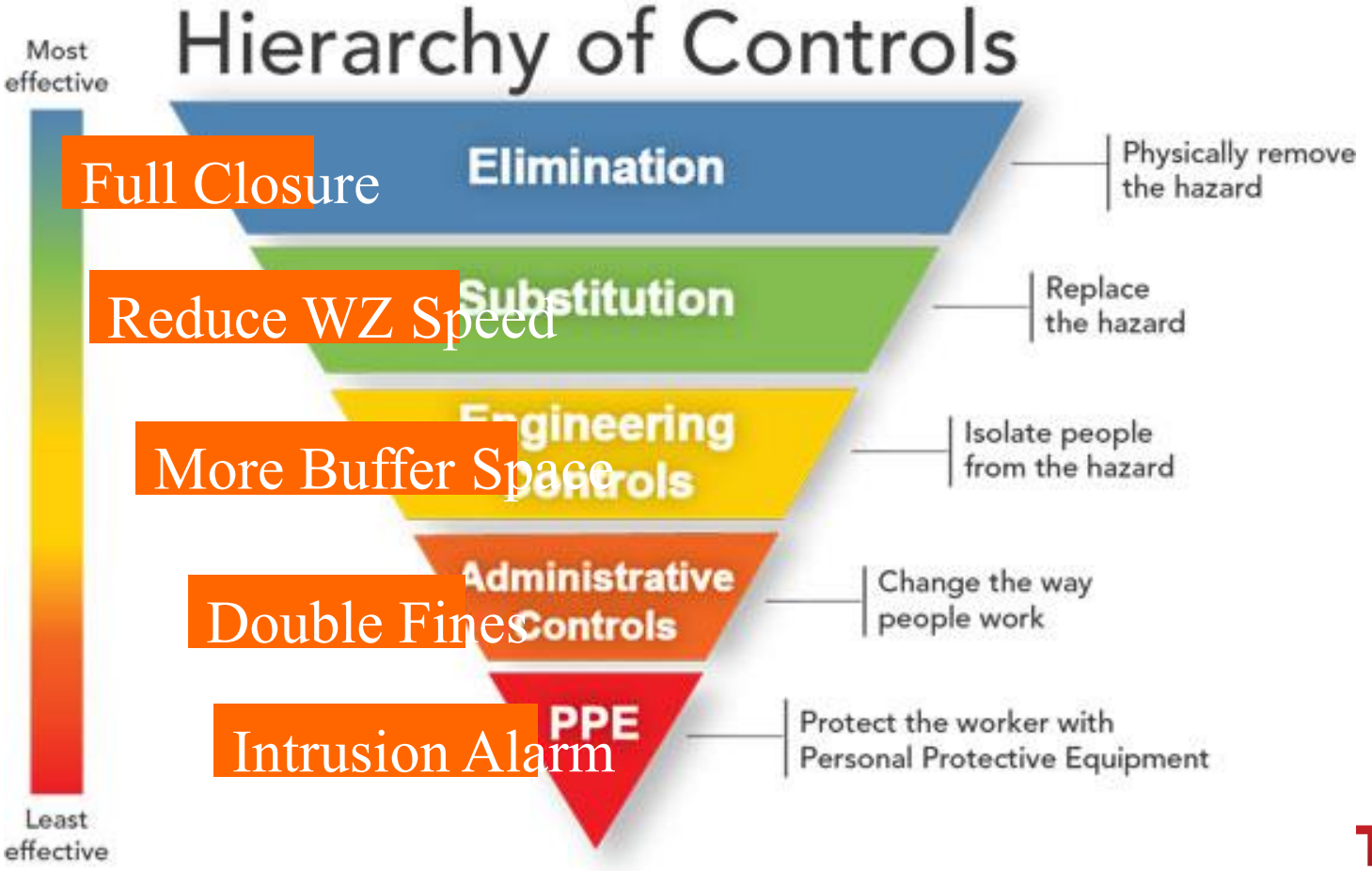
Ten Injury Prevention/Reduction Methods

(Haddon 1970)

#	Method	Work Zone Example
1	Prevent accumulation of energy that could result in an injury.	Close the work zone to all traffic.
2	Reduce amount of energy marshalled.	Reduce traffic speed through the work zone.
3	Prevent release of potential energy.	Install fences to keep pedestrians away from construction equipment, trenches, and open holes.
4	Modify energy release rate.	Install Truck-Mounted Attenuators on work vehicles.
5	Increase time or space between potential victims and hazards.	Increase lateral and longitudinal buffer space between vehicles and workers.
6	Place barriers between hazard and potential victims.	Install portable concrete barriers to separate travel lanes from work activity areas.
7	Modify contact surfaces to disperse impact energy in a less hazardous way.	Use temporary traffic control devices that have been tested for crashworthiness.
8	Strengthen structures and devices that might be damaged.	Use MASH Test Level 4 barriers instead of Test Level 3 barriers on corridors with high truck volumes.
9	Reduce casualties by detecting injuries rapidly.	Install and maintain remote video monitoring of work zone traffic during construction.
10	Expedite and improve post-crash medical treatment.	Begin medical treatment while victims are being transported to trauma center.

Effectiveness of Different Types of Controls

Examp



Full Closure

Reduce WZ Speed

More Buffer Space

Double Fines

Intrusion Alarm

Image: CDC

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Safe System Principles

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Safety Culture in Organizations

1. **Pathological:** The organization thwarts changes that improve safety, even when the need is obvious and the payoff is rapid.
2. **Reactive:** Changes accepted only in response to a significant incident/threat.
3. **Calculative:** Potential improvements considered systematically as part of cost control and risk management.
4. **Proactive:** Organization actively searches for ways to improve performance and reduce risks.
5. **Generative:** Safety is an integral part of everything the organization does.

The 1960 Corvair dash baby cradle. Before infant car seats were a major requirement, this was considered to be a safe and comfortable

How to reduce the driver's risk?

- Follow standards and good practices -- MUTCD, Design Manuals, Best Practices, Road Safety Audit
- Keep your own eyes open for problems
- Train others to do the same 24/7/365
- Investigate resident complaints
- Pay attention to crashes and crash data
- Bring together a Traffic Safety Commission
- Create a Local Road Safety Plan