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# International Activities in Safety

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# Outline

- Background
- Emergency Preparedness
- SUNflower
- SnowFlake
- Teenage Driving
- Conclusions and Future Work

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# Background

- Mechanical and Industrial Engineering – Manufacturing System Design and Lean Manufacturing
- Projects funded by URI TC:
  - Modeling a Retail Distribution Warehouse to Reduce Truck Unloading Times
  - Enhancing the Preparedness and Response of the Rhode Island Transportation System in Natural or Human Caused Disasters
  - Improving Elder Drivers Comprehension of Dynamic Messages through a Human Factors Study
  - Global Transportation Flexibility in MNC Supply Chains
- Czech Republic, Young Researcher's Seminar, 2007

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# Disseminating Information with Variable Message Signs during Natural or Human-Caused Disasters

Presented in Brno, CZ

# Electronic Bulletin Boards

- Variable Message Sign (VMS)



- Amber only
- 3 lines
- 8 or 9 characters

- Dynamic Message Sign (DMS)



- Amber, red, or green
- 3 lines
- 20 characters

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# Research Questions

- How prepared is the transportation system with respect to different natural or human caused disaster scenarios?
- What are the available means of communication in case of emergency?
- What kind of messages could be displayed and disseminated to the public in these scenarios?
- How will the driving public react to such VMS messages during emergencies?

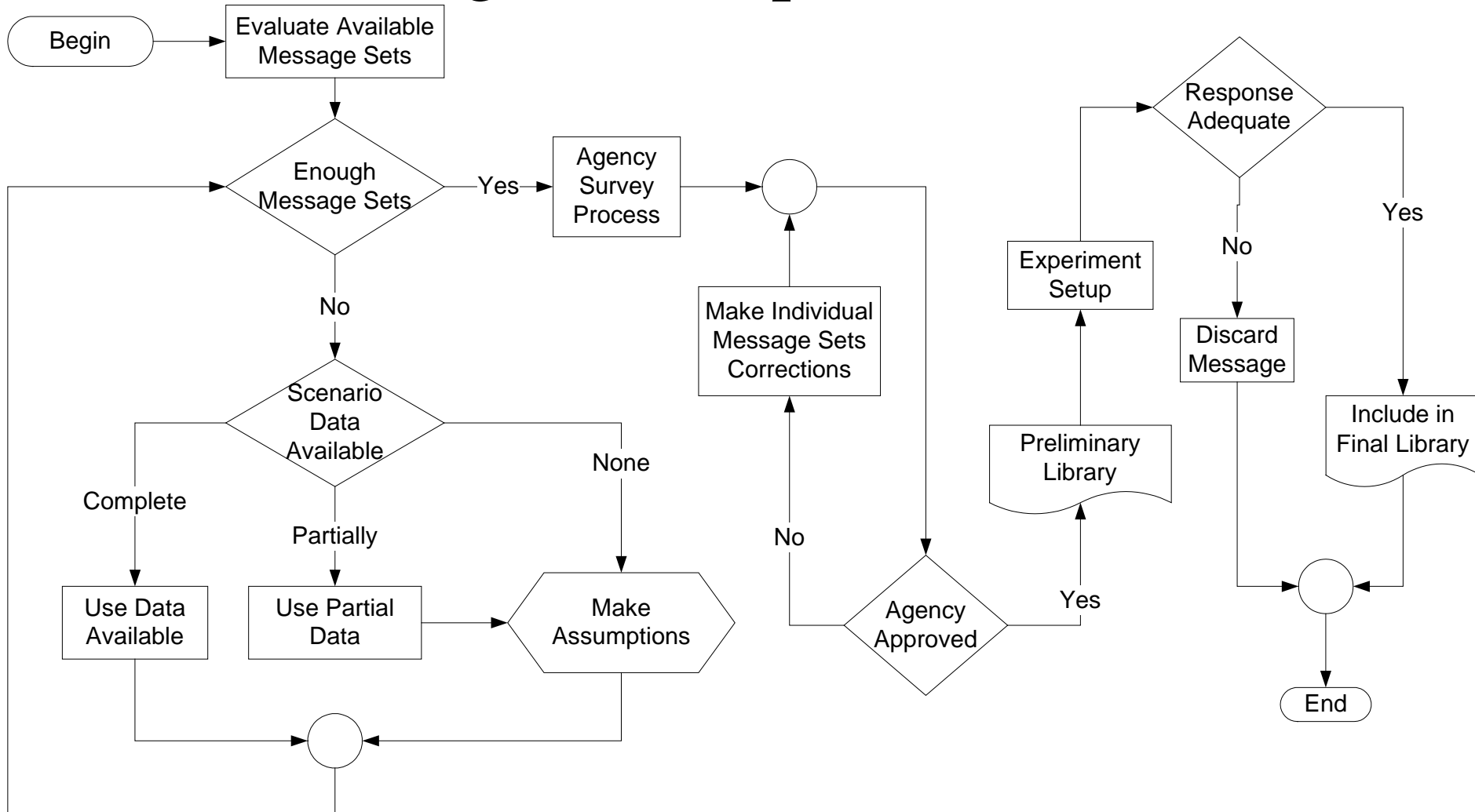
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# Literature Review

- Current emergency communication capabilities
  - Transportation Management Center has VMS signs for road closures, road work, congestion, and adverse weather
  - Custom messages are possible but require time and effort
  - Approved shelters and evacuation routes exist, but may change during actual emergencies
- VMS research
  - Legibility, colors, fonts, size, number of panels, level of detail, abbreviations, flashing, etc.
  - Manual on Uniform Traffic Control Devices

# Message Development Process



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# Scenarios

- Hurricane
  - Worst Case Category 4
  - EMA phases, with warning and prep time
  - Access to shelters
- LNG Explosion or Chemical Leak
  - Man-made or Natural Causes
  - In-bound and Out-bound traffic
- Bridge Collapse
  - Rerouting traffic, longer term

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# State Emergency Operations Plan

- Awareness >48 hours before event
  - FILL GAS TANKS
- Preparedness 24-48 hours before event
  - HURRICANE WATCH
  - EVACUATE USE RTE 1 N
- Response on the day of the event
  - SHELTER NEXT EXIT
- Recovery after the event
  - BEACHES AND PARKS CLOSED
- Stages may be truncated or condensed for events with little or no warning

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# VMS Potential

- Agency resources are better spent coordinating responses during an emergency
- Messages can be tested in advance
- Dynamic conditions can be updated real-time
- Helpful to residents, commuters, commercial drivers, and tourists

# Preliminary Message Library

- Messages for 24 hours before hurricane arrival

LINE 1	LINE 2	LINE 3
EVACUATE	AHEAD	1610 AM
ROADWORK	BEAR	AHEAD
SHELTER	EXIT	AT EXIT X
TUNE	NEXT EXIT	EXIT XX
	RADIO	LEFT
	STRAIGHT	RIGHT
	TURN	RTE XX
	TURN LEFT	
	TURN RIGHT	
	USE	
	VIA	

LINE 1	LINE 2	LINE 3
ONTO	NORTH TO	RTE XX
RIGHT	ON RTE XX	XX RD
RTE XX	ONTO	
THEN	RTE XX	
THEN EXIT	SCHOOL	
TO HIGH	SOUTH TO	
TO MIDDLE	XXX	
USE		

# Preliminary Message Library

- Messages for 76 to 24 hours before hurricane arrival, or after hurricane arrival

LINE 1	LINE 2	LINE 3
BEACHES	AND PARKS	CLOSED
FILL	CLOSED	AHEAD
FLOOD	FOR POWER	ITEMS
HURRICANE	GAS TANKS	OUTAGES
PREPARE	HAZARDS	SUPPLIES
ROAD	LOOSE	YET
SECURE	NOT OPEN	
SHELTER	OPEN	
STORM	WARNING	
	WATCH	
	WATER	

LINE 1	LINE 2	LINE 3
OFFICIAL	USE ONLY	
DRIVE	CAREFULLY	

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# Public Opinion Survey

- **Goals:**
  - Assess public familiarity with and attitudes toward VMS and other emergency communication systems
  - Assess driver approval of expanding the role of VMS in emergencies
  - Test driver preference and comprehension of several emergency messages to assess basic design elements
- Administered to 233 respondents at 3 locations with diverse age, gender, native language, education level, and driving experience

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# Survey Design Considerations

- Message wording based on current standard practice and recent research for VMS
- Accessibility for a broad demographic of respondents
- Concise, clear, non-offensive wording
- Focus on VMS for potential use in emergencies and versatility of messages on DMS also

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# Sample Survey Question

Which of the following signs do you prefer?

(A)



(B)



# Public Opinion Survey Results

Q1 – I am familiar with current evacuation routes near my home

Q2 – The following methods of highway communication are useful  
sources of information for me:

Q3 – I use the following methods of highway communication frequently:

Question	Strongly Agree			Strongly Disagree		Total #
	1 %	2 %	3 %	4 %	5 %	
Q1	18.7	13.3	21.7	17.3	28.8	225
Q2 Radio	26.3	16.4	24.9	16.0	17.4	213
Television	26.2	25.7	19.3	14.4	14.4	202
511 Call-in	12.0	5.8	19.9	21.5	40.8	191
VMS	30.0	27.1	21.3	11.6	10.6	207
Internet	14.7	16.2	21.8	20.8	26.4	197
Fixed Sign	44.3	21.0	14.8	10.5	9.5	210
Q3 Radio	25.9	9.4	22.6	13.7	28.3	212
Television	27.0	14.2	23.5	14.7	20.6	204
511 Call-in	7.7	4.1	17.0	18.0	53.1	194
VMS	28.9	24.0	23.0	10.3	13.7	204
Internet	10.8	12.8	20.5	18.5	37.4	195
Fixed Sign	47.4	19.6	18.2	7.2	7.7	209

# Public Opinion Survey Results

Q4 – I would like the highway transportation system to provide more information about emergencies

Q5 – I follow advice from electronic variable message signs (VMS) regarding road work or detours

Q6 – I am willing to follow instruction provided by VMS during emergency situations

Q7 – I find the following VMS messages helpful in preparing for emergencies

Question	Strongly Agree			Strongly Disagree		Total
	1	2	3	4	5	
	%	%	%	%	%	#
Q4	45.0	25.5	16.4	6.8	6.4	220
Q5	47.2	29.4	12.4	4.6	6.4	218
Q6	68.7	20.3	4.6	1.8	4.6	217
Q7						
fill gas tanks	38.6	19.0	22.9	7.6	11.9	210
blizzard	48.6	24.3	16.2	3.3	7.6	210
secure water supplies	33.0	18.9	28.2	7.3	12.6	206
prepare for outages	36.7	24.2	23.7	6.3	9.2	207
icy road ahead	62.7	20.1	10.0	2.9	4.3	209
expect high winds	47.6	23.6	17.3	6.3	5.3	208
secure loose objects	36.6	20.0	20.5	10.7	12.2	205

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# Further Survey Results

- Q8 – 69.7% of respondents preferred the sign that matches established protocol for 3 line messages:
  - specific emergency (HURRICANE)
  - required action (EVACUATION)
  - and method or direction for that action (RTE 1N)
- Other questions involved map interpretation and free response for input to future research

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# Project Conclusions

- An integrated plan is needed to minimize the impact of natural and human caused disasters
- Includes communication, evacuation, emergency response, shelter information, etc.
- Mitigates effects on the transportation system
- VMS is an important plan element within ITS
- Message design, library development, testing, and deployment plans are needed in advance

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# Collaboration and Comparison

- Presentation in the Czech Republic led to further international collaboration
- Visit from Josef Mikulik, CDV, to TRB meeting
- Expansion of the SUNflower project
  - Comparison of road safety statistics in 3 EU nations – Sweden, United Kingdom, Netherlands
  - Expanded to 6 more nations, including Czech Republic, Hungary, Slovenia, Greece, Portugal, Spain, Catalonia Region
- “SnowFlake” project
  - Comparison of EU nations to US states
  - Began in 2008 with CZ and RI
  - Expanded in 2009 to 5 states and 1 territory
  - Continuing in 2010

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# SUNflower + 6 Report

- Development and application of a footprint methodology for the SUNflower+6 countries (1999)
- By Peter Morsink, Siem Oppe, Martine Reurings, and Fred Wegman
- Goal of reducing road crashes and fatalities
- Compare road safety policies, programs, and performance
- Identify trends and best practices
- Learn from other nations, to encourage road safety improvements

# Model



- Figure 2.1. *A target hierarchy for road safety (Koornstra et al., 2002; LTSA 2000).*

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# Road Safety Expense

- Medical costs – medical care after a crash, such as hospital treatment, rehabilitation, medicine, and adaptations for the handicapped
- Gross production loss – due to loss of labour by road crash victims on account of absenteeism, death and disablement
- Material costs – damage to vehicles, road side objects...
- Settlement costs – costs of fire brigade, police, courts
- Traffic jam costs – costs of traffic jams (loss of time) caused by road crashes
- Human costs – monetary loss of quality of life

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# SUNflower + 6 Analysis

- Transport Modes
  - Car occupant, pedestrian, cyclist, motorcyclist, mopedist
- Road Users
  - Age groups – 0-14, 15-17, 18-24, 25-64, 65+
  - Behavior aspects
    - Alcohol and drug use
    - Speeding
    - Wearing protection systems
- Roads – Motorways, A level roads, Other Rural Roads, Urban Roads
  - Difficulty in finding uniform definitions

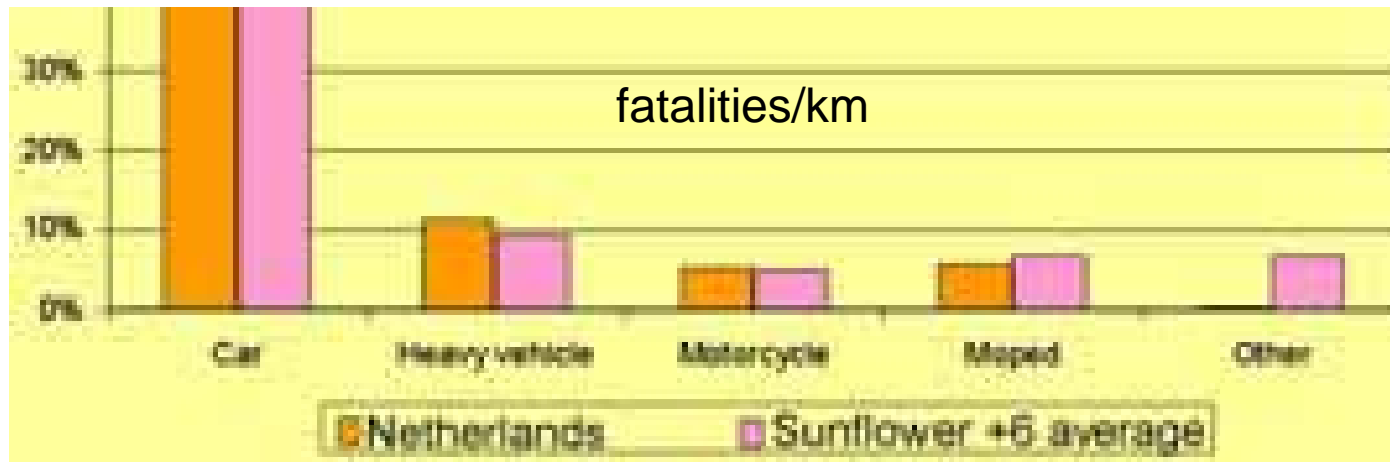
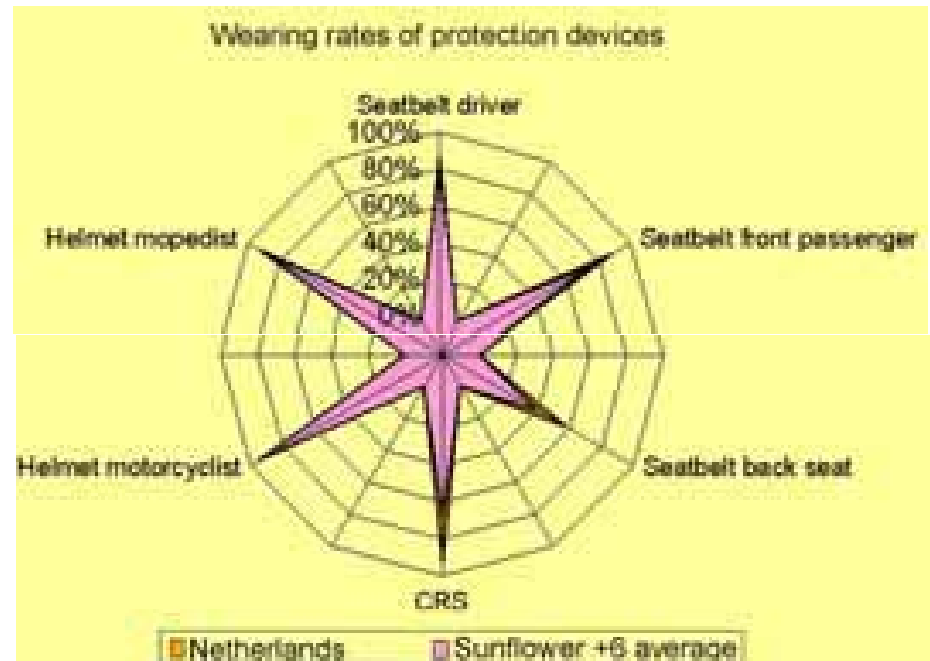
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# Sample Metrics

- Fatalities/km
- Fatalities/vehicle
- Fatalities/population
- Fatalities/km per mode
- Fatalities/population in specific age groups
- Percentage of fatalities due to substance abuse
- Percentage of fatalities of car occupants not wearing seatbelt
- Fatalities/km per road type, per mode
- Road network – percentage length of road types
- Protective system usage rates

# SUNFlower Sample Results



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# SnowFlake Study

- US – Central European Technology Exchange Program
- Cooperative effort between US and Central Europe Highway Transportation agencies
- Similarities and differences in national road safety policies and performance
- Data from
  - EU International Road Traffic and Accident Database (IRTAD) and Community database on Accidents on the Roads in Europe (CARE)
  - US Fatality Analysis Reporting System (FARS)
  - RI Electronic Accident Reporting System (EARS)

# SnowFlake Data

	2004	2005	2006	Average
<b>Czech Republic</b>				
Population (million)	10.211	10.220	10.251	10.227
Area (thousand sq km)				78.867
Density (population/sq km)	129.5	129.6	129.9	129.7
GDP per capita (US dollar)*	18077	19506	20754	19445
<b>Rhode Island</b>				
Population (million)	1.078	1.073	1.067	1.073
Area (sq km)				3145
Density (population/sq km)	342.8	341.2	339.2	341.2
GDP per capita (US dollar)**	37500	38700	39900	38700

**TABLE 1 Basic Data Comparison**

\*1 US dollar = 15 CZK    \*\* Approximate data based on 2001 – 34906 and 2006 – 41214

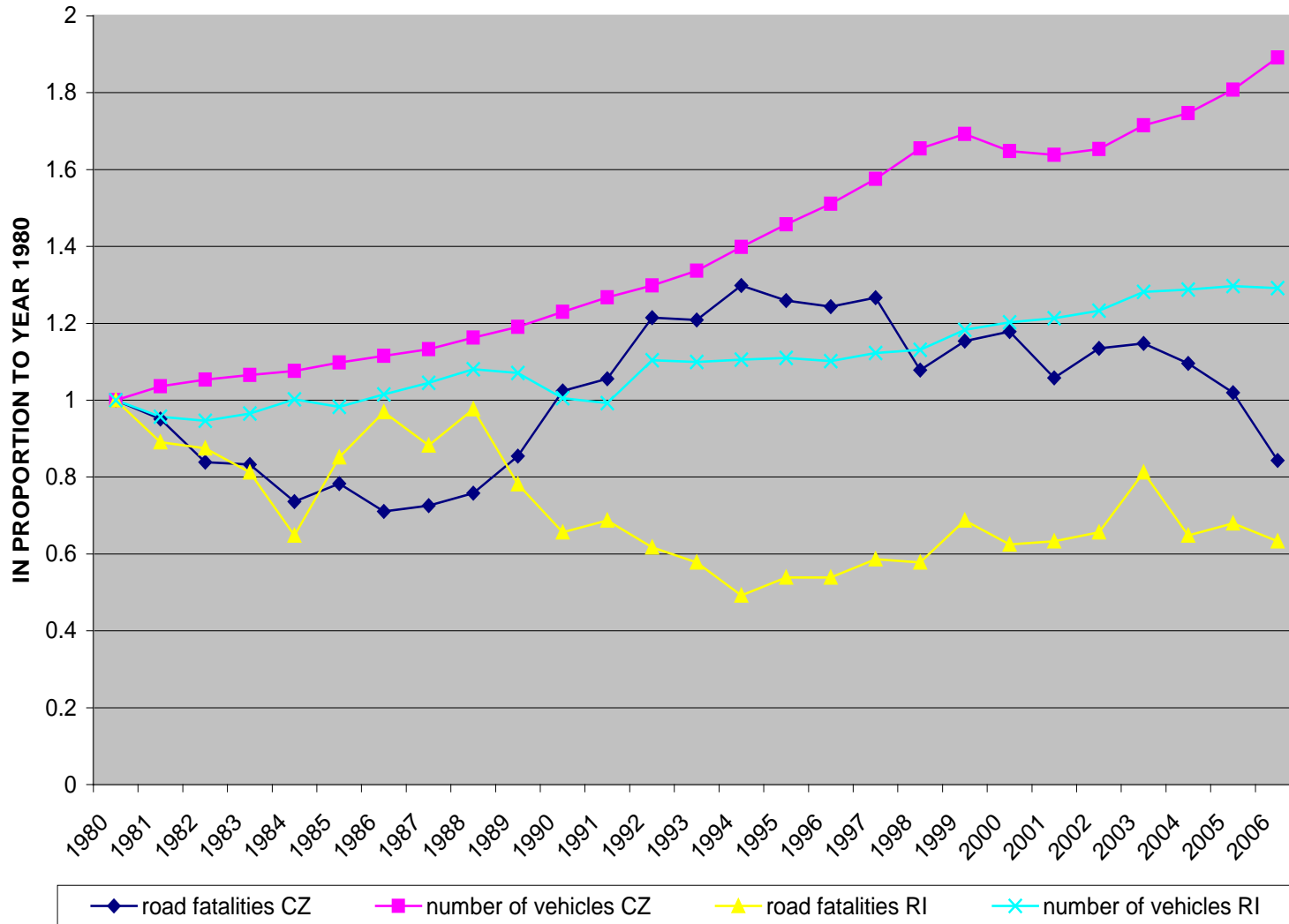
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# CZ and RI comparisons

- Czech Republic population is 10 times larger than RI
- CZ area is 25 times larger than RI
- Population density is 2.6 times greater in RI
- GDP per capita is 2 times larger in RI
- Road network density is 3.5 times higher in RI
- CZ – 37% of passenger volume is by public transport
- Motorization levels increasing in CZ, stable in RI

# SnowFlake Data



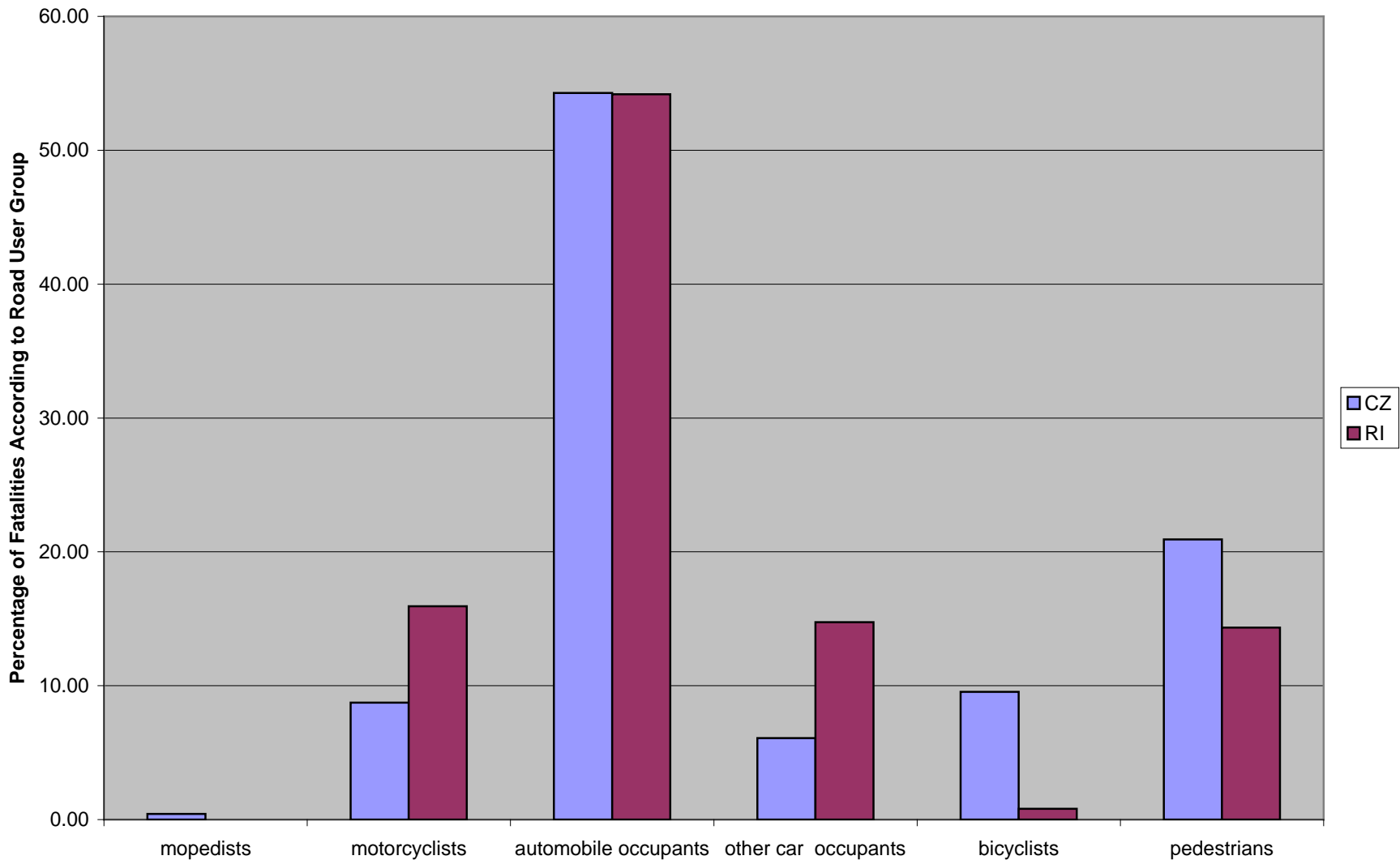
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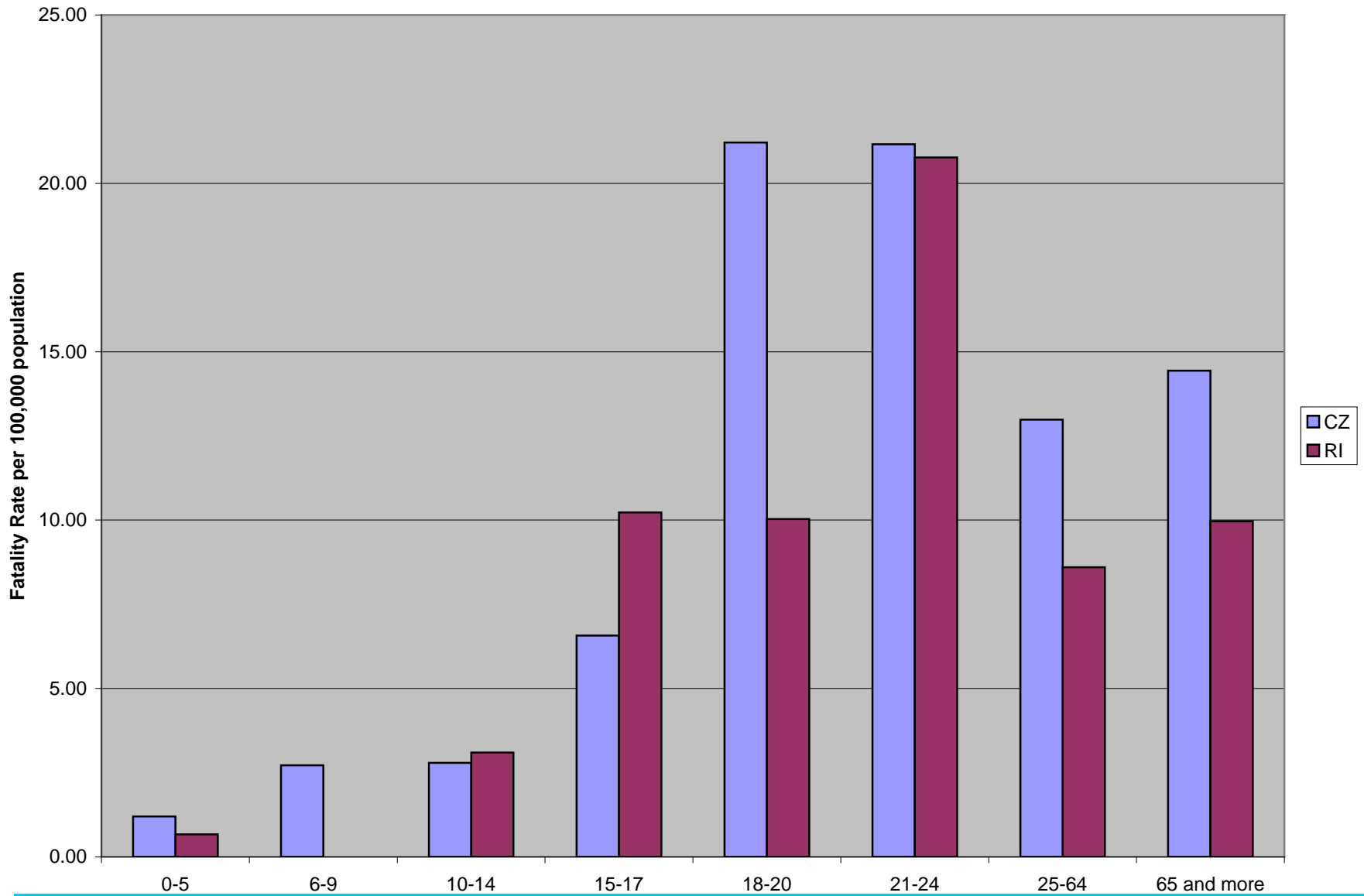
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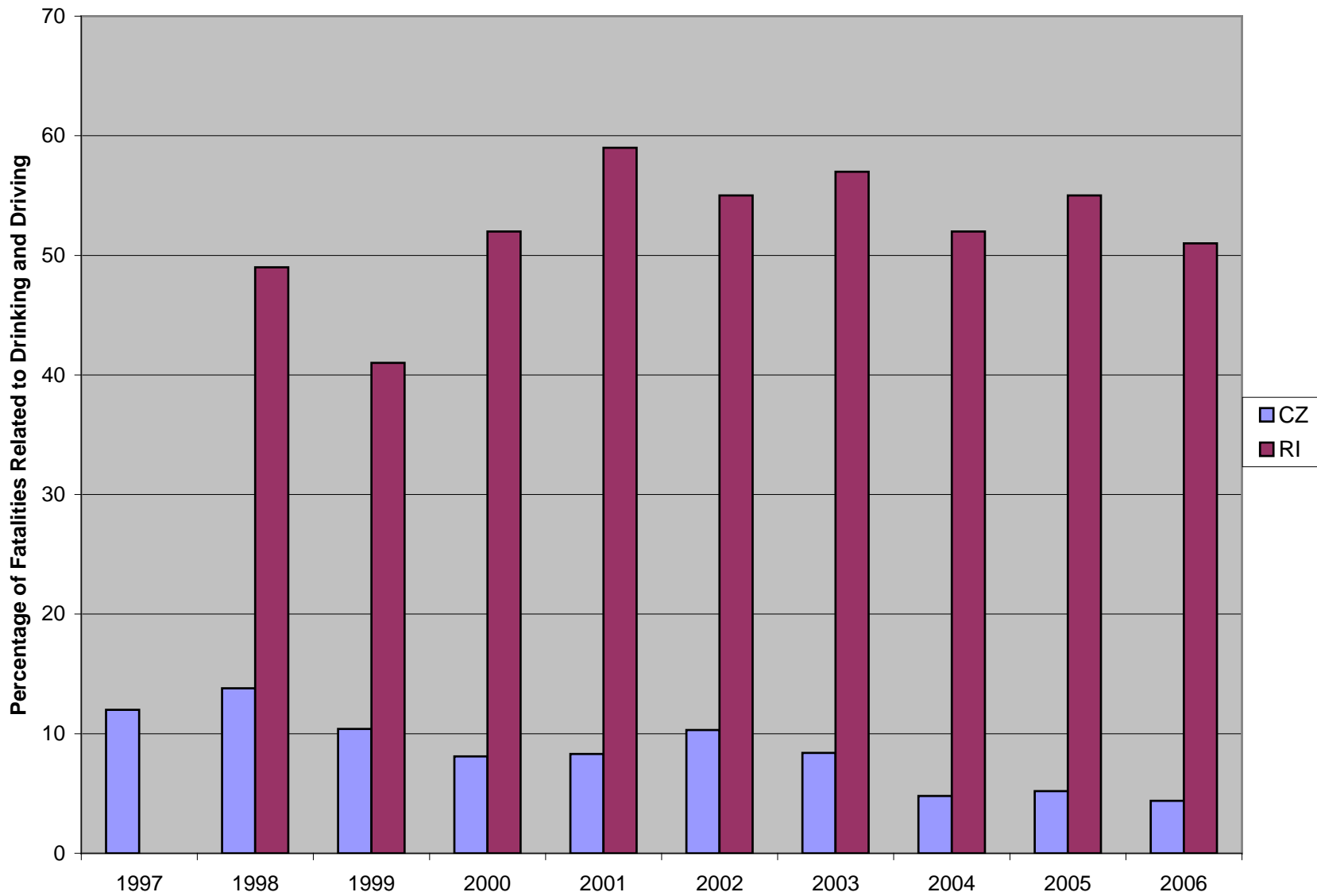
# Policy Comparisons

- 40 year overview of various policy enactments
- Changes in speed limit
- Seat belt regulations
- Motorcycle helmet regulations
- Child safety restraint laws
- Air bags
- Alcohol and driving – absolute numbers comparable between CZ and RI, despite population differences (CZ has a zero tolerance BAC limit while RI allows 0.08 BAC)

## DISTRIBUTION OF FATALITIES ACCORDING ROAD USER GROUPS







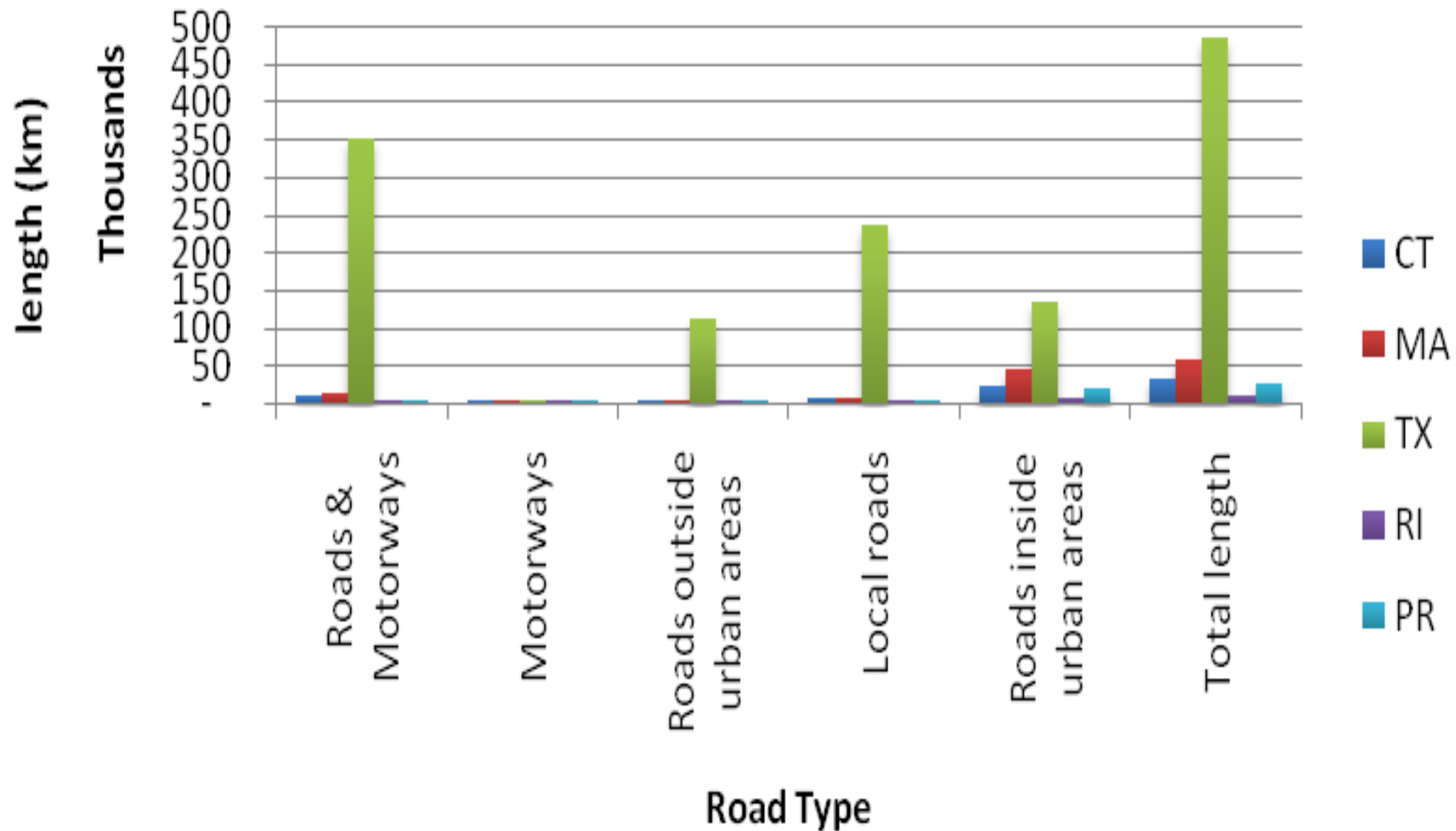
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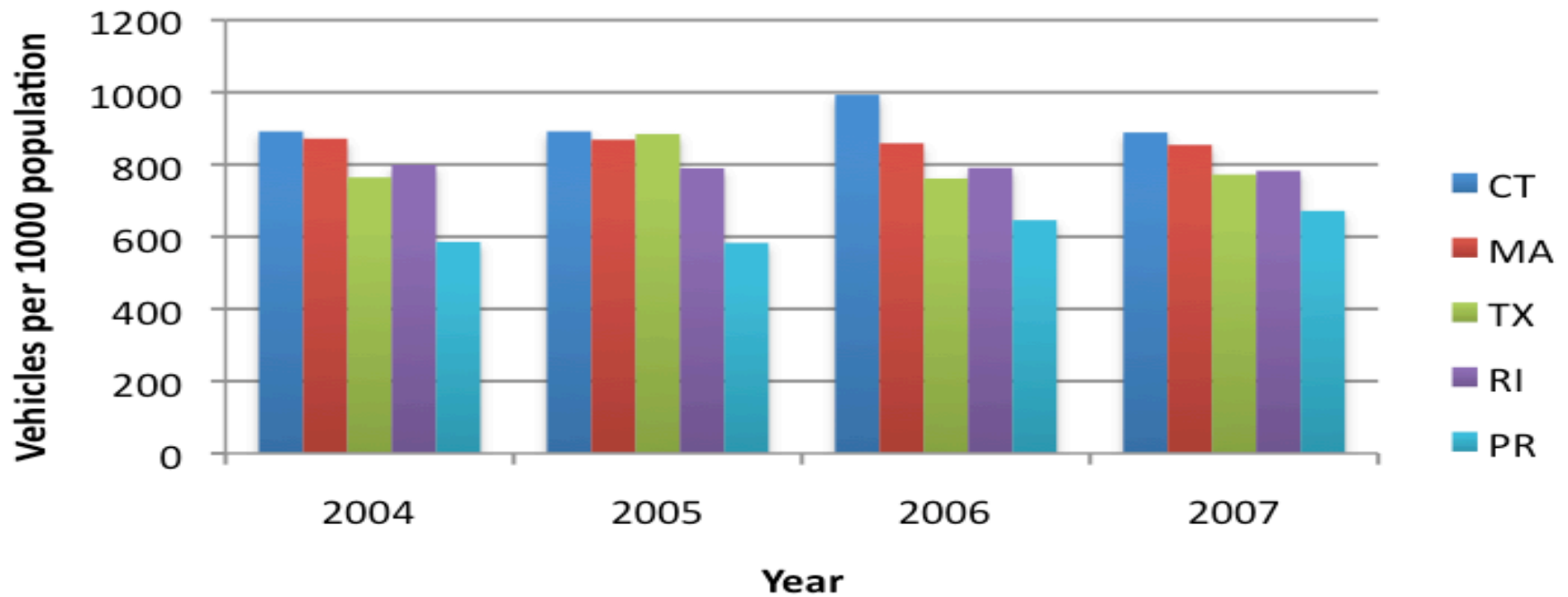
# SnowFlake II

- Comparison of 5 US states or territories
- Connecticut, Massachusetts, Rhode Island, Texas, and Puerto Rico
- 2004 – 2007
- New England Region vs Texas vs Puerto Rico

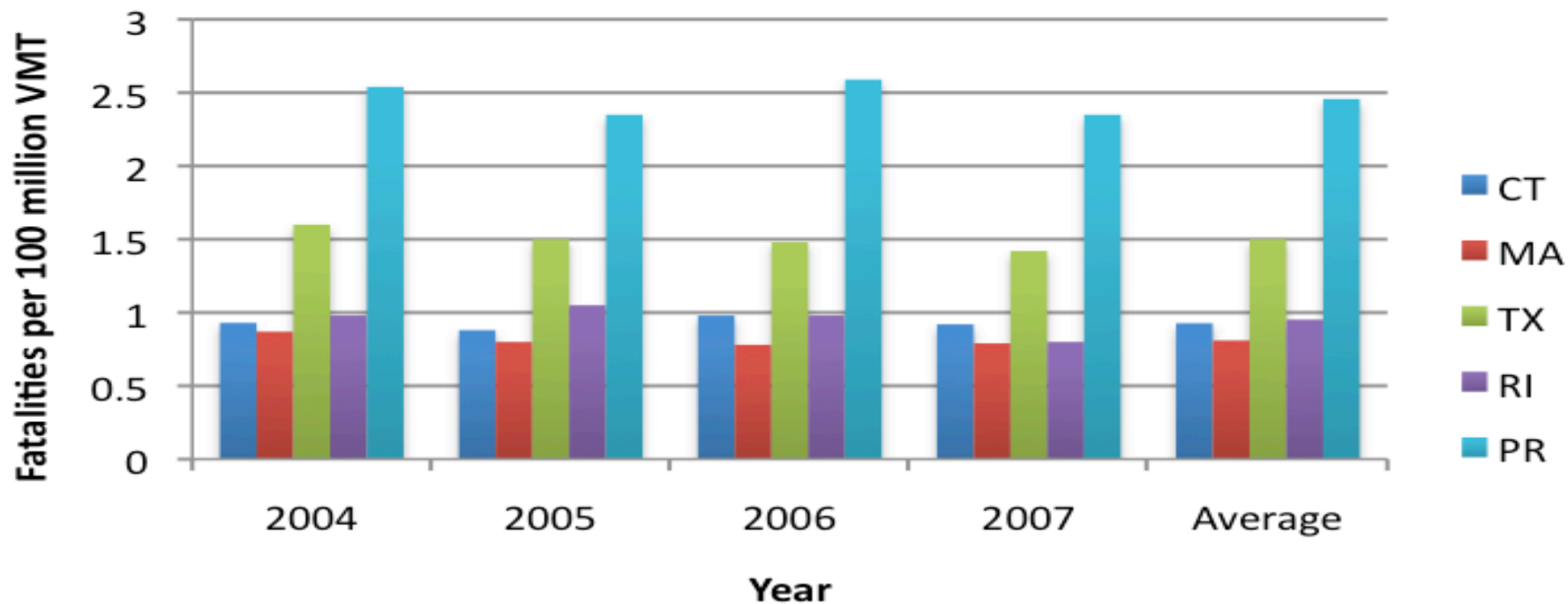
# Road infrastructure



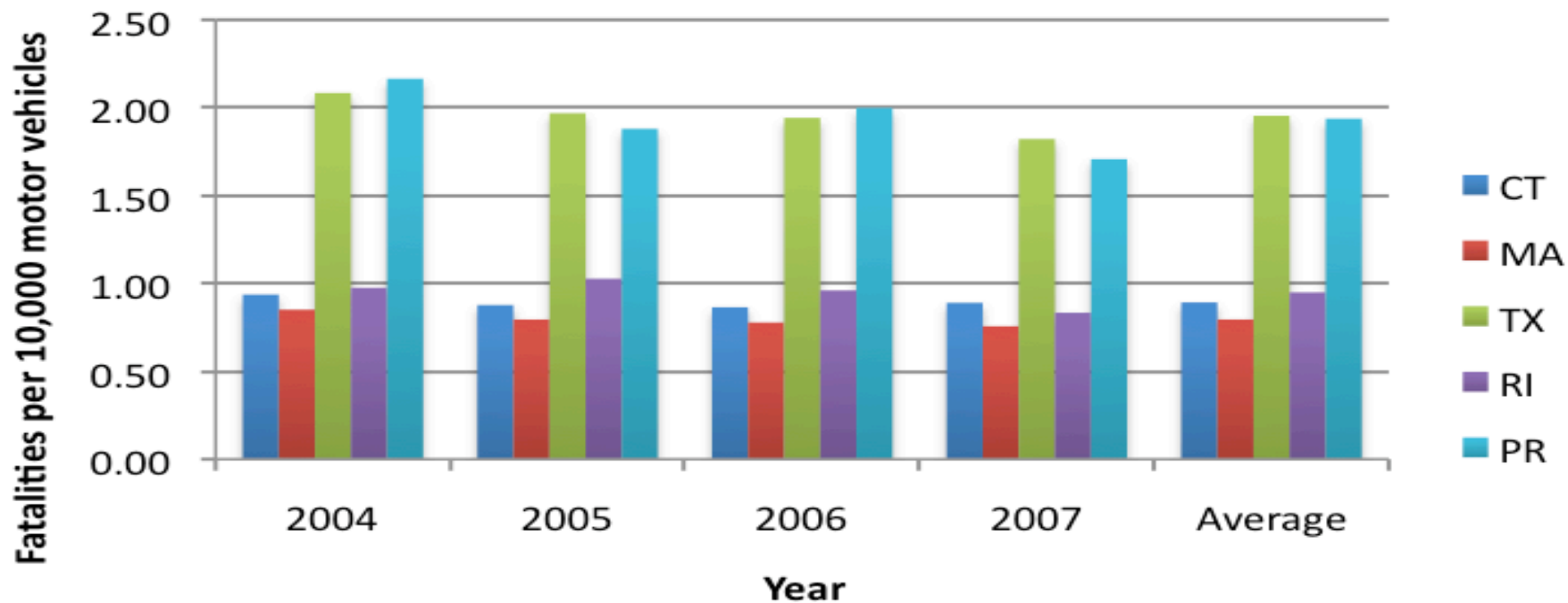
# Motorization



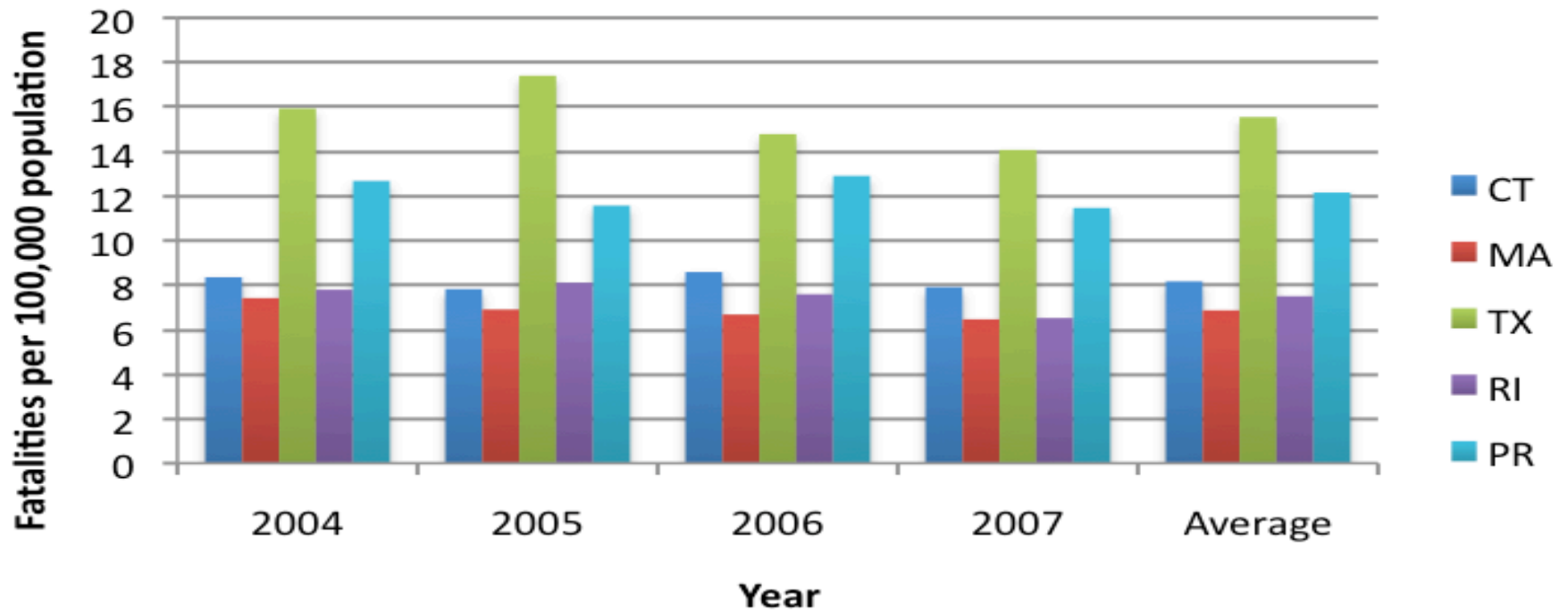
# Fatalities per vehicle miles traveled



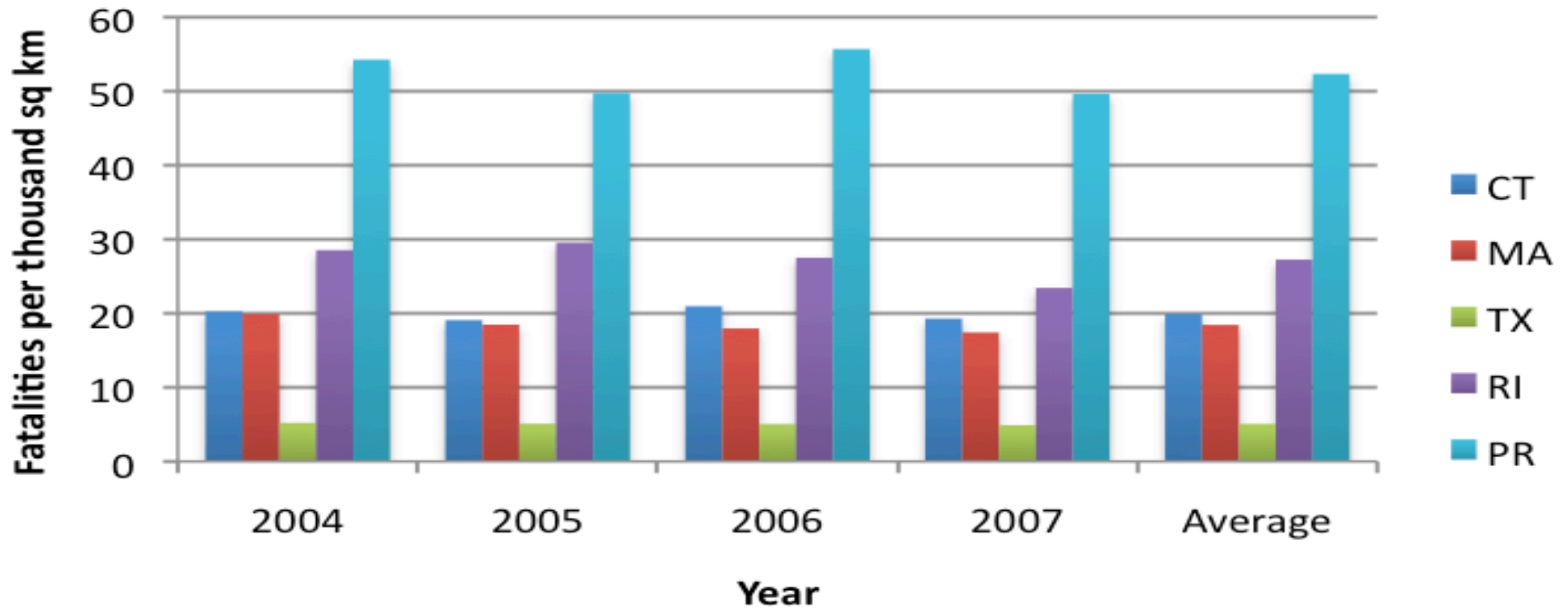
## Fatality rate



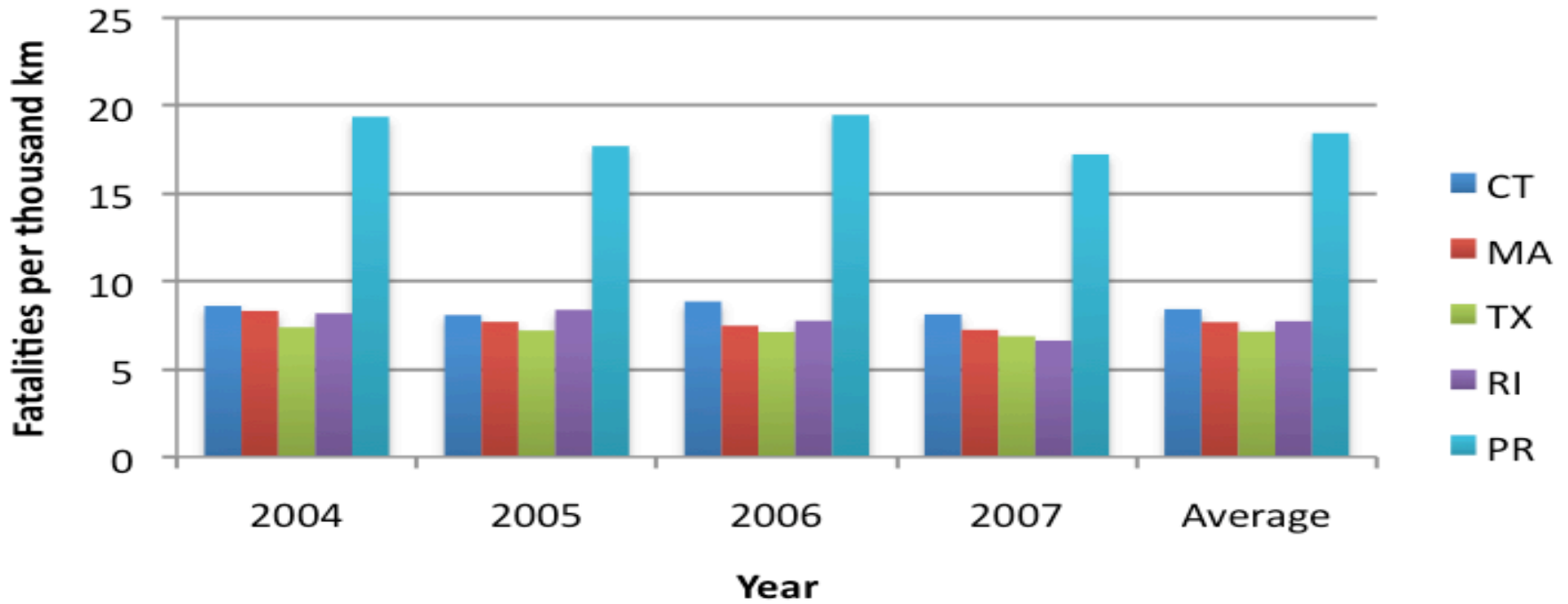
# Health risk



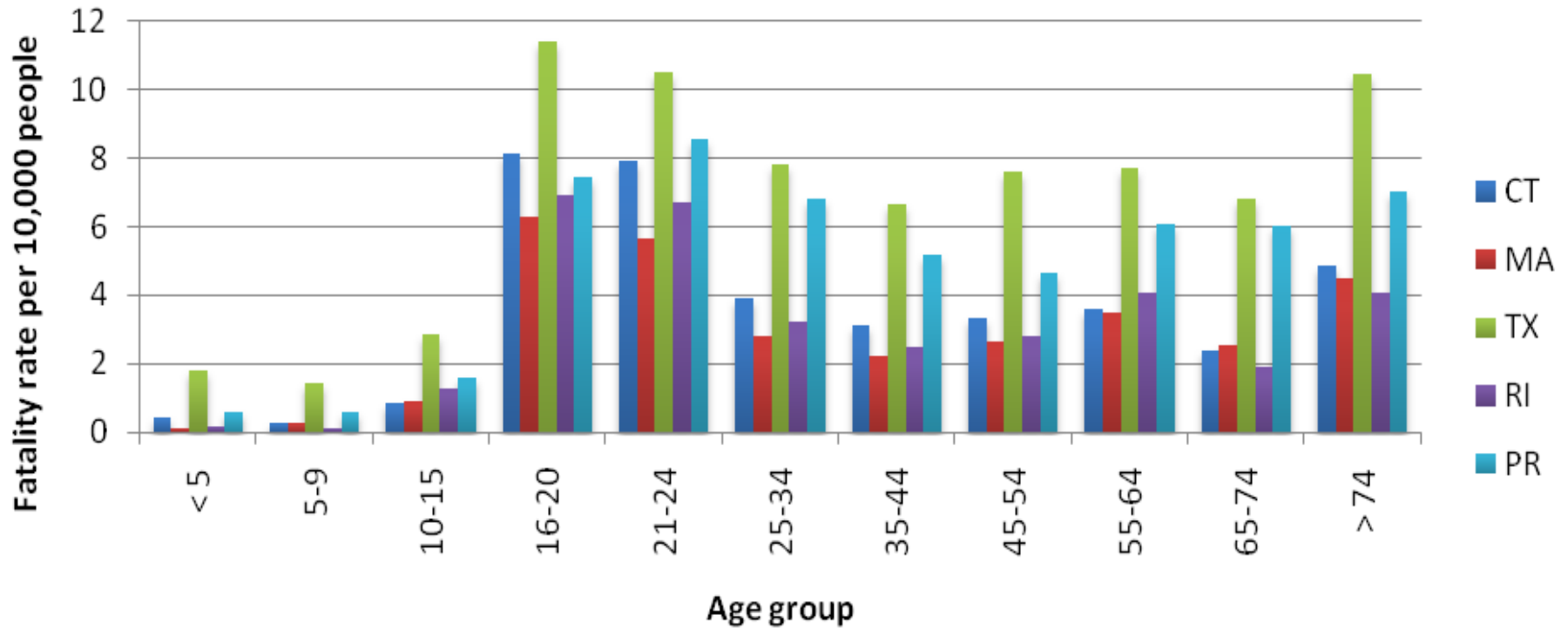
## Fatalities per area



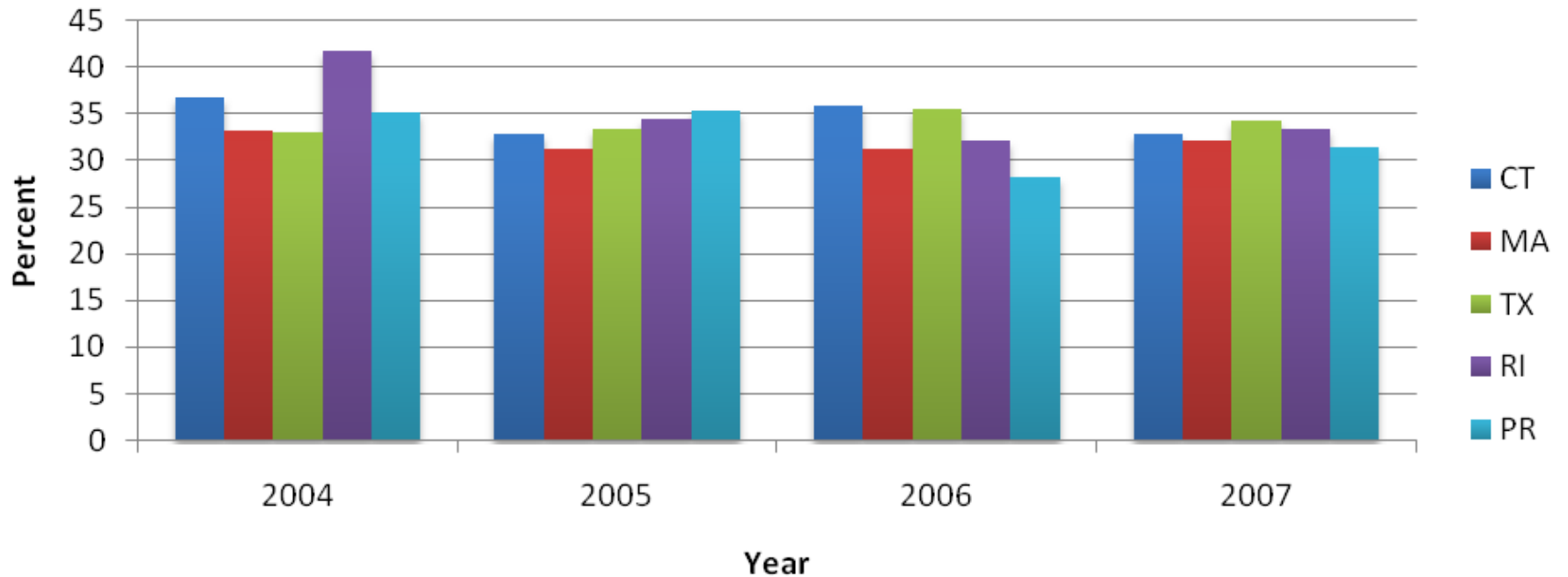
# Fatalities per road infrastructure



## Fatality Rate by Age Group



## DUI fatalities percentages by year

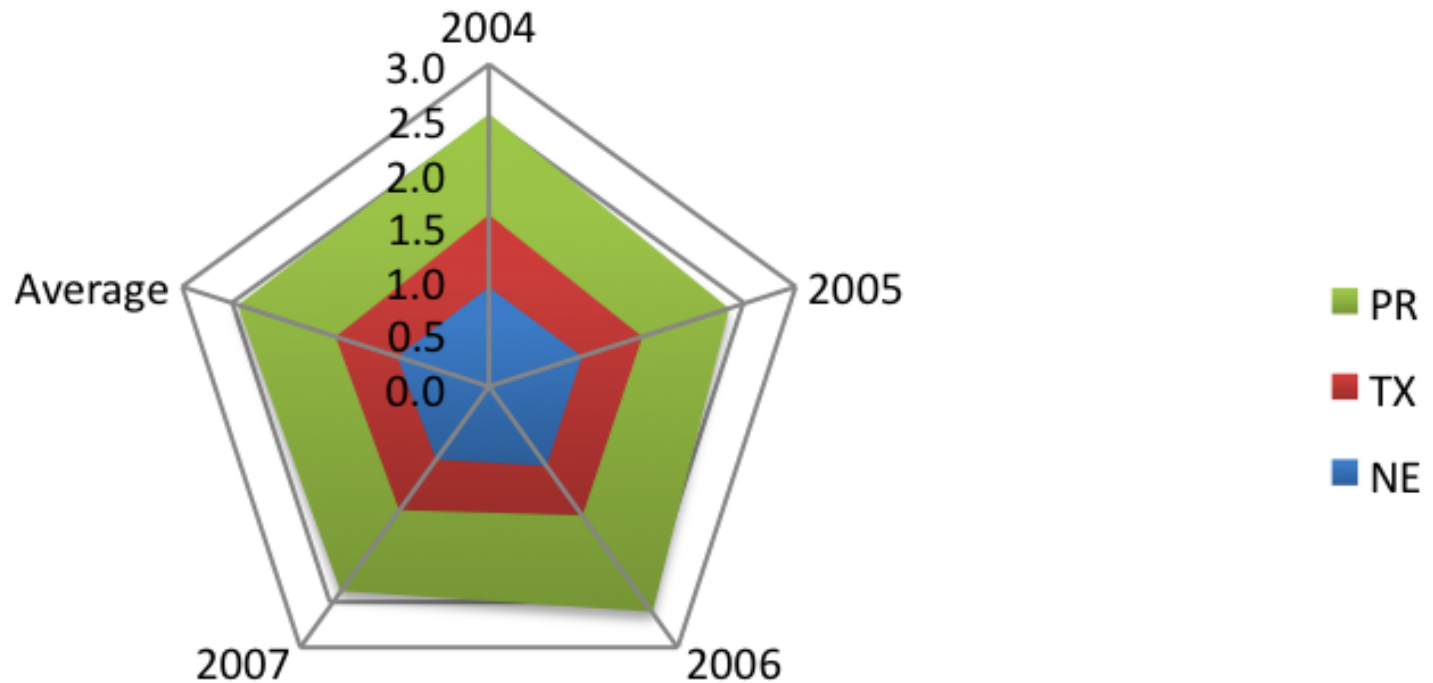


- Can individual states be combined into on New England Region

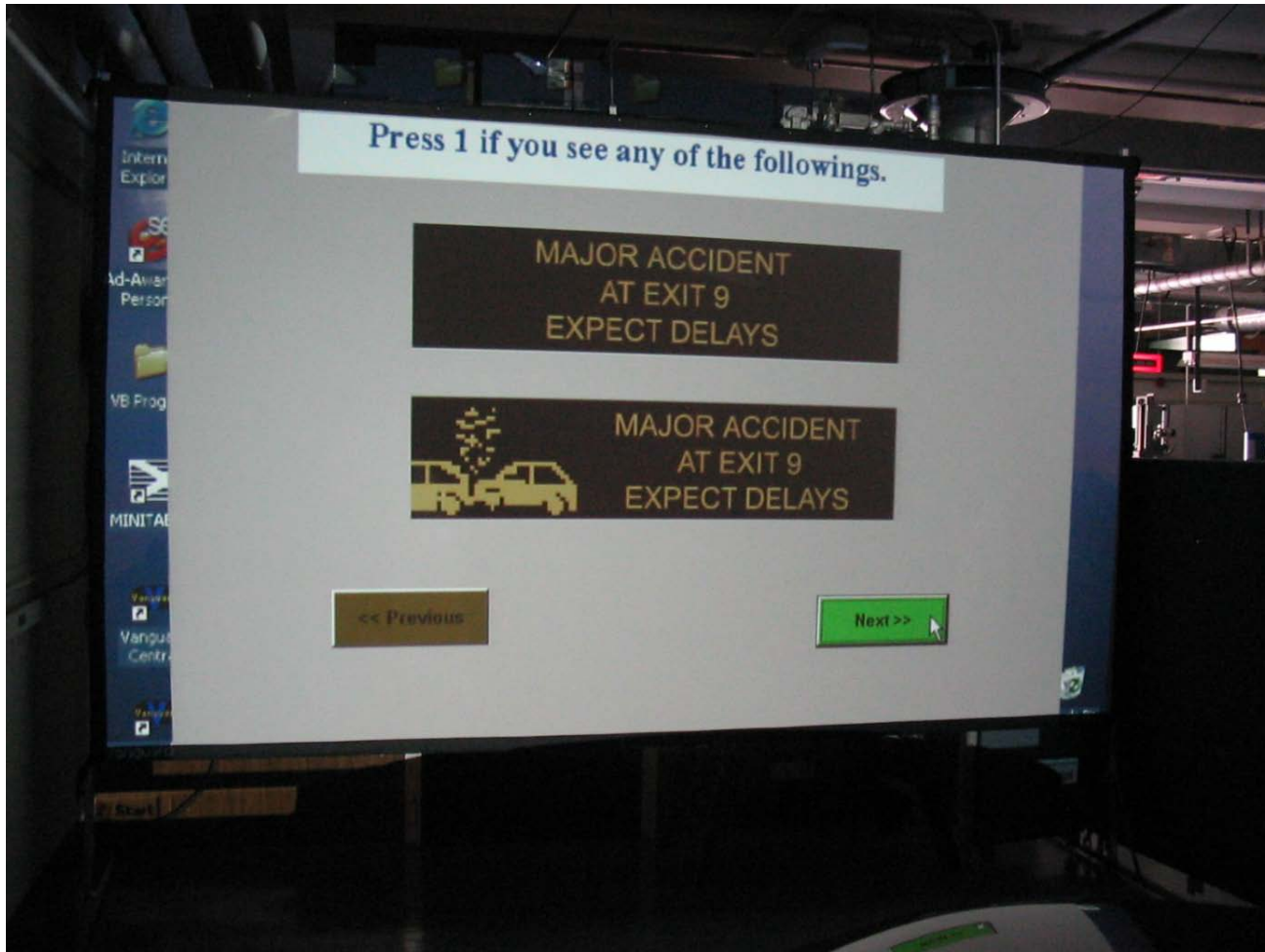
**TABLE 2 Comparison between individual New England states and southern New England**

	CT	MA	RI	NE
Fatality Rate	0.89	0.80	0.95	0.84
Health Risk	8.17	6.87	7.50	7.34
Per road infrastructure	8.41	7.68	7.73	7.93
Per area	19.90	18.44	27.26	19.58
Per VMT	0.93	0.81	0.95	0.90

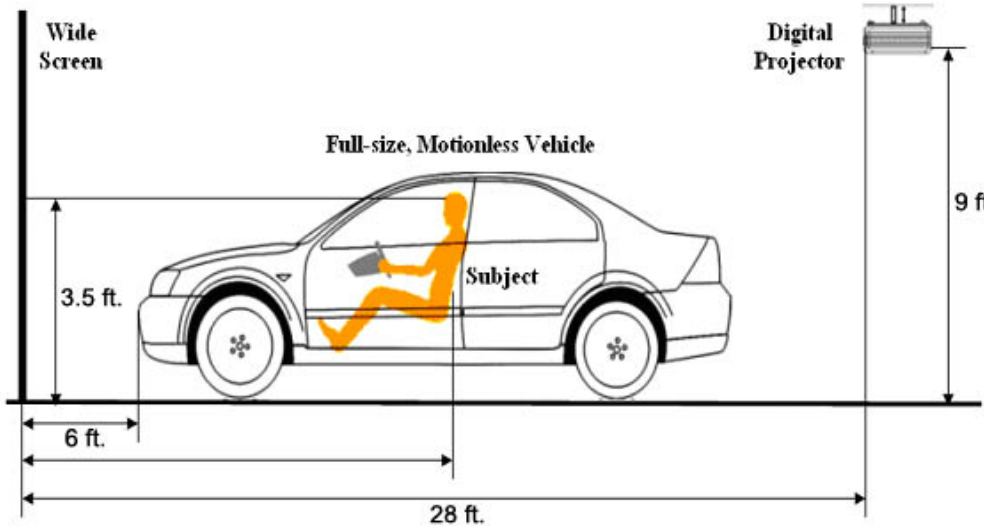
# Fatalities per vehicle miles traveled



# Photo of Passive Simulation



# Photo of Layout



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# Photo of Passive Simulation



# TRANSIM VS IV

## DRIVER TRAINING SIMULATOR

TranSim VS™ IV provides high-fidelity real-world driving environments that can be customized for various markets, including trucking, snowplow, bus, ready mix, fire, police, EMS and the military.



### KEY FEATURES

- 180° view using three-channel plasma screen Immersive driving environment combines look and feel of a real vehicle.
- State-of-the-art software delivers sharp visuals and crisp images to enhance learning objectives.
- Force-loaded steering provides real-time feedback to augment muscle memory in situations such as tire blowout or sloshing loads.
- Users can choose from more than 140 transmissions, 240 engines and 33 axle ratios.

# Capabilities of Active Simulation

- Functioning controls
- Truck and car mode
- Weather conditions
- Risk situations



Recognize and anticipate hazardous driving situations in difficult and common city environments.



Simulate environmental factors, such as adverse weather.

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# Future Work

- New URI TC project – Integrating Driving Simulation into Teenage Driver Education
  - Pilot study began Summer 2010
  - Four more sections planned for December 2010
- Further collaboration with Czech Republic – project funded by the American Science Information Center in the Czech Republic

THANK YOU

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- Eisenhower Summer Students from Puerto Rico: Alvin Nieves, Kelvin Chaparro
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- Rhode Island Department of Transportation
- Rhode Island Emergency Management Agency