

## IRF-IC Lecture Series: 6<sup>th</sup> Lecture

25<sup>th</sup> October 2023, IIC Annex, New Delhi

# When our roads are built following standards, why do accidents occur?

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# Built-in safety of a road

$$\text{Safety} = f(\text{Geometry})$$

$$\text{Geometry} = f(\text{Speed})$$

Therefore,

Safety is derived from the safer design (i.e. safe speed and corresponding safe geometry)

Road Safety Expert & Highway Design Engineer  
Must Understand an important fact.

**Safety can be built into a highway/ road, only if he/she understands Road Safety fully to be as a blend of art and science:**

**Art:** The understanding/ anticipating about how the road users are likely to be using the road

**Science:** Scientific methods/solutions to avoid potential crashes & their severity



Therefore, Safety in **Design** is to be provided by

Designing “**self explaining roads**” and “**forgiving road side**” by selecting the most desirable design standards (and **NOT the minimum standards**) involving the critical considerations for safety.

**Safety needs more than what is given as minimum standards**

# Safe Road Infrastructure

- To be designed safe (Safety engineering principles are to be adopted...)
- Safety audit to be conducted (not just eye-wash audits by so called auditors...)
- To be built and maintained safe
- The existing facilities **are used unsafely**, as they are not designed for safety; and these always invite for unsafe use

# Principles for Safer Road Design

- **A safe road environment should**
  - **WARN** for unusual features
  - **INFORM** of conditions to be encountered
  - **GUIDE** through unusual sections
  - **CONTROL** through conflict points
  - **FORGIVE** for errant behaviors
- **A safe road environment is one which provides**
  - **No surprises**
  - **Controlled release of relevant information**
  - **Repeated pertinent information**

# **Reasons for poor safety in a road network**

- **Design deficiencies**
- **Poor road user behaviour (indiscipline)**
- **Weak enforcement**

**The consequences are seen in our accident/crash data year after year**

**Table 1.1: Total number of Accidents, Fatalities and Persons Injured during 2016 to 2021**

Year	Accidents	% change over previous period	Fatalities	% change over previous period	Persons Injured	% change over previous period
2016	4,80,652	-	1,50,785	-	4,94,624	-
2017	4,64,910	-3.28	1,47,913	-1.9	4,70,975	-4.78
2018	4,67,044	0.46	1,51,417	2.37	4,69,418	-0.33
2019	4,49,002	-3.86	1,51,113	-0.2	4,51,361	-3.85
2020	3,66,138	-18.46	1,31,714	-12.84	3,48,279	-22.84
2021	4,12,432	12.64	1,53,972	16.9	3,84,448	10.39

**\*2022**      **500,000**      **180,000 ???**      **600,000**

Let us hope it is not like these

**\* Intuitive Projection**

Source: Road Accidents in India 2021, MoRTH, GoI

# Road Accident Deaths to **Two-Wheeler Riders**

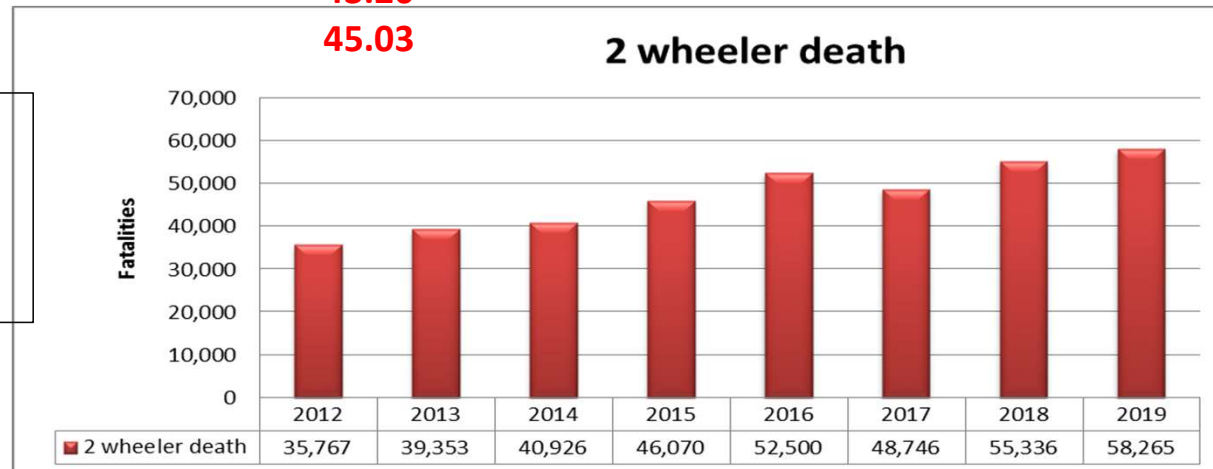
Road Accident Deaths to Two-Wheeler Riders		
Year	2-Wh Road Deaths	% share of total road deaths
2012	35,767	25.9
2013	39,353	28.6
2014	40,926	29.3
2015	46,070	31.5
2016	52,500	35.4
2017	48,746	32.9
2018	55,336	36.54
2019	58,265	38.55

**2020**                      **56,873**  
**2021**                      **69,385**

**43.20**  
**45.03**

**During last 20 years, more than 25 lakh people died in road crashes and another 7-10 million people injured, and a major group of whom might be left disabled for life**

Source: Ministry of Road Transport and Highways, India





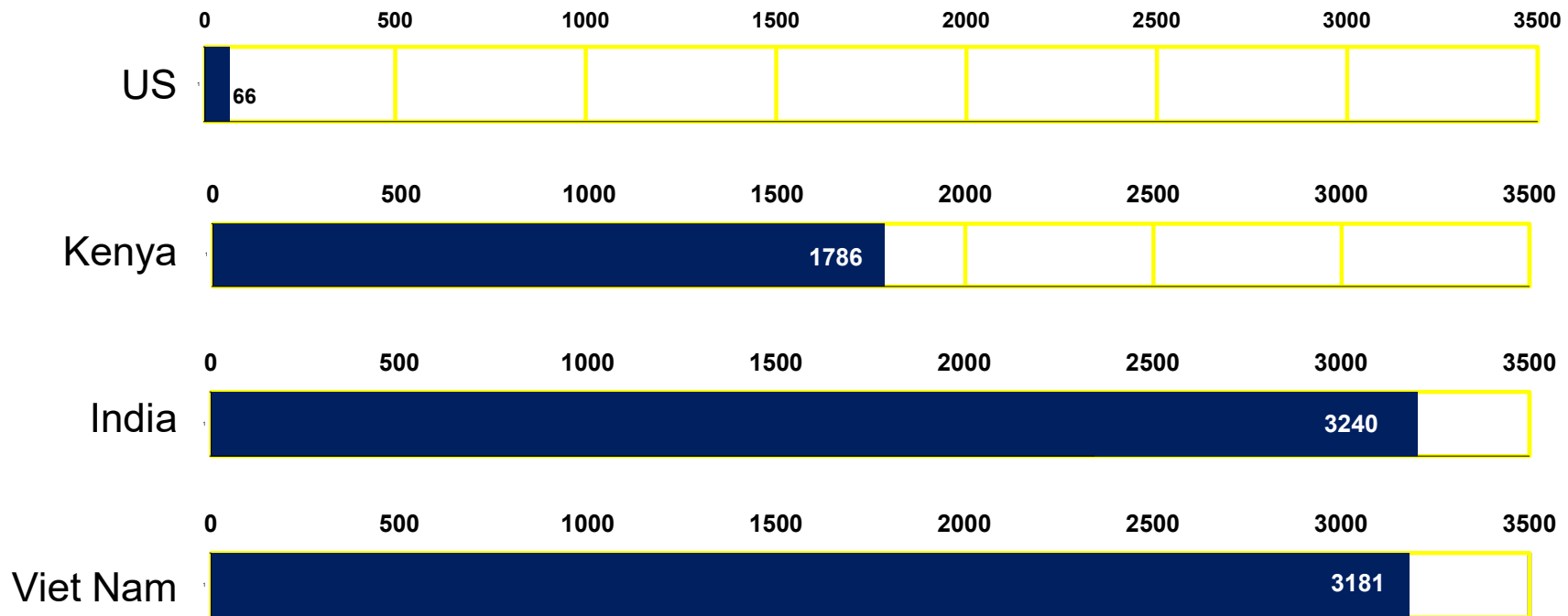
# Road Accidents..... *A Silent Disaster*

<b>Disaster (Natural and Man-made)</b>	<b>Death</b>	<b>Injured/Affected</b>
Bhopal Gas Tragedy, India, Dec. 1984	20,000	530,000
Latur (Killari) Earthquake, India, Sep. 1993	9,000	20,000
Orissa Super Cyclone, India, Oct. 1999	20,000	NA
World Trade Centre ( 9/11), USA, Sep. 2001	3,000+	NA
Bhuj (Kuchch) Earthquake, India, Jan. 2001	13,800	166,800
Asian Tsunami, many countries, Dec. 2004	245,000	1.0 million
Sichuan Earthquake, China, May, 2008	90,000	375,000
Haiti Earthquake, January,2010	2,25,000	23,00,000
Uttarakhand floods,India,June,2013	5,700	100,000 (missing)
Nepal Earthquake, April 2015	9000+	23000+
Hurricane Matthew, USA, October , 2016	1200	-
Monsoon flooding in Bangladesh, and Nepal, September , 2017	1200	4 Million (Affected)
Tsunami and Earthquake (Sulawesi island Indonesia) September 2018	2783	330,000 (Affected)
<b>Corona Virus: Covid-19 Pandemic</b> (up to 25 Oct. 2023) in India	<b>532,037</b>	<b>45 million</b>
<b>Road Accidents (India), 2021</b>	<b>1,53,972</b>	<b>4,12,432</b>

# Fatality Rates

Fatality rates are higher in developing countries

Fatalities per 10,000 crashes





# 'The main reasons for accidents are faulty road engineering, bad junction design, inadequate signage and road markings'

*Union road transport and highways minister Nitin Gadkari is passionate about enhancing road safety standards and simultaneously expanding the road network. He shares his ideas with Dipak Kumar Dash:*

■ **A total of 140 countries including India recently adopted a resolution to halve road deaths in the next 10 years. How do you see India's role in achieving this target?**

It's very unfortunate that we top the list of countries in road fatalities. Recently, I came to know that 578 people die every year in road accidents in my district, Nagpur, alone. Now we have decided to engage engineering colleges to identify deficiencies in road design and we will rectify them. We will extend this to all parts of the country. We have to put proper road and lane markings and signage while focusing on enforcement of traffic rules. Nearly 70% of people dying on our roads are young; we can't afford to lose them.

■ **What is the impact of the amended Motor Vehicles Act?**

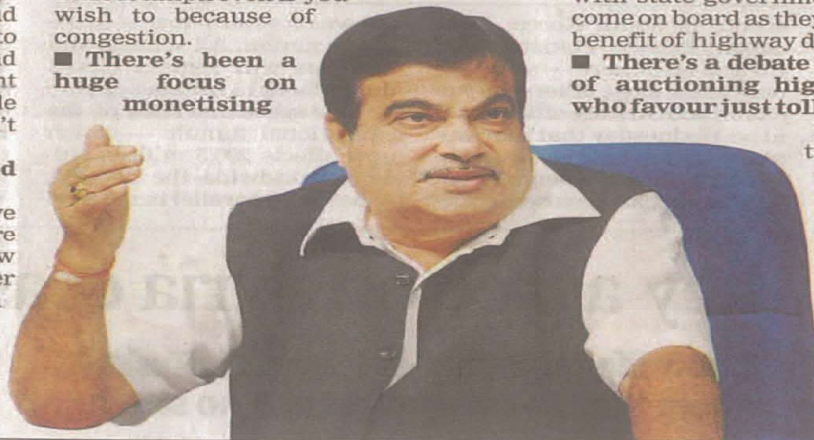
To my knowledge, most states have accepted and implemented the law. There are some issues with the fines. But the law gives ample powers to states to fix lower fines (within the permitted range) for a number of offences. If states are keen, they can save more lives. If Tamil Nadu could bring down deaths by 24% in one year by taking right steps, why can't others do it? We can follow that model

across states. I am sure the impact of the revamped MV law will be visible across the country in the next two years.

■ **Road safety advocates pushed for slowing down, capping speed at 30 kmph on stretches where there is mixed traffic. How do you look at it?**

To single out speeding as the reason for accidents and deaths is not a correct approach. The main reasons are faulty road engineering, defective DPRs (detailed project reports), bad designing of junctions, inadequate signage and road markings. In countries like Germany and the US, the speed limit is more on highways, but they have fewer fatalities. So far as the city traffic in our country is concerned, you can't drive at more than 40 kmph even if you wish to because of congestion.

■ **There's been a huge focus on monetising**



**assets. What is NHAI's plan?**

NHAI has sent a proposal for land monetisation. Once highways are built, land cost along the road increases manifold. But we don't get any benefit of this. So, we are working on a model to create land banks along highways, which can be commercially exploited to fund building of new stretches and for expansion of existing roads. Recently, the cabinet approved a proposal to give authority to major port trusts for development of land under their jurisdiction. Similarly, there is a need to see whether we can make NHAI the development authority for stretches along the NHs (national highways). We want to work with state governments. States need to come on board as they reap the maximum benefit of highway development.

■ **There's a debate between advocates of auctioning highways and those who favour just toll collection.**

Every initiative has two sides. People say we need to get foreign investment in infrastructure and highways are a prime sector to attract such investment. The auctioning, which is called toll operate transfer (TOT), is being done

keeping in mind the fund requirement for highway development programme and after considering the best viable options.

■ **Hasn't bidding out highway projects slowed down this year?**

We will be close to meeting the target by March end. A false narrative was created last year by different people about the financial health of NHAI and that impacted the pace of award of works. There is no financial problem; NHAI has potential to execute more work.

■ **How do you look at the revival of private investment in highways sector?**

Public-private-partnership (PPP) won't work for some more time. We have to roll out more projects on EPC (engineering procurement construction), which is 100% government funding. We are trying to address the concerns of private players to revive their interest in the sector.

■ **You advocate waterways and railways as best modes of transportation. Then, why do we continue investing more on highways?**

We have high volume of vehicles on our roads and that has happened over the years. There will be chaos, if we don't expand our roads to meet the immediate requirement. However, we have made good progress in development of waterways for transportation. There have been some successes and some failures. I tried my best to introduce seaplanes, but could not succeed.

Q&A



TOT  
22.1.18

# 'I am hopeful of the daily highway construction reaching close to 40 km a day by next year'

*Nitin Jairam Gadkari is Cabinet Minister in charge of transport through roads, inland waterways, shipping and also in charge of rejuvenating river Ganga. He talks to Dipak Dash about his plans for India's infrastructure:*

## ■ What is your target for 2018-19 in the highways sector?

We have pushed both award and construction of highways. I am hopeful of the daily highway construction reaching close to 30 km by the end of March. By next year I am hopeful of taking it close to 40 km a day, which I had set as target. Undoubtedly, it's an ambitious target. But high target was set to achieve maximum progress.

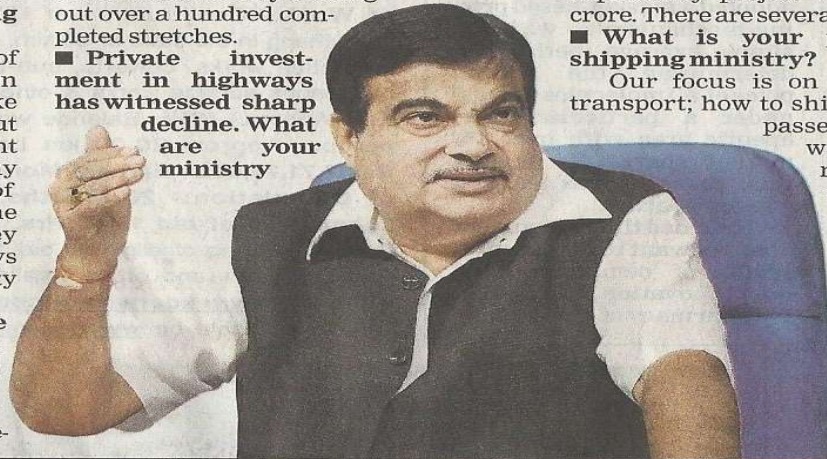
## ■ You had also set a high target for award. Don't you think government should focus more on building high quality roads rather than tendering projects?

We have a high target for award of works. I agree that much of stress on award doesn't help if we don't make adequate land available for carrying out works. We are unable to give appointment date (official start of work) for many projects because of non-availability of land. We need a lot of support from the state governments to acquire land. They must help us as construction of highways helps them by improving connectivity and pushing economic activities.

## ■ Every state you visit, you announce big investment in highway sector. Do you keep track and what are the funding sources?

All announcements made for highway development are part of the plan already prepared by my ministry. We have enough sources to get funds for undertaking works. National Highways Authority of India (NHAI) has about Rs 10,000 crore as annual revenue from toll collection. Budgetary allocation for highway construction has increased substantially in the past three years. I am expecting an increase of Rs 25,000 crore during 2018-19. The government has given us permission to raise Rs 70,000 crore through bonds. We will issue more bonds to fund projects. We will also auction completed projects for fixed years to private players under Toll Operate and Transfer (TOT) model. The operators will pay us upfront and recover the amount by collecting toll. They will have to maintain the road and charge toll as decided by the government. We can get up to Rs 1 lakh crore by bidding out over a hundred completed stretches.

## ■ Private investment in highways has witnessed sharp decline. What are your ministry



## and NHAI doing to revive it?

We came out with a Hybrid Annuity Model (HAM) which de-risks private investment in the sector. We are getting good response. The TOT projects I talked about will get investment from private sector and big global firms are keen in these projects. We are confident of bidding out the first tranche of completed projects next month. It will be a test case. As we bid out more such projects, more private investment will flow. We will use that fund for undertaking more works.

## ■ How much investment or expenditure do you foresee in the highway sector in the next few years?

We will easily see more than Rs 10 lakh crore investment. Mumbai-Vadodara expressway project will cost Rs 44,000 crore. There are several big projects.

## ■ What is your priority in the shipping ministry?

Our focus is on promoting water transport; how to shift more cargo and passenger movement to waterways from roads and rail. We are working hard to complete the work to make National Waterway-1 (Haldia to Varanasi stretch of Ganga) navigable round the year. This project costs approximately Rs 6,000 crore.

We are also working on a project to maintain minimum two metre draft in the Ganga between Allahabad and Varanasi so that barges can ply between these two cities during the Kumbh Mela. Shifting a large number of people from using roads to taking waterways will reduce congestion and vehicular pollution as well. Sagarmala, the flagship programme under shipping ministry, has potential for about Rs 15 lakh crore investment.

## Q&A

## ■ How much is the system responsible for delays?

There are obstacles in every field. To give an example, we built a multi-level car parking at Transport Bhawan to address parking issues. It took us one-and-a-half years to get approvals and clearances from different agencies. One can imagine how many obstacles common people face in getting things done.

## ■ You believe the one field where success is insignificant is road safety. What is the way ahead?

We are losing more than 1.5 lakh people every year and another 5 lakh are left injured in road accidents. These are not just numbers, but people and their families. We need to have a robust law and proper enforcement. We have introduced the Motor Vehicles Amendment Bill in the Parliament with adequate provisions. Passage of the law will set the ground. But what remains crucial is objective enforcement of the laws by states and police. The fear of getting caught every time for violating traffic and transport rules will bring the change.

**But, let us build only safe roads**









KEEP LEFT FOR BHALE!  
भारत के लिये बाँचे रहे  
गाँवों में सही जगह राहें









Photo: Vinay K. Suresh

Rajahmundry Dharmavaram Road Project on NH-5





Some of them have glaring problems

- Unattended design deficiencies...
- Implementation flaws/Network management deficiencies....
- Road use behaviour (absence of enforcement)...

**With Malice to None....**



Consistency in Design Essential



Improperly designed entry ramp



**Intersection of village road not  
designed for safe geometry  
(... this could be pointed out by audit)**





Geometry for a high speed road!!!







Geometry for a high speed road!!!

08.04.2006

Level difference between the two carriageways

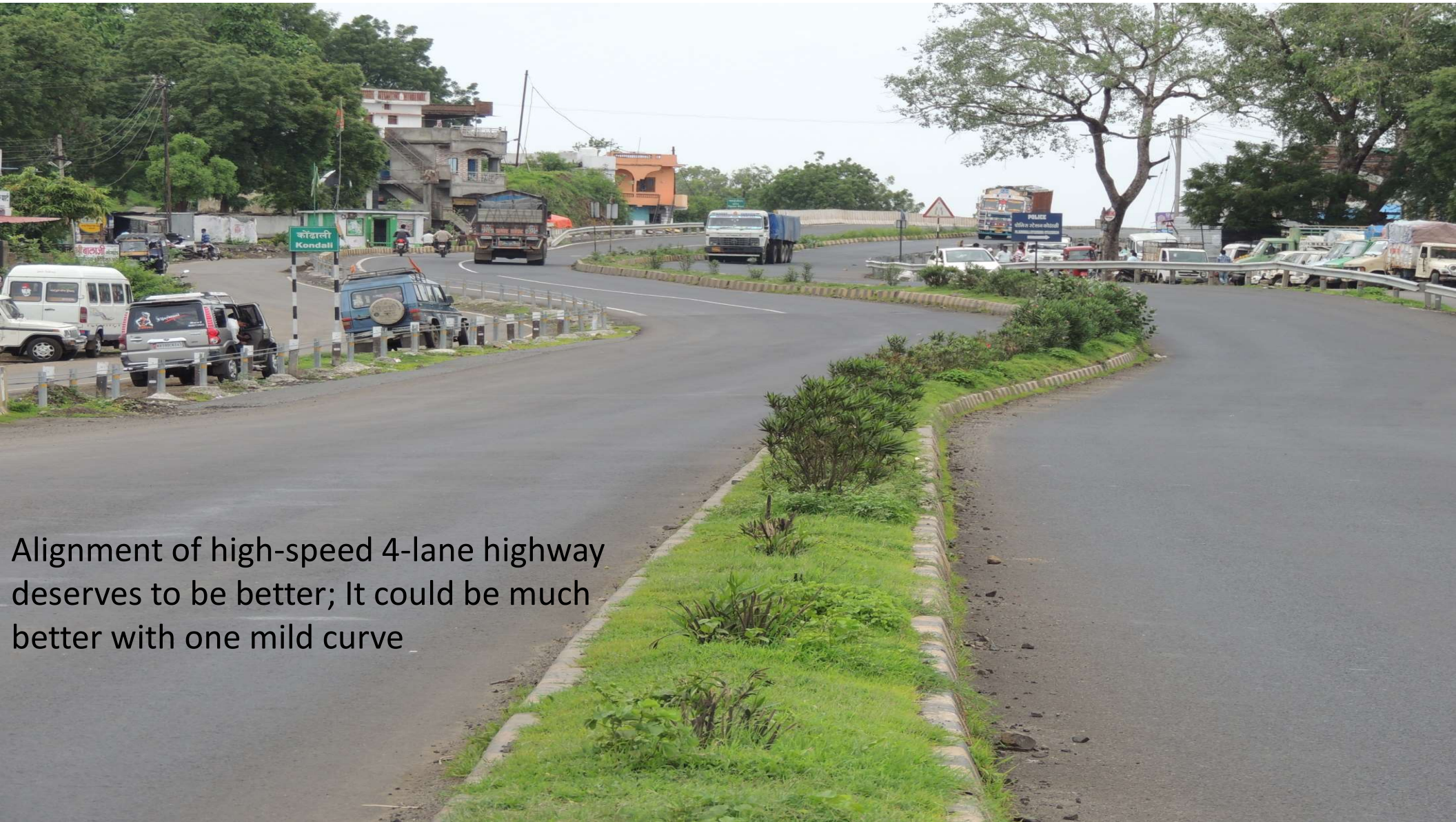




# Deficient design and Implementation of road junctions







Alignment of high-speed 4-lane highway deserves to be better; It could be much better with one mild curve





**Erroneous channelisation**



## Pedestrians required to cross a 6-lane wide road



Ill designed roundabout...





# Incompetent Design of Signage



**Innovation by Road Authority...**











**Protection of Median; Dangerous for Motorist**

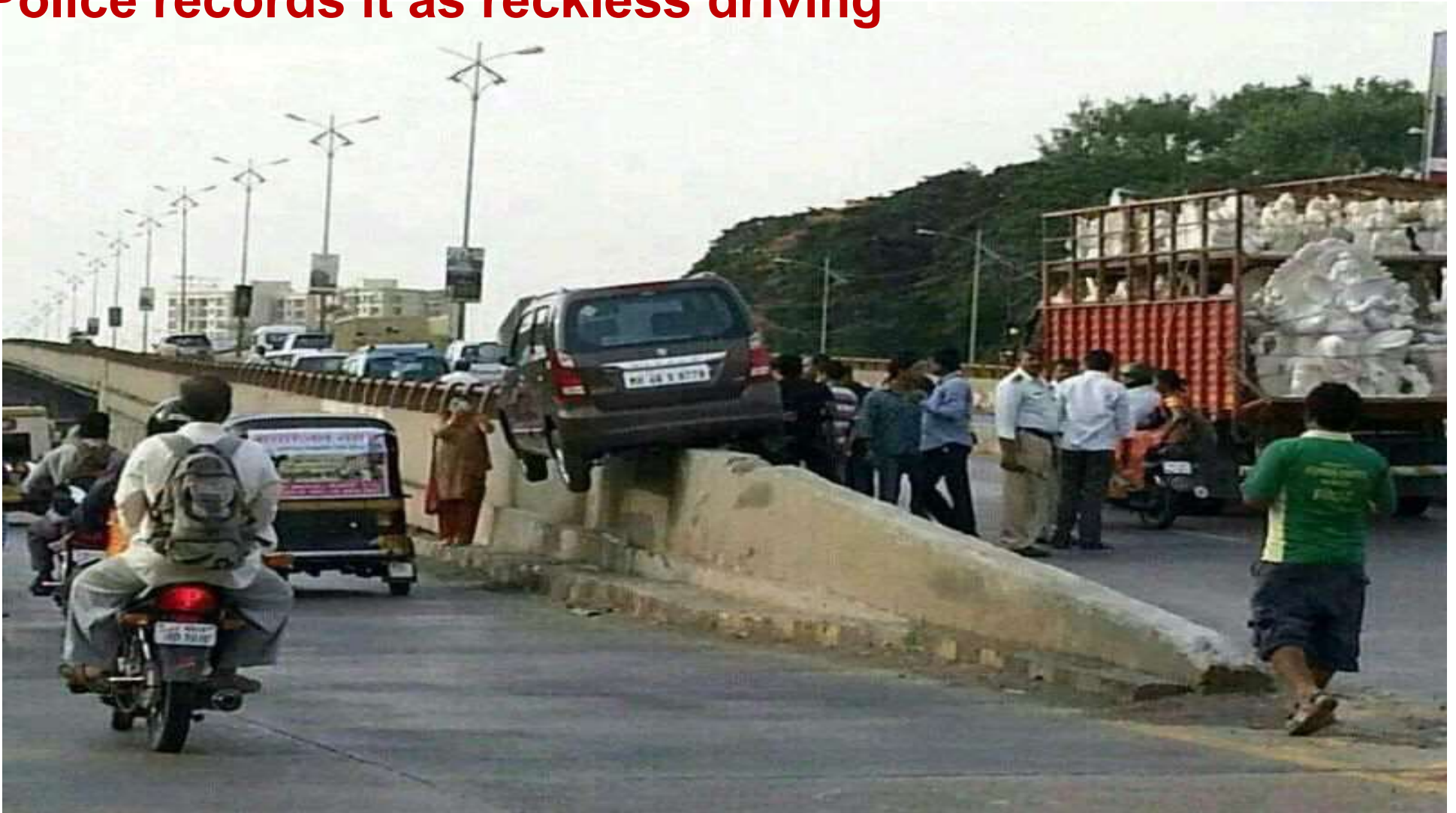
**Implementation/Maintenance Problems....**



**Police records it as reckless driving**



## Police records it as reckless driving





# Traffic Signs (Chevron signs)





Closely spaced chevron sign for the curve; New guidelines should be followed for spacing based on speed and curve radius





Non-standard median opening; serious hazard for all





Serious hazard for smaller vehicles,  
who use the paved shoulders generally





**Crash barrier: no transition and not connected...**





## Hanging crash barrier (Not Fixed) and Without Transition



Crash barrier behind the kerb and will have no purpose served





**Pedestrian cross-walk  
marked in wrong place**



# Pedestrians Facility





Figure 6.1



Surya River Bridge

Figure 6.2



**Surya River Bridge**



# **Unsafe Road User Behaviour....**

# Risky Behaviour



**7 people on a M/C**



Enforcement absent; non-motorised traffic violation





**Unsafe Use of Vehicle: On inter-city roads**





**Unsafe Use of Vehicle: In Urban**



Carrying animal on a motor cycle





**Dangerous Ride on Public Transport**

**Consequence is very serious**





I WANNA PLAY... BUT I CAN'T



- ▶ Millions of People suffering permanent disabilities

**IS THIS FAIR TO OUR YOUNG GENERATION ? ?**

# **Enforcement on Highways....**



# **NHAI upgrades ATMS standards deploys AI to enhance road safety and digital enforcement (19<sup>th</sup> Oct.**

**2023)**  
Updated policy to implement upgraded and forward-looking Advanced Traffic Management System (ATMS) Standards and Specifications 2023

Digital enforcement using VIDS (Video Incident Detection System), which has capability to detect 14 different types of incidents

**Till date there is no single road having complete automated enforcement system (ATMS), while every PPP project has this component as part of the project to be implemented**

**Main issue is that we do not know our  
road safety problem....**

**What we cannot measure,  
we cannot manage...**



We can see only the tip of the **Iceberg**



# The problem is much bigger than we think (what we know is just tip of the iceberg ?)

Many injury and damage only accidents are not recorded in police statistics

5-10% ?

Where crash data is available

1:15:70

- Unreported major/minor injury accidents could be as high as 1,500,000/year ?

International

**1 death : 85 injuries**

Unreported damage only crashes could be over 2,000,000/year ?

**India  
1 : 3**

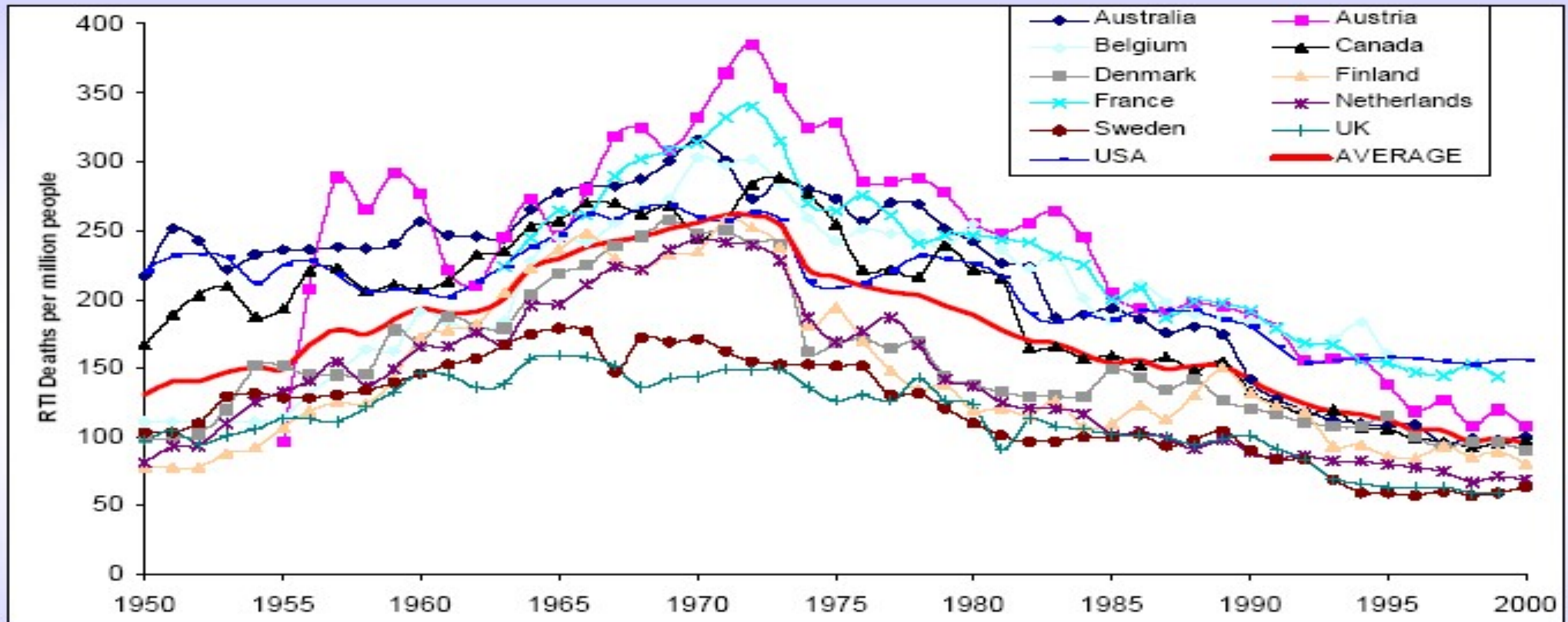
**As per 2019 Data  
Deaths = 151,113  
Injuries = 451,361**





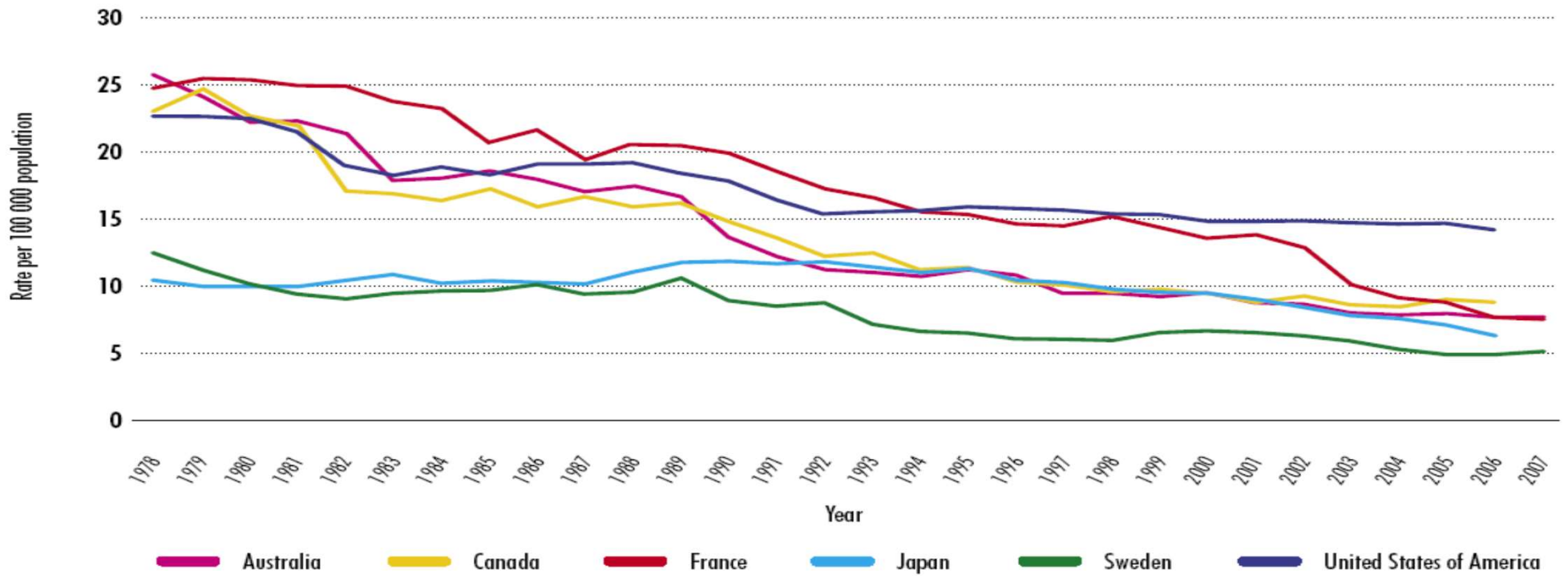
**Western and Rich Nations had the  
Similar Road Safety Problems in  
1960s, as we have now....**

## History of RTI death rates in rich countries





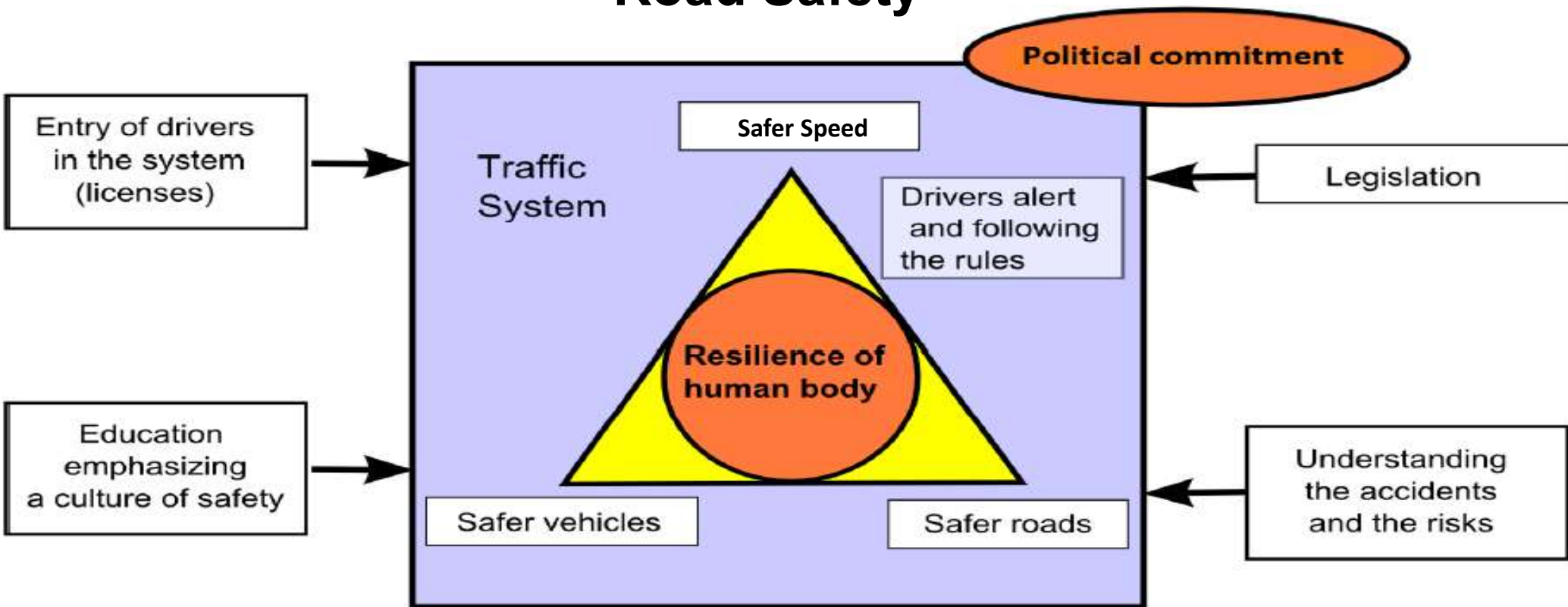
# Trends in Road Traffic Fatality Rates in Developed Countries



**Rich nations embraced “Safe  
System Approach”**

**They did not focus only on  
blackspots...**

# Safe System Approach for Road Safety



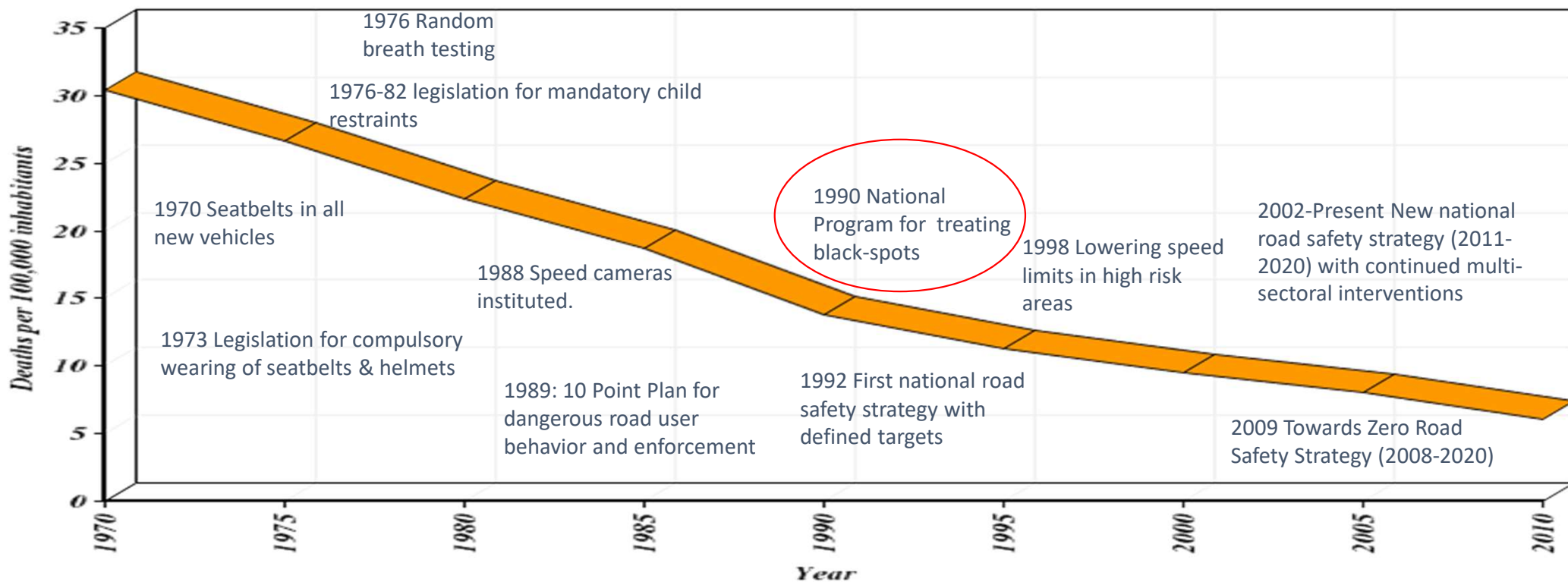
**All five ingredients: Safe Road, Safe Vehicle, Safe Road User (Education), Enforcement, and Emergency Care (with overall Management)**





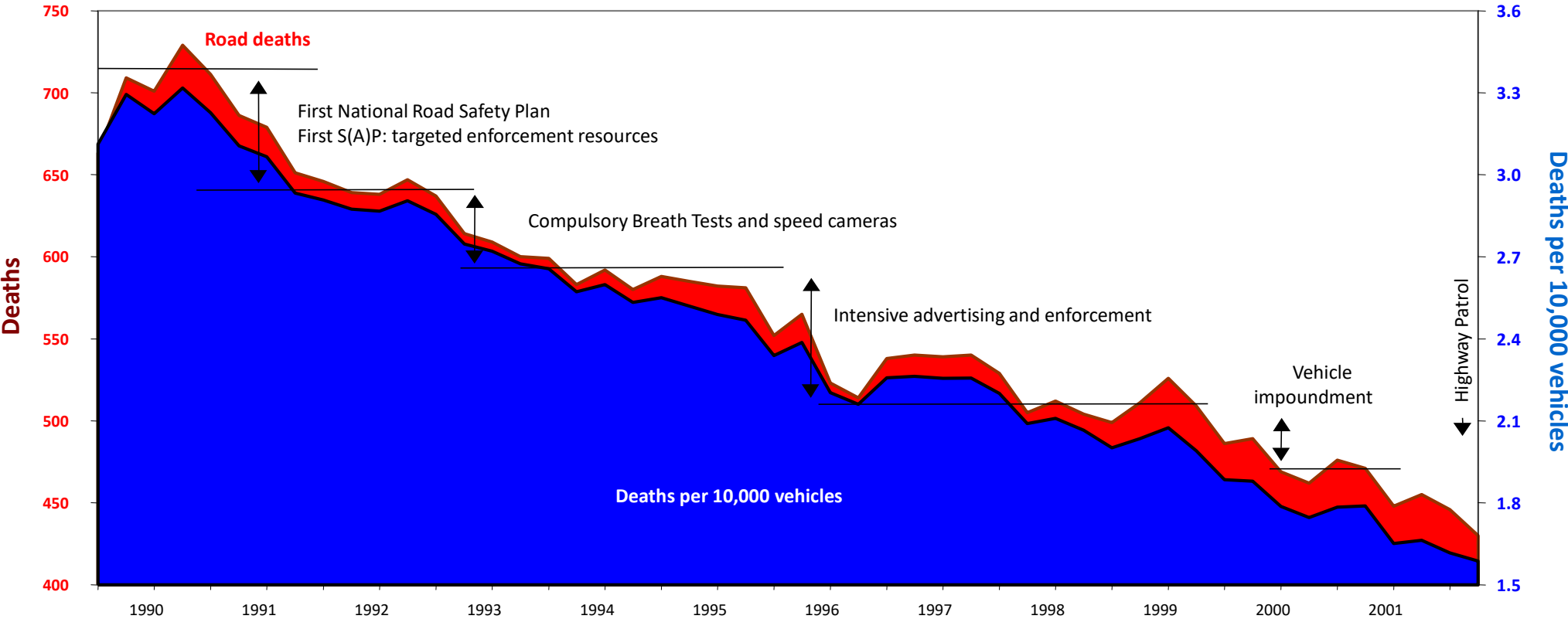
## But with Effective Policy and Planning

- *case example of Australia*



A structured multi-sectoral action plan was implemented

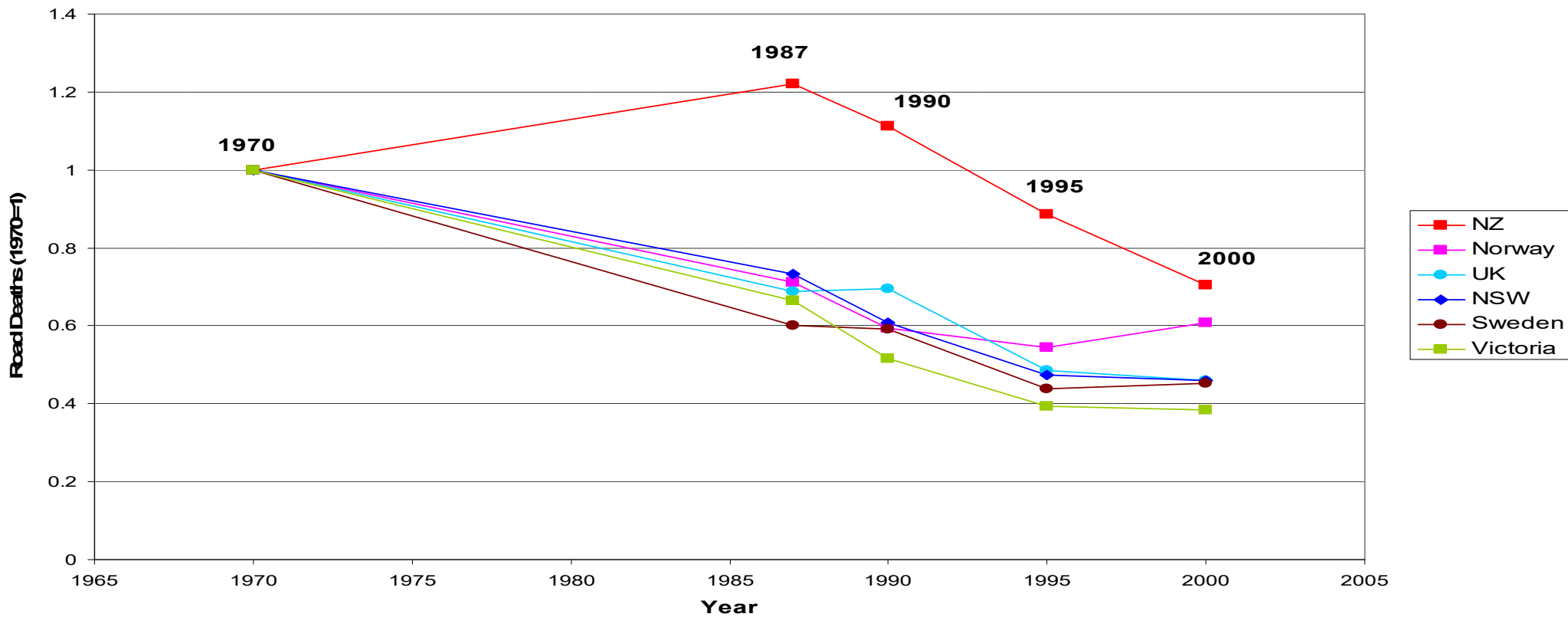
# NZ's effective new measures and multiple initiatives kept reducing the death toll



Slide courtesy of Tony Bliss

# Road traffic death rates have been dramatically reduced in developed countries

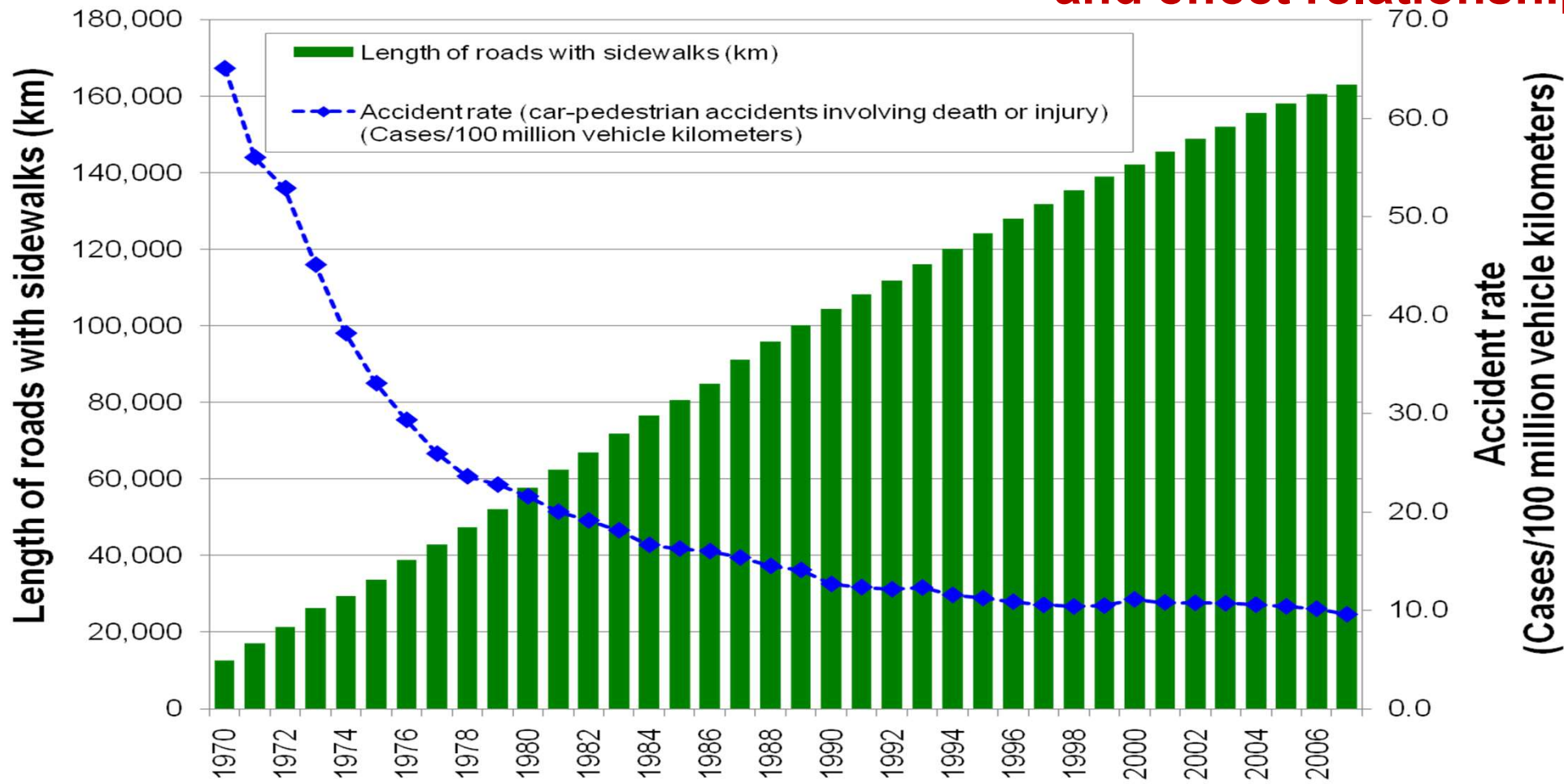
- New Zealand started later than other countries but achieved a rapid decrease in road traffic death rates





# Example of Road Safety Measures in Japan

Best example of cause and effect relationship



## In Conclusion

It is not only the design or the standards, there are many other requirements for realising complete road safety

- **Safe System (Adopted through 5 Es)**
  - **Societal consciousness for road safety**
- Above all, the providers of the road transport system (the network, vehicle and operating systems) have to be made responsible in equal proportion for any mishap/accident that takes place









*Thank You*

***Let us build only safe  
roads....***