Welcome to the
"Practical Road Safety Engineering" Workshop

Module 1 Road Safety Engineering
– THE BIGGER PICTURE

1

I would like to thank the Asian Development Bank, and the Asia Pacific Road Safety Observatory for supporting this workshop.

And all of you for giving your time.

This is the first of 8 modules – on-line due to the pandemic. We have 250 participants!!!

2

Module One: Road Safety Engineering – the bigger picture.

Detailing what engineers can do to reduce road trauma, outlining the global and national road safety problem; emphasising "the road" in road safety.

Key processes in the road safety engineering profession – an overview of several key RSE processes, both reactive and proactive.

3

I am pleased to welcome each and every one of you to the workshop – with so many countries on line I will do my best to include you all.

And I want to emphasise in this module a simple message – the world needs more road safety engineers!

4

WELCOME TO YOU ALL

250 participants from 16 countries across Asia and the Pacific.

5

250 participants from:

ADB STAFF	MYANMAR
AFGHANISTAN	NEPAL
ARMENIA	PHILIPPINES
BANGLADESH	SRI LANKA
BHUTAN	THAILAND
CAMBODIA	TONGA
INDIA	TURKMENISTAN
KIRIBATI	VIETNAM
MALAYSIA	

6

I encourage you to treat road safety as a business, and to appreciate that your work as engineers is important for road safety.

Police, other government agencies, politicians and more are important for road safety. **So are engineers.**

Whether you drive on the left side, or on the right side – the message is the same.

Let's put the **ROAD** into road safety!

7

Successful completion of this workshop requires

- Participation in all eight modules
- Attempted answers to the Poll Quiz questions
- Satisfactory preparation of a hazardous road location report with recommended treatments
- Satisfactory completion of a road safety audit report.

8

Objectives of this presentation:

- outline the extent of the global road safety problem.
- to discuss the cost of crashes in the your countries.
- to explain the "bigger picture" in road safety engineering
- to outline the "chain of events" leading to a crash
- to encourage you all to work towards safer road infrastructure.

Friend
Foreigner
Fellow engineer
I have worked in many of your countries – from Samoa and Kiribati in the east to Armenia, Iran and Turkey in the west.

9

Road Safety INTERNATIONAL

Phillip Jordan

- 31+ years with VicRoads in Melbourne
- Program Manager, AUSTROADS Road Safety Audit
- 15 years in consulting
- Traffic and road safety engineering
- 42 countries of work so far……

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Wally the Wombat

And several Polls!

13

14

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A question for you

How many deaths occur each year on the roads of the world?

16

Global road safety

- The world has a major health problem involving road safety.
- 1,350,000 or more killed each year.
- Millions (up to 50 million) injured.
- We ended the Decade of Action in Road Safety in May.

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19

INDIA

Population	$GDP	Level	Reported road deaths	Estimated number of road deaths	Death rate per 100,000 pop
1,324,171,392	$1680	Middle	150,785	299,091	22.6

21

Fatality rates are high! The Pacific

WHO 2018

- Fiji 9.6 per 100,000 population
- Kiribati 4.4 per 100,000 population
- New Caledonia 16.5 per 100,000 population
- PNG 14.2 per 100,000 population
- Samoa 11.3 per 100,000 population
- Tonga 16.8 per 100,000 population
- Solomon Islands 17.4 per 100,000 population
- Vanuatu 15.9 per 100,000 population

22

Fatality rates are high! SE Asia

WHO 2018

Cambodia	17.8 per 100,000 population
Indonesia	12.2 per 100,000 population
Laos	16.6 per 100,000 population
Malaysia	23.6 per 100,000 population
Philippines	12.3 per 100,000 population
Thailand	32.7 per 100,000 population
Timor Leste	12.7 per 100,000 population
Vietnam	26.4 per 100,000 population

23

Fatality rates are high! South Asia

WHO 2018

Bangladesh	15.3 per 100,000 population
Bhutan	17.4 per 100,000 population
India	22.6 per 100,000 population
Maldives	0.9 per 100,000 population
Myanmar	19.9 per 100,000 population
Nepal	15.9 per 100,000 population
Sri Lanka	14.9 per 100,000 population

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Fatality rates are high! (Central Asia)

WHO 2018

Afghanistan	15.1 per 100,000 population
Azerbaijan	8.7 per 100,000 population
China	18.2 per 100,000 population
Georgia	15.3 per 100,000 population
Kazakhstan	17.6 per 100,000 population
Kyrgyzstan	15.4 per 100,000 population
Mongolia	16.5 per 100,000 population
Pakistan	14.3 per 100,000 population
Tajikistan	18.1 per 100,000 population
Turkmenistan	14.5 per 100,000 population
Uzbekistan	11.5 per 100,000 population

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Fatality rates are high! Western Asia and the Caucuses

WHO 2018

Armenia	17.1 per 100,000 population
Iran	20.5 per 100,000 population
Turkey	18.2 per 100,000 population

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Fatality rates are low!

WHO 2018

Sweden	2.8 per 100,000 population
United Kingdom	3.1 per 100,000 population
Netherlands	3.8 per 100,000 population
Denmark	4.0 per 100,000 population
Iceland	6.6 per 100,000 population
Australia	5.6 per 100,000 population

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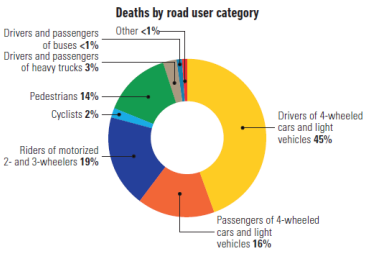
AUSTRALIA



Source: 2016, Australian Road Deaths Database and National Crash Database

1296 reported deaths
1351 deaths (WHO estimate)
5.6 fatalities per 100,000 pop.

28

1.35
million deaths each year

8th
leading cause of death for people of all ages

3
times higher death rates in low-income countries than in high-income countries

1st
leading cause of death for children and young adults 5–29 years of age

Global road trauma

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Table 1: Leading causes of death, all ages, 2016

Rank	Cause	% of total deaths
	All Causes	
1	Ischaemic heart disease	16.6
2	Stroke	10.2
3	Chronic obstructive pulmonary disease	5.4
4	Lower respiratory infections	5.2
5	Alzheimer's disease and other dementias	3.5
6	Trachea, bronchus, lung cancers	3.0
7	Diabetes mellitus	2.8
8	Road traffic injuries	2.5
9	Diarrhoeal diseases	2.4
10	Tuberculosis	2.3

2016 WHO Global Health Estimates

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Global Road Safety – a challenge for us all

RANK	LEADING CAUSE 2004	%
1	Ischemic heart disease	12.2
2	Cerebrovascular disease	9.7
3	Lower respiratory infections	7.0
4	Chronic obstructive pulmonary disease	5.1
5	Diarrheal diseases	3.6
6	HIV/AIDS	3.5
7	Tuberculosis	2.5
8	Trachea, bronchus, lung cancers	2.3
9	Road traffic injuries	2.2
10	Prematurity and low birth weight	2.0
11	Neonatal infections and other	1.9
12	Diabetes mellitus	1.9
13	Malaria	1.7
14	Hypertensive heart disease	1.7
15	Birth asphyxia and birth trauma	1.5
16	Self-inflicted injuries	1.4
17	Stomach cancer	1.4
18	Cirrhosis of the liver	1.3
19	Nephritis and nephrosis	1.3
20	Colon and rectal cancers	1.1

RANK	LEADING CAUSE 2030	%
1	Ischemic heart disease	12.2
2	Cerebrovascular disease	9.7
3	Chronic obstructive pulmonary disease	7.0
4	Lower respiratory infections	5.1
5	Road traffic injuries	3.6
6	Trachea, bronchus, lung cancers	3.5
7	Diabetes mellitus	2.5
8	Hypertensive heart disease	2.3
9	Stomach cancer	2.2
10	HIV/AIDS	2.0
11	Nephritis and nephrosis	1.9
12	Self-inflicted injuries	1.9
13	Liver cancer	1.7
14	Colon and rectal cancer	1.7
15	Oesophageal cancer	1.5
16	Violence	1.4
17	Alzheimer and other dementias	1.4
18	Cirrhosis of the liver	1.3
19	Breast cancer	1.3
20	Tuberculosis	1.1

Leading causes of mortality 2004 and 2030

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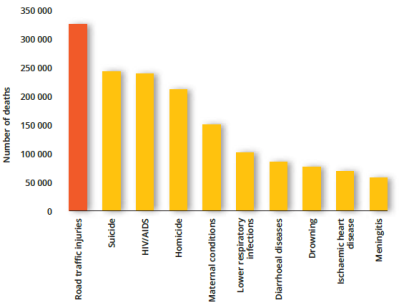
FIGURE 1
Top ten causes of death among people aged 15–29 years, 2012



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The world needs more road safety engineers

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THE COST OF CRASHES

What does a road crash fatality cost your country?

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Road crashes cost your country

- The cost of a fatality is estimated 70 x GDP per capita
- GDP per capita in your country: USD$X,000
- One death costs: 70 x USD$ X thousand
- Cost of a serious injury: 0.25 x fatality cost
- A serious injury costs: 17.5 USD$ X thousand

Sources:
McMahon, K. and Dahdah, S. (2008) The True Cost of Road Crashes: Valuing life and the cost of a serious injury. http://irap.org/library.aspx; International Monetary Fund, 2013.

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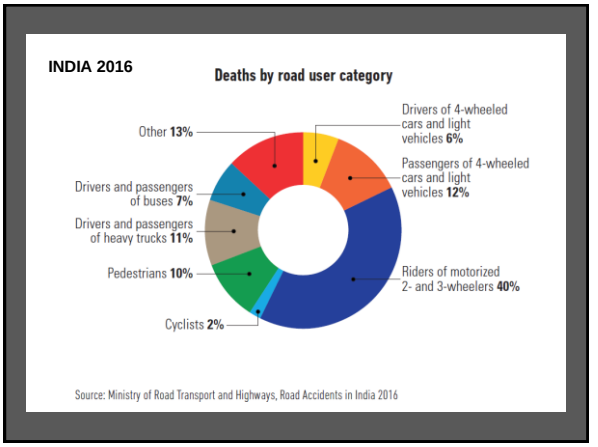

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Road crashes cost India…

- The cost of a fatality is estimated 70 x GDP per capita
- GDP per capita in India: USD$1,680
- One death costs: 70 x $1,680 = USD$117,600
- Cost of a serious injury: 0.25 x fatality cost
- A serious injury costs: USD$29,400

Sources:
McMahon, K. and Dahdah, S. (2008) The True Cost of Road Crashes: Valuing life and the cost of a serious injury. http://irap.org/library.aspx; International Monetary Fund, 2013.

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Multiple the number of deaths and injuries by these figures

WHO estimate 300,000 deaths on Indian roads in 2016

300,000 x $117,600 = $35,280,000,000

(35 billion USD each year!)

Serious injuries cost much more again
(maybe double this amount again!)

Sources:
McMahon, K. and Dahdah, S. (2008) The True Cost of Road Crashes: Valuing life and the cost of a serious injury. http://irap.org/library.aspx; International Monetary Fund, 2013.

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If you do not want to see a video of a violent crash…..

…turn away now

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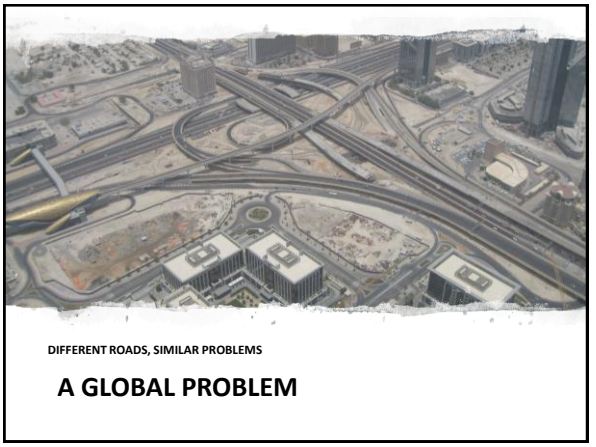

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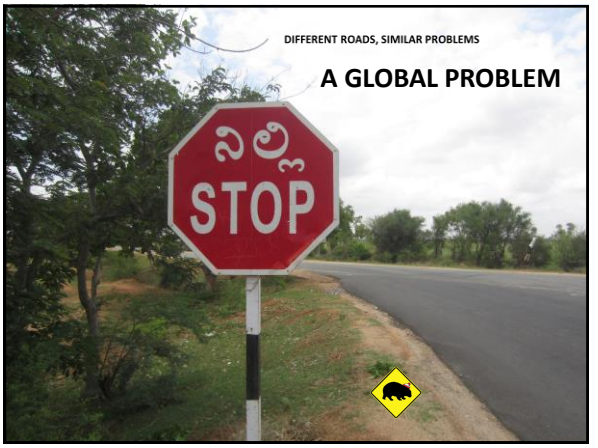

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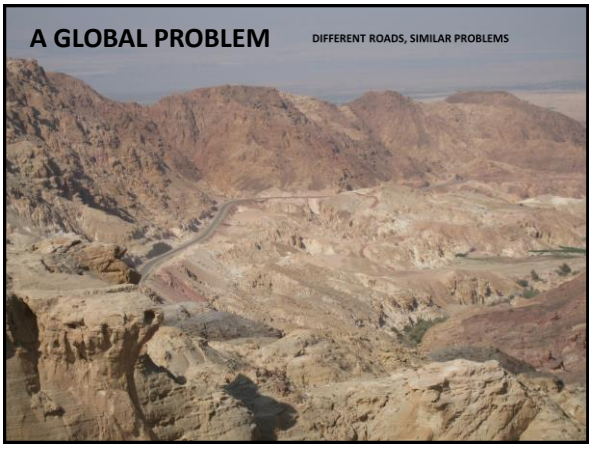

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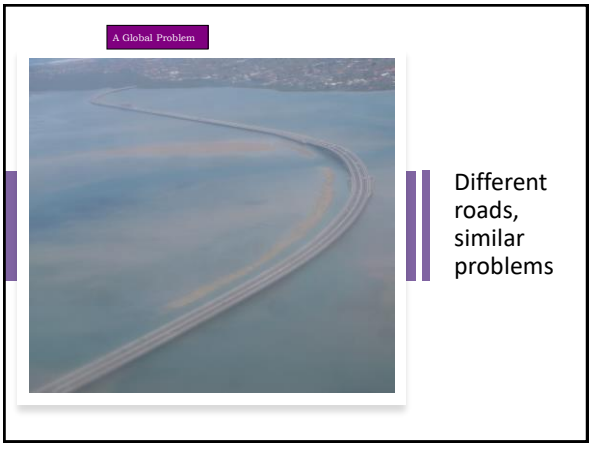

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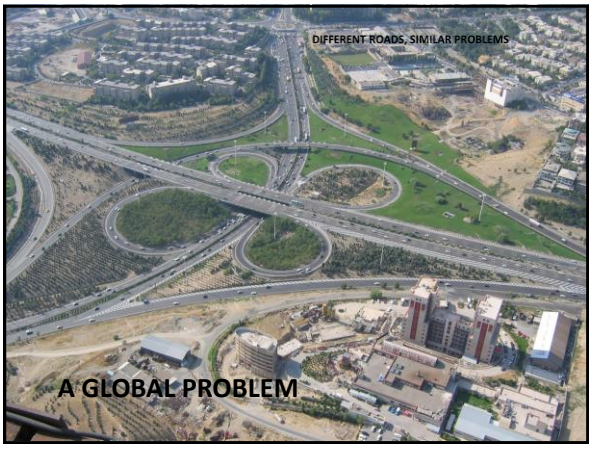

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A GLOBAL PROBLEM

DIFFERENT ROADS, SIMILAR PROBLEMS

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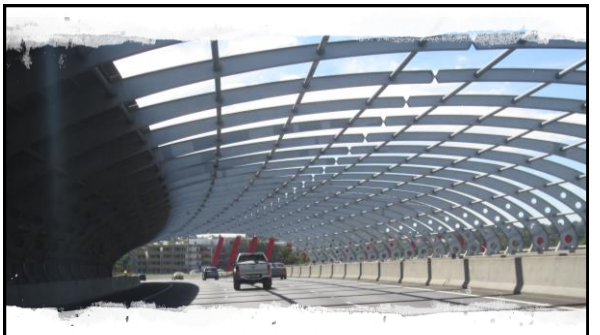

DIFFERENT ROADS, SIMILAR PROBLEMS

A GLOBAL PROBLEM

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DIFFERENT ROADS, SIMILAR PROBLEMS

A GLOBAL PROBLEM

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DIFFERENT ROADS, SIMILAR PROBLEMS

A GLOBAL PROBLEM

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DIFFERENT ROADS, SIMILAR PROBLEMS

A GLOBAL PROBLEM

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DIFFERENT ROADS, SIMILAR PROBLEMS

A GLOBAL PROBLEM

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DIFFERENT ROADS, SIMILAR PROBLEMS

A GLOBAL PROBLEM

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DIFFERENT ROADS, SIMILAR PROBLEMS

A GLOBAL PROBLEM

58

A GLOBAL PROBLEM

DIFFERENT ROADS, SIMILAR PROBLEMS

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Why is *your* job important for safety?

- Different nations = different roads = different road user mixes.
- Improve the road network – wider, straighter, flatter
- Then, many vehicles travel faster – more vehicles run off the road; pedestrians at higher risk.
- Road safety engineering can help
- Safer work sites, treating blackspots, undertaking road safety audits, and roadside hazard management can help.
- They can be applied in any country.
- They need resourcing and co-ordination from a National Road Safety Action Plan
- Experienced trained road safety engineers are essential

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I am from Victoria, Australia

1970

- Terrible road crash record
- Drink driving common
- Speeding common
- Poor highways
- No freeways

- **1061 deaths**
- **> 30 deaths/100,000 pop.**
- **Higher than the Solomons today!**

2018

- Lowest number of lives lost – ever
- One of the lowest fatality rates in the world
- Seat belt law – a world first!
- Random BAC testing
- Strong enforcement
- Safer roads – many rural highways and freeways

- **214 deaths**
- **4 deaths / 100,000 pop.**

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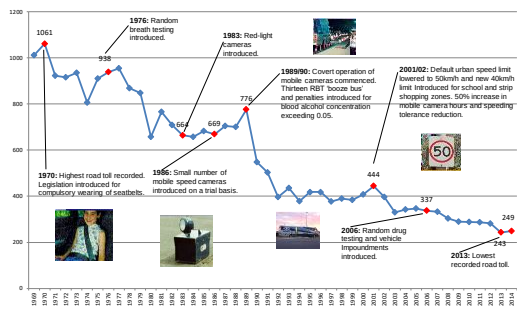
Lives lost, Victoria, Australia 1970 - 2014



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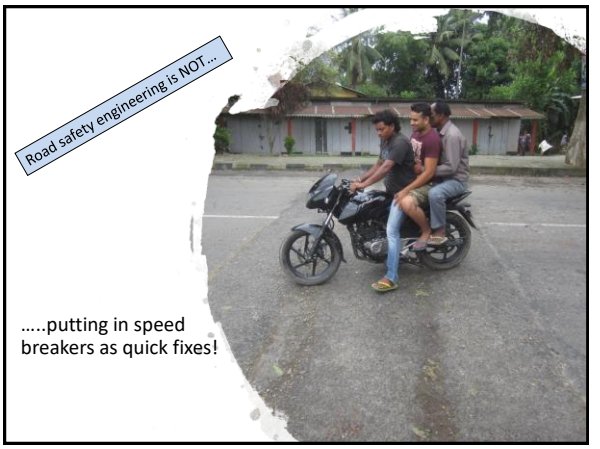

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….installing line marking – without checking the design very closely!

66

Our aim should be to…….

create easy-to-understand, forgiving roads for all our road users!

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How? We need to think about…

- warn
- inform
- guide
- control
- forgive

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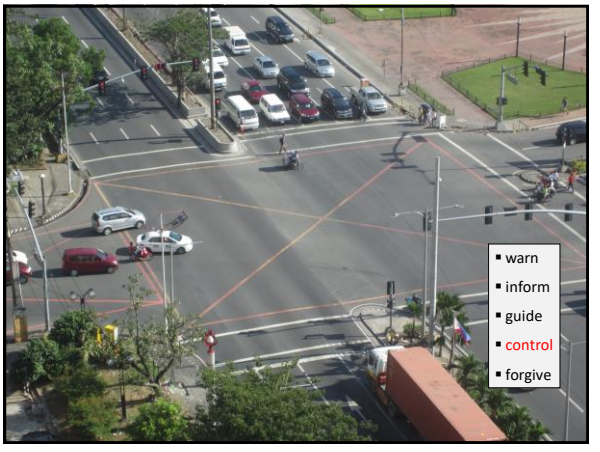

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Its easy to look at photos of roads and traffic control devices like these....

Our big challenge is to know what/when/where to use these and how to correctly use them

That is what we will try to cover in various ways throughout this series of workshops

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85

Road safety engineering is one profession that has an important role to play in road safety.

Police, teachers, researchers, doctors and others also have important roles in road safety.

86

A road crash is the end result of a chain of events…

To break that chain, where do we start? Let's look at a "typical" chain of events…

87

The chain of events…

A 35-year-old male is the driver of this truck. He is also the mechanic. His boss allows him to drive it home some weekends.

88

The chain of events……

- One weekend, he spends the whole weekend on it.
- The brakes were very worn.
- He finishes late Sunday – it took much more time than he had expected.
- Friends drop around – just as he finishes the repairs.
- Relaxing - they drink and talk until very late.
- He does not get much sleep.

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- Monday morning – he must start early loading sand at the river near the city.
- Little sleep, no breakfast, late for work.
- Drives the truck along a National Highway towards work.

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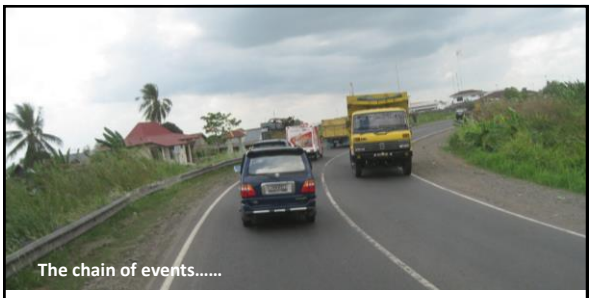

- Traffic is heavy.
- The highway has unsealed shoulders.

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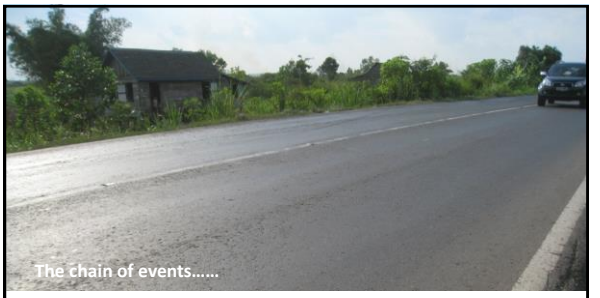

- The road is very "slick" - it has little skid resistance.
- Light rain is falling.
- There are no sealed shoulders. Many big "drop-offs" from the pavement.

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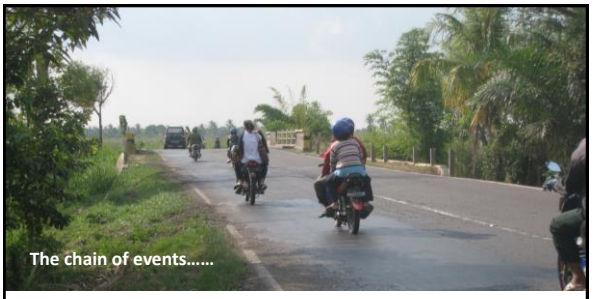

- He travels fast.
- Many motorcyclists – plus some pedestrians and bicyclists.

93

- He drives very close to the truck ahead of him – impatient to overtake.
- The truck ahead has dirty/broken brake lights.
- There is a bus in front of that truck.

94

The chain of events……

- He knows there is an overtaking lane ahead – he accelerates to overtake the slow bus and truck.

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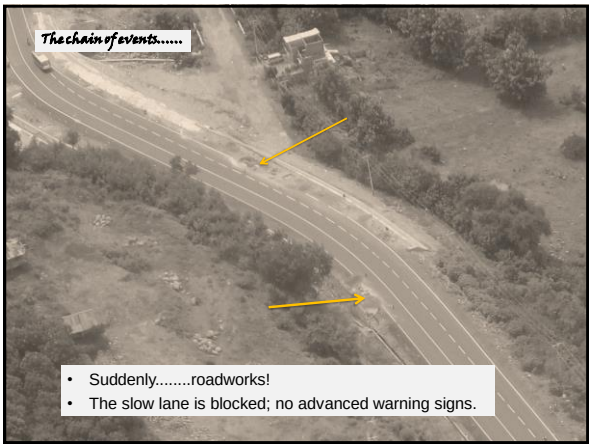

- Suddenly……..roadworks!
- The slow lane is blocked; no advanced warning signs.

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97

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The chain of events……

- Our truck driver brakes late and hard – but the new brakes "grab".
- The truck strikes the motorcyclists.
- It then side swipes the bus.

99

One passenger dead

100

- Two motorcyclists killed (head injuries)
- One seriously injured
- One bus passenger also killed
- Police and legal action follows

What - in this chain of events - 'caused' the crash ?

101

Possible causes……

- His frustrating weekend? His drinking?
- His lack of sleep? Excessive speed?
- His impatience and inattention?
- The girls on the motorcycle – not wearing helmets?

- The new brakes of his truck?
- The dirty/broken brake lights of the other truck?
- The rain?

- The bus and truck swerving road because of the roadworks?
- Materials being stored on the road?
- The "slick" road conditions? The lack of sealed shoulders?
- The big "drop-off" from the pavement?
- No advanced warning of the roadworks?

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- Engineers could have broken this chain of events by:
  - Storing materials off the road
  - Much better advance warning of the road works
  - Sealing the shoulders (create an "escape" route)
  - Eliminating the big drop offs from pavements
- **Improving the safety of the *road* – including roadworks – is the contribution engineers can make towards road safety.**

YOU CAN SAVE LIVES!

103

Road safety engineering applies engineering principles …. to identify road improvements that will cost effectively reduce the cost of crashes (and break the chain of events that would lead to a collision

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Engineers can save lives on your roads (and globally)

105

Throughout this series of workshops we will have presentations on road safety audit, on blackspot programs, on low cost ways to reduce roadside hazards and to improve pedestrian safety, and safer road works.
Today I will introduce you to some of the key road safety engineering concepts

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ADB

Key road safety engineering processes

How engineers can make roads safer?

Road Safety

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Objectives of this session:

To introduce key road safety engineering concepts:

- **Road safety audit**
- **Treating hazardous locations (blackspots)**
- **Road work safety**
- **Roadside hazard management**
- **Pedestrian safety**

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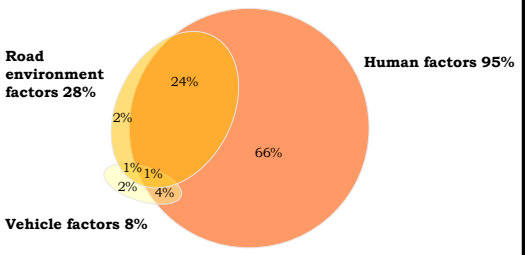
The factors involved with crashes



Based on British and American research

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Do you have the CAREC road safety engineering manuals?

They are a useful series to help you make your roads safer.

Go to the ADB website

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The manuals are for use by…

- Engineers in national road agencies
- Traffic Police
- Consultants, Contractors, PIU
- Academics and students

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AUSTROADS GUIDES (many in each set)

- Guide to Road Design
- Guide to Traffic Management
- Guide to Road Safety

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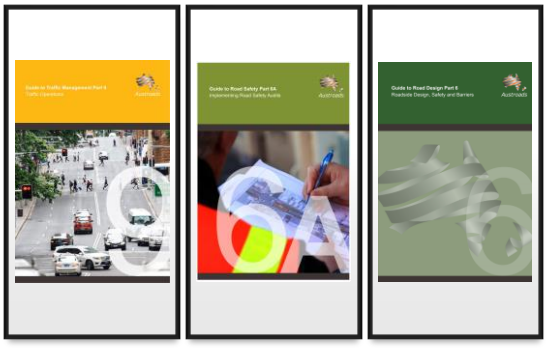

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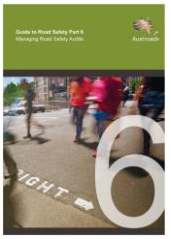
Road Safety

The new pair of AUSTROADS Road Safety Audit guides (2019) now provide the national focus for road safety audit



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Road Safety Audit

Prevention is better than cure

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RSA – the process is straight forward

- It is the skills, experience and judgement of the audit team that is vital
- Good judgement is essential
- But this is also the most difficult thing to gauge in a person – until after the event!
- Management of audits is important too
- Some of you may never do an audit – but may "purchase" many audits
- Knowing what is good value in an audit is important too.

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A road safety audit is…. "a formal examination of a future road/traffic project (or an existing road) in which an independent, qualified team reports on the project's crash potential and safety performance"

(AUSTROADS 2019)

118

A road safety audit is…. "a **formal examination** of a future road/traffic project (or an existing road) in which an **independent, qualified team** reports on the project's crash potential and safety performance"

(AUSTROADS 2019)

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Engineers are problem solvers

Auditors need to be problem finders!

120

What projects should we audit?

- Big road projects
- Complex road projects
- Small road projects
- Projects on high speed roads, and low speed roads
- Rural projects
- Traffic management schemes
- Pedestrian projects/motorcycle projects/bicycle projects
- Road works

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Road safety audit is for big projects

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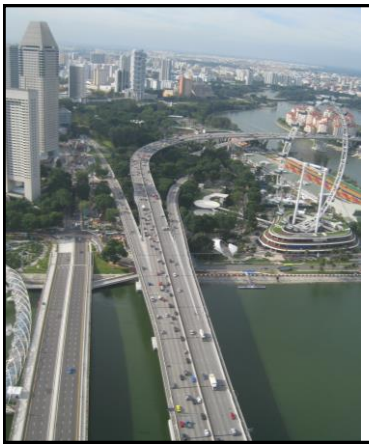

Road safety audit is for urban projects

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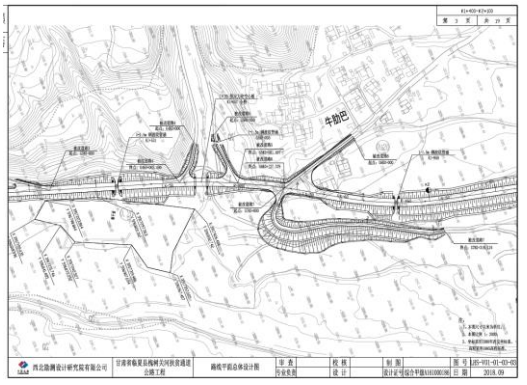
Road safety audit is for <u>rural</u> road projects



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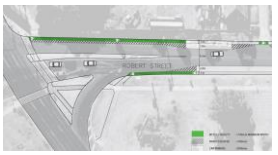
Road safety audit is for bicycle projects



Prevention is better than cure - by Phillip Jordan

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Road safety audit is for road works

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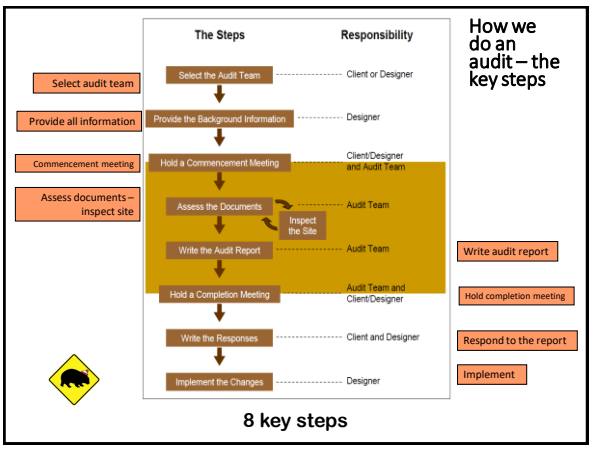

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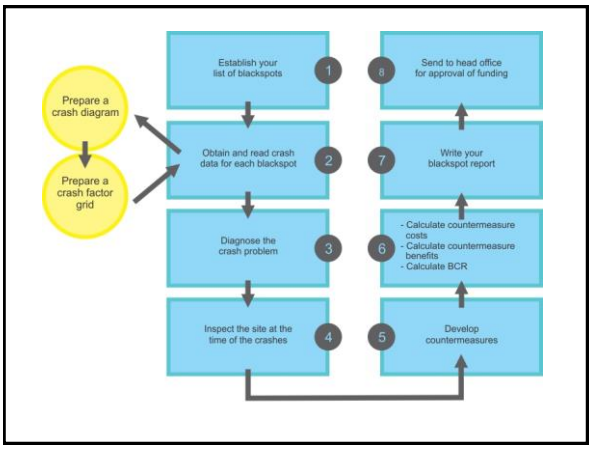

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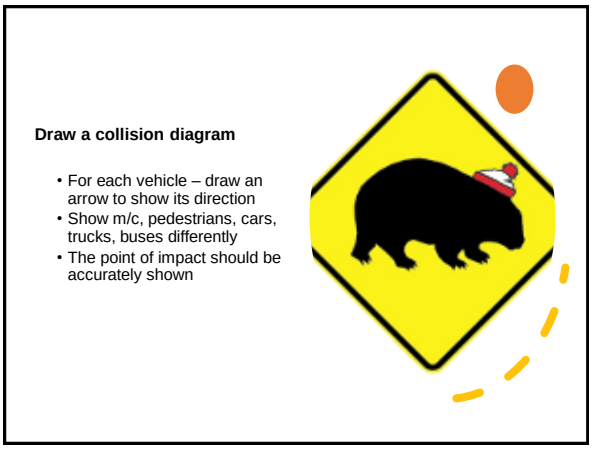

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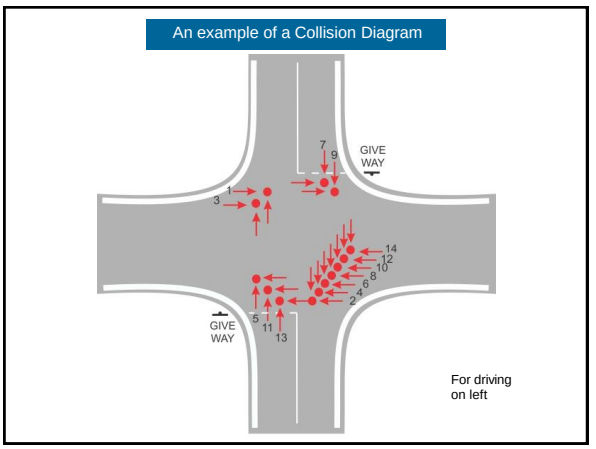

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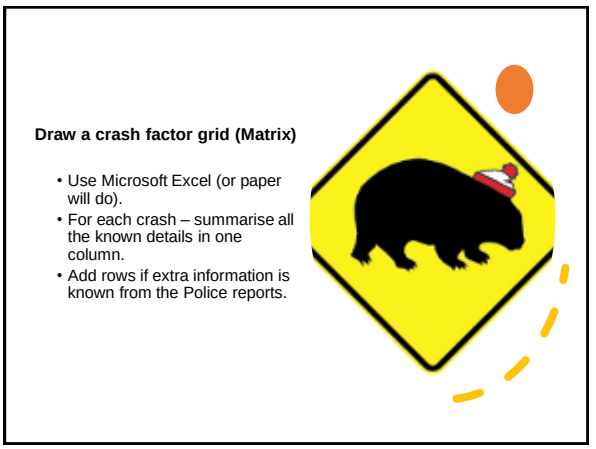

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An example of a Crash Factor Matrix

Accident Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Date: day: month	1307	0409	1912	0806	0307	0711	3012	2702	0305	2407	1804	2105	1406	2008
Date: year	17	17	17	18	18	18	18	18	18	19	19	19	19	19
Day of week	Sat	Wed	Thu	Sun	Thu	Fri	Tue	Fri	Sun	Fri	Sun	Fri	Mon	Fri
Time of day	1700	1855	1530	1900	1345	2145	1900	1220	1800	2000	1845	1610	1735	1855
Severity	3	3	2	3	2	4	3	3	4	2	3	2	2	3
Light conditions														
Road Conditions	W	W	D	D	D	D	D	D	D	D	D	D	W	D
DCA Code	101	101	101	101	101	101	101	101	101	101	101	101	101	101
Object 1	Car	Car	Car	Car	Car	Car	Car	Car	Car	Car	Car	Car	Van	Car
Object 2	Car	Car	Truck	Car	Car	Car	Car	Truck	Car	Car	Car	Car	Car	Car
Object 3					Car			Car			Car			
Direction 1	N	S	N	S	N	S	S	S	S	S	N	S	N	S
Direction 2 (& 3)	E	W	E	W	W,E	W	E	W,N	E	W	W,E	W	W	W
Other														

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Decide on low cost countermeasures

- Signs – warning, regulatory, direction
- Line marking
- Delineation
- Shoulder sealing
- Roadside hazard removal
- Pedestrian facilities
- Speed limits
- Closures, bans, restrictions, prohibitions
- Traffic signals
- Roundabouts
- Lighting

Spend $1 on a blackspot treatment, return $4 in crash savings to the community

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Safe Traffic Control at Road Works

This field guide details good road safety practices for work sites.

It encourages road authorities to include more road safety into the planning, design and operation of work sites.

What guidelines do you use?

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Traffic management of road works should consider..

Four Zone Concept

- delineation
- traffic control
- safety of workers
- signs, lighting … and more

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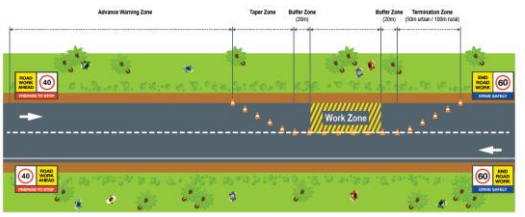
THE FOUR ZONE CONCEPT



The "Zone Concept" is a method of breaking a work site down into four individual zones.

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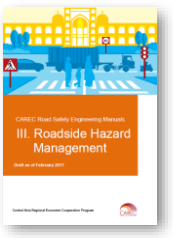
Roadside hazard management

Too many people die in "run-off-road" crashes – in every country.



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A strategy for Roadside Hazard Management

1. Keep vehicles on the road
2. Provide a forgiving roadside

- i. remove the hazard
- ii. relocate the hazard
- iii. alter to reduce severity
- iv. protect people with barriers

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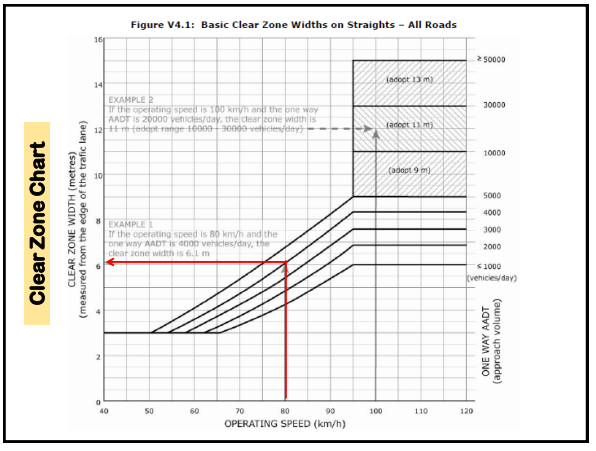

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Semi-rigid - W Beam Safety Barrier

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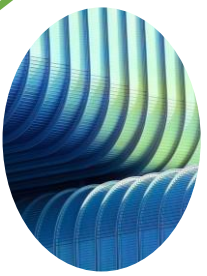
Think of all your customers:

SENIOR CITIZENS - 19% OF PEDESTRIAN FATALITIES ARE OVER 65 YEARS

YOUNG - 20% OF PEDESTRIAN FATALITIES ARE AGED 4-12 YEARS

INTOXICATED - 43% OF NIGHTTIME PEDESTRIAN FATALITIES ≥ 0.15% BAC

THE DISABLED



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There are three basic pedestrian strategies…

- Segregation – freeways, malls
- Separation – in time or in space
- Integration – where vehicles and pedestrians "share" the road

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Segregation – expressways

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Segregation – malls

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SEPARATION – IN SPACE

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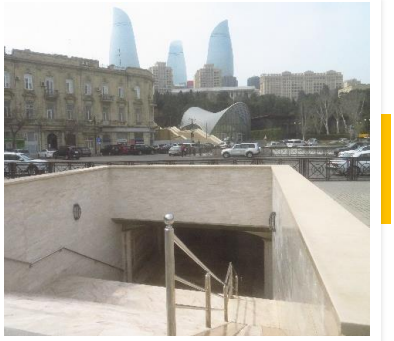

SEPARATION – IN SPACE

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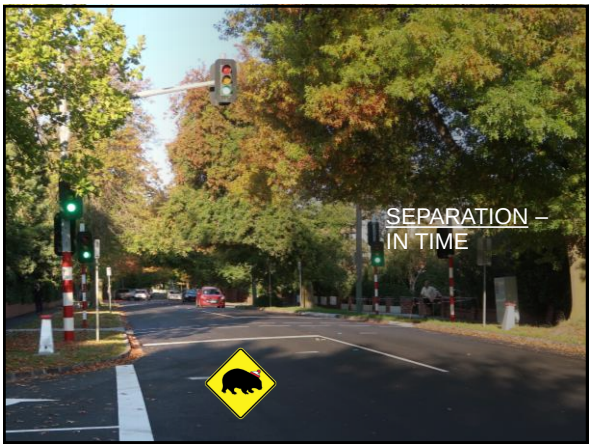

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The world needs safer roads, and more road safety engineers.
I hope you can join the challenge.

THANK YOU - YOUR QUESTIONS ARE WELCOME

ADB

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