SUPERSEDED PUBLICATION

This document has been superseded.

It should only be used for reference purposes.

For current guidance please visit the Austroads website:

www.austroads.com.au

Guide to Road Safety Part 1

Road Safety Overview

Austroads

Guide to Road Safety:
Part 1: Road Safety Overview

Sydney 2013

Guide to Road Safety Part 1: Road Safety Overview

Third edition project manager: David Reed

Third edition prepared by: Dr Peter Cairney

Abstract

This document is an overview of Austroads Guide to Road Safety. It commences with a discussion of road crash costs and road agencies' duty of care to provide safe travel. The advantages and disadvantages of different ways of measuring road safety are discussed, and these methods are used to illustrate progress in road safety in Austroads' member jurisdictions in recent years. The Safe System approach as a conceptual framework for road safety management is explained, along with the merits of an evidence-based approach to countermeasures. The report concludes with overviews of the Guide to Road Safety and of the Austroads Guides generally.

Keywords

road safety, duty of care, Safe System, measurement

Edition 3.1 published August 2018

- Format updated.

Edition 3.0 published February 2013

- In this edition the Safe System content has been updated throughout, the costs of road crashes has been updated, approaches to calculating crash costs have been added including differences between human capital approach and WTP, and graphs (and associated commentary) comparing fatalities and serious injuries with other OECD countries have been updated.

Edition 2.0 published October 2009

Edition 1.0 published 2006

ISBN 978-1-921991-61-5XXX

Austroads Project No. SP1646

Austroads Publication No. AGRS01-13

Pages 23

Publisher

Austroads Ltd.
Level 9, 287 Elizabeth Street
Sydney NSW 2000 Australia

Phone: +61 2 8265 3300

austroads@austroads.com.au
www.austroads.com.au

About Austroads

Austroads is the peak organisation of Australasian road transport and traffic agencies.

Austroads' purpose is to support our member organisations to deliver an improved Australasian road transport network. To succeed in this task, we undertake leading-edge road and transport research which underpins our input to policy development and published guidance on the design, construction and management of the road network and its associated infrastructure.

Austroads provides a collective approach that delivers value for money, encourages shared knowledge and drives consistency for road users.

Austroads is governed by a Board consisting of senior executive representatives from each of its eleven member organisations:

- Roads and Maritime Services New South Wales
- Roads Corporation Victoria
- Queensland Department of Transport and Main Roads
- Main Roads Western Australia
- Department of Planning, Transport and Infrastructure South Australia
- Department of State Growth Tasmania
- Department of Infrastructure, Planning and Logistics Northern Territory
- Transport Canberra and City Services Directorate, Australian Capital Territory
- Australian Government Department of Infrastructure and Regional Development
- Australian Local Government Association
- New Zealand Transport Agency.

Acknowledgements

The authors would like to acknowledge the input of Nicholas Mackay (Queensland Department of Transport and Main Roads) in the preparation on this third edition of the Austroads Guide to Road Safety Part 1: Road Safety Overview. The authors would also like to acknowledge the input of the Austroads Safety Task Force for their contributions to this and previous editions.

Summary

This document provides an overview of the Austroads *Guide to Road Safety*, the nine parts of which provide guidance for the core road safety-related responsibilities of road agencies.

Safe System principles are the basis for road safety programs in Australia and New Zealand. Safe System seeks to ensure that no road user is subject to forces in a collision which will result in death or an injury from which they cannot recover. It recognises that road user error cannot be completely eliminated (although it can be reduced), so the road transport system must therefore be designed to make collisions survivable. This is achieved through a combination of design and maintenance of roads and roadsides, design of vehicles and their safety equipment, speed management, and having alert and compliant road users.

Road trauma imposes a significant burden on the community in terms of death and injury, pain and psychological suffering, and economic losses. There are therefore sound economic and social returns to be derived from effective road safety programs. The implications for road agencies of recent High Court decisions recognising the duty of care which road agencies owe to the travelling public are discussed.

If road safety is to be managed, it must be measured effectively. The advantages and disadvantages of a number of different measures are discussed. These measures are used to illustrate progress in road safety in Austroads member jurisdictions in recent years, and to compare performance with that of other developed countries. In adopting the Safe System approach both Australia and New Zealand now place greater emphasis on fatalities and serious injuries as opposed to all injuries.

The benefits of an evidence-based approach to countermeasures are discussed. Reliable information about effective treatments is difficult to obtain, and personal experience is no substitute. It is therefore necessary to insist on results from well-designed studies to guide road safety programs. Ethical and practical considerations are major constraints on following ideal methods.

A brief description of each of the nine parts of the Austroads *Guide to Road Safety* is provided. The parts are:

- Part 1: Road Safety Overview (this document)
- Part 2: Road Safety Strategy and Evaluation
- Part 3: Speed Limits and Speed Management
- Part 4: Local Government and Community Road Safety
- Part 5: Road Safety for Rural and Remote Areas
- Part 6: Road Safety Audit
- Part 7: Road Network Crash Risk Assessment and Management
- Part 8: Treatment of Crash Locations
- Part 9: Roadside Hazard Management.

Austroads has published a series of Guides, covering many areas of road agency activity. The final section of Part 1 outlines the links between the *Guide to Road Safety* and the other Guides.

Contents

Tables

Figures

1. Introduction

Austroads supports its members through the publication of technical guidelines, manuals and research reports. This document provides an overview of the Austroads *Guide to Road Safety*, the nine parts of which provide guidance for the core road safety-related responsibilities of road agencies.

The document consists of:

- Section 1 (this section) is an introduction to the document.
- Section 2 contains a description of Safe System, the guiding principles for road safety programs in Australia and New Zealand.
- Section 3 consists of an overview of road agencies' responsibilities for road safety, and how performance in meeting these responsibilities is managed and measured.
- Section 4 is an overview of the structure of the Guide and its remaining eight parts.
- Section 5 provides an overview of the linkages between the *Guide to Road Safety* and the other Austroads Guides.

2. Safe System

Safe System principles have been acknowledged in successive national road safety strategies and action plans since 2003 as the guiding principles for road safety programs in Australia. The commitment is continued in the current strategy, *National Road Safety Strategy 2011–2020* (ATC 2011). Safe System principles are also central to *Safer Journeys*, New Zealand's Road Safety Strategy 2010–2020 (Ministry of Transport 2010a).

Safe System recognises that there are limits to the forces the human body can withstand in a collision, and seeks to ensure that no road user is subject to forces in a collision which will result in death or an injury from which they cannot recover. It must be recognised that human error is a feature of the road transport system and that while much can be done to reduce it, it cannot be eliminated.

The Safe System framework is shown in Figure 2.1. A Safe System should provide road users with:

- positive guidance in order to safely negotiate the road transport system
- clear direction regarding appropriate speed for the situation
- space to recover from mistakes, when mistakes do occur (in order to avoid collisions)
- protection from serious injury or death when crashes do occur.

The Safe System framework requires that:

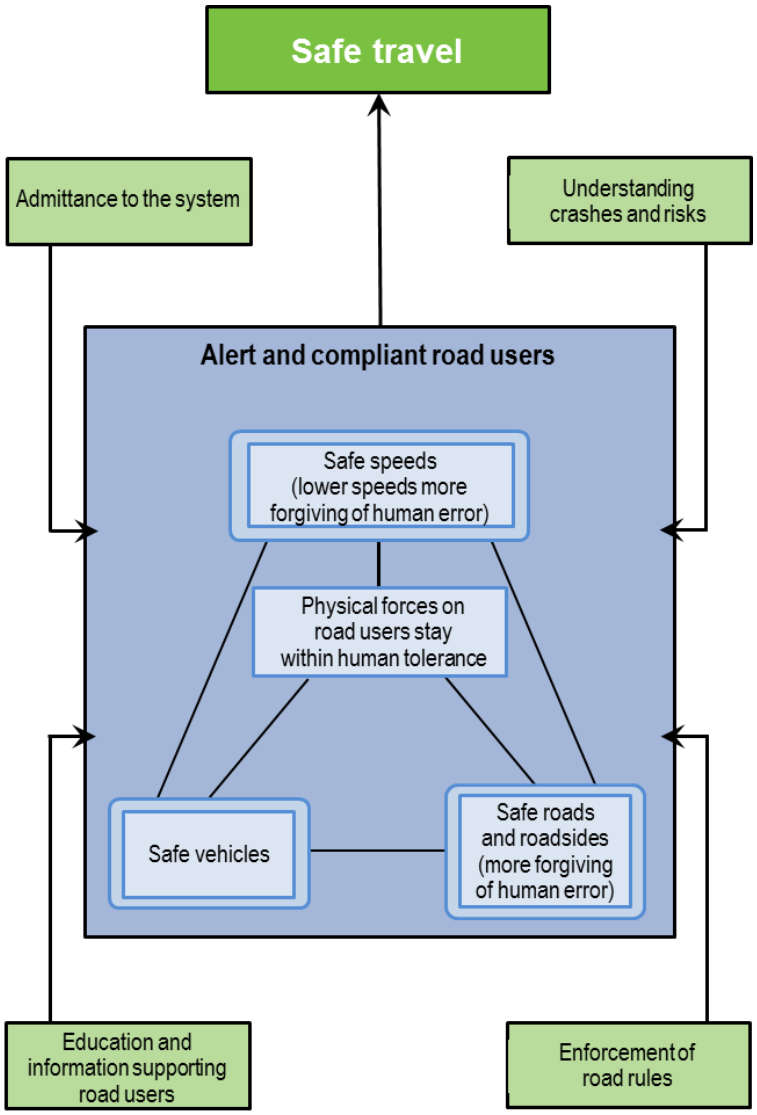
- The road transport system is designed, built and maintained so that the forces road users are subjected to in collisions will not result in death or serious injury.
- Roads and roadsides should be improved to reduce the risk of crashes and the severity of impacts when crashes do occur; vulnerable road users must be considered in this process.
- Inclusion of effective active and passive safety systems in vehicles should be encouraged to reduce the number of crashes and reduce the impact forces on occupants and road users outside the vehicle.
- Speeds should be managed, taking account the risks on different parts of the road transport system.

In addition, the realisation of Safe System requires alert and compliant road users. This is achieved through:

- limiting the admittance to the system to qualified drivers who have been trained appropriately and do not suffer from disabilities which prevent them from driving safely, and excluding drivers whose poor driving record makes them an unacceptable risk to the community
- encouraging road users to understand crashes, the factors which contribute to them, and the risks associated with them
- enforcement of the road rules, accompanied by publicity regarding the extent of enforcement, the extent of offences detected, and the penalties imposed
- on-going advice, education and encouragement to promote safe road user behaviour.

Both the *National Road Safety Strategy 2011–2020* and *Safer Journeys* acknowledge the importance of research to identify cost-effective interventions and the importance of promoting public understanding and endorsement of the Safe System approach and public participation in achieving a safer road transport system (ATC 2011; Ministry of Transport 2010a). In light of this the Austroads Guides are being progressively updated to incorporate the Safe System approach. As of 2012, the Guides to Road Safety and Road Design are two such guides being updated.

Figure 2.1: A conceptual overview of the Safe System framework



Source: ATC (2009).

The Safe System framework is at the core of the *National Road Safety Strategy 2011–2020*, launched in May 2011, and the New Zealand *Safer Journeys* strategy, launched in March 2010. It is expected that Safe System principles and their application in Australia and New Zealand may continue to evolve in the future as the knowledge base expands through further research and experience of road agencies.

3. Road Agencies' Responsibility for Road Safety, its Management and Measurement

3.1 Core Responsibility

Road safety is a core responsibility for road agencies in Australia and New Zealand. However, road safety goals cannot be considered in isolation.

A lot is expected of the road transport system and competing demands must be acknowledged when considering road safety goals. In addition to its primary functions of providing for the movement of people and goods to support economic and social activities, the road transport system is expected to provide for all members of the community as road users in an equitable manner. It is also expected not to intrude unreasonably on residential and recreational areas, or on areas with high scenic or conservation values, and not to result in unacceptable levels of pollution or resource depletion. It is expected to deliver the benefits of mobility while retaining environmental quality, and to do so at reasonable cost whilst maintaining the highest levels of safety for its users.

A Safe System framework aims to prevent road fatalities and serious injuries from occurring on the road network, yet it seems these are almost a by-product of the competing demands on the road transport system, the operation of which is essential for the efficient functioning of modern societies. As such, ambitious road safety goals cannot be achieved by road safety agencies working alone; instead cooperation and collaboration is required between a range of government and non-government agencies as well as the general public.

The *National Road Safety Strategy 2011–2020* states (ATC 2011, p. 34):

> *Many organisations – the 'system managers' – have a primary responsibility to provide a safe operating environment for road users. They include the government and industry organisations that design, build, maintain and regulate roads and vehicles. These and a range of other parties involved in the performance of the road transport system, and the way roads and roadsides are used, all have responsibility for ensuring that the system is forgiving when people make mistakes.*

The *National Road Safety Strategy 2011–2020* notes that 'responsibility for road safety is shared by all'. The support of various stakeholder groups is required to achieve road safety goals including:

- the whole community of road users
- road agencies
- specific groups of road users and the associations that represent them
- the police and justice sector
- vehicle manufacturers
- employers of road users
- parents and schools
- planners and designers
- health care professionals
- governments that allocate funding to road safety programs and health services
- the insurance industry.

In many jurisdictions, the interdependence of the leading stakeholders is formalised in a Memorandum of Understanding or similar agreement which sets out the respective commitments and responsibilities of the participating organisations, together with arrangements for coordination, consultation and review. The present document, and the *Guide to Road Safety* as a whole, should be of interest to these different road safety stakeholders as well as to the road agencies.

In New Zealand road safety action is coordinated by the National Road Safety Committee (NRSC) which is made up of the government agencies that have a role in road safety. The NRSC is led by the Ministry of Transport and includes the New Zealand Police, the NZ Transport Agency, the Accident Compensation Corporation, and Local Government New Zealand. The Ministries of Health, Education and Justice and the Department of Labour are associate members. The New Zealand Road Safety Strategy, *Safer Journeys*, identifies the need to develop whole of government approaches to address issues that cut across a number of areas, such as alcohol-related harm. Stating, 'agencies working together to develop shared approaches to reducing these problems have a greater chance of success' (Ministry of Transport 2010a, p. 44). *Safer Journeys* also acknowledges that in order to be effective the NRSC agencies will need to work with key stakeholders and the wider community, on a national and regional scale, in developing and implementing these actions. Regional transport committees and regional Road Safety Action Plans will be a key part of developing and monitoring these regional actions and ensuring consistency with national programs (see Austroads *Guide to Road Safety Part 2: Road Safety Strategy and Evaluation* (Austroads 2013)) for detail about developing road safety action plans.

3.2 Costs to the Community

The community expects a high level of road safety and that the road transport system will be managed to produce good safety outcomes. This is reflected in the high profile of road safety in the political life of each state and territory, and the wide coverage given to road crashes and their aftermath in print and electronic media.

Road trauma imposes a significant burden on the community in terms of death and injury, pain and psychological suffering, and economic losses. Estimates of the current costs of road crashes for Australia and New Zealand are shown below (see inset), updated from the original figures by applying the relevant index figures in the Australian Bureau of Statistics, Consumer Price Index series (ABS 2011).

Costs of road crashes in Australia

The average cost of crashes of different severities is estimated as:

- fatal crash $3 083 000
- serious injury crash $307 500
- other injury crash $17 000
- non-injury crash $11 500

The total cost of all crashes per year is estimated at $20.64 billion.

Based on crashes occurring in 2006 (from BITRE 2009); costs are in 2011 Australian dollars (Calculated using the Reserve Bank of Australia inflation calculator (RBA 2012).

Costs of road crashes in New Zealand

The average cost of crashes of different severities is estimated as:

- fatal crash $4 322 000
- serious injury crash $455 500
- other injury crash $26 000
- non-injury crash $2 500

The total cost of all crashes per year was estimated at $3.54 billion.

Based on crashes occurring in 2010; costs are in 2011 New Zealand dollars (from Ministry of Transport 2011).

Estimates of the costs of crashes have been derived in different ways in Australia and New Zealand. In the past Australia has used the human capital approach, reflected above, which identifies all the losses which occur as a result of road traffic crashes as a total cost to the nation. This includes loss of life and life quality, loss of productivity, medical, legal and court and property damage costs. This is sometimes referred to as the ex-post approach, as it is based on events subsequent to the crash. New Zealand relies on a hybrid measure to estimate the cost of road crashes. It uses a similar method of estimating loss of productivity, medical, legal and court and property damage costs, but estimates the cost of loss of life and life quality based on what road users would be willing to pay in order to avoid a fatal or injury crash. The willingness-to-pay approach is sometimes referred to as the ex-ante approach since it is based on payments that would occur before the crash.

Although the different approaches to estimating the social cost of crashes produce different results, the overall impact of both estimates is substantial. The Bureau of Infrastructure, Transport and Regional Economics (BITRE) estimated the social cost of road crashes in Australia in 2006 to be $17.85 billion ($20.64 billion when adjusted to 2011 Australian dollars), equivalent to 1.7% of Australia's gross domestic product (GDP) in 2006, and down 7.5% from 1996 estimates (BITRE 2009). The New Zealand figures tell a similar story. There are therefore considerable economic benefits to the community in addressing road safety issues. If an appropriate mix of countermeasures were to be chosen, and they were implemented effectively, the economic and social returns to the community would be high.

In recent years, there has been a re-focusing amongst the Australian jurisdictions and New Zealand in the way the cost of road trauma is calculated, from the ex-post or human capital method to the ex-ante willingness-to-pay (WTP) approach.

> *The WTP approach estimates the value of life in terms of the amounts that individuals are prepared to pay to reduce risks to their lives (this is the value to the individual on an ex-ante basis, or before the fact). This approach uses people's preferences (either stated or revealed) to ascertain the value they place on reducing risk to life, and reflects the value of intangible elements such as quality of life and joy of living (BITRE 2009).*

The shift to WTP is in part a recognition that the cost of fatalities and injuries to society associated with road crashes has been undervalued, but also due to the need to focus on establishing the amount, ex-ante, that individuals are willing to pay to reduce the risk of exposure to circumstances that might lead to death injury on the road network.

Table 3.1 compares the BITRE human based capital approach to costing road trauma with several adjusted WTP estimates. There are a number of different approaches for calculating WTP estimates and at the time of updating this guide there was no universally agreed method in Australia. To enable comparison, the WTP estimates in Table 3.1 have been adjusted to 2011 Australian dollars from Australian, New Zealand, UK and USA methods. The different estimates of WTP are primarily due to way they assess people's preferences. Some use the 'stated choice approach', whereby respondents are required to choose how much they would actually be willing to pay for each of several different alternatives that would avoid road trauma. Other methods use a 'revealed preference approach' which rely on real world decisions to build an estimate of how much consumers would be willing to pay to avoid road trauma, for example buying a car with (or without) safety features or the decision to wear (or not to wear) a seatbelt (de Blaeij et al. 2003). Despite the differences in methods, all estimates of WTP increase the estimated total cost of road crashes in Australia, the largest of these by more than 48% (Hensher et al. 2009). Hensher et al. (2009) estimated the WTP in Australia to avoid a road fatality to be \$7.1 m[1] for non-urban roads and \$7.2 m[1] for urban roads, more than double the BITRE human capital estimate. Hensher et al. (2009) outlines one approach for calculating WTP estimates. BITRE (2009) provides more detailed discussion on WTP.

Table 3.1: Difference between human capital crash costing and willingness-to-pay estimates using approaches from various countries (Social cost)

Approach to valuing road trauma	Total road crash cost ($b)(1)	Change to road crash cost if willingness-to-pay approach was used
BITRE human capital based estimate(a)	$20.64	–
WTP Australia(b)	$30.64	48.45%
WTP New Zealand(a)	$24.06	16.57%
WTP United Kingdom(a)	$26.72	29.46%
WTP United States(a)	$28.15	36.39%

1 Estimates converted to 2011 Australian dollars to enable comparison.

Note: calculated using RBA inflation calculator (Reserve Bank of Australia 2012).

Sources:

(a) BITRE (2009).

(b) Hensher et al. (2009).

[1] Note, Hensher et al. (2009) provided these estimates in 2007 dollars. In 2007 dollars, the figures were \$6.3 m (for non-urban roads) and \$6.4 m (for urban roads). To enable comparison with other figures in this section, these estimates have been converted to 2011 Australian dollars using RBA inflation calculator (Reserve Bank of Australia 2012).

The differences in estimating the social cost of a crash between the human capital approach and the WTP method are most pronounced for the more severe crashes. Table 3.2 compares the estimated social cost of different levels of casualty severity as a result of a road crash using the human capital approach and the WTP method. As the table shows, using the WTP method results in a much higher estimate of the cost of fatalities as well as serious injuries and disabilities compared with the human capital approach. However, the estimated cost of property damage only crashes remains relatively stable between the two approaches.

Table 3.2: Social cost of different crash severities using the human capital based approach and the willingness-to-pay method in Australia

Crash severity	Human capital based approach ($b)[(1) (a)]	Willingness-to-pay ($b) [(1) (b)]
Cost of fatalities	$4.44	$11.20
Cost of injury and disability	$8.25	$11.68
Cost of property damage only	$7.94	$7.76
Total road crash cost	$20.64	$30.64

1 Estimates converted to 2011 Australian dollars to enable comparison.
Note: calculated using RBA inflation calculator (Reserve Bank of Australia 2012).
Sources:
(a) BITRE (2009).
(b) Hensher et al. (2009).

While the willingness-to-pay approach is widely regarded as superior (BITRE 2009), the techniques for determining willingness-to-pay values vary and are quite complex. Willingness-to-pay estimates are used in some areas of transport safety valuation; however, there is growing acceptance that this practice should be adopted more widely and more consistently in Australia. When it comes to making investment decisions, particularly on road infrastructure projects, this would be expected to increase the economic justification for projects with a substantial safety component. The Australian *National Road Safety Strategy 2011–2020* (ATC 2011) acknowledges that there is a need to develop a nationally agreed upon willingness-to-pay model to estimate the cost of road trauma. This is identified as a 'First Step' to be actioned within the first three years of the strategy.

3.3 Road Agencies' Duty of Care

In Australia, a series of court decisions at the start of this century have effectively removed the former doctrine of highway immunity which protected road agencies from legal claims arising from road deficiencies which they had not addressed. This has been replaced by a recognition that road agencies owe all road users a duty of care, and must do what is reasonable to be aware of deficiencies in the road transport system, to assess and prioritise them, and have a system for remedying them (Sarre 2003).

These legal decisions have established that road agencies owe road users and adjoining land owners a duty of care, i.e. they are expected to keep the road transport system as safe as their resources will allow, and to alert road users to foreseeable dangers.

Road agencies are obliged to have in place reasonable programs of inspection to allow them to identify problems with their roads. This assessment should take into account the fact that road users might fail to take proper care of their own safety.

Road agencies should also have in place arrangements to make sure that deficiencies which pose a risk to road users are dealt with in a reasonable time, having regard to available resources.

Note that the requirement of duty of care does not demand that there be no deficiencies in the road transport system – only that a road agency will do what is reasonable to monitor and remedy problems. The court decisions recognise that the resources available to an agency, including the availability of material and skilled labour, may limit how quickly repairs can be made, and how work is to be prioritised. If this results in a delay to remedying a situation which is hazardous for road users, the road agency should consider other alternatives such as using signs to alert road users of the hazard or, in extreme cases, closing the road.

In New Zealand, road controlling authorities (RCAs) have no specific duty under law to consider and implement measures to address road safety risk. Instead, personal injury is considered a community responsibility and individuals who are injured are not entitled to sue whether the injury was caused by individuals or by organisations. Insurance cover for injuries resulting from motor vehicle crashes is provided by the Accident Compensation Corporation through its Motor Vehicle Account, which is funded by a levy on petrol sales and a component of the motor vehicle licence fee. Nevertheless, the community has an expectation that authorities will provide safe travel conditions.

Jurisdictions have reacted differently to these and other legal developments. In Victoria, following extensive community and stakeholder consultation, the *Road Management Act 2004* (Victoria) was passed in 2004 to 'establish a coordinated management system for public roads that will promote safe and efficient state and local public road networks and the responsible use of road reserves for other legitimate purposes, such as the provision of utility services and public transport' (*Road Management Act 2004*). The key principles of the Act are:

- clear allocation of road asset ownership and management
- established processes and accountabilities for policy decisions and performance standards
- provision of operational powers to achieve targets and performance standards
- clarification of civil liability laws for the management of the roads (*Road Management Act 2004*).

Queensland, on the other hand, has legislated to provide some protection for road authorities similar to the earlier position that authorities could not be sued for not acting on problems they were not aware of (*Civil Liability Act 2003*, Part 3 | Division 1| Schedules 35 – 37, www.legislation.qld.gov). However, these provisions do not apply if the act or omission of the authority is so unreasonable that the authority is not exercising its functions in a reasonable manner (schedule 36, subsection 2) or the authority had actual knowledge of the particular risk which resulted in the harm (schedule 37, subsection 2).

3.4 Measuring Road Safety

If road safety is to be managed effectively, then it is necessary to measure the amount and type of resource inputs, the road safety outcomes and the other outcomes which come about as a result of road safety activity (e.g. delays at traffic signals, reductions in exhaust omissions as a result of traffic calming, or reductions in fuel consumption through lower traffic speeds), and to understand how these affect the community. Effective management also requires an understanding of the links between inputs and outputs.

A number of different measures of road safety are available[2]. It is essential that practitioners understand the distinctions between them, and that they are aware of the advantages and disadvantages of different measures for different purposes.

[2] This section describes some overarching measures of road safety. More specific and targeted safety performance indicators are discussed in detail in Section 5.2 of the *Guide to Road Safety Part 2: Road Safety Strategy and Evaluation* (Austroads 2013).

- **Number of crashes, or numbers of fatalities and injuries**. Most crash data systems allow analysis in terms of number of crashes, or in terms of numbers of fatalities and injuries. The number of fatalities is usually the most up-to-date road safety measure with some jurisdictions having preliminary data available in daily updates. Crashes may be broken down by the most serious injury to result from the crash, e.g. fatal, serious injury, other injury and non-injury is a typical classification. Analysis in terms of crashes is a convenient way to look at the impact of infrastructure improvements or enforcement programs. Total numbers of fatalities and injuries for a jurisdiction are essential for evaluating the effectiveness of state-wide measures, such as vehicle crashworthiness, restraints and protective helmets. Numbers of fatalities and injuries are also important in describing the impact of crashes on the health of the community. The number of fatalities in particular is regarded as the key indicator by the media and is the indicator to which the political system is most sensitive. It does not take into account changes in population or travel.
- **Fatalities and injuries per 100 000 population** takes into account changes in population, but not changes in travel. It is a measure of the safety of the population, and can readily be equated to other indicators of population injury, e.g. fatalities and injuries from other types of injury such as falls or burns per 100 000 population, or number of cases of heart disease or diabetes per 100 000 population. In terms of analyses in road safety, it is particularly useful when considering the overall impacts of road safety programs, or issues such as fatality and injury rates amongst different segments of the population (e.g. age, gender or residence).
- **Fatalities and injuries per vehicle kilometres travelled (VKT)** takes into account changes in travel. It is a measure of the safety of travel, and is particularly useful when considering issues such as the relative safety of different classes of road user, different types of vehicle, or different types of road. Crashes per unit of travel is also a useful measure, and may simplify analysis of the safety performance of roads. In practice, the units are varied to suit the needs of the situation, so that fatalities per 10^9 vehicle kilometres may be appropriate when comparisons between jurisdictions are being considered, fatalities per 10^8 vehicle kilometres when different road classes are being compared, and fatalities per 10^7 kilometres when short-distance modes such as walking or cycling are being considered.
- **Fatalities and injuries per 10 000 registered vehicles** is a proxy measure for fatalities and injuries per unit of travel, as the number of vehicles on register is generally readily available whereas data on vehicle use may not be available. It assumes a constant average amount of travel for vehicles. It is useful in overall analyses of traffic system performance, but has limitations when used for other purposes.
- **Fatalities and injuries per hours travel or per trip** provide an alternative perspective on safety of travel, particularly for low-kilometre modes such as walking and cycling. Rates are generally expressed as fatalities or serious injuries per 10^6 trips. Anderson, Montesin and Adena (1989) illustrate the value of this approach very clearly. When considered in terms of fatalities per kilometre travelled, walking appears to be a high risk mode compared to travel by car. For example, the fatality rate *per 10^7 kilometres travelled* for male pedestrians was 15.7 times higher than that for car drivers, but the fatality rate *per million trips* was only 2.1 times greater.

Different indices are appropriate for different purposes. Using the wrong index can give an exaggerated impression of the extent to which particular types of road users are at risk. In adopting the Safe System approach both Australia and New Zealand now place an increased emphasis on reducing fatalities and serious injuries and increasingly many of the road safety countermeasures used are targeted at these.

In Australia and New Zealand, it is generally accepted that all road fatalities are captured by the national, state or territory crash data systems, and that the treatment of these events is sufficiently uniform for comparisons to be made across jurisdictions. Comparing injury data, however, presents serious challenges. Injuries are under-reported, and the extent of the under-reporting varies with factors such as the mode of travel, the seriousness of the injury, the location and the type of crash. One study which investigated the matches between hospital records and police crash reports (Rosman & Knuiman 1994) found the lowest match was for single vehicle motorcycle crashes, where police accident reports matched only 27% of patients admitted to hospital as a result of that type of incident. The proportional rates for pedestrians and pedal cyclists were 69% and 74%, respectively.

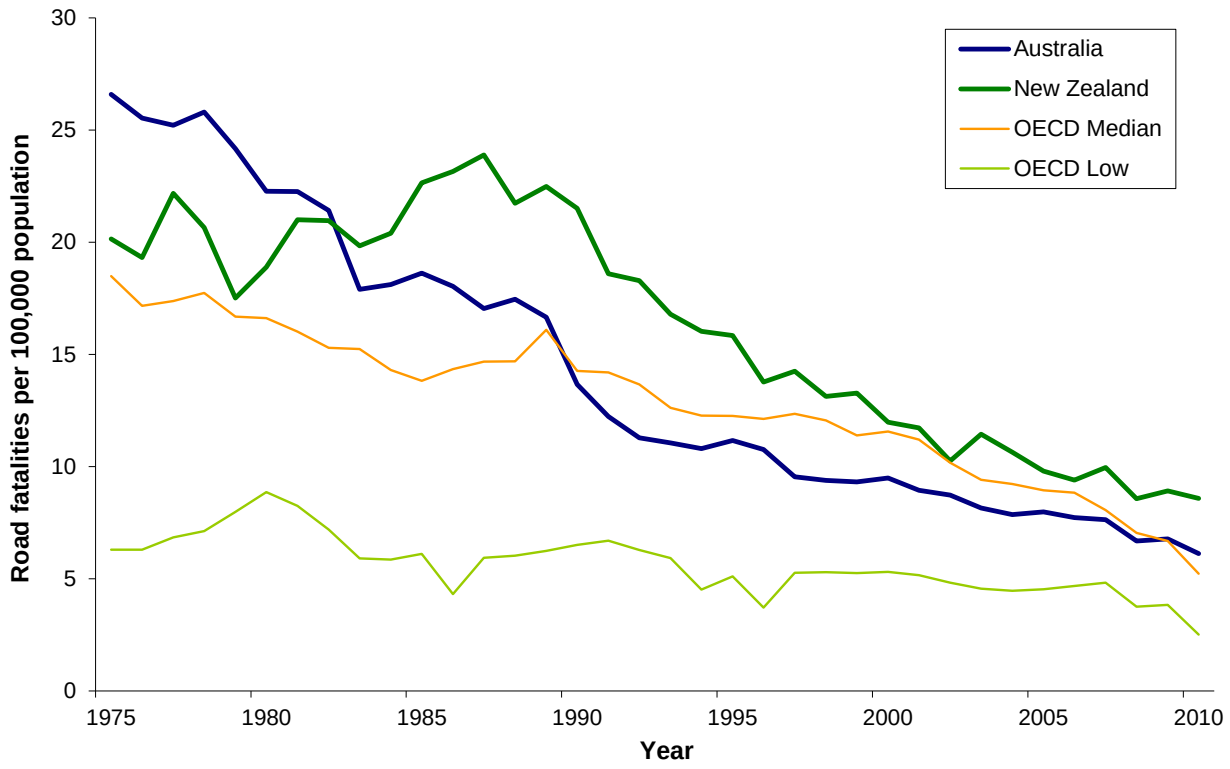
The comparison of national data on injuries has always had problems, such as different ratios of injury crashes to fatalities in different jurisdictions. The collation of national statistics in Australia stopped for a period during the 1990s, but has since resumed, using data obtained from the Department of Health in each jurisdiction.

3.5 Progress in Road Safety

Comparison with other countries

In common with many other developed economies, Australia and New Zealand have experienced substantial reductions in road fatalities and injuries over the past three decades (DITRDLG 2009a). As Figure 3.1 shows, in the 1970s and early 1980s, road fatalities per 100 000 population in Australia were above the median for countries belonging to the Organisation for Economic Cooperation and Development (OECD). From 1990 until 2008 Australia was consistently below the OECD median. In 2009 Australia experienced a slight increase in road fatalities per 100 000 population whilst the OECD median continued to drop. As a result Australia was above the median for the first time in almost two decades and remains some way above the best-performing OECD countries, indicated on the graph by 'OECD Low'. 'OECD Low' was the country with the lowest fatality rate in the comparison year (since 1980, always Norway, Iceland, Sweden, the Netherlands or the UK).

Figure 3.1: Progress in reducing road fatalities per 100 000 population in Australia and New Zealand compared to OECD benchmarks 1975–2010

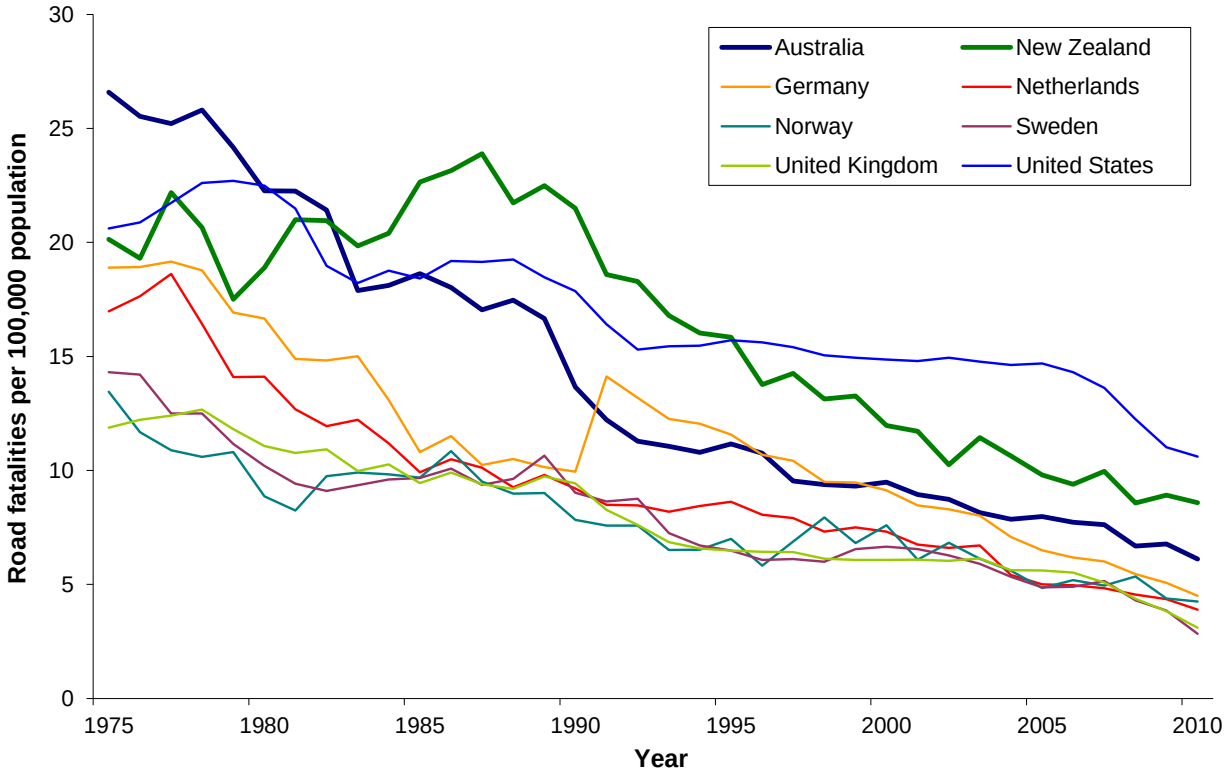


Data sourced from: OECD (2012a), OECD (2012b).

Road fatalities per 100 000 population in Australia, New Zealand and selected OECD countries are shown in Figure 3.2.

The UK, Norway and Sweden have had consistently lower crash rates than the other countries. New Zealand, Germany and Australia had high crash rates in the early 1980s, but experienced considerable reductions over the subsequent period and are now closer to the UK, Norway and Sweden. The USA, on the other hand, experienced a slight reduction between 1989 and 1992, but remained at approximately the same level until 2005. In recent years the USA has seen a rapid reduction in road fatalities per 100 000 population, experiencing a 25% reduction in the years 2005–2009, although, the rate is still nearly three times the rate of the best performing nations. Australia and New Zealand have made considerable progress over the period, but still remain well above the fatality rates of the best-performing countries such as the UK, Sweden, Norway and more recently Germany. Germany has seen a 78% reduction in road fatalities per 100 000 population over the past 30 years, the largest reduction of the benchmark OECD countries. Meanwhile, Australia and New Zealand have seen 73% and 55% reductions respectively over the same period.

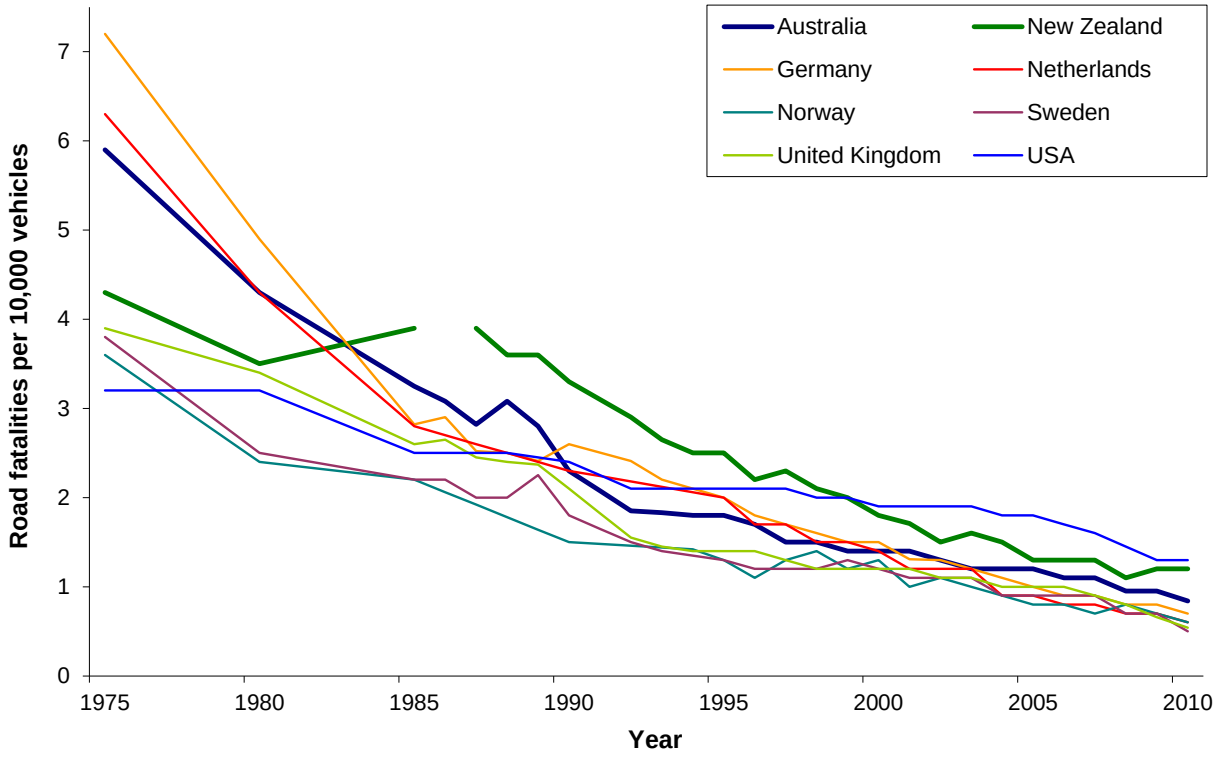
Figure 3.2: Road fatalities per 100 000 population in Australia, New Zealand and selected OECD countries 1975–2010



Note: In 1991 there was a change in the coding of fatalities in Germany and this is reflected by the sharp increase in the rate of fatalities per 100 000 population.
Data sourced from: OECD (2012a), OECD (2012b).

Fatalities per 10 000 vehicles for the same countries from 1983 to 2010 are shown in Figure 3.3. Since the early 1980s, all jurisdictions have shown downward trends. The downward trend in the USA has been less marked than in other countries. The fatality rates per 10 000 vehicles in most jurisdictions fell within a fairly narrow range in 2005 and have continued to track downwards at similar rates since, the exception being the USA. In 2009, both Australia and New Zealand experienced an increase in the fatality rates per 10 000 vehicles (up 10% from 2008), while the other countries continued a downward trend. Overall though, Australia and New Zealand have shown considerable reductions in their fatality rates per 10 000 vehicles over the last two decades (Australia, 55% and New Zealand, 65%).

Figure 3.3: Road fatalities per 10 000 vehicles in Australia, New Zealand and selected OECD countries 1975–2010

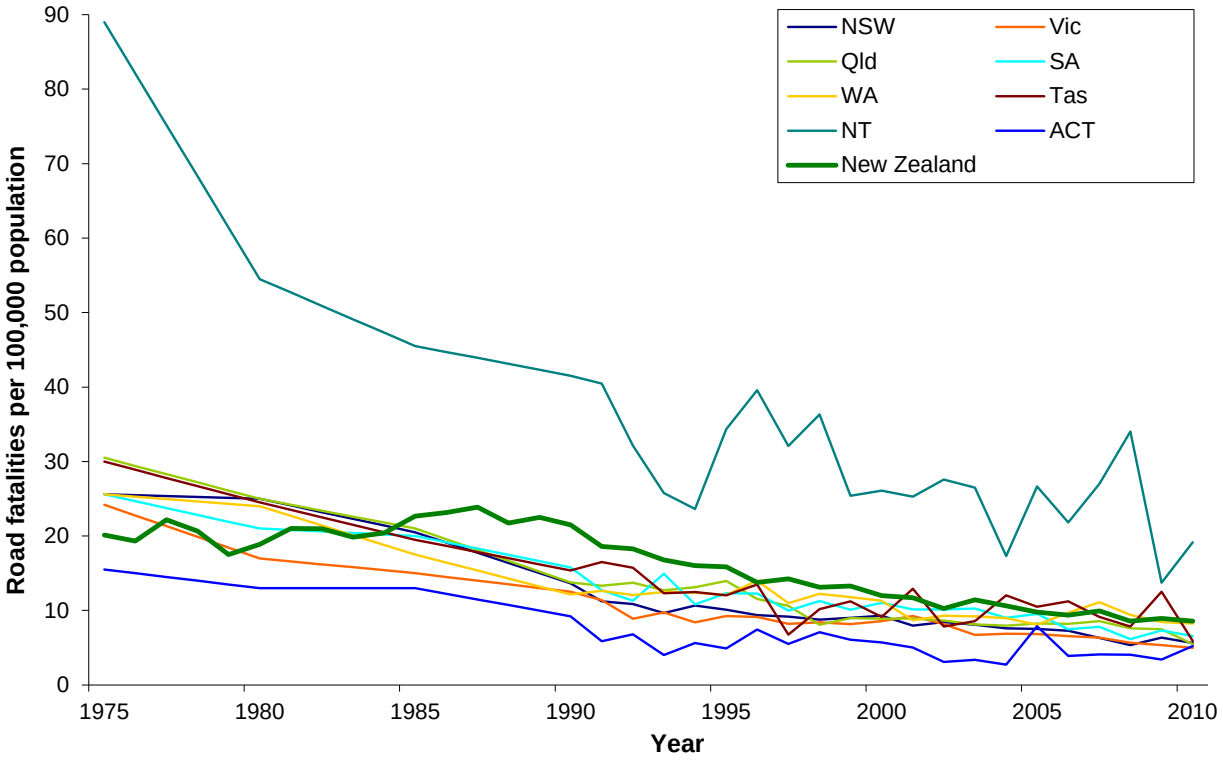


Note: Data was only available at five yearly intervals from 1975 to 1985. Data was unavailable for New Zealand for 1986. Data sourced from: DITRDLG (2009a), BITRE (2010).

Comparison among jurisdictions

Road fatalities per 100 000 population in the different Australian jurisdictions and New Zealand are shown in Figure 3.4, and the road fatalities per 100 million vehicle kilometres travelled are shown in Figure 3.5.

Figure 3.4: Road fatalities per 100 000 population in Australia and New Zealand 1975–2010

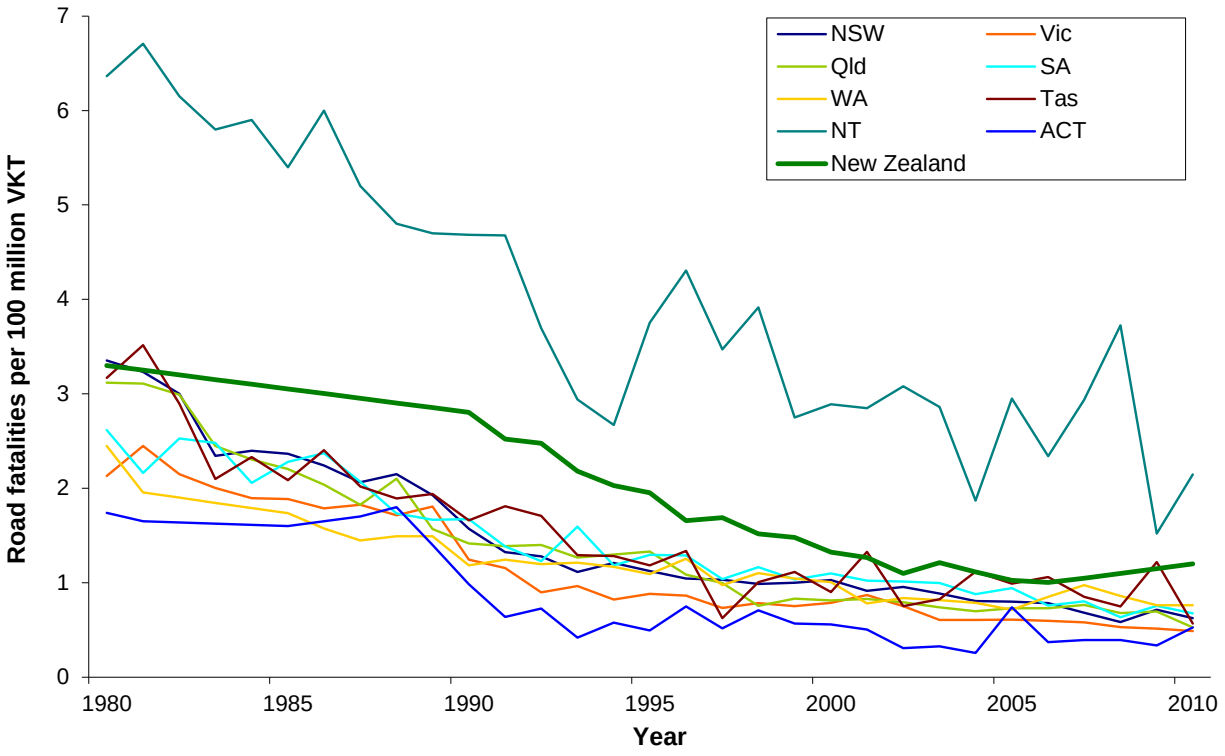


Note: Data was only available at five yearly intervals between 1975 and 1990 for the Australian jurisdictions.
Data sourced from: ABS (2010), DITRDLG (2009b), OECD (2012a), OECD (2012b).

The reductions in road fatalities shown in Figure 3.4 have occurred across all Australian jurisdictions and have followed a similar pattern in New Zealand. For a variety of reasons, safety performance varies widely. The ACT has a consistently lower fatality rate than other jurisdictions, but it should be noted that almost as many fatalities involving ACT drivers or ACT registered vehicles occur in NSW as occur in the ACT itself. The Northern Territory has had a consistently and substantially higher fatality rate than other jurisdictions. It should be noted that historically there is considerable variability in this rate for the Northern Territory (due to the relatively small population and the small amount of total fatalities), so caution must be taken when interpreting this. Road fatalities per 100 000 population were slightly higher in New Zealand than in most Australian jurisdictions until the mid-1990s, but have since dropped and are now similar to those found in the Australian jurisdictions. All jurisdictions have shown substantial reductions over the period, and fatality rates have converged.

Figure 3.5 shows fatalities per 100 million vehicle kilometres travelled (VKT). Estimates of VKT were sourced from Australian state and territory fuel sales (BITRE 2011) and New Zealand Ministry for the Environment (2009). Road fatalities per 100 million vehicle kilometres travelled show very much the same picture as Figure 3.4, with substantial reductions over the period, lowest rates consistently in the ACT, with rates in the NT consistently (and substantially) higher than other Australian jurisdictions. As is the case with fatalities per 100 000 population, fatality rates in different jurisdictions have converged within a narrow range.

Figure 3.5: Road fatalities per 100 million vehicle kilometres travelled in Australian States and New Zealand 1980–2010



Note: Data was only available at five yearly intervals for New Zealand between 1980 and 1990.
Data sourced from: DITRDLG (2009b), BITRE (2011), ITF (2012), Ministry for the Environment (2009).

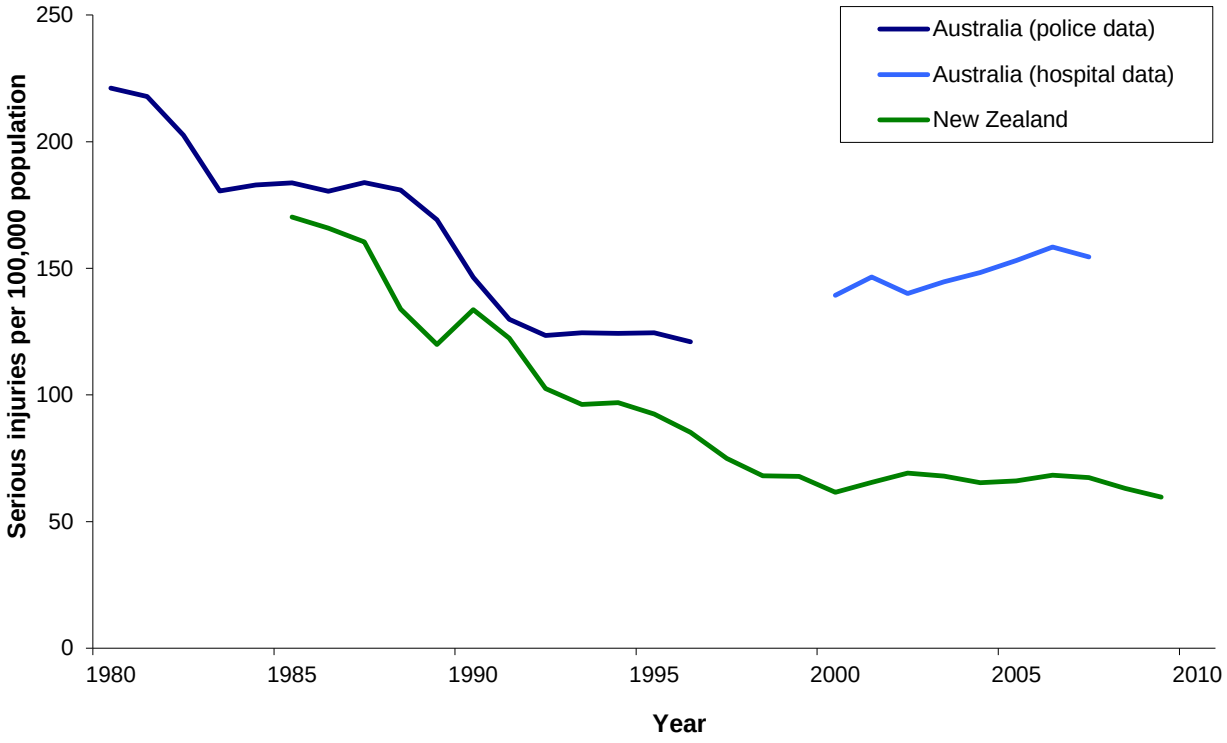
Progress with reducing injuries

Serious injuries resulting from road crashes in Australia and New Zealand between 1980 and 2009 per 100 000 population are shown in Figure 3.6. Some caution should be exercised when interpreting these figures as there are likely to be differences in the reporting of serious injuries between jurisdictions. New Zealand serious injury data was not available before 1985 and is sourced from Ministry of Transport (2010b) since. For Australia the data were supplied from two separate sources. From 1980–1996 the data are derived from police reports and from 2000–2007 the data were supplied by the Australian Institute of Health and Welfare (Henley & Harrison 2011) and are based on hospital records. Serious injury figures for Australia between 1997 and 1999 are not available as police reports were not nationally collated from 1997 onwards and reporting of figures based on hospital records 1997–1999 was not comparable with 2000 onwards due to coding changes (ATSB 2004). Due to the differences in reporting, the absolute numbers for the two Australian series are not directly comparable. As such it is unsound to look for a continuation in trends across the two series, although, one likely reason that the serious injury rate in Australia is higher from 2000–2007 compared with the 1996 police data is the under-reporting of crashes to police which are more likely to be recorded on hospital admissions databases. Also, some of the crashes captured in the hospital admissions database may have occurred off road, on private property, and would have been out of the scope of police data previously. Despite not being able to make comparisons between data sources it is, however, still appropriate to examine the direction of the trends in serious injuries.

As can be seen in Figure 3.6, serious injuries due to road crashes in Australia fell by approximately 30% between 1980 and 1992, but remained fairly constant until 1996. However, between 2000 and 2007 Australia experienced a steady increase (10% over this period). Rates of serious injuries per 100 000 population in New Zealand declined from 1985 until 2000. Since 2000, the rate of serious injuries due to road crashes has remained relatively stable, although in most recent years (from 2007) the rate of serious injuries per 100 000 population has begun trending downward again. Over the 1985 to 2009 period, New Zealand experienced a 65% reduction in the rate of serious injuries due to road crashes. Due to the differences in data sources identified above, a comparison with Australia is not appropriate.

It is worth noting that it is possible that the recent increase in serious injuries in Australia and the flattening of the trend line for New Zealand could be an artefact of the implementation of Safe System countermeasures that are designed to reduce the severity of injuries as a result of road crashes. As can be seen in the above figures the fatality rate per 100 000 population has steadily decreased for both Australia and New Zealand and as such it is possible that some of the reductions in fatalities may partly be represented in the serious injury trends below.

Figure 3.6: Serious injuries per 100 000 population for Australia and New Zealand, 1980–2009



Data sourced from: ABS (2010), Henley & Harrison (2011), ATSB (2004), Ministry of Transport (2010b).

3.6 Evidence-based Approach

It is important to recognise that effective road safety programs must rely on an evidence–based approach. In the introduction to his influential book on before-after studies in road safety, Hauer (1997) makes the point that factual knowledge about road safety is not easy to obtain. Despite popular belief, the proposition that personal experience is a good source of factual knowledge about road safety is ‘dangerously untrue’ (p. 1). Nevertheless, ‘the field of road safety abounds with strongly held but unfounded opinions……In road safety gut feeling and folklore are frequently wrong’ (p. 1).

The benefits of an evidence-based approach are self-evident. It means that the bulk of road safety funds can be put into programs and projects which return high levels of benefit to the community and little time and energy is devoted to programs or projects with no impact, or which are counter-productive. Although, in some cases, substantial investments are made in programs which are difficult to justify on grounds of a demonstrated contribution to crash reduction (e.g. road safety education, or school crossing supervisors). Often in these cases, there are strong community expectations that such programs will be provided and there may be reasonable a priori or intuitive grounds for expecting them to have some effect even though it is difficult to measure. Caution must be taken when directing large amounts of money at programs with little or no evidence base. If an evidence-based framework for considering road safety initiatives is in place, it does not guarantee that only programs which meet set benefit-cost criteria will be invested in, but it does mean that investments will be undertaken in an informed manner and that decision makers will have a realistic picture of what can be expected from different forms of investment.

Much research in road safety is characterised by methods which limit the extent to which generalisations can be made. The two main methods open to road safety research are the cross-sectional comparison (e.g. Tsyganov, Warrenchuk & Machemehl, 2006) and the before and after comparison (e.g. Sapkota, Anderson & Dua, 2011). See the Austroads Guide to Road Safety Part 2: Road Safety Strategy and Evaluation (Austroads 2013) and the Introductory Guide for Evaluating Effectiveness of Road Safety Treatments (Austroads 2012) for detailed road safety evaluation methodologies including their limitations and constraints.

Care must be taken with the design and interpretation of road safety studies. The major (and seemingly inevitable) limitation on such studies is that, for a range of practical and ethical reasons, it is generally not possible to randomise the allocation of treatments to sites, as would occur in a classical experimental design. A further limitation in the case of road safety is that the number of sites (and hence the number of crashes) available for study may be small, so that results may be inconclusive. There is a danger that inconclusive results will be interpreted as showing a treatment is ineffective, when the appropriate conclusion should be that there are insufficient data to allow a reasonable test. The logic of statistical testing should prevent inconclusive results as being interpreted as supporting the hypothesis that a treatment is effective; however, wishful thinking or the need to be seen to be acting on a problem may result in this interpretation.

Despite the fact that much research in road safety is of poor quality, there is a body of reliable evidence from evaluation studies conducted in Australia and New Zealand and overseas. Although not all safety measures have been properly evaluated, there is evidence relating to a sufficient number of measures to guide the direction of comprehensive road safety strategies. Practitioners need to be able to distinguish these reliable findings from less satisfactory work, to have confidence in this work, and to use it to guide their own activities and to educate the public and the political system about the realities of road safety.

A recent development in road safety is the adoption of the practice of systematic reviews of research literature. In contrast to traditional narrative reviews, they focus on answering a particular question, set rules to define the type and methodological standards for the papers to be included, and try to consider all studies, not just those where treatments have been successful, in order to produce a comprehensive estimate of the likely effectiveness of a particular measure.

Statistical methods for estimating the effects of treatments pooled across several or many studies are also available (Elvik et al. 2009). A powerful statistical technique, known as meta-analysis, focuses on combining and contrasting results from different studies in order to identify patterns among results, identify sources of disagreement and control for extraneous or irrelevant variables. Meta-analyses have been used to evaluate a number of road safety initiatives, for example: the effect of mass media campaigns on reducing accidents (Phillips, Ulleberg & Vaa 2011); the relationship between speeding and crash risk (Elvik, Christensen & Amundsen 2004); the effectiveness of random breath testing operations (Erke, Goldenbeld & Vaa 2009). As the body of road safety research increases, the meta-analysis technique is likely to find increasing application in the future.

Where there is no proven solution to a particular problem, there may be a case for going beyond evidence-based treatments. Where this occurs, the treatments should be developed with reference to basic principles and careful consideration of accumulated experience with the most similar types of treatment that are available. It is essential to ensure that adequate evaluation of new treatments is undertaken.

4. The Guide to Road Safety

Road safety is a major strategic area for Austroads. The continuing reduction in road trauma is a key objective of all Austroads members and the aim of the *Guide to Road Safety* is to provide the tools to assist organisations to fulfil this objective. It also provides links to other Austroads Guides where road safety is a key consideration, or where aspects of other Guides cover essential aspects of changes to the road transport system which are being considered for safety reasons. For example, the *Guide to Road Safety* does not attempt to cover areas such as intersection design or pedestrian crossings but directs users to the relevant Parts in the Traffic Management or Road Design Guides. As well as meeting the direct needs of Austroads members, it is intended that the *Guide to Road Safety* will encourage and sustain partnerships with other road safety stakeholders by making key road safety concepts, principles and examples readily accessible.

The *Guide to Road Safety* is not intended to provide complete coverage of every aspect of road safety activities. Publications other than the Guide will continue to provide new information, promote discussion, or deal with issues where other stakeholders have primary responsibility, such as education or enforcement. Such publications may contribute to future revisions or expansion of the Guide.

The *Guide to Road Safety*, in association with other key Austroads publications, will provide road safety practitioners with the knowledge and techniques that will enable the application of Safe System principles.

The *Guide to Road Safety* consists of the following parts:

- **Part 1:** Road Safety Overview (this document).
- **Part 2:** Road Safety Strategy and Evaluation – this Part presents an overview of past road safety plans and essential processes, evidence-based approach to road safety, strategic partnerships, setting realistic goals, safer roads, vehicles and road users, and monitoring and review.
- **Part 3:** Speed Limits and Speed Management – this Part explains the function of speed limits and their relation to road hierarchy, setting speed limits, time-based speed limits, signing and marking related to communicating information about speeds, and speed management.
- **Part 4:** Local Government and Community Road Safety – this Part covers the role of local governments and communities in road safety, strategic partnerships and capacity building, developing a road safety strategy, funding a plan and mobilising resources, implementation, monitoring, evaluation and review; it also provides some case studies in strategy development and road safety activities.
- **Part 5:** Road Safety for Rural and Remote Areas – this Part deals with special considerations in rural and remote areas, fatigue management, community road safety programs, road design (including delineation), tourist and other directional signing, incident detection and patient retrieval.
- **Part 6:** Road Safety Audit – this Part is a manual which describes the principles of road safety audit, gives detailed instructions on how to conduct different types of audit, and provides checklists to facilitate the audit.
- **Part 7:** Road Network Crash Risk Assessment and Management – this Part covers road agencies' responsibility for managing risk, the principles of risk management applied to a road network, and the impact that different treatments have on risk.
- **Part 8:** Treatment of Crash Locations – this Part describes how to identify contributing factors at crash locations, how to select appropriate treatments to eliminate or reduce the effects of these factors, and the extent of crash reductions which can be expected with different types of treatments.
- **Part 9:** Roadside Hazard Management – this Part deals with identification of roadside hazards, clear zone theory, delineation, appropriate treatment of hazards in different settings (i.e. removal, relocation, modification or protection), and treatments in environmentally sensitive areas.

5. The Austroads Guides

The Austroads publication strategy is focused on the following ten areas:

- Asset Management
- Bridge Technology
- Pavement Technology
- Project Delivery
- Project Evaluation
- Road Design
- Road Safety
- Road Transport Planning
- Road Tunnels
- Traffic Management.

The safety issues relevant to each Guide include:

Asset Management: maintenance to an appropriate condition is of critical importance for the safety performance of the road transport system. Of particular importance are road surface characteristics (skid resistance, macrotexture and rutting).

Bridge Technology: road safety issues include the protection and design of abutments, the design of railings, the interface of the bridge with the roads at each end, provision for pedestrians, and the exposure of workers to risk during inspection and maintenance activities.

Pavement Technology: friction/skid resistance has direct links to road safety, and the durability of a design and the need for maintenance affect the frequency of roadworks, which have the potential to increase risk for their duration.

Project Delivery: road safety projects are subject to the same requirements as other projects, and will benefit from this Guide.

Project Evaluation: evaluation is particularly important for road safety projects. From the point of view of the road agencies establishing priorities and setting goals, it is important that safety projects be evaluated by the same methods and criteria as other projects.

Road Design: safety performance is fundamental to road design. Links are made to the Parts of the *Guide to Road Safety* dealing with road network risk assessment and management, road safety engineering, road safety audit, roadside hazard management guide, safety for rural and remote areas, and speed limits and speed management.

Road Safety: this guide.

Road Transport Planning: key safety issues for transport planning include reducing the amount of travel through better integration of land use, encouraging travel by safer modes, and protecting travellers on foot or bicycle.

Road Tunnels: provides guidance on planning, design, implementation, operation and maintenance including safety in road tunnels.

Traffic Management: safe operation is a fundamental goal for traffic engineering, and links are made with the Parts of the *Guide to Road Safety* dealing with road network risk assessment and management, road safety engineering, road safety audit, roadside hazard management, and speed limits and speed management.

References

Anderson, PR, Montesin, HJ & Adena, MA 1989, *Road fatality rates in Australia 1984-85,* report CR70, Federal Office of Road Safety, Canberra, ACT.

Australian Bureau of Statistics 2010, *Measures of Australia's progress: September 2010,* ABS, Canberra, ACT.

Australian Bureau of Statistics 2011, *Consumer price index*, Australia, December release, 6401.0, ABS, Canberra, ACT.

Australian Transport Council 2009, *National road safety action plan: 2009 and 2010,* ATSB, Canberra, ACT.

Australian Transport Council 2011, *National road safety strategy: 2011-2020*, ATSB, Canberra, ACT.

Australian Transport Safety Bureau 2004, *Serious injury due to road crashes*, ATSB, Canberra, ACT.

Austroads 2012, *An introductory guide for evaluating effectiveness of road safety treatments*, AP-R421-12 Austroads. Sydney, NSW.

Austroads 2013, *Guide to road safety: part 2: road safety strategy and evaluation,* AGRS02-13, Austroads, Sydney, NSW.

Bureau of Infrastructure, Transport and Regional Economics 2009, *Road crash costs in Australia 2006*, report 118, BITRE, Canberra, ACT.

Bureau of Infrastructure, Transport and Regional Economics 2010, *International road safety comparisons 2009,* BITRE, Canberra, ACT.

Bureau of Infrastructure, Transport and Regional Economics 2011, *Road vehicle kilometres travelled: estimation from state and territory fuel sales*, research report 124, BITRE, Canberra, ACT.

de Blaeij, A, Florax, R, Rietveld, P & Verhoef, E 2003, 'The value of a statistical life: a meta-analysis', *Accident Analysis and Prevention*, vol.35, no.6, pp.973-86.

Department of Infrastructure, Transport, Regional Development and Local Government 2009a, *International road safety comparisons: the 2007 report*, road safety report no.5, DITRDLG, Canberra, ACT.

Department of Infrastructure, Transport, Regional Development and Local Government 2009b, *Road deaths Australia: 2008 statistical summary*, road safety report no.4, DITRDLG, Canberra, ACT.

Elvik, R, Christensen, P & Amundsen, A 2004, *Speed and road accidents: an evaluation of the power model*, report no. 740/2004, Institute of Transport Economics, TØI, Oslo, Norway.

Elvik , R, Høye, A, Vaa, T & Sørensen, M 2009, *The handbook of road safety measures*, 2nd edn, Emerald Publishing, Bingley, UK.

Erke, A, Goldenbeld, C & Vaa, T 2009, 'The effects of drink-driving checkpoints on crashes: a meta-analysis', *Accident Analysis and Prevention,* vol.41, no.5, pp.914-19.

Hauer, E 1997, *Observational before-after studies in road safety*, Pergamon, Oxford, UK.

Henley, G & Harrison, JE 2011, *Trends in serious injury due to land transport accidents, Australia 2000–01 to 2007–08,* Injury research and statistics series no. 54, Australian Institute of Health and Welfare, Canberra, ACT.

Hensher, DA, Rose, JM, de Ortúzar, J & Rizzi, LI 2009, 'Estimating the willingness to pay and value of risk reduction for car occupants in road environment', *Transport Research Part A: Policy and Practice,* vol.43, no.7, pp.692-702.

International Transport Forum 2012, *Road safety annual report 2011,* ITF & OECD, Paris, France.

Ministry for the Environment 2009, *Vehicle kilometres travelled by road: environmental report card March 2009,* Ministry for the Environment, Wellington, New Zealand.

Ministry of Transport 2010a, *Safer journeys: New Zealand's road safety strategy 2010-2020,* Ministry of Transport, Wellington, New Zealand.

Ministry of Transport 2010b, *Motor vehicle crashes in New Zealand 2009: section 1 historical,* Ministry of Transport, Wellington, New Zealand.

Ministry of Transport 2011, *The social cost of road crashes and injuries: June 2011 update*, Ministry of Transport, Wellington, New Zealand.

Organisation for Economic Co-operation and Development 2012a, *Road injury accidents (number): data cube,* OECD, viewed June 18, 2012, <http://stats.oecd.org/index.aspx?DatasetCode=ROAD_INJURY_ACCIDENTS>

Organisation for Economic Co-operation and Development 2012b, *Population: data cube,* OECD, viewed June 18, 2012, <http://stats.oecd.org/index.aspx?queryid=254#>

Phillips, RO, Ulleberg, P, & Vaa, T 2011, 'Meta-analysis of the effect of road safety campaigns on accidents', *Accident Analysis and Prevention,* vol.43, no.3, pp.1204-18.

Reserve Bank of Australia 2012, *Inflation calculator*, Reserve Bank of Australia (RBA), Sydney, NSW, viewed May 2012 <www.rba.gov.au/calculator/>.

Rosman, DL & Knuiman, MW 1994, 'A comparison of hospital and police road injury data', *Accident Analysis and Prevention,* vol.26, no.2, pp.215-22.

Sarre, R 2003, 'Liability in negligence and the High Court decisions in Brodie and Ghantous: where to from here for road authorities?', *Road and Transport Research,* vol.12, no.4, pp.3-12.

Sapkota, J, Anderson, C & Dua, A 2011, 'Effectiveness of combined treatments: shoulder sealing and guard fence', *Australasian College of Road Safety conference, 2011, Melbourne, Victoria, Australia*, Australasian College of Road Safety, Pearce, ACT, 10pp.

Tsyganov, AR, Warrenchuk, NM & Machemehl, RB 2006, 'Safety impact of edge lines on rural two-lane highways in Texas', *ARRB conference, 22nd, 2006, Canberra, ACT, Australia*, ARRB Group, Vermont South, Vic, 13pp.

Austroads' **Guide to Road Safety Part 1: Road Safety Overview** provides an overview of the Guide to Road Safety. It commences with a discussion of road crash costs and road agencies' duty of care to provide safe travel. The advantages and disadvantages of different ways of measuring road safety are discussed, and these methods are used to illustrate progress in road safety in Austroads' member jurisdictions in recent years. The Safe System approach as a conceptual framework for road safety management is explained, along with the merits of an evidence-based approach to countermeasures.

Guide to Road Safety Part 1

1

Austroads

Austroads is the association of Australasian road and transport agencies.

www.austroads.com.au