Dear Mr Thompson

Thank you for the invitation to contribute to the Victorian Parliamentary Road Safety Committee Inquiry Into Serious Injury. VicRoads is pleased to provide this submission that responds to all the Inquiry Terms of Reference.

The focus on serious injury is an important component of Victoria’s Road Safety Strategy 2013-22 and an important community issue that affects the health and well being of thousands of Victorians and their families.

This inquiry represents a significant opportunity to improve our collective knowledge and understanding of serious injury in Victoria and to think of new ways to reduce the terrible consequences of trauma in the community.

Yours sincerely

GARY LIDDLE
CHIEF EXECUTIVE
VICROADS SUBMISSION TO THE PARLIAMENTARY ROAD SAFETY COMMITTEE INQUIRY INTO SERIOUS INJURY

May 2013
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Executive Summary

This inquiry presents a unique opportunity to improve our knowledge and understanding of serious injury in Victoria and to strengthen Victoria’s leadership position in road safety.

Over 5,000 persons are seriously injured each year or 14 serious injuries each day. These injuries can range from a broken bone to quadriplegia. The economic cost to the community of serious injuries is around $2.5 billion a year, the impact on families and loved ones is immeasurable.

In the last 25 years the road toll has been reduced by 60 per cent but the hidden road toll of serious injuries has only been reduced by around 45 per cent in the same period.

Victoria’s new road safety strategy 2013-22 sets an ambitious challenge to reduce deaths and serious injuries by more than 30 per cent and for the first time in Australia establish a measure of severe injury.

This submission outlines the need for a reliable measure of injury severity and what may constitute a severe serious injury. Importantly more research is required to better understand injury outcomes and the mechanisms of injuries to better inform the development of countermeasures and improve existing measures that will have an impact on reducing the number and severity of serious injuries.
VicRoads and Road Safety

VicRoads’ purpose is to deliver social, economic and environmental benefits to communities throughout Victoria and to improve safety on the roads for users.

Victoria’s Road Safety Strategy 2013-2022 is based on proven Safe System approach, which recognises that people will continue to make mistakes, and the transport system must accommodate these. The transport system should not result in death or serious injury as a consequence of errors on the roads.

There are known physical limits to the amount of force our bodies can take before we are injured.

A Safe System ensures that the forces in collisions do not exceed the limits of human tolerance. Speeds must be managed so that people are not exposed to impact forces beyond their physical tolerance.

Responsibility for road safety is shared by all. While individual road users are expected to be responsible for complying with traffic laws and behaving in a safe manner, it can no longer be assumed that the burden of road safety responsibility simply rests with the individual road user. System designers and managers such as VicRoads need to take into account the limits of the human body in designing and maintaining roads, vehicles and speeds.

The overarching safety responsibilities of VicRoads are found in the Transport Integration Act 2010 (the Act). VicRoads has a central role in ensuring that the transport system is safe, supports health and wellbeing and is continually improved (s. 13 of the Act). Under Section 87, it states that VicRoads’ road safety function is to:

…lead in the development and implementation of strategic and operational policies and plans to improve the safety of the road system for all users.

The Act requires the Corporation to adopt a collaborative approach:

…in collaboration with relevant bodies including other road authorities, Victoria Police, the Transport Accident Commission, the Director of Public Transport, … and the Department of Justice, to improve the safety of the road system for road users and seek to reduce deaths and injuries.

VicRoads works collaboratively not only with those agencies identified in the Act, but also with industry, user group representatives and the community.

Victoria is at the forefront of Australian and international efforts to reduce road trauma, to deliver further major improvements to the road transport system and to achieve greater safety for all Victorian road users. VicRoads is committed to ensuring Victoria’s leadership in this area continues and strengthened.

In developing information and material for this submission it has been evident that a number of opportunities should be explored and developed to maintain our leadership position.

These opportunities relate to fostering new partnerships with the health and medical sectors to better understand the nature and extent of injuries and their severity arising from road crashes.

In the 1970’s it was the medical fraternity that advocated for the introduction of seat belts in Victoria. Subsequently Victoria became the first jurisdiction in the world to make it compulsory to wear a seat belt. The result of this measure and the reduction in trauma is well documented.

This involvement together with improved knowledge and understanding of injury consequences from the health sector will greatly assist the Government and the road safety partners to develop more effective countermeasures that can better reduce injuries and their severity.

Equally more research in a number of areas such as crash types and specific injury outcomes is required and why programs that have been so successful in reducing the numbers of fatalities have failed to address injuries.

This Submission responds to all Terms of Reference (ToR) set out by the Road Safety Committee.
2 Background

Parliamentary Inquiry Terms of Reference

VicRoads is responding to the Terms of Reference of the Parliamentary Road Safety Committee’s Inquiry into Serious Injury.

The terms of reference for the inquiry were announced in the Legislative Assembly on 29 November 2012, as follows:

That under s 33 of the Parliamentary Committees Act 2003, the Road Safety Committee is required to inquire into, consider and report no later than 12 December 2013 on the nature and extent of serious injury in motor vehicle accidents in Victoria and the Committee should:

a) determine the appropriate methodology to identify the cost of a serious injury to the Victorian community and economy;

b) identify processes, including the exchange of data and information between agencies, that will facilitate accurate, consistent and timely reporting of road related serious injuries;

c) consider best practice definitions and measures of road related serious injury and injury severity, and recommend how road related serious injuries and their severity should be identified and reported in Victoria;

d) determine the correlation between reductions in fatalities and serious injuries (including for different levels of severity) resulting from different road safety countermeasures;

e) identify cost effective countermeasures to reduce serious injury occurrence and severity; and

f) identify best practice in managing long term reductions in serious injury including raising the profile of the serious injury burden.

This VicRoads’ submission addresses all of the points listed in the terms of reference.
This section addresses the following Term of Reference:

a) determine the appropriate methodology to identify the cost of a serious injury to the Victorian community and economy

Glossary of Terms

Ex-ante: Before the event.

Ex-post: After the event.

Human Capital (HC): Traditional approach used to calculate social cost of crashes. Based on income flow that would be lost by the economy following loss of life or injury.

Hybrid Human Capital: Human capital approach used to calculate social cost of crashes, supplemented with cost estimate for ‘pain and suffering’ as well as additional costs associated with road crashes.

Income Elasticity: The factor by which a measure is estimated to change given a 1% change in real income. An income elasticity of less than one is termed ‘income inelastic’.

Revealed Preferences: Preferences determined from actual purchases (e.g. risk reduction devices such as air bags).

Road User Effects (RUE): Components used to calculate benefits when undertaking benefit cost analysis. Includes crash cost savings, travel time savings, vehicle operating cost savings and reductions in environmental externality costs.

Stated Preferences: Preferences determined from surveying respondents via questionnaires or other market research techniques.

Willingness to Pay (WTP): Alternative approach used to calculate social cost of crashes. Based on survey data to establish how much society is willing to pay to reduce the risk of a fatality or serious injury.

Value of Serious Injury (VSI): Estimated cost of a serious injury.

Value of Statistical Life (VSL): Estimated cost of a fatality.

Cost of Serious Injury – Current Methodology (Human Capital Approach)

Cost-benefit analysis is used to allocate resources to road safety programs and to rank projects based on their economic viability. In order to carry out cost-benefit analysis, the social cost of a crash needs to be determined.

The social cost of crashes is used to work out crash cost savings. Crash costs savings, along with travel time savings, vehicle operating costs savings and reductions in environmental externality costs are the key components used to calculate benefits when undertaking project evaluation. These components are collectively called the Road User Effects (RUE).

VicRoads crash costs are based on the methodology outlined in Austroads Report AP-R238, which in turn is based on estimates carried out by the Bureau of Transport Economics. The Austroads cost estimates are updated on a regular basis in the Austroads Guide to Project Evaluation: Part 4 Project Evaluation Data. These estimates are based on a Human Capital (HC) methodology, supplemented with a ‘quality of life’ component. The ‘quality of life’ component allows for pain, grief and suffering.
The Human Capital method estimates the impact of life loss or injury on current and future levels of output and is calculated by the present value of the income flow that would be lost by the economy. The HC approach is an ex-post ("after the fact") method. That is, it measures the cost to the community after the event (e.g. fatality or injury) has occurred by using historical data to predict the value of the same event occurring again in the future. It involves measuring the economic output an individual produces over their productive life. Accordingly, the value of a life lost due to premature death and the value of a serious injury is the discounted stream of future earning of that individual. In Australia and in some other countries, the element of pain, suffering and grief arising from a crash is also included but it is mostly arbitrarily determined.4

The Bureau of Infrastructure, Transport and Regional Economics (BITRE) has revised the methodology that produced the BTE 2000 crash cost estimates. The revised costs are based on a 'hybrid' Human Capital approach in which the standard HC estimates are supplemented with a cost estimate for 'pain and suffering'.5 The revised crash costs are based on 2006 crash data and unit costs and are referred to as BITRE 2006 crash costs.

The BITRE 2006 crash costs were not adopted by the jurisdictions due to a number of key components such as travel delays, vehicle costs and other general costs being valued significantly less than under the historical approach used by Austroads for these costs. Further work was considered necessary, but given developments in the area of crash cost estimates and the move towards Willingness to Pay as the preferred method (discussed in detail in the next section), a decision was made to review the Austroads RUE values and to update them to 30 June 2010 figures.6

The Austroads RUE unit values have been adopted and accepted by the Standing Council on Transport and Infrastructure (SCOTI) as the appropriate parameter values to be applied for the economic evaluation of road projects in Australia.

The Austroads report estimates the cost of a fatality to be $1.8 million, the cost of a serious injury to be $440,000 and the cost of other injury to be $17,000 (in 2010 prices).7

These estimates have been indexed by VicRoads to June 2012 prices based on the Consumer Price Index (CPI) and the Average Weekly Earnings (AWE) data from the Australian Bureau of Statistics (ABS).

Table 3-1 illustrates the cost of road crashes per person and the total annual crash cost to the community for each of the injury levels currently reported, based on the actual number of persons killed or injured. The total cost of serious injuries in Victoria for 2012 was estimated at $2.5 billion.

<table>
<thead>
<tr>
<th>INJURY LEVEL</th>
<th>COST PER PERSON (JUNE 2012 PRICES) AU$</th>
<th>NUMBER OF PERSONS (2012 FOR FATALITIES (2011-12) FOR SERIOUS AND OTHER INJURIES)</th>
<th>ANNUAL COST AU$ MILLION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality</td>
<td>2,112,166</td>
<td>282</td>
<td>596</td>
</tr>
<tr>
<td>Serious Injury</td>
<td>478,126</td>
<td>5,312</td>
<td>2,540</td>
</tr>
<tr>
<td>Other Injury</td>
<td>18,310</td>
<td>12,376</td>
<td>227</td>
</tr>
</tbody>
</table>

Table 3-1: Crash cost by injury level, Victoria 2012

Note: While all fatality data for 2012 is now complete, coding of non-fatal crash data reported for 2012 is 98 per cent complete. To allow for this, July 2011 – June 2012 data was used as a surrogate for 2012 serious and other injury numbers.
The breakdown of these costs by component is shown in Table 3-2.

<table>
<thead>
<tr>
<th>COST COMPONENT</th>
<th>FATAL INJURY (JUNE 2012 PRICES) AU$/PERSON</th>
<th>SERIOUS INJURY (JUNE 2012 PRICES) AU$/PERSON</th>
<th>OTHER INJURY (JUNE 2012 PRICES) AU$/PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Costs</td>
<td>1,968,700</td>
<td>317,832</td>
<td>6,830</td>
</tr>
<tr>
<td>Ambulance</td>
<td>478</td>
<td>478</td>
<td>260</td>
</tr>
<tr>
<td>Hospital In-Patient</td>
<td>2,585</td>
<td>10,343</td>
<td>53</td>
</tr>
<tr>
<td>Other medical</td>
<td>1,917</td>
<td>15,527</td>
<td>75</td>
</tr>
<tr>
<td>Long Term Care</td>
<td>0</td>
<td>117,490</td>
<td>0</td>
</tr>
<tr>
<td>Labour in the workplace</td>
<td>696,168</td>
<td>32,917</td>
<td>0</td>
</tr>
<tr>
<td>Labour in the household</td>
<td>579,121</td>
<td>27,447</td>
<td>0</td>
</tr>
<tr>
<td>Quality of life</td>
<td>639,670</td>
<td>68,629</td>
<td>3,647</td>
</tr>
<tr>
<td>Insurance claims</td>
<td>18,063</td>
<td>31,831</td>
<td>1,903</td>
</tr>
<tr>
<td>Criminal prosecutions</td>
<td>2,330</td>
<td>674</td>
<td>83</td>
</tr>
<tr>
<td>Correctional services</td>
<td>12,811</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Workplace disruption</td>
<td>12,158</td>
<td>12,495</td>
<td>810</td>
</tr>
<tr>
<td>Funeral</td>
<td>2,559</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Coroner</td>
<td>840</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vehicle Costs</td>
<td>14,480</td>
<td>12,201</td>
<td>11,241</td>
</tr>
<tr>
<td>Repairs</td>
<td>12,519</td>
<td>10,460</td>
<td>10,322</td>
</tr>
<tr>
<td>Unavailability of vehicles</td>
<td>1,588</td>
<td>1,409</td>
<td>744</td>
</tr>
<tr>
<td>Towing</td>
<td>373</td>
<td>332</td>
<td>175</td>
</tr>
<tr>
<td>General Costs</td>
<td>128,986</td>
<td>148,092</td>
<td>238</td>
</tr>
<tr>
<td>Travel delays</td>
<td>71,767</td>
<td>86,859</td>
<td>113</td>
</tr>
<tr>
<td>Insurance administration</td>
<td>45,990</td>
<td>55,663</td>
<td>72</td>
</tr>
<tr>
<td>Police</td>
<td>9,253</td>
<td>3,179</td>
<td>48</td>
</tr>
<tr>
<td>Property</td>
<td>1,490</td>
<td>1,803</td>
<td>3</td>
</tr>
<tr>
<td>Fire</td>
<td>486</td>
<td>589</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,112,166</td>
<td>478,126</td>
<td>18,310</td>
</tr>
</tbody>
</table>

Table 3-2: Crash cost per person by component and injury level, 2012

Source of Data: Austroads Report AP-R238 Table 5, ABS CPI & AWE Indices (7% discount rate)
The major component of the fatality cost is labour in the workforce, accounting for 33 per cent of the total fatality cost. The second and third largest components are quality of life (30 per cent) and labour in the household (27 per cent). Travel delay costs are the fourth largest component, accounting for 3 per cent of the total fatality cost.

The major component of the serious injury cost is long term care, accounting for 25 per cent of the total serious injury cost. The second and third largest components are travel delays (18 per cent) and quality of life (14 per cent). Labour in the workforce (7 per cent) and labour in the household (6 per cent) are the fifth and seventh largest components of the total serious injury cost respectively.

The travel delay costs listed above are less for a fatality than for a serious injury. The impact of travel delays is greater in the metropolitan area. A larger proportion of serious injuries occur in metropolitan areas compared to the proportion of fatalities that occur in metropolitan areas, resulting in increased travel delays per serious injury.

In comparison, the BITRE 2006 crash costs, adjusted for CPI and AWE to 2012 figures, estimate a fatality at $3,161,340, a serious injury at $290,818 and other injury at $13,933.

The main differences between the Austroads crash costs and the BITRE 2006 crash costs are:

- The discount rate used to express future costs in present prices. The Austroads method uses a 7 per cent per annum real discount rate whilst the BITRE 2006 method uses a 3 per cent real discount rate. A lower discount rate results in greater costs being estimated for components with significant liability in future years such as disability related-costs and workplace and household labour losses.
- Workplace and household losses are 94 per cent higher for fatalities and 80 per cent higher for serious injuries under the BITRE 2006 method than the equivalent labour in the workforce and labour in the household costs under the Austroads method (2012 prices).
- Travel delay costs under the BITRE 2006 method are 92 per cent lower for a fatality and 89 per cent lower for a serious injury (2012 prices). The model used by BITRE did not capture the network congestion that occurs when a crash disrupts a major road or intersection during peak periods.
- The value of a serious injury is 9 per cent of the value of a fatality under the BITRE 2006 method (2012 prices). In comparison, the value of serious injury is 23 per cent of the value of a fatality using the Austroads method (2012 prices).
Alternative Methodology for Calculating Serious Injury Cost
(Willingness to Pay Approach)

An alternative method to calculate the social cost of crashes is the Willingness to Pay (WTP) approach.

The WTP approach differs from the HC approach in that it attempts to gauge how much members of the community are willing to pay in order to reduce the risk of, for example, a fatality occurring. This methodology is also able to provide cost estimates of how much road users are willing to pay to reduce the risk of serious injury, minor injury and property damage outcomes resulting from road crashes. The WTP approach is an ex-ante (“before the event”) method. That is, it measures how much the community is prepared to pay to reduce the risk of an event (e.g. fatality or injury) occurring in the future.

As an example, if, on average, individuals in a group of 100,000 people are willing to pay $30 each to reduce the risk of a fatality by 1 in 100,000 for each member of the group, the value of statistical life would be $30 x 100,000 which equates to $3 million. Similarly, if these individuals are willing to pay $5 each to reduce the risk of a serious injury by 1 in 100,000 for each member of the group, the value of a serious injury would be $5 x 100,000 which equates to $0.5 million.

The data employed to estimate these user preferences can be based on revealed trends in market behaviour (revealed preferences) and on surveys of individuals (stated preferences).

Revealed preference methods refer to the observation of preferences revealed by actual market behaviour, for example through purchases of risk reduction devices such as air bags, electronic stability and collision-avoidance systems in vehicles. This represents real-world evidence on choices that individuals exercise.

Stated preference methods use questionnaires or other market research techniques to survey respondents about their preferences for hypothetical scenarios/alternatives relating to travel choices and road crash scenarios. These scenarios are designed in such a way as to enable the respondents’ choices to be used to determine their willingness to pay to reduce the risk of an event (e.g. fatality or injury) occurring. These scenarios can be used to measure their preference for one event over another (for example, choosing between one route that is longer but has a lower risk of being seriously injured than a shorter route with a higher risk of being seriously injured). The results of these surveys, as well as measuring the relative preference of safety above other living activities, also reflect what the individual is able to pay.

Stated preference (survey) methods can be used to supplement the revealed preference (actual choices) data or as an alternative to the revealed preference method in situations where revealed preference data are unavailable or where relevant markets do not currently exist.

The best approach is to first make use of available revealed preference choice data, before commissioning a stated preference data collection with the use of questionnaires. This combined set of data then provides the best set for analysis of user preferences, which in turn can produce the most statistically robust estimates.

The use of the WTP approach for estimating the statistical value of life and injury is considered by the majority of economists to be methodologically superior to the HC approach as it provides a fuller estimate of the community’s valuation of avoiding loss of life. Good stated preference data can be collected using proven market research techniques.
In contrast, the HC approach only focuses on the income loss effects to the economy and does not account for the value and enjoyment of life. Even with the inclusion of a ‘pain and suffering’ component, the HC approach is likely to underestimate the social value of road crashes. The WTP approach better reflects the way people value reducing the risk of loss of life, enabling efficient allocation of scarce resources whilst contributing to the maximisation of social welfare.9

The WTP technique for valuing crash costs has been adopted over the last two decades by a number of developed countries, including Austria, New Zealand, Sweden, the United Kingdom and the United States. A pilot study of WTP was undertaken by NSW Roads and Traffic Authority (RTA, now Roads and Maritime Services (RMS)) in 2008.

The National Road Safety Strategy 2011-2020 (NRSS) acknowledges that the WTP approach is the best practice in terms of evaluating the economic value of human life and identifies a need for Australia to develop and adopt suitable willingness-to-pay estimates at a national level.

The Action Plan for the first three years of the NRSS includes the development of ‘a nationally agreed approach to applying the willingness-to-pay methodology to value safety’.10

An Austroads project was commissioned to scope a national WTP study for estimating the social cost of crashes in Australia.11 Austroads also carried out a review and assessment of the implementation of WTP by NSW, New Zealand, Sweden, Norway, the United Kingdom and Singapore. Scoping covered the following areas: methodology; data requirements; empirical estimation of WTP parameters; types, roles and selection criteria of/for consultants; and indicative costs and timeframe of study.

The Austroads report recommended that work on a national WTP should commence without further delay, given the length of time (3-4 years) required for producing and implementing national WTP estimates. Austroads also recommended that, in the interim, a set of WTP values based on those produced by the NSW pilot study be used across all jurisdictions. These values will be developed to reflect travel exposure (traffic volumes) in each jurisdiction and will be regularly updated using the consumer price index (CPI) or growth in per capita gross domestic product (GDP), adjusted by the income elasticity. The income elasticity is the factor by which the VSL is estimated to change given a 1% change in real income. The recommended factor for income elasticity is less than 1 (income inelastic).12

Based on the NSW pilot WTP study, the NSW Treasury approved the use of the WTP approach for valuing crash cost in 2010. NSW RTA/RMS has been applying the WTP values obtained from this pilot study in their economic appraisals of both rural and urban road projects, including those submitted to the Commonwealth Government seeking Federal funding.
Comparison of Human Capital Approach and Willingness to Pay Approach

Advantages and disadvantages of the HC approach

As presented in Austroads, the advantage of the HC approach lies in its simplicity in calculations, and provision of reliable and consistent numbers, which are useful for public-sector decision makers. However, there are a number of conceptual and empirical limitations in the HC approach, including:

- Failure to reflect society’s views about the importance of safety. The BTCE identified from several studies that most people value safety in a way that reflects their aversion to the prospect of serious injury for themselves and others, rather than as a means of preserving current and future earnings.
- Ignoring the loss of ‘joy of life’, while values assigned for pain, grief and suffering are often arbitrary.
- Undervaluation of those not in the labour force (e.g. children, elderly and home-makers), omission of externalities (e.g. pain and suffering in some cases) and exclusion of socio-economic characteristics (e.g. occupation, education and indigenous populations).
- Overestimation of cost in an economy with less than full employment.

Advantages and disadvantages of the WTP approach

The WTP approach, on the other hand, is regarded as the theoretically sound method for valuing life and aversion to death and injury for conventional cost-benefit analysis (Austroads 2011). The approach values small changes in the probability of injury or death that an individual could gain from a road safety program.

The WTP approach has the advantage of reflecting the way people value lives, thereby enabling the efficient allocation of scarce capital whilst contributing to the maximisation of social welfare. Its implementation enables public investment decisions to recognise the social value to the wider community in a more comprehensive manner. Decisions are focused on:

- Outcome (that is, reducing risk of death and threats to quality of life);
- Process (achieving greater equity and social justice for all groups in the community);
- Context (relative risk of different mode of travel, e.g. road user versus public transport user versus air traveller).

In addition, the WTP approach more completely captures road safety costs and may result in higher benefit-cost ratios due to higher social cost of crashes values, leading to more projects with a safety focus being funded. It is used by other developed countries and brings Australia’s estimates in line with these countries. Based on international comparison data as reported in Austroads:

- For developed countries using the WTP, on average the value of statistical life (VSL) is calculated to be 77 times the country’s GDP per capita. The international benchmark for the VSL is 70 times the country’s GDP per capita.
- For developed countries using the HC approach or hybrid HC approach, on average the VSL is calculated to be 53 times the country’s GDP per capita. Australia’s VSL (under the HC approach) is 45 times the GDP per capita.
- The international benchmark for the value of serious injuries (VSI) is 17 times the country’s GDP per capita (that is, 25 per cent of the VSL).
- Australia’s VSI is 10 times the GDP per capita.

In terms of disadvantages, this approach has been criticised from a conceptual viewpoint. It is based on the assumption that people always correctly perceive the risks associated with a given behaviour. However, people can often ignore external social costs in decision-making, and some actually gain utility from risk-taking.
Furthermore, there is a degree of complexity in terms of designing and implementing the approach. Eliciting preferences of individuals can be difficult and people are not always fully informed of the risks of deaths and injuries.

Also, it may be costly to produce and implement WTP values. For example, Austroads has estimated that it will cost around $1 million to develop national WTP values for Australia. A major update of the WTP values (mostly to update community preferences about road safety) would need to be carried out every 8-10 years.

In order to overcome some of the disadvantages of the WTP approach, careful consideration is required in terms of employed survey techniques, including statistically robust sampling and questionnaire design as well as development of appropriate estimation methods to derive robust parameters of community preferences for reducing the risk of death and injury. This is an important part of the process, as these parameters are the cornerstone of developing WTP values for road safety.

The design of survey techniques and methodology would need to also carefully consider the influence of factors such as socio-economic status, age, gender and geographical location.

As with the HC approach, other administrative type costs such as emergency services response costs, insurance overhead costs and costs related to clearing and restoring crash sites would normally be calculated separately and added to the WTP costs.

Table 3-3 provides a summary of the comparison between the two approaches:

<table>
<thead>
<tr>
<th>HC APPROACH</th>
<th>WTP APPROACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex-post method. It measures the cost to the community after the event (e.g. fatality or injury) has occurred.</td>
<td>Ex-ante method. It measures how much road users are willing to pay to reduce the risk of a fatality or injury.</td>
</tr>
<tr>
<td>Focuses on income loss to the economy resulting from a fatality or injury. Ignores the loss of ‘joy of life’. Values assigned for pain, grief and suffering are often arbitrary.</td>
<td>Better reflects society’s view about the importance of road safety.</td>
</tr>
<tr>
<td>Data obtained from measuring the economic output an individual produces over their productive life.</td>
<td>Data obtained by combining available (Revealed Preference) information (e.g. derived from actual purchases of risk-reduction devices), and generated by survey (Stated Preference) information.</td>
</tr>
<tr>
<td>Undervalues life for those not in the labour force such as children, elderly and homemakers.</td>
<td>Requires careful design when addressing socio-economic status, demographics such as age and gender, and geographical location.</td>
</tr>
<tr>
<td>Values of statistical life, as a proportion of the country’s GDP/capita, is lower under the HC approach than under the WTP approach.</td>
<td>Greater focus on safety leading to higher benefit-cost ratios. Brings Australia’s estimates of value of statistical life and value of statistical injury in line with other developed countries that are using the WTP approach.</td>
</tr>
</tbody>
</table>

Table 3-3: Comparison of HC and WTP approaches
Comparison of social cost of crashes based on human capital approach with willingness to pay approach

A comparison of the social cost of crashes by injury level using the HC and the WTP methods is shown in Table 3-4.

<table>
<thead>
<tr>
<th>METHOD</th>
<th>COST PER PERSON – FATALITY (JUNE 2010 PRICES) $</th>
<th>COST PER PERSON – SERIOUS INJURY (JUNE 2010 PRICES) $</th>
<th>COST PER PERSON – OTHER INJURY (JUNE 2010 PRICES) $</th>
<th>SERIOUS INJURY COST/PERSON AS PROPORTION OF FATALITY COST/PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austroads Hybrid HC Approach</td>
<td>1,838,785</td>
<td>440,823</td>
<td>17,277</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td>(current methodology)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW WTP – Urban</td>
<td>6,919,993</td>
<td>337,101</td>
<td>17,982</td>
<td>5%</td>
</tr>
<tr>
<td>NSW WTP – Rural</td>
<td>6,842,214</td>
<td>210,634</td>
<td>22,066</td>
<td>3%</td>
</tr>
</tbody>
</table>

Table 3-4: Comparison of HC and WTP for calculation of social cost of crashes, Australia

In this table, estimates obtained using the HC method are as reported in Austroads. The WTP estimates are based on the pilot study undertaken by NSW (also reported in this Austroads report). Whilst it is difficult to strictly compare these estimates, they do present an interesting range of values for fatality cost, reflecting the methodology used to produce these figures. From the data in the above table, the value of a fatality is nearly four times higher under the WTP method (based on the NSW WTP value for urban areas, i.e. the Sydney metropolitan area) than it is under the HC method (based on the Austroads hybrid HC method). The value of a serious injury, however, is nearly a third higher under the HC method (based on the Austroads hybrid HC method) than it is under the WTP method (based on the NSW WTP value for urban areas, i.e. the Sydney metropolitan area). The NSW WTP – Rural values are based on a too narrow a sample for them to be of any great value.

Under the Austroads HC approach, the value of serious injury (VSI) is 24 per cent of the value of statistical life (VSL) which is close to the international benchmark of 25 per cent. The NSW WTP approach results in a much lower value of serious injury compared to the statistical value of life (3 to 5 per cent).

Source of Data: Austroads Guide to Project Evaluation: Part 4 Project Evaluation Data, Table 4.2 and Table 4.4;
The higher cost weighting of fatalities compared to serious injuries under the NSW WTP method would affect prioritisation of projects. More emphasis would be placed on those projects where a fatal crash has occurred than on those projects where there are a number of serious injuries. Under the current Austroads methodology, approximately four serious injuries equate to the cost of one fatality. Using the NSW WTP (Urban) values, approximately 20 serious injuries equate to the cost of one fatality.

Table 3-5 shows the total social cost of crashes (in 2010 AUS) based on the actual number of fatalities (288), serious injuries (5,106) and other injuries (12,365) in Victoria for 2010, for the two methods.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Austroads Hybrid HC Approach</td>
<td>530</td>
<td>2,251</td>
<td>214</td>
<td>2,994</td>
</tr>
<tr>
<td>(current methodology)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW WTP (Note 1)</td>
<td>1,993</td>
<td>1,721</td>
<td>222</td>
<td>3,937</td>
</tr>
</tbody>
</table>

Table 3-5: Annual social cost of crashes using HC and WTP methodology, Victoria 2010

The total social cost of crashes is highest under the RTA WTP approach ($3.94 billion) than under the Austroads HC approach ($2.99 billion).

Table 3-6 provides an international comparison of the social cost of fatalities (VSL) and serious injuries (VSI) using the different approaches (HC and WTP). However, the figures are indicative only and care should be taken when comparing one country’s figures with that of another country, as there are differences in the environments, the timeline, the definitions and the methodologies used to produce these figures.

Source of Data: Austroads Guide to Project Evaluation: Part 4 Project Evaluation Data Table 4.2 and Table 4.4; VicRoads RCIS data.

Note1: For simplicity, the NSW WTP Urban figures were used and applied to the total Victoria crash numbers. Applying the urban and rural WTP figures to Victorian metropolitan Melbourne crashes and Victorian country Victoria crashes gives an overall total social cost of crashes of $3.71 billion.
<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>VSL 2010 AUS</th>
<th>VSI/VSL %</th>
<th>VSI 2010 AUS</th>
<th>METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUSTRALIA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austroads Hybrid HC Approach (current methodology)</td>
<td>1,838,785</td>
<td>24%</td>
<td>440,823</td>
<td>HC (Hybrid)</td>
</tr>
<tr>
<td>NSW WTP - Urban</td>
<td>6,919,993</td>
<td>5%</td>
<td>337,101</td>
<td>WTP</td>
</tr>
<tr>
<td>NSW WTP - Rural</td>
<td>6,842,214</td>
<td>3%</td>
<td>210,634</td>
<td>WTP</td>
</tr>
<tr>
<td>INTERNATIONAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand - Ministry of Transport (2010)</td>
<td>3,420,988</td>
<td>18%</td>
<td>622,514</td>
<td>WTP</td>
</tr>
<tr>
<td>Austria</td>
<td>3,854,930</td>
<td>12%</td>
<td>371,289</td>
<td>WTP</td>
</tr>
<tr>
<td>Canada</td>
<td>1,765,470</td>
<td>-</td>
<td>-</td>
<td>HC</td>
</tr>
<tr>
<td>France</td>
<td>1,533,544</td>
<td>11%</td>
<td>137,729</td>
<td>HC</td>
</tr>
<tr>
<td>Germany</td>
<td>1,537,325</td>
<td>8%</td>
<td>100,596</td>
<td>HC</td>
</tr>
<tr>
<td>Iceland</td>
<td>5,711,621</td>
<td>-</td>
<td>-</td>
<td>HC+PGS</td>
</tr>
<tr>
<td>Latvia</td>
<td>1,780,771</td>
<td>-</td>
<td>-</td>
<td>HC</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2,377,710</td>
<td>-</td>
<td>-</td>
<td>HC+PGS</td>
</tr>
<tr>
<td>Sweden</td>
<td>2,437,087</td>
<td>18%</td>
<td>362,822</td>
<td>WTP</td>
</tr>
<tr>
<td>UK</td>
<td>2,986,598</td>
<td>11%</td>
<td>252,137</td>
<td>WTP</td>
</tr>
<tr>
<td>USA</td>
<td>3,856,215</td>
<td>15%</td>
<td>450,000</td>
<td>WTP</td>
</tr>
</tbody>
</table>

Table 3-6: International VSL and VSI estimates

The estimates reported in Table 3-6 are also graphed in Figures 3-1 and 3-2 below to present a summary view of how the alternative methods for Australia compare with the international social cost of fatalities and serious injuries (in 2010 AUS). However, as previously noted, these estimates are indicative only and care should be taken when comparing one country’s figures with that of another country’s.

Note: PGS = Pain, Grief and Suffering.
Source of Data: The VSL and VSI/VSL ratio have been sourced from Austroads and iRAP. The VSI has been calculated based upon VSI/VSL ratio.
Figure 3-1: International VSL and VSI estimates

Figure 3-2: International VSI estimates
**Recommended Methodology for the Calculation of Serious Injury Cost to the Community**

The WTP approach is best practice for estimating the social cost of crashes as it better reflects the community’s preferences, and for that reason is also the method used by many developed countries.

From a project evaluation viewpoint, the WTP approach more completely captures road safety costs. As such, it may result in higher benefit-cost ratios for projects with greater safety benefits due to higher social cost of crash values, leading to greater safety benefits from investment programs.

When taking into account all injury levels, as an overall total, the NSW WTP method yielded a higher total social cost for Victoria than the Austroads HC method (in 2010 prices and using 2010 crash data).

Over time, the number of crashes has decreased due to implementation of road safety strategies and programs, including infrastructure improvements. The costs of treatments, on the other hand, have increased. It is becoming more difficult to develop projects that meet historical benefit cost ratio funding thresholds. Using WTP values is likely to lead to a better assessment of projects with a safety focus.

The WTP approach places a higher economic value on human life and wellbeing relative to mobility than the HC approach.

Work on developing acceptable Australia-wide values based on the WTP approach needs to commence at the earliest opportunity as the estimated timeframe to obtain these values is lengthy (3 to 4 years).

Implementation of a WTP approach would need to be done in conjunction with other jurisdictions and other government areas as it is important that costs resulting from road crashes be consistent between jurisdictions and with those associated with other areas of safety valuations (e.g. other transport modes or other industries). For consistency, it is also desirable that other components of RUE (that is, travel time costs and environmental costs) are also estimated using the WTP approach. A coordinated approach, therefore, is required, with a lead agency for this shift in approach.

A robust methodology would need to be developed to minimise both the conceptual and the practical challenges when applying the WTP approach. Challenges faced by, and subsequent lessons from, other countries and jurisdictions that have implemented this approach should be taken into account.

Current approaches for calculating the social cost of crashes do not distinguish between the different levels of severity of serious injuries which can vary greatly in cost. The WTP methodology should include lifelong injuries (in addition to fatalities, serious injuries and other injuries) as lifelong injuries cost the community between $2 million to $5 million per injury (based on TAC estimates) and are not captured in the current crash cost estimation methodology. As a conservative estimate, 5 per cent of the serious injuries are lifelong injuries. This equates to around 250 lifelong injuries per annum. Around 90 of these are catastrophic injuries, including quadriplegia, paraplegia and severe acquired brain injury.

Additional costs arising from road crashes (e.g. emergency services costs and costs associated with cleaning and restoring crash sites) should continue to be separately estimated (as they have been done in the past by BITRE and Austroads) and added to WTP values used for the purposes of cost-benefit analysis of projects.

---

**Recommendation 1:** That Victoria endorses willingness to pay as the approach for the calculation of social costs of road crashes.

**Recommendation 2:** That the relevant agencies and jurisdictions across Australia collaborate to establish, implement and adopt a national willingness to pay methodology for the calculation of social costs of road crashes. The methodology should consider the higher costs associated with life long injury and care.
References

2. BTE (2000), Road crash costs in Australia, Report 102, Bureau of Transport Economics, Canberra, ACT.
3. Austroads (2012), Guide to project evaluation: part4: project evaluation data, AGPE04/12, Austroads, Sydney, NSW.
4. Austroads (2011), Updating Austroads RUE Unit Values and Related Methodologies, AP-R373/11, Austroads, Sydney, NSW.
5. BITRE (2009), Road crash costs in Australia 2006, Report 118, Bureau of Infrastructure, Transport and Regional Economics, Canberra, ACT.
6. Austroads (2012), Guide to project evaluation: part4: project evaluation data, AGPE04/12, Austroads, Sydney, NSW.
7. Ibid.
12. Ibid.
15. Austroads (2011), Updating Austroads RUE Unit Values and Related Methodologies, AP-R373/11, Austroads, Sydney, NSW.
16. Austroads (2009), Component Costs in Transport Projects to Ensure the Appropriate Valuing of Safety Effects, Table 3.3 and Table 3.7, AP-T125/09, Austroads, Sydney, NSW.
17. Austroads (2013), Social Cost of Road Crashes in Australia: the Case for Willingness-to-pay (WTP) Values for Road Safety, Austroads Project TS1720 (forthcoming), Austroads, Sydney, NSW.
18. Austroads (2012), Guide to project evaluation: part4: project evaluation data, AGPE04/12, Austroads, Sydney, NSW.
19. Austroads (2013), Social Cost of Road Crashes in Australia: the Case for Willingness-to-pay (WTP) Values for Road Safety, Austroads Project TS1720 (forthcoming), Austroads, Sydney, NSW.
This section addresses the following Term of Reference:

b) identify processes, including the exchange of data and information between agencies, that will facilitate accurate, consistent and timely reporting of road related serious injuries

### Glossary of Terms

**CODES**: Crash Outcome Data Evaluation System. CODES is a data linkage system used in the USA and is based on a probabilistic data linkage model.

**DCA**: Definition for Classifying Accidents. Three-digit code used to identify the type of crash that has occurred. For example, DCA 170 is ‘Off carriageway to left’.

**Deterministic Data Linkage**: A method of linking of datasets that share a unique identifier or key (e.g. Licence Number or Medicare Number)

**ICD-10-AM**: Coding as per the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification.

**ICISS**: International Classification of Disease Severity Score. ICISS indicates an injured person’s probability of death (when they are admitted to hospital).

**RCIS**: VicRoads Road Crash Information System. It contains data from TIS that is has an ‘approved’ status in TIS (that is, it excludes draft reports). TIS data is verified and enhanced by RCIS coders before it is made available for use.

**Probabilistic Data Linkage**: A method of linking datasets based on matches of a combination of data variables that are common in both datasets. The variables can be identifying (e.g. name) or not (e.g. gender, date of birth, time and date of event). This type of linkage focuses on the probability of a match (that is, the probability that the matched pair is a valid match) and thus does not require exact matches for a record to be linked.

**STRADA**: Swedish Traffic Accident Data Acquisition information system containing information on injuries and crashes on the entire Swedish road system. It combines hospital data and police-reported crash data and was commissioned in 1996.

**Sub DCA**: Three-digit codes that supplement the DCA code in providing more detailed information about the circumstances of a crash. For example, a sub-DCA code of C02 (Pedestrian stepped off safety zone, tram shelter) can be used to supplement DCA 108 (Pedestrian struck while boarding or alighting vehicle).

**TAC**: Transport Accident Commission.

**TIS**: Traffic Incident System. Crash data is entered into this database by Victoria Police and made available to VicRoads, the TAC and WorkSafe.

**VAED**: Victorian Admitted Episode Dataset. This is a state-wide collection of data on all admissions to Victorian hospitals. It is collected by the Victoria Department of Health and records every admitted episode for all Victorian hospitals (public and private).

**VISU**: Victorian Injury Surveillance Unit. VISU is the repository for de-identified injury data from VAED in Victoria, outsourced by the Department of Health.
Current Crash Data Collection Process

Victoria Police is responsible for collecting details of all injury crashes on Victoria’s roads.

For a crash to be reportable as a road-related crash, it must meet the ABS Guidelines for Reporting and Classifying Road Vehicle Accidents. That is, “any apparently unpremeditated event reported to the police or other relevant authority and resulting in death, injury or property damage attributable to the movement of a road vehicle on a road.”

The road is defined as “the entire way devoted to public travel where that way is in a surveyed road reserve.”

A road vehicle can include: a motor vehicle such as a car, station wagon, panel van, utility, motorcycle, bus, rigid truck, articulated vehicle; a pedal cycle; or other road vehicle such as tram and train operating within the road reserve, animal-drawn vehicle, ridden animal or wind-powered vehicle.

For a crash involving a pedestrian to be reportable as a road-related crash, a road vehicle needs to have been involved and the crash must have occurred on a road or road-related area.

In December 2005, a new data collection process and system was introduced by the Victoria Police – the Traffic Incident System (TIS).

Prior to the implementation of TIS, data was entered onto a paper form by the police, called the 510 Form. The data from the 510 Form was then manually entered into a database called the Traffic Accident Information System (TAIS). This data-entry occurred centrally within Victoria Police. Both the 510 Form and the electronic data from TAIS were sent to VicRoads for entry into the VicRoads Road Crash Information System (RCIS) and its predecessors.

TIS replaced the paper-based 510 Form and data-entry is decentralised within Victoria Police, with each police member able to enter data directly into TIS. Data from TIS is sent electronically to VicRoads for entry into RCIS. VicRoads Coders verify the data, spatially locate the crash and add additional attributes such as sub DCA codes.

RCIS is a reporting system whilst TIS is a data-entry system. Data from RCIS is used for analysis and reporting of crash statistics. It is a major input into the development and evaluation of road safety strategies, action plans, policies, programs and countermeasures.
Current Definition of Serious Injury

There are four injury levels in use in Victoria for persons involved in road crashes. These injury levels and their definitions are as follows:

1. Fatality – Person killed or died within 30 days as result of a road crash.
2. Serious Injury – Person who is injured in a road crash and admitted to hospital, irrespective of length of stay in hospital.
3. Other Injury – Person who is injured in a road crash but is not admitted to hospital. This can include injuries where medical attention is sought (e.g. broken arm) or minor injuries (e.g. bruising).
4. Not Injured – Person who does not sustain an injury but is involved in a road crash where at least one person in injured.

The current definition of serious injury used in Victoria is based on the values in two of the crash data fields recorded in the Victoria Police Traffic Incident System (TIS) as follows:

(a) Injury Code; and
(b) Admitted to Hospital.

In TIS there are four values in the Injury Code field. They are:

1. Killed or died within 30 days
2. Injured – Taken to Hospital
3. Other Injury
4. Not Injured

In TIS there are five values in the Admitted to Hospital field, two of which are no longer used. The five values stated are:

1. Checked – Admitted
2. Checked – Not Admitted
3. Checked – Not Known (no longer used)
4. Not Checked (no longer used)
5. Enquiries Pending

An injury is defined as ‘serious’ if the Injury Code value is 2 (Taken to Hospital) and if the Admitted to Hospital value is 1 (Checked – Admitted) or 5 (Enquiries Pending).

A person who is injured and is taken to hospital by ambulance is initially assigned an Injury Code of 2 (Taken to Hospital). The police check if the person has been admitted to hospital and assign the appropriate value to the Admitted to Hospital field. If the admission status is unknown, they assign 5 (Enquiries Pending) as the value.
Table 4-1 illustrates how the injury level is calculated based on the values in the two fields:

<table>
<thead>
<tr>
<th>TIS INJURY CODE</th>
<th>TIS ADMITTED TO HOSPITAL VALUE</th>
<th>INJURY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FATALITY</td>
</tr>
<tr>
<td>1 – Killed or died within 30 days</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>2 – Injured – Taken to Hospital</td>
<td>Checked - Admitted</td>
<td>yes</td>
</tr>
<tr>
<td>2 – Injured – Taken to Hospital</td>
<td>Checked – Not Admitted</td>
<td></td>
</tr>
<tr>
<td>2 – Injured – Taken to Hospital</td>
<td>Enquiries Pending</td>
<td></td>
</tr>
<tr>
<td>3 – Other Injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 – Not Injured</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4-1: Injury level calculation based on TIS data

For a serious injury to be considered road-related, the crash must meet the ABS Guidelines for Reporting and Classifying Road Vehicle Accidents.

Discontinuity and variability in serious injury data

Both the current and the past definitions of serious injury are based on hospital admission in Victoria.

The data fields used to capture the injury level and admission status have changed over time, resulting in discontinuity of the serious injury data. Two major discontinuities have occurred following the redevelopment of the 510 Form in 1989 and the implementation of TIS at the end of 2005.

As the serious injury definition is highly dependant on the ability of the police to determine the hospital admission status, the serious injury data is subject to some degree of variability.

Different hospitals have different approaches with regards to releasing hospital admission status to the police, depending mainly on the size of the hospital. The task to determine the admission status from the hospital may be quite difficult and alternate methods have been used, including contacting the injured person directly. Over the last few years, hospital claims data from the Transport Accident Commission (TAC) have been used to verify the hospital admission status.

The following chart shows the serious injury trend in Victoria from 1987 onwards and highlights the two major discontinuities in the serious injury data.
Figure 4-1: Victorian annual serious injuries

Timeliness of serious injury data

The timeliness of serious injury data is the length of time between when the crash occurs and when data on the serious injury is available for reporting.

The timeliness of the serious injury data is dependent on the length of time required for the TIS record to get completed and the length of time required to code the completed TIS record in RCIS.

When a crash occurs or is reported, there is an operational requirement for the police member to create a TIS report before the end of shift and for the TIS report to be completed within 28 days, unless a longer period is justified. Justifications for longer periods include waiting to interview the injured person or a crucial witness and waiting on results of investigation, for example a mechanical report. For those serious injuries not attended by police, the length of time between a crash occurring and the data being available is dependent on when the crash is reported to the Police by or on behalf of the injured person, which could be months after the crash has occurred.

Based on analysis of TIS data and RCIS data, serious injury data is approximately 98 per cent complete within four months of the crash occurring. For example, as at the end of April 2013, the following levels of completion were observed:

- December 2012: 98% complete
- January 2013: 90% complete
- February 2013: 85% complete
- March 2013: 75% complete

Measures are in place to ensure that crash data is timely. Current police business practices include reviewing outstanding records and sending ‘chasers’ which identify the missing information and provide assistance with completion of the record.

Note 1: In December 2005, a new data collection process and system was introduced by Victoria Police. As a result, a discontinuity in the data series has occurred. Non-fatal data from 2006 onwards should not be compared to previous years’ data when undertaking a time-series trend analysis due to the discontinuity.

Note 2: While all fatality data for 2012 is now complete, non-fatal data reported for 2012 is 98 per cent complete.
Victorian serious injury numbers
Based on the current definition, there were an average of 5,111 serious injuries per annum between 2010 and 2012. In comparison, for the same period there was an average of 286 fatalities and 12,166 other (minor) injuries per annum. This equates to 14 persons seriously injured each day.

Recording of serious injuries in other jurisdictions and countries
Each jurisdiction has its own definition of injury and what constitutes a reportable crash. Table 4-2 provides a comparison of the injury definitions in each jurisdiction (where available). New Zealand and UK definitions are included for comparison.

<table>
<thead>
<tr>
<th>JURISDICTION</th>
<th>SERIOUS INJURY DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victoria</td>
<td>Taken to hospital and admitted. (Those who are taken to hospital but whose admission status is unknown are still counted as seriously injured).</td>
</tr>
<tr>
<td>New South Wales</td>
<td>Serious Injury not available. Serious injuries are not distinguished from other / minor injuries.</td>
</tr>
<tr>
<td>Queensland</td>
<td>Hospitalisation crash (injury crash requiring hospitalisation).</td>
</tr>
<tr>
<td>South Australia</td>
<td>A person who sustains injuries and is admitted to hospital as a result of a road crash and who does not die as a result of those injuries within 30 days of the crash. The SA Police definition of what constitutes a hospital admission is a person who is taken to a ward, that is not part of the emergency department, and that the admission is an overnight stay or more.</td>
</tr>
<tr>
<td>Western Australia</td>
<td>The person was admitted to hospital as an inpatient for treatment of injuries sustained in the crash, but did not die within 30 days of the crash.</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Fractures, concussion, internal injuries, crushings, severe cuts and lacerations, severe general shock necessitating medical treatment, and any other injury involving removal to and detention in hospital.</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>An injury for which a person is detained in hospital as an “in-patient”, or any of the following injuries whether or not they are detained in hospital: fractures, concussion, internal injuries, crushings, burns (excluding friction burns), severe cuts, severe general shock requiring medical treatment and injuries causing death 30 or more days after the accident.</td>
</tr>
</tbody>
</table>

Table 4-2: Serious injury definition in Australian jurisdictions, New Zealand and UK

Source of Data for Table 4-2:
- VicRoads RCIS
- RTA NSW Statistical Statement for the year ended 31/12/2011
- 2009 Road Traffic Crashes in Queensland, Transport and Main Roads, October 2012
- Dept of Planning, Transport and Infrastructure, Road Crashes in South Australia 2011
- New Zealand Ministry of Transport publication, Motor Vehicle Crashes in New Zealand 2011
- Department of Transport (UK), Statistical Release – Reported Road Casualties in Great Britain: Main results 2011

The National Road Safety Strategy 2011-2020 (NRSS) acknowledges that currently there is no reliable national collection of serious injury crash data, largely due to jurisdictional differences in injury definitions and reporting arrangements. Adoption of nationally consistent road crash classification definitions and an improved national serious injury database is identified as a priority in the NRSS. The definition of ‘serious injury’ in the NRSS strategy is ‘injury from a road crash with enough severity to require hospitalisation’. Victoria’s existing definition of serious injury is consistent with the definition in the NRSS.
Table 4-3 shows how serious injuries are recorded in a number of overseas countries from the International Road Traffic and Accident Database (IRTAD).

<table>
<thead>
<tr>
<th></th>
<th>THE POLICE AT THE SCENE OF THE CRASH</th>
<th>THE HOSPITAL</th>
<th>CHECKED LATER WITH HOSPITAL INJURY SEVERITY (EXC. FATALITIES)</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>✓</td>
<td></td>
<td></td>
<td>The hospital keeps separate records of its own. No data matching except in Western Australia.</td>
</tr>
<tr>
<td>Austria</td>
<td>✓</td>
<td></td>
<td></td>
<td>If the police officer in charge is uncertain of the severity of injury, the box &quot;NEG&quot; (unknown injury level) is ticked</td>
</tr>
<tr>
<td>Czech Republic</td>
<td></td>
<td>✓</td>
<td></td>
<td>The severity is determined by the acting doctor. It can be modified later by the hospital (up to 30 days).</td>
</tr>
<tr>
<td>Denmark</td>
<td></td>
<td>✓</td>
<td></td>
<td>If only slight injury is indicated on the form the severity is regarded as slight. Otherwise it is regarded as serious, and then information is often gathered by asking at the emergency department.</td>
</tr>
<tr>
<td>Finland</td>
<td></td>
<td>✓</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>France</td>
<td></td>
<td></td>
<td></td>
<td>Checks can be made for the seriously injured.</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
<td>✓</td>
<td>Referring to fatalities the police have to wait at least 30 days before finishing the report in the case of an injury crash. The crash category is adjusted by the police by contact with the hospital.</td>
</tr>
<tr>
<td>Great Britain</td>
<td></td>
<td></td>
<td></td>
<td>Data protection issues may prevent the police obtaining information from medical staff.</td>
</tr>
<tr>
<td>Hungary</td>
<td>✓</td>
<td>–</td>
<td>✓</td>
<td>The doctor predicts days of recovery.</td>
</tr>
<tr>
<td>Israel</td>
<td></td>
<td></td>
<td></td>
<td>The police officers basically judge severity by the fact that an involved person is transported by ambulance, they ask to which hospital the victim is transported. Later they receive or ask information from/at the hospital whether the person involved is still there, and whether he/she was admitted for in-patient treatment; this also includes a stay overnight for observation. If the person dies this is an unnatural death and it is always reported back to the police, but possibly not always to the police officer that reported the crash.</td>
</tr>
<tr>
<td>Japan</td>
<td>No</td>
<td>✓</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Lithuania</td>
<td>–</td>
<td></td>
<td></td>
<td>The police officers basically judge severity by the fact that an involved person is transported by ambulance, they ask to which hospital the victim is transported. Later they receive or ask information from/at the hospital whether the person involved is still there, and whether he/she was admitted for in-patient treatment; this also includes a stay overnight for observation. If the person dies this is an unnatural death and it is always reported back to the police, but possibly not always to the police officer that reported the crash.</td>
</tr>
<tr>
<td>Netherlands</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Spain</td>
<td>✓</td>
<td>✓</td>
<td>No</td>
<td>Police gather on the spot information based on their own judgement. Also, hospital details are taken from ambulance personnel at the scene of the crash.</td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
<td></td>
<td></td>
<td>With STRADA, there is great potential to compare the police assessment with the hospitals. However, major flaws in the police assessment are found.</td>
</tr>
<tr>
<td>Switzerland</td>
<td></td>
<td></td>
<td></td>
<td>Specic procedures can vary from state to state. In general the assessment is not checked against hospital or medical records.</td>
</tr>
<tr>
<td>United States</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

Table 4-3: Serious injury recording in overseas jurisdictions.

Source: Survey among IRTAD countries (2010)
Current Data Quality Process

To ensure data quality is maintained, a TIS Data Quality Working Group was formed comprising representatives from Victoria Police, VicRoads, the Transport Accident Commission (TAC) and WorkSafe Victoria. This working group meets on a regular basis. Data quality issues are raised at these meetings and solutions are proposed and prioritised.

One of the items considered by the working group is serious injury data quality. Since the introduction of TIS, several improvements have been made to decrease the variability of the serious injury data. These improvements include:

- Training and supporting police in understanding the definition and the importance of checking hospital admission status. (Ongoing)
- Using TAC hospital claim files to confirm the admission status of persons injured in crashes and adjusting values if necessary. (November 2008). This is currently a manual process.
- Replacing the values in the Admitted to Hospital field of “Checked – Not known” and “Not Checked” with “Enquiries Pending” to improve the level of checking of admission status. (January 2009)
- Proactively returning records with “Enquiries Pending” to informants for determination of admission to hospital status. (January 2010)

Since the improvements outlined above have been made, there has been less variability in the serious injury data from 2010 onwards. However actions outside the control of the working group, such as police industrial bans (June 2011 to October 2011), can still introduce variability in the data.

Improving the process

In July 2010 a workshop to identify the most appropriate definition of serious injury that is both accurate and timely was organised by and involved analysts from VicRoads, TAC, Victoria Police, Monash University Accident Research Centre (MUARC) and the Department of Health.

A recommendation from this workshop was that the existing definition of serious injury should be maintained, because it provides data that is comparable with most jurisdictions in Australia and, despite the limitations, provides the best early indicator of crash severity.

Advice from MUARC was that the best mix would involve police reporting in the short term that is validated by hospital data when it becomes available. In the absence of an arrangement between Victoria Police and hospitals, TAC claims data was considered to be the best source of hospital admissions data for the purpose of validation, however a recommendation was made that Victoria Police should work with individual hospitals to improve the sharing of admission data as there are limitations with TAC claims data, such as potentially lengthy delay in receiving data and the exclusion of some serious injuries as not all injured persons lodge claims with the TAC.

Additionally, TAC claims are not restricted to those that meet the ABS guidelines for reporting.

It was also agreed that a pilot program be established whereby TAC claims data is stored in parallel to existing TIS data. The TAC claims data will not overwrite any police-entered TIS data but will supplement the TIS data. This data will be monitored by the TIS Data Quality Working Group with a view to assessing its suitability for validating police data.

An enhancement to store TAC claims data in TIS has been scoped and business approval for the works to go ahead has been completed. This enhancement has a high priority and is anticipated to be implemented late 2013. This enhancement will allow road safety data analysts to compare the police-determined admission to hospital value with the TAC claims data and to propose and pilot a methodology to improve the accuracy of injury level. During the pilot phase, the quality of serious injury data will be monitored and evaluated. Police-entered data will also be subject to additional data quality checks based on the TAC claims data.
Additional Serious Injury Data Sources

In addition to police crash data as recorded in TIS and RCIS, other sources of serious injury include:

- TAC claims data involving hospital admission
- Hospital admissions data – Victorian Admitted Episodes Dataset (VAED).

TAC claims data involving hospital admission

The TAC receives invoices from hospitals for road trauma victims. This data is entered into a database and contains information such as whether the admission is acute or not (that is, within seven days of the crash) and the length of stay in hospital. There can be a delay between when a crash occurs and when the TAC receives a hospital claim. Around 90 per cent of the claims are received within three months and the majority of the claims are received within six months.

Table 4-4 gives a breakdown of TAC claims data by severity of injury, based on length of stay.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>CATASTROPHIC CLAIMS</th>
<th>ACUTE HOSPITALISED &gt; 28 DAYS</th>
<th>ACUTE HOSPITALISED &gt; 14 DAYS</th>
<th>ACUTE HOSPITALISED &gt; 1 DAY</th>
<th>TOTAL ADMITTED (ACUTE* AND NON-ACUTE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>101</td>
<td>627</td>
<td>924</td>
<td>2,870</td>
<td>5,941</td>
</tr>
<tr>
<td>2003</td>
<td>111</td>
<td>589</td>
<td>901</td>
<td>2,831</td>
<td>5,835</td>
</tr>
<tr>
<td>2004</td>
<td>106</td>
<td>568</td>
<td>856</td>
<td>2,566</td>
<td>5,449</td>
</tr>
<tr>
<td>2005</td>
<td>100</td>
<td>589</td>
<td>920</td>
<td>2,901</td>
<td>5,937</td>
</tr>
<tr>
<td>2006</td>
<td>121</td>
<td>579</td>
<td>903</td>
<td>2,816</td>
<td>5,550</td>
</tr>
<tr>
<td>2007</td>
<td>112</td>
<td>592</td>
<td>949</td>
<td>2,904</td>
<td>5,788</td>
</tr>
<tr>
<td>2008</td>
<td>89</td>
<td>603</td>
<td>902</td>
<td>2,825</td>
<td>5,627</td>
</tr>
<tr>
<td>2009</td>
<td>103</td>
<td>566</td>
<td>891</td>
<td>2,705</td>
<td>5,415</td>
</tr>
<tr>
<td>2010</td>
<td>91</td>
<td>541</td>
<td>840</td>
<td>2,707</td>
<td>5,563</td>
</tr>
<tr>
<td>2011</td>
<td>104</td>
<td>595</td>
<td>890</td>
<td>2,972</td>
<td>5,802</td>
</tr>
<tr>
<td>2012</td>
<td>87</td>
<td>559</td>
<td>892</td>
<td>2,768</td>
<td>5,444</td>
</tr>
</tbody>
</table>

Source of data: TAC

Table 4-4: TAC claims data involving hospital admission by severity

Note: Acute means admitted to hospital within 7 days of the crash; Data is not mutually exclusive (e.g. ‘Acute Hospitalised > 14 days’ includes ‘Acute Hospitalised > 28 days’).
Table 4-5 provides a comparison between TAC claims data involving hospital admissions and police-reported crash data (from RCIS).

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TOTAL HOSPITAL ADMISSIONS (TAC)</th>
<th>SERIOUS INJURIES (RCIS)</th>
<th>PROPORTION SERIOUS INJURIES RCIS/TAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>5,941</td>
<td>6,923</td>
<td>1.17</td>
</tr>
<tr>
<td>2003</td>
<td>5,835</td>
<td>6,695</td>
<td>1.15</td>
</tr>
<tr>
<td>2004</td>
<td>5,449</td>
<td>6,400</td>
<td>1.17</td>
</tr>
<tr>
<td>2005</td>
<td>5,937</td>
<td>6,246</td>
<td>1.05</td>
</tr>
<tr>
<td>2006</td>
<td>5,550</td>
<td>7,207</td>
<td>1.30</td>
</tr>
<tr>
<td>2007</td>
<td>5,788</td>
<td>7,914</td>
<td>1.37</td>
</tr>
<tr>
<td>2008</td>
<td>5,627</td>
<td>7,340</td>
<td>1.30</td>
</tr>
<tr>
<td>2009</td>
<td>5,415</td>
<td>6,273</td>
<td>1.16</td>
</tr>
<tr>
<td>2010</td>
<td>5,563</td>
<td>5,106</td>
<td>0.92</td>
</tr>
<tr>
<td>2011</td>
<td>5,802</td>
<td>5,370</td>
<td>0.93</td>
</tr>
<tr>
<td>2012</td>
<td>5,444</td>
<td>4,794</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Source of data: TAC and RCIS

Table 4-5: TAC claims data involving hospital admission compared to police-reported serious injury data

In general, it is expected that there would be a difference between the number of police-reported serious injury records and the TAC claims data records for the following reasons:

- Not all injured persons lodge a TAC claim.
- Some road user / crash types such as single-vehicle cyclist crashes are not eligible for TAC insurance cover.
- TAC insurance cover is linked to vehicle registration and therefore can cover injuries that occur in locations that do not meet the ABS criteria for a reportable crash (that is, off road crashes such as in car-parks).

A comparison of police-reported serious injury data (based on RCIS data – that is, TIS records that have been approved) and TAC claims data involving hospital admissions is shown in the following chart.
Whilst the TAC data shows a small decline in hospital admissions, the police-reported serious injury data shows variability, with less police-reported serious injuries than TAC hospital admissions from 2010 onwards.

**Victorian admitted episode dataset**

The Victorian Admitted Episode Dataset (VAED) is a state-wide collection of data on all admissions to Victorian hospitals. It is collected by the Victoria Department of Health and records every admitted episode for all Victorian hospitals (public and private). The Victorian Injury Surveillance Unit (VISU), on behalf of the Department of Health, is the repository for de-identified injury data in Victoria.

The VAED contains a 3-character ICD External Cause Code which can be used to identify the road user type involved (e.g. V01 – V09 relate to ‘Pedestrians injured in transport accident’, V10-V19 relate to ‘Pedal cyclist injured in transport accident’). This dataset also contains a 4-character ICD10-AM field which can be used to identify if a person was injured in a ‘traffic accident’.

According to ICD10-AM, a ‘traffic accident’ is defined as any vehicle accident occurring on the public highway (this includes originating on, terminating on or involving a vehicle partially on the highway). A ‘public highway’ is the entire width between property lines of land open to the public as a matter of right or custom for purposes of moving persons or property from one place to another. These inputs are recorded by hospital personnel and may not correlate to the ABS guidelines on road crashes.

Information on the circumstances of the crash however is limited as very little is known regarding the validity of the external causes codes used to identify crash characteristics.\(^5\)
Table 4-6 shows a comparison of police-reported serious injury crash data (from RCIS) with hospital admissions data (from VAED). The VAED data is sourced from the George Institute reports.  

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PEDESTRIAN SERIOUS INJURIES (RCIS)</th>
<th>PEDESTRIAN ‘TRAFFIC ACCIDENT’ HOSPITAL ADMISSIONS (VAED)</th>
<th>PEDESTRIAN SERIOUS INJURIES RCIS/VAED</th>
<th>CYCLIST SERIOUS INJURIES (RCIS)</th>
<th>CYCLIST ‘TRAFFIC ACCIDENT’ HOSPITAL ADMISSIONS (VAED)</th>
<th>CYCLIST SERIOUS INJURIES RCIS/VAED</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>623</td>
<td>535</td>
<td>1.16</td>
<td>329</td>
<td>626</td>
<td>0.53</td>
</tr>
<tr>
<td>2005</td>
<td>604</td>
<td>483</td>
<td>1.25</td>
<td>369</td>
<td>690</td>
<td>0.53</td>
</tr>
<tr>
<td>2006</td>
<td>687</td>
<td>598</td>
<td>1.15</td>
<td>451</td>
<td>800</td>
<td>0.56</td>
</tr>
<tr>
<td>2007</td>
<td>798</td>
<td>594</td>
<td>1.34</td>
<td>502</td>
<td>862</td>
<td>0.58</td>
</tr>
<tr>
<td>2008</td>
<td>749</td>
<td>592</td>
<td>1.27</td>
<td>489</td>
<td>959</td>
<td>0.51</td>
</tr>
<tr>
<td>Total</td>
<td>3,461</td>
<td>2,802</td>
<td>1.24</td>
<td>2,140</td>
<td>3,937</td>
<td>0.54</td>
</tr>
</tbody>
</table>

From this comparison, there are nearly a quarter more pedestrian serious injuries recorded in the police data than there are in the hospital admissions dataset. This could be the result of definitional differences between the two datasets as to what constitutes a hospital admission and what constitutes a road-related crash.

For cyclist serious injuries, there is nearly double the number of records in the hospital dataset than there is in the police-reported data. This could be due to significant lower reporting of crashes by cyclists, particularly single-vehicle crashes where a TAC claim is not available, therefore limiting the incentive for reporting the crash to the police.


Similarly to the analysis undertaken by the George Institute, VISU selected records from the VAED based on the ICD-10-AM code. 4 VAED records were initially extracted based on the principal diagnosis and the external cause code being “land transport accidents” (that is, V00 to V89). To limit the dataset to on-road crashes, records were only retained if the external cause code indicated that the incident was traffic-related (defined as occurring on a public highway) or if the place of occurrence indicated the incident occurred on the road / street / highway (to account for cases where the location code was mistakenly not assigned to the traffic-related external cause code). Transfers within and between hospitals, and deaths within hospitals, were excluded.
Table 4-7 shows a comparison of VAED road traffic hospitalisation data (as extracted by VISU) with police-reported serious injury crash data from RCIS for the period 2007-2011 by road user type. As the road user definitions used in the VAED hospital data do not exactly match those used in the police-reported crash data, assumptions were made as to how to group the road user / vehicle types in the two datasets to allow comparison with the VAED data.

<table>
<thead>
<tr>
<th>ROAD USER TYPE</th>
<th>VAED HOSPITALISATION DATA 2007-2011</th>
<th>RCIS SERIOUS INJURY DATA 2007-2011</th>
<th>VAED VS RCIS (NUMBERS)</th>
<th>VAED VS RCIS (PERCENTAGE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians</td>
<td>3,816</td>
<td>3,442</td>
<td>+374</td>
<td>+10%</td>
</tr>
<tr>
<td>Cyclists</td>
<td>8,073</td>
<td>2,274</td>
<td>+5,799</td>
<td>+72%</td>
</tr>
<tr>
<td>Motorcyclists (including pillion passengers)</td>
<td>8,370</td>
<td>4,912</td>
<td>+3,458</td>
<td>+41%</td>
</tr>
<tr>
<td>Drivers and Passengers</td>
<td>25,193</td>
<td>21,360</td>
<td>+3,833</td>
<td>+9%</td>
</tr>
<tr>
<td>Car Occupants (VAED)</td>
<td>22,747</td>
<td>20,590</td>
<td>+2,157</td>
<td>+9%</td>
</tr>
<tr>
<td>Heavy Vehicle Occupants (VAED)</td>
<td>554</td>
<td>400</td>
<td>+154</td>
<td>+28%</td>
</tr>
<tr>
<td>Bus Occupants (VAED)</td>
<td>442</td>
<td>128</td>
<td>+314</td>
<td>+71%</td>
</tr>
<tr>
<td>All Road Users</td>
<td>45,452</td>
<td>32,003</td>
<td>+13,499</td>
<td>+30%</td>
</tr>
</tbody>
</table>

Source of data: VAED and RCIS

Table 4-7 shows a comparison of RCIS data with VAED data by road user type

From this comparison, there were nearly a third more hospital admission records than there were police-reported serious injuries for the 2007 to 2011 five-year period. The percentage difference between hospital admissions data and police-reported serious injury data varies by road user type. Police-reported pedestrian serious injuries and car occupant serious injuries were within 10 per cent of the VAED data. Cyclist, motorcyclist, bus occupant and heavy vehicle occupant serious injuries, on the other hand, had significantly lower levels of reporting in the police-reported serious injury data.

Hospital data does have limitations on the accuracy of numbers. Hospitals record all admissions, including those transferred to/from another hospital (often referred to as a separation), formal admissions and statistical admissions. A formal admission is one where the hospital commences treatment and/or care and/or accommodation of a patient. A statistical admission refers to the commencement of a new episode of care for a patient within one hospital stay at the same campus. For example a person injured in a road crash maybe admitted to a regional hospital, then transferred to a major hospital and later transferred to a rehabilitation facility. While this is only one serious injury for police purposes, hospitals will count this as three admissions. Similarly, a person injured in a road crash may be admitted to a hospital and treated in the cardiac ward and then moved to a geriatric ward due to their age. The hospital will count this as two statistical admissions. VISU has attempted to reconcile this but cannot guarantee multiple admissions have not been included in their analysis. In the analysis undertaken by the George Institute, transfers to other hospitals and statistical admissions were excluded to avoid double counting.

Note1: Road User Types are based on RCIS categories. VAED road user types were grouped to approximate the RCIS road user types. Drivers and Passengers (RCIS) include Car occupants (VAED), Heavy Vehicle occupants (VAED), Bus occupants (VAED), Pick up truck and Van occupants (VAED) and other land transport (VAED). Motorcyclists (RCIS) include Motorcycle riders (VAED) and Three-wheeled motor vehicle occupants (VAED). There are 15 serious injury records in RCIS where the road user type is unknown. These have been included in the ‘All Roads Users’ total.

Note 2: In RCIS, Car occupants include drivers and passengers of: cars; station wagons; taxis; utilities; panel vans and minibuses. Bus occupants include buses/coaches but exclude minibuses. Heavy vehicle occupants include rigid trucks > 4.5 tonnes gvm and all articulated trucks. It is not clear how car occupants or bus occupants are defined in VAED data.
The following are findings from the analysis of the VAED data undertaken by VISU:

- Nearly two-thirds of the hospital admissions were coded as TAC compensable. The percentage varies by road user type which is consistent with the lower level of reporting observed for certain road user groups and illustrates the deficiencies with solely relying on TAC data to verify hospital admissions.
  - Only 22 per cent of the cyclist hospital admissions and 24 per cent of the heavy vehicle occupant hospital admissions were TAC compensable.
  - Fifty-eight per cent of the motorcyclist hospital admissions were TAC compensable.
  - The majority of pedestrian (78 per cent) and car occupant (82 per cent) hospital admissions were TAC compensable.

- Around 30 per cent of the hospital admissions were classified as serious based on the International Classification of Disease Severity Score (ICISS). ICISS indicates an injured person’s probability of death (when they are admitted). VISU used the internationally accepted definition of serious injury as an ICISS of less than or equal to 0.941 – meaning the injured person has a probability of death (when admitted) of at least 5.9 per cent.

- Over a quarter of the hospital admissions resulted in a stay of three or more days. Of these, 62 per cent were considered to be serious, based on the ICISS. Around four percent of the hospital admissions resulted in a stay of 14 or more days. Of these, 82 per cent were considered to be serious, based on the ICISS. As the serious hospital admissions and the length of stay do not always overlap, length of stay may not be a good proxy for severity (as defined by a threat-to-life scale).

- The predominant mechanism of injury for hospital admissions that were considered serious (based on the ICISS) varies by road user.
  - The majority (86 per cent) of the pedestrian serious hospital admissions resulted from a collision with a car, pick-up truck or van.
  - For cyclist serious hospital admissions, the predominant mechanism of injury (38 per cent) was a non-collision transport accident (that is, one that did not involve a collision with a vehicle, pedestrian or fixed / stationary object). A further 31 per cent resulted from a collision with a car, pick-up truck or van.
  - For motorcyclist serious hospital admissions, the predominant mechanism of injury (37 per cent) was a collision with a car, pick-up truck or van. A further 32 per cent resulted from a non-collision transport accident.
  - For car occupant serious hospital admissions, the predominant mechanism of injury (42 per cent) was a collision with a car, pick-up truck or van. A further 35 per cent resulted from a collision with a fixed or stationary object.
Table 4-8 and Figure 4-3 provide a comparison of the police-reported serious injury data (from RCIS), the TAC claims data involving hospital admissions and the VAED hospital admissions data between 2007 to 2011.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>RCIS SERIOUS INJURIES</th>
<th>TAC TOTAL ADMITTED</th>
<th>VAED HOSPITALISATION DATA</th>
<th>PROPORTION RCIS/TAC</th>
<th>PROPORTION RCIS/VAED</th>
<th>PROPORTION TAC/VAED</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>7,914</td>
<td>5,788</td>
<td>9,098</td>
<td>1.37</td>
<td>0.87</td>
<td>0.64</td>
</tr>
<tr>
<td>2008</td>
<td>7,340</td>
<td>5,627</td>
<td>9,115</td>
<td>1.30</td>
<td>0.81</td>
<td>0.62</td>
</tr>
<tr>
<td>2009</td>
<td>6,273</td>
<td>5,415</td>
<td>8,825</td>
<td>1.16</td>
<td>0.71</td>
<td>0.62</td>
</tr>
<tr>
<td>2010</td>
<td>5,106</td>
<td>5,563</td>
<td>8,898</td>
<td>0.92</td>
<td>0.57</td>
<td>0.63</td>
</tr>
<tr>
<td>2011</td>
<td>5,370</td>
<td>5,802</td>
<td>9,516</td>
<td>0.93</td>
<td>0.56</td>
<td>0.61</td>
</tr>
<tr>
<td>Total</td>
<td>32,002</td>
<td>28,195</td>
<td>45,452</td>
<td>1.14</td>
<td>0.70</td>
<td>0.62</td>
</tr>
<tr>
<td>Annual Average</td>
<td>6,401</td>
<td>5,639</td>
<td>9,090</td>
<td>1.14</td>
<td>0.70</td>
<td>0.62</td>
</tr>
</tbody>
</table>

Table 4-8: Comparison of RCIS data with VAED data and TAC claims data  
Source of data: RCIS, TAC and VAED

Figure 4-3: Comparison of TAC claims data, VAED hospital admissions data and police crash data (from RCIS)

The data source with the highest number of serious injury records (based on the definition of admitted to hospital) is the VAED. Over the 2007 to 2011 five-year period, there were 30 per cent less police-reported serious injuries (based on RCIS data) and 38 per cent less TAC claims involving hospitalisation compared to hospital admissions (based on VAED). The reasons for these differences include difficulty in police ascertaining if a person is admitted to hospital or not, lower levels of reporting of crashes by certain road user groups such as cyclists and motorcyclists, not all hospital admissions being eligible for TAC funding and possible incorporation of multiple admissions in the VAED.
Linkages of Serious Injury Data Sources

Neither the hospital data nor the police-reported serious injury crash data by themselves contain all of the information required to understand and develop countermeasures for serious injuries resulting from road crashes. Instead, each dataset has its strengths and weaknesses.

Hospital data contains a wealth of information related to the injuries sustained by a person but has limited information about the circumstances of the crash. The circumstances of the crash, for example the crash type, details about the location of the crash including speed zone and road classification and details of other road users and vehicles involved in the crash, are essential to developing road safety programs, including infrastructure programs to target serious injuries. Hospital data, however, enables the admission status of a person to be confirmed, allows severe serious injuries to be distinguished from the less severe serious injuries and provides information about the types of injuries that have occurred.

Police-reported crash data has information on the circumstances of the crash but limited information on the injuries sustained by the person. The determination of serious injury is dependant on the ability of the police to determine the admission status of the person injured in the crash and this can be difficult. Police-reported serious injury data, although timely, is therefore subject to variability.

Table 4-9 provides a summary of the comparison between the two datasets:

<table>
<thead>
<tr>
<th>POLICE-REPORTED SERIOUS INJURY CRASH DATA</th>
<th>HOSPITAL DATA (VAED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timely but prone to lack of consistency and accuracy in terms of determining if an injury is serious or not. Relies on the ability of police to determine if a person has been admitted to hospital or not.</td>
<td>Consistent and accurate data on serious injuries, however there may be a lag in obtaining this data. Based on expert medical assessment of injury.</td>
</tr>
<tr>
<td>Does not distinguish the more severe serious injuries from the less severe ones.</td>
<td>Allows severe serious injuries to be identified.</td>
</tr>
<tr>
<td>Contains detailed information on the circumstances of the crash such as location details and details of other road users involved.</td>
<td>Contains very limited information on the circumstances of the crash.</td>
</tr>
</tbody>
</table>

In Victoria, linking of the hospital data with police-reported crash data on a unit record has not been possible due to legislated privacy protection and ethical considerations.

Western Australia has established a Data Linking Unit (DLU) that links road crash reports to hospital morbidity and mortality data using personal identifiers. In order to comply with privacy legislation and ethical considerations, the identifiers are removed after the linkage. This de-identified data is then provided to external agencies.

An evaluation of road crash injury severity using diagnosis based injury scaling was carried out in 2008 using the Western Australia linked data. This evaluation used the ICISS methodology to determine the severity of a road crash.

Similarly to the analysis undertaken by VISU on the VAED, the analysis of the Western Australia linked data showed lower levels of reporting for certain road user groups, including motorcyclists, cyclists and pedestrians. However, the Western Australian-linked data showed an over-representation of motor vehicle serious injuries in the police data, indicating that not all crashes classified as requiring hospitalisation by the attending police officer actually ended up being admitted to hospital.

Linkage of police-reported crash data and hospital data would greatly enhance the quality and accuracy of the police-reported serious injury data. It would overcome the issues of variability in the serious injury numbers that is currently observed in the crash data and would allow severe injuries to be identified and targeted in road safety programs. Understanding the types of injuries that have occurred can also lead to better countermeasures that target serious injuries.
VicRoads and the Department of Health have held preliminary discussions on a data linkage project to better understand the relationship between crash type, injury severity and the region of the body affected. This will allow more effective countermeasures to be developed that address severe serious injuries.

For this project, data linkage involves the bringing together of two or more different data sources that relate to the same individual or event. There are two possible methods of data linkage: deterministic and probabilistic. The deterministic method involves the linking of data sets that share a unique identifier or key, while the probabilistic method matches cases based on certain elements of data that may lead to the identification of an event and/or person. The probabilistic method achieves this by matching cases based on a combination of variables such as name, date of birth, gender, and time and date of event. Any data linkage project with the Department of Health and VicRoads would require the probabilistic method and, as such, cases within both datasets could possibly remain unmatched.

The following diagram provides an example of how a data linkage project might be undertaken in Victoria.

**Data linkage**

![Diagram of data linkage model - probabilistic](image)

Data is vital to informing policies and interventions designed to reduce the burden of road trauma. It is possible that linking key data sets has the potential to overcome the limitations of single data sources and to maximise the collective benefit of data relating to road trauma.

However, further research needs to establish whether road safety data linkage is feasible in Victoria and whether linked data provides a significant advantage over non-linked data in quality and quantity.

Research on data linkage has been conducted nationally and internationally. Some overseas countries have electronic linkages between sources of injury data such as STRADA in Sweden and the CODES system of the United States.

Based on research undertaken by the European Transport Safety Council, completeness and accuracy of road crash statistics is an issue experienced by all countries. This study found that the level of reporting for injuries treated in hospitals is, on average, less than 50 per cent. It also found that injuries were not always classified correctly in police crash reports and that there was a lower level of reporting for cyclists, in particular those not involving other road users and single-vehicle motorcycles injuries.
Table 4-10 shows the level of reporting of serious injuries in some European countries compared to Victoria. However, the figures are indicative only and care should be taken when comparing one country’s figures with that of another country, as there are differences in definitions, recording methods and time-frames.

<table>
<thead>
<tr>
<th>COUNTRY / JURISDICTION</th>
<th>PERCENT OF ALL SERIOUS INJURIES REPORTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Czech Republic</td>
<td>97%</td>
</tr>
<tr>
<td>Denmark</td>
<td>57%</td>
</tr>
<tr>
<td>France</td>
<td>39%</td>
</tr>
<tr>
<td>Great Britain</td>
<td>38%</td>
</tr>
<tr>
<td>Hungary</td>
<td>87%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>82%</td>
</tr>
<tr>
<td>Norway</td>
<td>69%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>77%</td>
</tr>
<tr>
<td>VICTORIA</td>
<td>70%</td>
</tr>
</tbody>
</table>

Table 4-10: Comparison of level of serious injury reporting in various countries / jurisdictions

Table 4-11 shows the level of reporting of injuries (serious and slight) in some European countries. As previously noted, the figures are indicative only and care should be taken when comparing one country’s figures with that of another country.

<table>
<thead>
<tr>
<th>COUNTRY / JURISDICTION</th>
<th>PERCENT OF ALL SERIOUS AND SLIGHT INJURIES REPORTED</th>
<th>CAR OCCUPANTS</th>
<th>MOTORCYCLISTS</th>
<th>CYCLISTS</th>
<th>PEDESTRIANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Czech Republic</td>
<td>66%</td>
<td>90%</td>
<td>85%</td>
<td>31%</td>
<td>62%</td>
</tr>
<tr>
<td>Denmark</td>
<td>21%</td>
<td>48%</td>
<td>31%</td>
<td>10%</td>
<td>39%</td>
</tr>
<tr>
<td>France</td>
<td>42%</td>
<td>42%</td>
<td>47%</td>
<td>10%</td>
<td>44%</td>
</tr>
<tr>
<td>Germany</td>
<td>39%</td>
<td>52%</td>
<td>44%</td>
<td>22%</td>
<td>45%</td>
</tr>
<tr>
<td>Great Britain</td>
<td>56%</td>
<td>68%</td>
<td>44%</td>
<td>66%</td>
<td>81%</td>
</tr>
<tr>
<td>Hungary</td>
<td>76%</td>
<td>74%</td>
<td>67%</td>
<td>51%</td>
<td>64%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>43%</td>
<td>63%</td>
<td>56%</td>
<td>24%</td>
<td>49%</td>
</tr>
<tr>
<td>Norway</td>
<td>37%</td>
<td>56%</td>
<td>37%</td>
<td>16%</td>
<td>45%</td>
</tr>
<tr>
<td>Sweden</td>
<td>54%</td>
<td>77%</td>
<td>55%</td>
<td>29%</td>
<td>70%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>25%</td>
<td>44%</td>
<td>22%</td>
<td>8%</td>
<td>38%</td>
</tr>
</tbody>
</table>

Table 4-11: Comparison of level of injury reporting in various European countries by road user

Source of data: Victorian Data - RCIS as a proportion of VAED data; European Data – ETSC

Source of data: ETSC
The report produced by ETSC recommended that electronic linkages between sources of injury data should be encouraged and outlined the advantages of such linkage. The sources of data include the road safety community (e.g. agencies responsible for crash data), the medical/health community (e.g. hospitals) and insurance and other stakeholders. The advantages of linkage, as detailed in the report, include:

- Providing a more complete “picture” of road crashes.
- Offering incentive for public sector (police, other public agencies) and private sector (hospitals and the trauma community) to work together in better understanding the overall traffic crash injury situation.
- Providing information on the pre-crash, crash and post-crash phases.
- At the local level, making available information on the types and severity of injuries, populations at risk and specific crash characteristics.
- At the state and national level, providing a firmer basis for setting policy objectives, standards and directives with respect to the reduction of serious injuries, and better enabling evaluation of effectiveness of countermeasures in reducing serious injuries.

The report also outlined some obstacles that needed to be overcome with a linked data system, in particular the confidential nature of patient medical records. It recommended that studies should be undertaken to determine the possibility of electronically merging police records and hospital records in ways that will not violate protection of privacy and personal integrity and mentioned that adequate safeguards should be established to ensure patient anonymity under legislative or administrative policies whilst still allowing for access to necessary crash injury information.

In addition, the report highlights the need to reduce the level of underreporting, and the need to adopt standardised definitions of injuries and injury severity so that crash statistics are more informative and more comparable. This would also help with data linking, especially if a probabilistic model is adopted.

In October 1996, the Swedish Roads Administration was commissioned by the Swedish government to initiate a new information system covering injuries and crashes in the entire roads system. This data collection system is referred to as STRADA (Swedish Traffic Accident Data Acquisition) and development of it was accomplished in co-operation with the Swedish Police, the Swedish National Board of Health and Welfare, the Swedish Institute for Transport and Communications Analysis, Statistics Sweden and the Swedish Association of Local Authorities and Regions. STRADA incorporates data from the police as well as from hospitals.

Official statistics of road traffic injuries use data extracted from STRADA but are based exclusively on crashes reported to the police. The information derived from the hospitals is shown in a supplement containing medical statistics since not all hospitals report as yet to STRADA. Use of STRADA has been mandatory for police since 2003, however, for hospitals, registration in STRADA is voluntary and economically compensated by the Swedish Transport Agency. As at October 2012, 19 of the 21 counties in Sweden had registration for all hospitals in the country, one county had partial registration and one county had no registration.
The following diagram illustrates the linkage in STRADA.

![Diagram of STRADA linkage](image)

Figure 4-5: Data linkage - STRADA

The benefits observed from bringing together the two data sources in STRADA are outlined below:

- More detailed information is available, thus increasing the knowledge of road traffic injuries and crashes.
- Inclusion of hospital data decreases in the number of unrecorded cases, since the police have limited knowledge about some road traffic accidents (mainly involving unprotected road users: pedestrians, cyclists and moped drivers).
- The hospitals’ reporting of diagnoses broadens the knowledge of the injuries and their degree of seriousness.

The USA has developed a linkage system referred to as CODES (Crash Outcome Data Evaluation System). CODES evolved from a 1991 congressional mandate to report in the benefits of safety belts and motorcycle helmets in terms of medical and financial outcome. Five million dollars were provided to the National Highway Traffic Safety Administration (NHTSA) for the study with the requirement for results to be reported to Congress by February, 1996.\(^{13}\) As at 2005, the NHTSA has since funded almost two-thirds of the States to develop linkage capabilities.\(^{14}\)

CODES is based on a probabilistic data linkage model. This type of linkage focuses on the probability of a match (that is, the probability that the matched pair is a valid match) and thus does not require exact matches for a record to be linked. The benefit of this type of linkage model is that it does not depend on unique identifiers (e.g., licence number or medicare number) for the linkage and can deal with missing or inaccurate data.

Probabilistic linkage works by linking on a combination of common variables in the two datasets. The combination of the variables selected must be sufficiently powerful to discriminate among events and the people involved in a specific event. In simplified terms, a weighting is assigned to each variable, based on the frequency of occurrence of that variable. Rare occurrences have a higher weighting than more frequent occurrences. For example, a birth-date would have a higher weighting than age. Values are also assigned to the linkage itself. If there is an exact match, then the match receives the full weighting. If the match is not exact, then the weighting is adjusted. All of the variable weights are totalled and a composite weight is assigned to each record pair. The composite weight will be positive for matched record pairs and negative for unmatched record pairs. Unsure matches include record pairs with low positive composite weights, duplicates and record pairs which do not match on critical variables. These need to be reviewed and re-classified as a match or non-match. On average, 10 per cent of the record pairs were found to be in the unsure category.\(^{15}\)
An example of the variables used for linkage in CODES include: age, date of birth, gender, residence postcode, name (if available), social security number (if available), seating position, injury level, date of crash, time of crash, location of crash, type of crash, type of vehicle, vehicle identification number, hospital.

CODES data has been used to identify traffic safety priorities that have an impact on improving mortality, morbidity and crash severity, to support traffic safety decision-makers, to support traffic safety legislation, to educate the public, to monitor effectiveness of specific countermeasures and to support a systems approach to evaluating emergency medical service effectiveness.16

The following chart illustrates the linkage in CODES.

Data linkage

![Data linkage chart](image)

Research undertaken by MUARC17 regarding de-identified data linkage between hospital, TAC and police-reported crash data has found that the match rate between the police-reported crash data and VAED data was 36 percent, indicating that linking without identifying data may not be feasible. Some of the problems encountered were difficulties in identifying road crash related hospital admissions, lack of information on the location of the event leading to hospital admission reducing the number of variables that could be used in a matching key, and identifying the relevant transfer and re-admission cases. These problems would need to be overcome to improve the success rate for de-identified data linkage in Victoria.

Recommendation 3:
That the road safety partners work with the Department of Health to set up a mechanism by which the Victoria Police can obtain information on the admission status of a person conveyed to hospital following a road crash.

Recommendation 4:
That the road safety partners work with the Department of Health on data linkages between hospital data and police-reported crash data, acknowledging that this linkage will be based on non-identifiable data from both sources. As part of this work, standardisation of definitions such as road user type should be investigated to make datasets more comparable.
References
1 Australian Transport Council (ATC) (2011), National Road Safety Strategy 2011-2020, Canberra, ACT.
The George Institute (2010b), Factors in Cyclist Casualty Crashes in Victoria, Sydney, NSW
3 Ibid.
4 VISU (2010), Road traffic injury hospitalisations in Victoria, 2007-2011 & 2011/12, Monash University Injury Research Unit, Victorian Injury Surveillance Unit, Melbourne, VIC
6 Rosman, D (2001), The Western Australian Road Injury Database (1987-1996): ten years of linked police, hospital and death records or road crashes and injuries, Department of Public Health, WA
9 Ibid.
10 Ibid.
16 NHTSA (2009), The Crash Outcome Data Evaluation System (CODES) and Applications to Improve Traffic Decision Making, National Highway Traffic Safety Administration, USA
This section addresses the following Term of Reference:

c) consider best practice definitions and measures of road related serious injury and injury severity, and recommend how road related serious injuries and their severity should be identified and reported in Victoria

Glossary of Terms

**Abbreviated Injury Scale (AIS)**: An anatomical injury severity scoring system, derivatives include Maximum AIS (MAIS), Injury Severity Score (ISS), New Injury Severity Score (NISS)

**Disability-Adjusted Life-Year (DALY)**: the sum of the years of life lost due to premature mortality in the population and the years lost due to disability

**ICD-10-AM**: Coding as per the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification.

**ICISS**: International Classification of Disease Severity Score. ICISS indicates an injured person’s probability of death (when they are admitted to hospital).

**IRTAD**: The International Traffic Safety Data and Analysis Group

**OECD**: The Organisation for Economic Co-operation and Development (Australia is a member)

**RPMI**: Risk of permanent medical impairment

**Survival risk ratio (SRR)**: a proportion of cases with a certain injury diagnosis in which the patient does not die

**VAED**: Victorian Admitted Episode Dataset. This is a state-wide collection of data on all admissions to Victorian hospitals. It is collected by the Victoria Department of Health and records every admitted episode for all Victorian hospitals (public and private).

**VISU**: Victorian Injury Surveillance Unit. VISU is the repository for de-identified injury data from VAED in Victoria, outsourced by the Department of Health.
Measuring Injury Severity

Growth over the past two decades in the number and variety of injury severity scales reflects recognition that severity classification is critical for surveillance, epidemiological investigations and evaluations of programs and policies aimed at mitigating the impact of injury at both the individual and societal levels. Injury severity generally describes the impact of an injury in terms of the extent of tissue damage (that is, the pathologic evidence of trauma) and/or the physiologic response of the body to that damage.1

There are a number of injury severity measures that are currently available including threat to life measures and quality of life measures. While there are many options present it will be important to select a measure that is fit for purpose, alternatively, the solution for Victoria’s requirement may be a combination of measures, each with a specific purpose and need.

Current Definition used by VicRoads

As detailed in Chapter 4 of this submission, the current definition of serious injury used in Victoria is a person who has been admitted to hospital.

A person who is injured and is taken to hospital by ambulance is initially assigned an Injury Code of 2 (Taken to Hospital). The police check if the person has been admitted to hospital and assign the appropriate value to the Admitted to Hospital field. If the admission status is unknown, the police assign 5 (Enquiries Pending).

The injury level is considered to be a ‘serious injury’ if the Injury Code is ‘Taken to Hospital’ and the Admission to Hospital code is ‘Checked Admitted’ or ‘Enquiries Pending’.

This definition has some limitations:

- As the serious injury definition is highly dependent on the ability of police to determine the hospital admission status, the serious injury data is subject to variability.
- The Police are not expert in determining the severity of an injury and are dependent on hospitals providing information on admission status. The ease of which this information can be obtained varies by hospital. If a patient gets transferred from one hospital to another, it can be difficult for the police to determine the admission status.
- The serious injury definition covers a wide range of injuries from life-impacting injuries such as acquired brain injury and quadriplegia to less severe injuries such as broken bones. As such there is no severity measure.

Despite these limitations, the current definition has the benefit of relative timeliness with 90 per cent of serious injuries coded within 6 months.

Threat to life measures of injury severity

The Victorian Injury Surveillance Unit (VISU) is the repository for de-identified injury surveillance data in Victoria, outsourced by the Victorian Department of Health. The Department of Health collects coded data on all admitted patients from Victorian public and private acute hospitals including rehabilitation centres, extended care facilities and day procedure centres.

This data forms the Victorian Admitted Episodes Dataset (VAED). VISU currently holds VAED data for the fiscal years 1988/89 to 2011/12.

VicRoads sought assistance from VISU to provide explanations of the various common measures of injury severity, outline and explain which of these can and cannot be readily applied to health sector data held by VISU, and explain what type of information would be possible from the health sector data if the relevant measures were applied.2

Injury severity scoring systems

Many differing injury severity scoring systems have been proposed, each with its own benefits and limitations. The discussion of injury severity in this document will be limited to scales that have scoring systems based on anatomy. Although a second set of injury severity scales exist which are based upon the physiological results of injury (i.e., the immediate effects on bodily function), these measures cannot be readily applied to the VAED data held by VISU.
An overview of the different measures and the origins of data can be seen below.

**Threat to life measures**

**Abbreviated Injury Scale (AIS)**

The AIS, first published in 1971 by the Association for the Advancement of Automotive Medicine, was designed to catalogue anatomic injuries sustained in motor vehicle crashes and its primary role was to aid in crash investigations by providing detailed anatomical descriptions of occupant injury.

The AIS has two components, the injury descriptor which is a unique numerical identifier for each injury description; and the severity score. The severity score ranges from 1 (minor) to 6 (maximum). An AIS 1 injury will generally not require hospital treatment, whereas an AIS 6 injury is almost certainly fatal. The actual scores to be assigned to various types of injury were derived by consensus among a wide variety of medical specialists.

Detailed information about the injury diagnosis is required to assign an AIS severity score e.g., for a lower leg fracture, the exact type of fracture and the specific bones that are fractured is needed. As trauma patients commonly have more than one injured body part, the severity score for the most severe injury is often used – this is termed the maximum AIS (‘MAIS’).

**AIS Severity Component Example**

1. **Minor** - Fracture of a finger
2. **Moderate** - Closed undisplaced tibial fracture
3. **Serious** - Perforation of the colon
4. **Severe** - Incomplete transection of the thoracic aorta
5. **Critical** - Bilateral intracerebral bleeding
6. **Unsurvivable** - Penetrating injury to the brain stem

Figure 5.1 Overview of threat to life measures

Figure 5.2 Overview of AIS severity
The AIS has long been regarded as the injury coding ‘industry standard’ with respect to its ability to describe the actual injury diagnosis. However, the AIS severity score has limitations. It does not address the effects of multiple injuries within one particular body region and scores are not necessarily comparable across body regions (e.g., a brain injury given an AIS score of 4 may represent greater mortality risk than an injury to the lower extremity given the same AIS score).

As a result of these, and other, limitations, the AIS has undergone many revisions and several scoring systems have also been developed to overcome these shortcomings, including some derived from the AIS.

The AIS Severity Score (ISS)

The Injury Severity Score (ISS), created in 1974 and based on the AIS, was developed as a means for describing patients with multiple injuries using a single severity score. To calculate an ISS for an injured person, the body is divided into six body regions (head or neck, face, chest, abdomen or pelvic contents, extremities or pelvic girdle, external injuries) and only the highest AIS severity score in each body region is used. The three most severely injured body regions have their score squared and added together to produce the final ISS.

<table>
<thead>
<tr>
<th>AIS SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small subdural haematoma</td>
</tr>
<tr>
<td>Parietal lobe swelling</td>
</tr>
<tr>
<td>Major liver laceration</td>
</tr>
<tr>
<td>Upper tibial fracture</td>
</tr>
</tbody>
</table>

\[
\text{ISS} = 4^2 + 4^2 + 3^2 = 41
\]

While the ISS is thought to give a better fit between overall severity and probability of survival than the AIS or MAIS, it does have several limitations. These include its inability to account for multiple injuries to the same body region and its limiting of the total number of contributing injuries to only three and consequently, the possible omission of significant injuries altogether.

The New Injury Severity Score (NISS)

A modification of the ISS, the New Injury Severity Score (NISS) was developed in 1997 to address the issue of multiple injuries in the same body region. It is very similar to the ISS except it scores the three most severe AIS scores regardless of their body region location, therefore, multiple injuries within a body region can be accounted for in the calculation of a NISS.

The change from ISS to NISS aimed at increasing the predictive value of the index and simplifying its calculation. Research has demonstrated that it is better able to predict survivors from non-survivors and is a more accurate predictor of post injury organ failure than the ISS.
ISS Vs NISS
An example

<table>
<thead>
<tr>
<th>AIS SCORE</th>
<th>REGION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple abrasions</td>
<td>1</td>
</tr>
<tr>
<td>Deep laceration tongue</td>
<td>2</td>
</tr>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>3</td>
</tr>
<tr>
<td>Major kidney laceration</td>
<td>4</td>
</tr>
<tr>
<td>Major liver laceration</td>
<td>4</td>
</tr>
</tbody>
</table>

- $\text{ISS} = 4^2 + 3^2 + 2^2 = 29$
- $\text{NISS} = 4^2 + 4^2 + 3^2 = 41$

Figure 5.4 Injury severity score – ISS and NISS - an example

Applying AIS scores and/or its derivatives to the VAED

AIS and derivative scores (ISS and NISS) could be applied to the VAED but this would require complex mapping processes and computer programming to convert the codes for the injury diagnoses into an injury severity score. Moreover, predictive power would be lost at each step of the mapping process.

There is currently no system to directly map ICD-10-AM injury diagnosis codes to AIS scores. There is, however, a method for translating ICD-9-CM codes to AIS scores via the proprietary software package ICDMAP-90. Therefore, to apply AIS scores to the VAED, injury diagnosis codes would first need to be ‘back-mapped’ from ICD-10-AM to ICD-9-CM.

While this is possible there is not always direct mapping between ICD-10-AM and ICD-9-CM codes so specificity of some codes would be lost. Specificity would again be lost when translating the generated ICD-9-CM codes to AIS scores as ICD-9-CM diagnosis codes do not, in all situations, correlate well with the AIS injury classification.

The consequences of this loss of specificity at several steps in this process are that an injury severity score would not be able to be assigned to some injuries, and inaccurate scores could be assigned to others. The resulting severity scores produced through this process would therefore need to be considered to be conservative measures of injury severity, and would be subject to a certain degree of error.

ICD-10-AM

ICD-10-AM refers to the Australian modification of the WHO ICD-10 base classification system. Its full name is the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification. This version of ICD has been modified to serve particular Australian needs and to support the national collection of data relevant to the population’s health.

It permits and supports the systematic recording, analysis, interpretation and comparison of morbidity data. ICD-10-AM is used to translate diseases and other health problems from words into an alphanumeric code, which permits easy storage, retrieval and analysis of the data.
International Classification of Diseases Injury Severity Score (ICISS)

The previous injury severity scores are all consensus-derived as they are based on the severity score of the Abbreviated Injury Scale (AIS) which was assigned by clinical experts. Severity scores can also be data-derived. The International Classification of Disease Injury Severity Score (ICISS) is data-derived and in contrast to the classifications mentioned previously, is based on the actual average fatality rate for a specified injury calculated using a given large trauma database.

Originally defined in 1996 the ICISS is a score between 0 and 1 and is a “threat-to-life” method that involves estimating probability of death for each ICD injury diagnosis code. Determining an ICISS score involves calculating a survival risk ratio (SRR) for each individual injury diagnosis, using a large sample of injured people. An SRR is the proportion of cases with a certain injury diagnosis in which the patient does not die, or in other words, a given SRR represents the likelihood that a patient will survive a particular injury. Each patient’s final ICISS score (survival probability) is calculated by multiplying the probabilities of surviving each of their injuries individually. This may be a single SRR, as in the case of a patient with a single injury, or it may be multiple SRRs, as in the case of a patient with multiple injuries.

A severity threshold can then be used to classify hospital admissions as either “serious” or “non-serious”. For example, serious non-fatal injury can be defined using a severity of injury threshold less than or equal to 0.941 with those cases with an ICISS score greater than 0.941 considered to be “non-serious”. An ICISS score of less than or equal to 0.941 is equivalent to selecting patients whose injuries give a survival probability of 94.1% or a probability of death of at least 5.9%.

There are many benefits to using the ICISS such as: scores derived from ICD coding have been shown to provide a reasonable estimate of injury severity; it accounts for multiple injuries; it is not dependent on a specific version of ICD; scores can be calculated directly from the injury codes contained in a given dataset; and, it can be applied retrospectively. Overall, the ICISS appears to be a better predictor of survival than the ISS.

Numerous limitations or problems with direct estimation using ICISS have also been documented. SRRs generated in one country may not be applicable to another due to different health care systems, and SRRs within countries, or even within areas in countries, may become less reliable due to changes in case outcomes over time. Further limitations of the ICISS include: inclusion of only deaths which occur in hospital could make severity estimates unreliable; the inability to identify individuals who underwent more than one separation within a given study period could result in an overestimation of survival; and, exclusion of non-injury diagnoses means comorbidity (comorbidity describes the effect of all other diseases an individual patient might have other than the primary disease of interest) is not taken into consideration.

Recent studies have addressed some of these issues and methods of developing ICISSs seem to be continually improving. For example, recent research from Australia and New Zealand investigated the predictive ability of ICISS by comparing different methods of calculating ICISS. Researchers found the inclusion of comorbidity and mortality data to markedly improve the performance of ICISS.
Applying ICISS to the VAED

VISU has calculated the ICISS for injured cases in the VAED for the years that are coded to ICD-10-AM. The set of Australian SRRs published in 2003 was used. These SRRs were calculated from ICD-10-AM coded Australian data for the period from 1 July 1999 to 30 June 2001. The relevant Australian SRR was assigned to each injury diagnosis in the VAED, and the ICISS was then generated for each record on the VAED.

VISU generally uses the previously defined threshold defined by Cryer & Langley for a serious injury i.e., if the ICISS is less than or equal to 0.941 – meaning the injured person has a probability of death (when admitted) of at least 5.9%.

While the application of published SRRs to the VAED to define serious injuries is a more direct process than applying the AIS, the limitations with the direct method of calculating SRRs need to be considered and addressed. Namely, the published Australian SRRs are outdated, and may not necessarily be accurate for Victoria.

As an example VISU has estimated proportions of road traffic injury hospital admissions that would be classified as serious using an ICISS cut-off of less than 0.941.

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2007-2011</th>
<th>2011/12</th>
</tr>
</thead>
<tbody>
<tr>
<td>serious injury (ICISS≤0.941)</td>
<td>2579</td>
<td>2513</td>
<td>2648</td>
<td>2673</td>
<td>2885</td>
<td>13298</td>
<td>2835</td>
</tr>
<tr>
<td>other injury (ICISS&gt;0.941)</td>
<td>6519</td>
<td>6602</td>
<td>6177</td>
<td>6225</td>
<td>6631</td>
<td>32154</td>
<td>6843</td>
</tr>
<tr>
<td>ALL ROAD TRAFFIC</td>
<td>9098</td>
<td>9115</td>
<td>8825</td>
<td>8898</td>
<td>9516</td>
<td>45452</td>
<td>9678</td>
</tr>
</tbody>
</table>

Table 5.1 Hospitalisations classified as serious – Source VISU

<table>
<thead>
<tr>
<th>Year</th>
<th>SERIOUS INJURY</th>
<th>SERIOUS INJURY</th>
<th>SERIOUS INJURY</th>
<th>SERIOUS INJURY</th>
<th>SERIOUS INJURY</th>
<th>SERIOUS INJURY</th>
<th>SERIOUS INJURY</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>yes 28.3</td>
<td>no 71.7</td>
<td>yes 100</td>
<td>no 9115</td>
<td>yes 100</td>
<td>no 8825</td>
<td>yes 100</td>
</tr>
</tbody>
</table>

Table 5.2 Hospitalisations classified as serious by road user group – Source VISU
Non – fatal measures of serious injury

Disability – Adjusted Life Year (DALY)

One DALY can be thought of as one lost year of "healthy" life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability.

DALYs for a disease or health condition are calculated as the sum of the Years of Life Lost (YLL) due to premature mortality in the population and the Years Lost due to Disability (YLD) for incident cases of the health condition.

A recent global study using the disability-adjusted life years (DALYs) to measure disease burden was done for 21 regions including Australasia for 1990, 2005, and 2010 with methods to enable meaningful comparisons over time. In relation to injuries the study found injuries collectively caused 11.2% of DALYs with many different injuries making important contributions. The largest was road injuries, which accounted for 27% of the injury total. Within road injuries, nearly equal shares were due to pedestrian injuries, injuries sustained by occupants of three or more wheeled vehicles, and the rest of road injuries.\(^{16}\)

Whilst measuring the non-fatal burden of injury would be of significant interest, measures such as the DALY still require appropriate validation, especially prior to use within the road safety context.\(^{17}\)

International measures in use for injury severity

In March 2013 the European Union announced a strategy on serious injuries and outlined the steps towards a comprehensive EU strategy on serious road injuries, notably:

- A common definition of serious road traffic injury,
- A way forward for Member States to improve data collection on serious road accidents, and
- The principle of adopting an EU-level target for the reduction of serious road traffic.

As well as noting many of the issues raised in this paper the Commission has adopted the measure of serious injury as MAIS3+.

The International Traffic Safety Data and Analysis Group (IRTAD) is a permanent working group of the Joint Transport Research Centre of the OECD and the International Transport Forum.

IRTAD recently produced a report ‘Reporting on Serious Road Traffic Casualties’ with a view to identify and assess methodologies for linking different sources of accident data in order to develop better estimates of the real number of road traffic casualties. The report made ten recommendations (Refer Appendix 5.1) including the adoption of MAIS3+ as the measure of injury severity.\(^{18}\)

With the European Union adopting the MAIS3+ injury severity measure it was noted\(^{19}\) that the long-term, non-medical impacts are not included such as:

- Brain, extremities, spinal cord injuries
- Loss of function
- Psychological impacts, e.g. post-traumatic stress disorder.
Risk of permanent medical impairment (RPMI)

A Swedish study assessed risk of permanent medical impairment (RPMI) based on road traffic injuries classified according to AIS-2005. Injured car occupants were followed for at least five years to assess permanent medical impairment. After an initial injury, the risk of permanent impairment was established for injuries to different body regions and AIS levels. Three risk levels of sustaining a permanent medical impairment (RPMI) were made. It was concluded that almost 10% of all car occupants with AIS1 injuries sustained a permanent medical impairment. The study found it important to include minor injuries leading to impairment when measuring loss of health due to road traffic crashes. Furthermore the highest risk of sustaining a permanent medical impairment from an AIS1 injury was associated with injuries to the cervical spine and upper and lower extremities. One third of AIS3 head and cervical spine injuries led to the highest RPMI level of impairment.20

Addressing Victoria’s needs

Victoria’s new road safety strategy aims to reduce death and serious injuries by more than 30 per cent over the next decade. It also aims to establish a new measure for severe injury.

In establishing this measure the ideal scenario would be a readily available measure that incorporates the severity of injury, the long term effects of the injury such as quadriplegia and serve as the basis for comparing road safety performance across Australia and internationally.

From the available literature it appears evident that without further research and considerable resources there is no single measure available at a single source that will meet the needs and aspirations of Victoria’s road safety strategy.

To enable continuing countermeasure development, particularly infrastructure safety improvements under the Safer Road Infrastructure Program, there will be a continuous need to have timely serious injury data that can be linked to crash locations and crash descriptions. The need for relatively up to date information is essential and will strongly rely on police reported crash data and severity levels. It will also be required to enable police enforcement activities to be targeted at those locations where injuries, particularly serious injuries are occurring.

The project referred to in Chapter 4 aims to link TAC claims data with Police reported serious injuries should go a long way to establishing a more reliable picture of the number of serious injuries. This enhancement to the Police TIS system will enable reliable reporting on a day to day basis.

The establishment of an injury severity measure should be based and on the International Classification of Diseases Injury Severity Score (ICISS). This data is readily available from the Victorian Injury Surveillance Unit, can be disaggregated into road user groups to focus countermeasure development and historical trends can be monitored over time. ICISS is suggested as the most viable threat-to-life measure of serious injury in Victoria. Similar studies in New South Wales and Western Australia have reached the same conclusions.
The following diagram provides an overview of what could be applied in Victoria.

Recommendation 5: While Police reported serious injury data when validated by Transport Accident Commission data provides timely information for road safety use, the official measure of injury severity should be based on the ICISS. This data should be provided by Department of Health or the Victorian Injury Surveillance Unit.

Recommendation 6: That further research and investigation be undertaken to develop a measure that incorporates a threat to life scale and a non-fatal measure such as the DALY.
References


2. Clapperton, A and Day, L. Measures of injury severity and their application to routinely collected health sector data held by the Victorian Injury Surveillance Unit, Monash University Injury Research Institute, Victorian Injury Surveillance Unit, April 2013.


18. Sigrun Malm, MSc, Maria Krafft, PhD, Anders Kullgren, PhD, and Anders Ydenius, MSc, Risk of Permanent Medical Impairment (RPMI) in Road Traffic Accidents, Folksam Research, Stockholm, Sweden and Karolinska Institutet, Solna, Sweden.
Appendix 5.1

International Traffic Safety Data and Analysis Group

Reporting on Serious Road Traffic Casualties

Recommendation 1:
A complete picture of casualty totals from road crashes is needed to fully assess the consequences of road crashes and monitor progress.

Recommendation 2:
Injury information should complement information on fatal crashes to give a fuller picture of road crashes. Information on injuries should become more important for international comparisons.

Recommendation 3:
Police data should remain the main source for road crash statistics. However, because of under-reporting problems and possible bias (for example with differing rates of reporting by vehicle type), police data should be complemented by hospital data, which are the next most useful source.

Recommendation 4:
The data from hospital emergency departments, available in some countries, should be monitored regularly and researched to determine if they might shed more light on road casualties.

Recommendation 5:
The assessment of the severity of injuries should preferably be done by medical professionals, and not by the police officer at the scene of the crash.

Recommendation 6:
Medical staff should be trained in order to systematically classify (road traffic) injuries using ICD International Classification of Diseases to assess severities with Indices such as the Abbreviated Injury Scale (AIS) or the Maximum Abbreviated Injury (MAIS). This information – without personal information – should be made easily available for statistical purposes, policymaking and research.

Recommendation 7:
Besides police data and hospital data, other sources are available. These have a limited value on their own, and cannot replace police or hospital data, but can be used to build a more balanced and comprehensive picture, to enrich the main data sources, and as a quality check.

Recommendation 8:
For linking data, the deterministic method is preferred if a unique personal identifier is available; otherwise the probabilistic method is a good alternative.

Recommendation 9:
The six assumptions needed to use the capture-recapture method must be considered carefully. Using this method combined with linking police and hospital data may be appropriate to give a fuller picture of road casualties.

Recommendation 10:
Having an internationally agreed definition of ‘serious’ injuries will help the safety research community to better understand the consequences of road crashes and to monitor progress. Given the existing knowledge and practices, IRTAD proposes to define a ‘seriously injured road casualty’ as a person with injuries assessed at level 3 or more on the Maximum Abbreviated Injury Scale i.e. “MAIS3+”.
This section addresses the following Terms of Reference:

d) determine the correlation between reductions in fatalities and serious injuries (including for different levels of severity) resulting from different road safety countermeasures

e) identify cost effective countermeasures to reduce serious injury occurrence and severity

Glossary of Terms

Active safety: Vehicle safety technology assisting in the prevention of a crash.

Australian New Car Assessment Program (ANCAP): Australasia’s leading independent vehicle safety advocate. Provides consumers with transparent advice on vehicle safety through its safety rating program.

Benefit Cost Ratio (BCR): An indicator, used in the formal discipline of cost-benefit analysis, that attempts to summarise the overall value for money of a project.

Crash reduction factor (CRF): The percentage crash reduction that might be expected after implementing a given countermeasure at a specific site.

Electronic stability control (ESC): A vehicle safety feature that detects and prevents (or recovers) a vehicle from skidding or losing control.

METS: Macro Estimates for Target Setting model developed by Monash University Accident Research Centre (MUARC).

Passive safety: Vehicle safety features that help reduce the effects of a crash, such as seat belts and airbags.

Safer Road Infrastructure Program (SRIP): A program to reduce intersection and run off road crashes through infrastructure improvements.
Correlation between fatalities and serious injuries

The correlation between fatalities and serious injuries is generally the ratio between fatalities and serious injuries, in Victoria this is approximately 1:18. In numerical terms fatalities have reduced by 36 per cent but serious injuries by only 20 per cent since 2001.

The trend of fatalities reducing at a greater rate is also being experienced overseas with mature road safety strategies. Recent research by the Institute for Road Safety Research, Netherlands (SWOV) examined why serious injuries had not decreased to the same extent as fatalities in the Netherlands. SWOV found that this was also occurring in many other jurisdictions and in some cases serious injuries were increasing. It was also noted that little research was being carried out on this issue.¹

The following graphs show reductions in fatalities greater than injuries in four European Union countries.
Figure 6.1 Comparison of performance in four European countries, 1990–2009. Source IRTAD.
Recent work to support the National Road Safety Strategy 2011-20 target of reducing deaths and serious injuries required jurisdictions to provide information on serious injuries. The following tables show serious injuries recorded and demonstrate the differences in fatality and serious injury ratios.

**Taken to hospital counts**

<table>
<thead>
<tr>
<th>Year</th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>WA</th>
<th>SA</th>
<th>TAS</th>
<th>ACT</th>
<th>NT</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>na</td>
<td>7516</td>
<td>6838</td>
<td>2891</td>
<td>5693</td>
<td>1754</td>
<td>101</td>
<td>639</td>
<td>25432</td>
</tr>
<tr>
<td>2009</td>
<td>na</td>
<td>6373</td>
<td>6673</td>
<td>2568</td>
<td>5481</td>
<td>1845</td>
<td>167</td>
<td>517</td>
<td>23623</td>
</tr>
<tr>
<td>2010</td>
<td>na</td>
<td>5196</td>
<td>6240</td>
<td>2532</td>
<td>5452</td>
<td>1708</td>
<td>121</td>
<td>512</td>
<td>21761</td>
</tr>
<tr>
<td>Base Ave</td>
<td>na</td>
<td>6247</td>
<td>6584</td>
<td>2664</td>
<td>5542</td>
<td>1769</td>
<td>130</td>
<td>556</td>
<td>23491</td>
</tr>
<tr>
<td>2011</td>
<td>na</td>
<td>5249</td>
<td>6133</td>
<td>2454</td>
<td>5102</td>
<td>1639</td>
<td>178</td>
<td>495</td>
<td>21152</td>
</tr>
</tbody>
</table>

| % change 2011 | na | -17.5 | -6.8 | -7.9 | -7.9 | 7.3 | 37.3 | -11.0 | -10.0 |

Table 6.1 Comparison taken to hospital counts in Australian jurisdictions

<table>
<thead>
<tr>
<th>Year</th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>WA</th>
<th>SA</th>
<th>TAS</th>
<th>ACT</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>na</td>
<td>1:25</td>
<td>1.21</td>
<td>1.14</td>
<td>1.57</td>
<td>1.45</td>
<td>1.7</td>
<td>1.9</td>
</tr>
<tr>
<td>2009</td>
<td>na</td>
<td>1:22</td>
<td>1.20</td>
<td>1.14</td>
<td>1.46</td>
<td>1.30</td>
<td>1.14</td>
<td>1.17</td>
</tr>
<tr>
<td>2010</td>
<td>na</td>
<td>1:18</td>
<td>1.25</td>
<td>1.13</td>
<td>1.46</td>
<td>1.55</td>
<td>1.6</td>
<td>1.10</td>
</tr>
<tr>
<td>2011</td>
<td>na</td>
<td>1:18</td>
<td>1.23</td>
<td>1.14</td>
<td>1.49</td>
<td>1.65</td>
<td>1.30</td>
<td>1.11</td>
</tr>
</tbody>
</table>

Table 6.2 Comparison taken to hospital counts in Australian jurisdictions

**The METS Model**

In assisting the development of Victoria’s new road safety strategy VicRoads commissioned MUARC in 2011 to undertake projections for reductions in fatalities and serious injuries (serious casualties) based on a range of potential initiatives that could be considered by Government.

The original Macro Estimates for Target Setting (METS) model developed for VicRoads during 2005 in support of the *arrive alive* Victorian road safety strategy was comprehensively updated with current police-reported serious casualty data, supplemented by TAC-recorded hospitalisations for the period 2002-2009. A range of further functional improvements to the model, to the quality of output as well as the underlying robustness and general functionality, were also incorporated.

Due to the discontinuity in Police reported data outlined earlier in this submission TAC hospitalisations instead of police-reported ‘taken to hospital’ measures were used to establish the METS reference trend. Furthermore, for all of the breakdowns by road user, crash type, speed limit and the like, the numbers within each would be established by scaling police-reported figures by the ratio, by year, between TAC-reported hospitalisations and police-reported taken to hospital. This relied upon the assumption that the ratio of hospitalised to ‘taken to hospital’ is the same for the sub-datasets as for the complete dataset for each year.

While projected 2010 figures were available for trend determination, a detailed dataset was only available up to 2009. As a result, the baseline period for modelling for the new strategy was assumed to be the average over the period 2007-2009, comprising 304 fatalities and 5665 serious injuries yielding an average of 5969 serious casualties per annum. Simply put this equates to nearly 19 serious injuries to each fatality.
The METS model examined a range of initiatives based on the Safe System groupings of measures such as infrastructure improvements, vehicle safety etc and provided estimates for road trauma reduction as a whole and within safe system elements. These reductions were in serious casualties and not disaggregated to fatalities and serious injuries.

However, it is to be noted that the model in assessing the benefits of countermeasures are generally multiplicative where they affect the same traffic and or behaviour, and additively where they do not. For example, if interventions A and B affect the same kinds of crashes, and each is capable of reducing the number of crashes by 40 per cent in isolation they will not reduce crashes by 80 per cent (= 0.4 + 0.4), but by 64 per cent (=1−(1 − 0.4)(1− 0.4)). The former is an additive interaction; the latter, a multiplicative one.

The following figure shows cumulative serious casualties by safe system element other than for infrastructure.

**Performance by Safe System cornerstone, applied in isolation**

![Figure 6.2 Benefits of countermeasures by safe system elements. Source MUARC](image)

The following chart provided by MUARC indicates the costs on a serious casualty basis for initiatives that could be considered in a road safety strategy.

**Individual Initiative Performance with Cost Effectiveness 2007-2016**

![Figure 6.3 Costs and benefits of countermeasures by initiatives. Source MUARC](image)

These figures are for comparison purposes and represent the application of the named initiatives in isolation of all other initiatives relative to Bau.
A general review of the road safety countermeasure evaluations has been undertaken to provide information in this area. There are many publications and guides that provide evidence on the effectiveness of particular countermeasures such as ‘Countermeasures That Work: A Highway Safety Countermeasure Guide For State Highway Safety Offices, 2011’ produced by the United States Department of Transportation, National Highway Traffic Safety Administration. As comprehensive as these guides are they do not identify countermeasures that have a particular higher benefit to reducing serious injuries than fatalities or vice versa.

Literature reviews of evaluations of road safety programs in Victoria and internationally have not revealed sufficient evidence on reductions achieved in serious injuries specifically, and even less on countermeasures and their effectiveness to reduce injury severity. The following information is focussed on the broader relationships between injury outcomes and various countermeasure types.

**Road and roadside infrastructure**

**A history of investment**

Since the early 1990s funding for accident Blackspot programs has occurred in Victoria. These programs have been delivered by VicRoads with a number of programs funded by the TAC, the Commonwealth and State funds.

The first of the TAC funded programs was implemented from 1992/93 and 1995/96 and had a budget of $85 million. In total, 559 distinct sites were treated under these programs.

A subsequent blackspot program, with a budget of $240 million was implemented from 2000/01 – 2003/04. This program, known as the Statewide Blackspot Program, had two distinct components, the accident blackspot program and the potential blackspot program. The 841 sites were treated under the Blackspot program were selected based on their poor history of casualty crashes over a number of preceding years – similar to that used for the $85 million program. However, the 285 sites treated under the Potential Black Spot component were identified using an alternative method that did not rely on crash histories of sites. Of the $240 million allocated to the Statewide Blackspot Program, approximately $20 million was allocated to the Potential Blackspot component.

Following on from this program was the Safer Road Infrastructure Programs (SRIP). The focus of the SRIP programs was to treat the most common types of crashes in Victoria, which were run off road crashes and side impact crashes at intersections.

The main criterion of this program was the use of serious casualties (fatal and serious injury crashes) as opposed to all injury crashes as the basis for identifying and selecting sites for treatment.

SRIP1 was a $130 million program running between 2004 and 2006, it treated 113 sites, 42 of which were intersections and 71 lengths of road.

SRIP 2 was a $110 million program running between 2006 and 2008, it treated 252 Sites, 196 of were intersections and 56 lengths of road.

SRIP 3 is a $650 million indexed 10 year program that commenced in 2008. To date 601 sites have been treated, included in these are 255 intersection projects and 140 run off road projects.

A new ten year program was recently announced by Government that will invest $1 billion over the next decade to improve the safety of Victoria’s roads and roadsides on treatments such as intersection improvements, wire rope barrier, guard rail and shoulder sealing.

The SRIP programs was have primarily used a methodology that used crash histories at a site or along a length of road to identify a site for treatment. In developing an appropriate type of treatment VicRoads applies a crash reduction factor (CRF) to that particular treatment, in part to determine a relevant benefit cost ratio. Crash reduction factors provide a simple and quick way of estimating crash reductions. Many jurisdictions have a set of crash reduction factors that are used for estimating the safety impacts of various types of engineering improvements. Crash reduction factors are constantly reviewed following extensive evaluation of infrastructure programs.
The following table provides examples of CRF’s for a treatment type for all casualty crashes.

<table>
<thead>
<tr>
<th>TREATMENT TYPE</th>
<th>CRASH REDUCTION FACTOR %</th>
</tr>
</thead>
<tbody>
<tr>
<td>New roundabout</td>
<td>85%</td>
</tr>
<tr>
<td>Convert intersection signals to roundabout</td>
<td>66% (rural) 43% (urban)</td>
</tr>
<tr>
<td>Removal of Y intersection</td>
<td>85%</td>
</tr>
<tr>
<td>Ban right turn at signalised intersection</td>
<td>95%</td>
</tr>
<tr>
<td>Installation of wire rope barrier (including median)</td>
<td>76%</td>
</tr>
</tbody>
</table>

Table 6.3 Crash reduction factors by treatment type

The following figure shows the reduction in serious injuries for run off road crashes and side impact at intersection crashes.

**Serious Injuries in Victoria - Rolling 12 Month Totals**

![Serious Injuries in Victoria - Rolling 12 Month Totals](image)

Source VicRoads RCIS.

Figure 6.4 Run off road and side impact crashes in Victoria.

Of the countermeasures applied as part of the SRIP2 program and evaluated by MUARC the most effective by far was the installation of a roundabout to replace give way/stop control intersections, with an estimated casualty crash reduction (all injury levels) of 76 per cent (95% C.I. 44-89%). An evaluation conducted in the Netherlands of roundabouts installed between 1999 and 2005 yielded reductions in killed and seriously injured of 46 per cent, with 76 per cent of fatalities being eliminated.

Where roundabouts may be unsuitable for traffic operation reasons, another solution is the use of traffic signals to control and assist the flow of traffic with the potential to effect similar levels of serious injury reduction in urban areas to reduce the speeds of vehicles coming into conflict. Modern cars are able to protect occupants from serious injury at impact speeds in a right-angle collision of up to about 50 km/h. The majority of signalised intersections on arterial roads are operating at 60 km/h or higher. Countermeasures to reduce impact speeds to 50 km/h or below will significantly reduce serious injury at intersections. A number of innovative intersection treatments aimed at reducing conflict speeds and optimising impact angles are to be trialled as part of a large intersection design study currently underway between MUARC and VicRoads.
Run-off-road crashes led to an average 1470 seriously injured persons annually between 2009 and 2011, with 52 per cent occurring in country Victoria and 48 per cent in metropolitan areas. On roads carrying significant volumes of traffic, the most effective countermeasure currently is flexible wire rope barrier, which has been shown to reduce serious casualty head-on and off-path crashes by 56% overall and by more than 80% on high-volume, high speed roads like the Eastern Freeway and Hume Highway.5

The issue of run-off-road serious injuries in inner urban areas is more problematic. Run off road crashes is an issue in urban areas particularly in growth areas and the urban rural interfaces. In these areas safety barriers have been installed without significant issues. However in inner urban areas it is impractical to install barrier systems on urban arterials, collector roads and the like due to access requirements. Solutions to the run-off-road issue for these road types will sometimes focus on setting appropriate travel speeds in the context of the desired road function with the road infrastructure being tailored to match.

VicRoads commissioned the Monash University Accident Research Centre to evaluate both the Statewide Blackspot program (SWBSP) and the SRIP program. The following table provides a summary of the crash reductions achieved by the program. Due to the relatively short period post treatment for the SRIP 3 program only casualty crash (all injury) reductions have been included and are preliminary only.

<table>
<thead>
<tr>
<th></th>
<th>SWBSP</th>
<th>SRIP 1</th>
<th>SRIP 2</th>
<th>SRIP 3*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SERIOUS CASUALTY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metropolitan</td>
<td>30%</td>
<td>36%</td>
<td>47%</td>
<td>29%</td>
</tr>
<tr>
<td>Rural</td>
<td>44%</td>
<td>28%</td>
<td>38%</td>
<td>34%</td>
</tr>
<tr>
<td>Intersection</td>
<td>45%</td>
<td>48%</td>
<td>48%</td>
<td>29%</td>
</tr>
<tr>
<td>Run-off-road</td>
<td>29%</td>
<td>27%</td>
<td>36%</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.4 Evaluation of Safer Road Infrastructure Programs.

The following table provides the Benefit Cost Ratio (BCR)s for the SRIP programs and for SRIP 1&2 the ratio of fatalities and serious injuries for the predicted reductions arising from the program. It should be noted the higher BCR and greater reductions from SRIP 2 is due in part to a greater program of intersection treatments than run off road treatments.

<table>
<thead>
<tr>
<th></th>
<th>CRASH REDUCTION</th>
<th>AVE TREATMENT LIFE (YRS)</th>
<th>BCR</th>
<th>FATAL INJURY CRASHES PREVENTED OVER LIFE*</th>
<th>SERIOUS INJURY CRASHES PREVENTED OVER LIFE*</th>
<th>RATIO F:SI</th>
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<tr>
<td>SRIP1</td>
<td>31%</td>
<td>16.9</td>
<td>2.1</td>
<td>131</td>
<td>905</td>
<td>1.7</td>
</tr>
<tr>
<td>SRIP2</td>
<td>34%</td>
<td>14.6</td>
<td>3.6</td>
<td>105</td>
<td>1296</td>
<td>1.12</td>
</tr>
<tr>
<td>SRIP3</td>
<td>31%</td>
<td>16.4</td>
<td>2.4</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Table 6.5 Evaluation of Safer Road Infrastructure Programs.
Safe Speeds

Speed has been identified as a key risk factor in road traffic injuries, influencing both the risk of a road crash as well as the severity of the injuries that result from crashes. Excessive speed is defined as exceeding the speed limit. Inappropriate speed is defined as driving at a speed unsuitable for the prevailing road and traffic conditions. Excessive and inappropriate speed is responsible for a high proportion of the mortality and morbidity that result from road crashes.

In high-income countries, speed contributes to about 30 per cent of deaths on the road, while in some low-income and middle income countries, speed is estimated to be the main contributory factor in about half of all road crashes. Speed also contributes to the severity of the impact when a collision does occur. For example, pedestrians have been shown to have a 90 per cent chance of survival when struck by a car travelling at 30 km/h or below, but less than 50 per cent chance of surviving an impact at 45 km/h. Pedestrians have almost no chance of surviving an impact at 80 km/h.

The work of Nilsson and Elvik and others has demonstrated the strong relationship between speed and serious injury. Reductions in mean travel speed of 5 per cent can result in serious injury savings of 15 per cent. While recent work has questioned the strength of the savings in urban environments, serious crash reductions of 5-10 per cent are still feasible under this more conservative model for urban arterials and perhaps higher for environments with a high proportion of vulnerable road users.

Much of this local and international research has driven efforts by the road safety partners to reduce the incidence of speeding and its consequences together with a range of measures to reduce limits in high pedestrian/cyclist activity areas. In essence an integrated countermeasure approach has been adopted by Victoria including:

Setting speed limits

The basis for any speed management policy is setting speed limits. Speed limits need to reflect the safe speed on that particular road, related to road function, traffic composition, and road design characteristics. Furthermore, speed limits need to be credible, i.e. they must be logical in the light of the characteristics of the road and the road environment. To this extent VicRoads engaged the community in the review of speed limits across Victoria. In all, 12 recommendations were endorsed by Government that will simplify speed zoning in Victoria and assist road users to understand and comply with speed limits.

Road engineering measures

At particular locations low speeds may be crucial for safety (perceived or actual). Examples are near schools or homes for the elderly, at pedestrian crossings, at intersections. At these locations, physical speed reducing measures such as speed humps and roundabouts can help to ensure cars maintain a safe speed. Victoria continues to implement a program of reduced limits where the risk of a pedestrian crash is high, including school speed zones, strip shopping centres and residential streets. The introduction of 40 km/h limits in strip shopping centres has been evaluated by MUARC. The results of the evaluation showed pedestrian injuries reduced by 17 per cent. A number of these treatments were also funded under the SRIP3 program, the economic evaluation showed a BCR of 34 with a crash reduction of 34 per cent.

Enforcement

Enforcement both conventional and automated has played a critical role in reducing speeding. Speed and red-light cameras are important in changing driver behaviour. They not only encourage drivers to slow down and obey traffic signals, but research has found that drivers who have received fines in the past are less likely to speed or run a red-light in the future.

Safety cameras were introduced on Victorian roads in the late 1980s and since then the annual road toll has more than halved. Research by MUARC has found evidence that safety cameras are in part responsible for this reduction.
In 2001-02, a package of speed enforcement initiatives was introduced, including a 50 per cent increase in mobile camera hours, a decrease in the speeding tolerance used in enforcement and the introduction of a 50 km/h urban speed limit.

An international review that examined a number of evaluations of automated speed technology found a lower number of crashes in the speed camera areas after implementation of the program. In the vicinity of camera sites, the reductions in fatalities or serious injuries were in the range of 11 to 44 per cent.

Effects over wider areas showed reductions for all crashes ranging from 9 to 35 per cent, with most studies reporting reductions in the 11 to 27 per cent range. For crashes resulting in death or serious injury reductions ranged from 17 to 58 per cent, with most studies reporting this result in the 30 to 40 per cent reduction range. The studies of longer duration showed that these positive trends were either maintained or improved with time.9

Information and education for drivers

The elements above have all been accompanied by information to driver on the problem of speed and speeding, what the speed limit system is based on and why, what additional measures are taken and why, and also on the (positive) outcomes of these measures.

Additionally many media campaigns are aimed at deterring the incidence of speeding. The conceptual framework underlying traffic enforcement has always been deterrence theory. That is, an increase in the penalty or sanction or frequency of detection will lead to a decrease in the level of illegal activity or a decrease the likelihood of the individual to engage in the illegal activity.

In the road safety arena, the main impetus of law enforcement is in increasing the certainty of apprehension and punishment, which is a subjective probability that depends on the individual’s information set, and two of the major determinants are the level of police presence on the roads and the apprehension rate.10 TAC campaigns are designed to reinforce the penalty and risk of detection, the recent ‘anywhere anytime’ campaign is an example of this approach.

Mass media campaigns targeted at improving road user behaviour are a common element of many road safety campaigns. This has largely been the domain of the Transport Accident Commission with additional support from Victoria Police, VicRoads and more recently the Department of Justice.

The key approaches adopted by the TAC are:

- to place key safety issues in the public agenda
- to promote awareness that ‘this could happen to me’ through the use of an emotive, realistic portrayal of road crashes and their consequences
- to signpost the introduction of new enforcement technologies
- to highlight the level and unpredictability of police enforcement efforts, and
- to reinforce the perception of the increased risk of detection.

The table contained in Appendix 6.1 lists a considerable body of research that has been undertaken in relation to speed & speeding.

The following diagram provides an overview of the multi faceted approach to the management of speed and speeding adopted in Victoria.
Safer Vehicles

Vehicle safety features protect people in case of unexpected events and provide significant benefits for road safety in the long term. Features like electronic stability control (ESC) can help avoid crashes by making it easier to regain control of your vehicle if you run off the road. Other vehicle safety features such as airbags reduce the severity of injury if a crash does occur.

Vehicle passive safety technology - vehicle crashworthiness - has progressed significantly in the last forty years, with modern vehicles being three times less likely to result in serious injury to their occupants in the event of a crash than those manufactured in the early 1970s. However, improved vehicle safety generally only occurs through vehicle replacement. In Victoria, the average vehicle age is 10 years (ABS, 2012) and annual replacement rates are around 5 per cent, meaning that a significant proportion of the vehicle fleet is without many advanced vehicle safety features and full turnover of the fleet takes around 20 years.

ESC is one of the latest safety technologies and has become a legal requirement for all new cars sold in Australia. Initial legislative requirements were introduced first in Victoria in 2011.

Side curtain airbags are a type of vehicle technology that can help prevent death and injury in side impact crashes with poles, trees and high vehicles such as SUVs. Side curtain airbags can help to prevent death and serious injury in any crash from the side where the head is at risk. Recent research into side curtain airbags that are designed to protect the head, neck, face and thorax were found to be highly effective in reducing injury due to side impact crashes. Combination airbags were associated with statistically significant reductions of:

- 51 per cent in the odds of death and injury to all body regions
- 61 per cent the odds of death and injury to the head, neck, face and thorax; and
- 53 per cent the odds of death and injury to the head, neck and face.
Perhaps the biggest gains in reducing serious injury in the future lie with active safety, or crash avoidance technology. Continual advances in available computing power and sensor technologies are helping modern vehicles to more accurately detect and monitor crash risks in the environment and consequently assist drivers to avoid a crash.

Also showing real promise are vehicle to vehicle and vehicle to infrastructure technologies, also known as cooperative intelligent transport systems (C-ITS). Fundamentally, these comprise location awareness (through GPS and other similar systems) and short range, low latency radio communication to relay vehicle locations or hazards to surrounding road users. Vehicles can then become aware of impending conflict situations independent of visual detection ability and either provide warnings to the driver or take control of the vehicle to prevent a crash. A conservative estimate of the potential benefits of full take-up of such technologies could reduce serious injuries by 25-35 per cent.\(^\text{13}\)

Victoria’s approach to improving vehicle safety has been to promote and advocate for higher vehicle safety standards through a consumer driven approach using tools and media such as howsafeisyourcar.com and support of the ANCAP program. Demonstrating leadership has been the role of the Victorian Government with its recent policy to purchase only 5 star safety rated passenger and light commercial vehicles.

**Safer road users**

In developing the METS modelling used for Victoria and other jurisdictions, MUARC found it difficult to identify individual evaluations of countermeasures aimed at driver behaviour that could be applied to the model. As an alternative expert experience and advice was used for this part of the model. The combined effectiveness of behaviour change initiatives implemented in year one of the strategy was assumed to be 5 per cent, with the effectiveness of subsequent initiatives every three years decaying to two-thirds of their previous implementation level (i.e. 3.3 per cent in year four, 2.2 per cent in year seven and 1.5 per cent in year ten). This is believed to be a conservative estimate.

However, one area that was modelled and treated individually was the introduction of the Victorian Graduated Licensing System (GLS) progressively introduced in Victoria since July 2007 with an estimate of benefit factored in from the Regulatory Impact Statement.

Early evaluation of the GLS has indicated that the changes to the GLS have been accompanied by a significant reduction in the crash involvement of newly licensed probationary licence holders. Following the introduction of the new GLS, crash involvements of probationary licence holders aged 18-20 in their first year of holding a licence fell by 23 per cent for all casualty crashes and by 31 per cent for serious casualty crashes.\(^\text{14}\) Further evaluation of the GLS will take place.

There is less opportunity to derive significant serious injury savings from road user-focused initiatives than in the preceeding components of the safe system. While enforcement and legislative practices supported by education and publicity continue to provide an integral part of any road safety strategy it is proving difficult to sustain.

The future landscape of road safety will require a heavy reliance on the introduction and uptake of existing and new technologies to modify driver behaviour and to deliver greater road user compliance. Intelligent speed assist, fatigue detection technology and alcohol interlocks are all examples of technologies that can either assist in modifying behaviours or eliminate the behaviour such as alcohol interlocks in the case of drink drivers. Mandatory alcohol interlock fitment to all new vehicles has the potential to prevent between 110 and 450 serious casualty crashes annually.\(^\text{15}\)

In this area new and existing research is pivotal in understanding both the scale of the problem and identifying effective countermeasures. For example recent research by MUARC indicates that driver distraction was a factor in 16 per cent of crashes derived from the forensic examination of 340 serious casualty crashes. Further research will be undertaken in this area that builds on world leading research from the United States. Victoria will be part of a real life driving study which will examine what drivers actually do and how often, in normal and critical situations, and their interactions with other people on the road.
As outlined earlier in this submission the trend of serious injuries in Victoria and overseas has not reduced at the same level as fatalities. While Victoria has been a world leader in developing and implementing innovative countermeasures there is still a deficit in the knowledge and understanding of the total benefits of these measures. Continual research is required into developing more effective road safety countermeasures with a particular focus on severity outcomes. Equally, future evaluations of road safety programs and crash reductions should disaggregate serious casualties into their components.

**Recommendation 7:** That the road safety partners enhance the METS model to disaggregate serious casualties (fatalities and serious injuries) and consider the most appropriate steps to further refine the model to take into account a new severe injury measure.

**Recommendation 8:** That the road safety partners as part of any project / program evaluation disaggregate serious casualties into fatalities and serious injury classifications to enable a better understanding of reductions in injury severity from countermeasure implementation.
References


### Appendix 6.1

<table>
<thead>
<tr>
<th>LINK</th>
<th>SUMMARY</th>
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<tbody>
<tr>
<td>Monash University Accident Research Centre (MUARC)</td>
<td>MUARC is one of the world’s largest and most respected transport safety research centre. It provides research, reports, projects and safety information for all modes of transport, in the workplace, in the community and in the home.</td>
</tr>
<tr>
<td>MUARC report 200 - Speed enforcement research: principles learnt and implications for practice</td>
<td>Provides a review of speed enforcement research and practical measures that can be used in planning for the future.</td>
</tr>
<tr>
<td>MUARC report 201 - The interaction between speed camera enforcement and speed-related mass media publicity in Victoria</td>
<td>Looks at how speed camera enforcement and speed-related publicity relate to injury severity and risk of casualties in crashes. It investigates whether publicity and TAC advertising changes perceptions of speed enforcement and if this alters driving behaviour and perceived risk of being caught when speeding.</td>
</tr>
<tr>
<td>MUARC report 202 - Scientific basis for the strategic directions of the safety camera program in Victoria</td>
<td>Provides a scientific case to support the development of a safety camera strategy</td>
</tr>
<tr>
<td>MUARC report 224 - Public perceptions of Victorian speed enforcement initiatives</td>
<td>Outlines the perceptions of Melburnians from two surveys that looked at new strategies and initiatives for speed limit enforcement. MUARC developed this report after assessing changes in public attitudes.</td>
</tr>
<tr>
<td>MUARC report 239 - Assessing community attitudes to speed limits: final report</td>
<td>Investigates community attitudes across Victoria, South Australia, Western Australia and Tasmania towards speed limits, speeding and safety.</td>
</tr>
<tr>
<td>MUARC report 242 - The history and development of speed camera use</td>
<td>Outlines the variation between the use of automated speed cameras across Australia, Britain and North America and the controversies associated with cameras.</td>
</tr>
<tr>
<td>MUARC report 261 - An evaluation of the default 50 km/h speed limit in Victoria</td>
<td>Impacts and findings of incident reduction following the introduction of the 50 km/h urban speed limit.</td>
</tr>
</tbody>
</table>
| MUARC report 267 - Overall impact during 2001-2004 of Victorian speed-related package | Evaluation of crash outcomes and the effectiveness of three speed enforcement initiatives introduced between December 2000 and July 2002. The initiatives were:  
- More covert operations of mobile speed cameras, including flash-less operations  
- 50 per cent increase in speed camera operating hours  
- Lowering of the speed camera detection threshold. |
| MUARC report 276 - The impact of lowered speed limits in urban and metropolitan areas | Outline of speed limit reduction, its impact on mobility and traffic system performance emphasising the relationship between speed and travel time. It also looks at vehicle speed, accident severity and speed management. |
| MUARC report 307 - Evaluation of the crash effects of Victoria’s digital speed and red-light cameras | Evaluated Melbourne digital speed and red-light cameras. The study found a 47% reduction in crashes on the intersection approach where a camera was installed, and a 26% reduction on the other intersection approaches. |
| Cochrane Collaboration - Speed cameras for the prevention of road traffic injuries and deaths | Analyses the effectiveness of speed cameras and whether they reduce traffic crashes, injuries and deaths. |
This section addresses the following Terms of Reference:

f) identify best practice in managing long term reductions in serious injury including raising the profile of the serious injury burden

Best practice approaches

By the late 1990s, two of the best performing countries in road safety had determined that improving upon the ambitious targets that had already been set would require rethinking of interventions and institutional arrangements. The Dutch Sustainable Safety and Swedish Vision Zero strategies re-defined the level of ambition and set a goal to make the road system intrinsically safe.1

The SUNflower study

There has been considerable research and evaluation of road safety performance amongst the best performing jurisdictions in the world. The SUNflower study – SUN stands for Sweden, the United Kingdom and the Netherlands is a comparison of the development of road safety in the SUN countries.2 The safety record of these three countries are some of the best in the world and all three countries have made impressive progress in recent decades. The aim of the study was to learn what exactly made road safety improve in the SUN countries and what possibly could be transferred to another SUN country or other countries.

The study revealed that while all three countries have taken targeted measures in relation to drink and drug driving, speeding, the use of seat belts and safer roads, policies are implemented in different ways. In addition, quantitative targets – that is, a percentage by which the number of road casualties must decrease within a set period of time – are used in all three countries.

Each of the three SUN countries has achieved similar levels of safety and policy areas targeted have been similar, but policies implemented have differed at a detailed level. Differences in focus for safety programmes result from both different relative sizes of crash type groups and differences in the structure of road safety capability that influence a country’s ability to deliver different types of policy.3

Interestingly, the safety visions of the SUN countries differ. These differences in vision refer to the Vision Zero approach in Sweden and the Sustainable Safety strategy in the Netherlands on the one hand, and the more problem-oriented and professional practitioner led approach in Britain on the other hand. Although a shift in the application of certain types of solutions and measures can be traced in Sweden and the Netherlands, it is still too early to demonstrate a corresponding difference in the safety gains in practice, whether these are detectable at all.

Vision Zero and Sustainable safety

Vision Zero and Sustainable Safety are two examples of a Safe System strategy. The various strategies now being developed in numerous countries represent the latest evolution in road safety strategies as a means to further improve safety outcomes. While these approaches remain firmly linked to previous efforts, they also have a number of distinctive characteristics, as follows:

They aim to eliminate all fatalities and serious trauma arising from road crashes in the long term.

They recognise that prevention efforts notwithstanding, road users will remain fallible and crashes will occur.
They stress that those involved in the design of the system need to accept responsibility for ensuring that no deaths or serious injuries occur as a result of using the road transport system, and those that use the system need to accept responsibility for complying with the rules and constraints of the system.

They aim to develop a transport system better able to accommodate human error by reducing crash energy through managing the interaction of all components of the transport system, but particularly through improved management of the road infrastructure, travel speed and vehicles.

They seek close to 100 per cent compliance with current rules, only possible through the implementation of innovative solutions including new technologies.

They rely upon comprehensive management structures incorporating all key government agencies and other organisations which have a role in determining the safe functioning of the transport system.

They align safety management decisions with broader transport and planning decisions that meet wider economic goals and human and environmental health goals.

They re-orient their interventions to focus on the inherent safety quality of the road infrastructure, and align travel speed to the safety thresholds implied by that infrastructure, whether it is an urban access street, or a major inter-regional highway.

They place greater priority on the use of technology to improve the safety of the road transport system, whether addressing drink driving through ignition interlocks, or improving the inherent safety of vehicles, and seek to develop technological links between the vehicle and the road infrastructure.

They address road safety at an organisational or corporate level, whether through improvements in the standards and guidelines used by road authorities, or through encouraging mechanisms such as the development of an ISO standard that helps create a commercial demand, and a commercial return, for safe products and services.

Today the growing view is that road safety is a system-wide and shared multi-sectoral responsibility which is becoming increasingly ambitious in terms of its results focus. Victoria adopted a Safe System approach in 2003 which has subsequently been the foundation of all Victorian and National strategies.

Sustaining the level of ambition now evident in high-income countries requires a road safety management system based on effective institutional management functions that can deliver evidence-based interventions to achieve desired results. Achievement of the ultimate goal of eliminating death and serious injury will require continued application of good practice with innovative solutions which are yet to be determined based on well-established safety principles.

Achieving road safety results requires long-term governmental ownership, leadership and political will. Victoria has long had an internationally recognised road safety management framework that has clear identification of a lead agency, a core group of government ministries, agencies and departments involved with roles and responsibilities defined and high-level strategic review of performance.
Measuring and projecting performance improvement

The Safe System approach requires considerable attention to be paid to the development and management of performance indicators, and the re-orientation of these indicators to the systems and interventions that are going to create the greatest safety value. As outlined in this submission, greater emphasis will need to be placed on establishing effective performance measures for serious injuries together with the more traditional indicators developed to monitor reductions in fatalities.

Within a safe system approach there is a need to combine injury based data (final outcomes) with performance data (intermediate outcomes). Some countries such as Sweden have already started to develop systems which give them an opportunity to address road safety problems within the road transport system without needing to wait to measure final outcomes in terms of fatalities and injuries.

There is of opportunity for jurisdictions at different levels of performance to refine their key indicators and better use these to promote delivery of safer services by key system designers. However, work on performance indicators under a Safe System approach demands a greater focus on ongoing monitoring and evaluation of different interventions.

Examples of safety performance indicators centred on achieving a safe system are to be found in Norway’s targets for its future strategy and in Sweden’s strategy for the period 1996 to 2007.

Performance indicators for Sweden’s 50 per cent fatality reduction target were as follows:

- Increasing the proportion of traffic on busy state roads protected from serious head-on and single vehicle accidents from 10 to 90 per cent.
- Reducing travel speed by 6 kph on the state road network (excluding roads that are protected from serious head-on and single vehicle accidents).
- Increasing seatbelt use to 91 per cent.
- Reducing the proportion of drivers under the influence of alcohol involved in fatal accidents from 28 to 17 per cent.
- Increasing the proportion of cars with at least four stars in EuroNCAP crashworthiness ratings, from 17 to 50 per cent.

Ultimately, performance indicators need to be lined up with the full aspiration of the Safe System approach. That is:

- Five star users – who are restrained, unimpaired, and complying with road rules.
- Five star vehicles – that avoid crashes, and protect road users.
- Five star roads – that are homogeneous, predictable, and forgiving.
- Five star speed limits – that are safely aligned with the road function.

To achieve this ultimate goal of a five star system it will be essential to understand the many factors that result in a serious injury. This new understanding will facilitate better countermeasure design, coupled with this new understanding more focussed performance indicators can be developed and the effectiveness of these measures more robustly assessed.

Building a culture of safety

One of the many principles of Vision Zero is that of shared responsibility. Victoria’s road safety strategy also holds that paradigm. For most people, the risk of death or serious injury in a road transport crash is not uppermost in their mind when they use the roads.

In adopting the Vision Zero policy the Swedish Government felt that traffic safety activities should be founded in people’s physical, mental and social prerequisites, the need for system design to permit human error, and the willingness and capacity of the individual to impose demands on the design and function of the road transport system. According to the Government, traffic safety work should enable all individuals to have a personal vision.
To raise awareness of serious injury the TAC in 2005 launched the “hidden toll” campaign, rather than mentioning death, this campaign pointed out the fact that at the time, 46 people were injured on road crashes in Victoria every day. This campaign has not been used recently but in order to raise awareness of this issue more could be done to publicise the number and severity of serious injuries and with further research publicise the likely injuries given risk scenarios, e.g. head and neck injuries resulting from a side impact crash. It will be vitally important to have the community aware of not just fatalities but serious injuries even if there are significant reductions over time.

Recommendation 9: That the road safety partners communicate more effectively to the community the cost and scale of the serious injury burden.

Recommendation 10: That the road safety partners develop a suite of performance indicators to supplement existing performance measures for serious injuries including injury severity and examine the potential for performance measures to be aligned to road safety infrastructure and crash types.
References


